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federal register

Friday
June 7, 1991

Part II

Environmental Protection Agency

40 CFR Parts 141 and 142

Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper; Final Rule

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 141 and 142

[FRL-3823-5]

RIN 2040-AB51

Drinking Water Regulations

Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper

AGENCY: Environmental Protection Agency.

ACTION: Final rule.

SUMMARY: In this notice, EPA is promulgating maximum contaminant level goals (MCLGs) and national primary drinking water regulations (NPDWRs) for controlling lead and copper in drinking water. EPA is promulgating an MCLG of zero for lead and an MCLG of 1.3 mg/L for copper. EPA is promulgating an NPDWR for lead and copper consisting of a treatment technique requirement that includes corrosion control treatment, source water treatment, lead service line replacement, and public education.

EFFECTIVE DATE: The provisions of 40 CFR 141.86, 141.87, 141.88, 141.89, 141.90, 141.91, 142.14, 142.15, 142.16, and 142.17 will be effective on June 6, 1991. The remainder of the rule shall become effective Nov. 6, 1991. The incorporation by reference of certain publications listed in the regulations is approved by the Director of the Federal Register as of June 6, 1991.

ADDRESSES: The rulemaking record, including public comments on the rule, the comment/response document, applicable **Federal Register** notices, other major supporting documents, and a copy of the index to the public docket for this rulemaking, are available for review at EPA's Drinking Water Docket: 401 M Street, SW.; Washington, DC 20460. For access to docket materials call (202) 382-3027 between 9 am and 3:30 pm Eastern Standard Time. Major supporting documents cited in the reference section of this notice are also available for inspection at the Drinking Water Supply Branches in EPA's Regional Offices, listed below.

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Glossary of Terms

The following definitions are presented to assist the reader in understanding common words or phrases used in the preamble and rule.

Action Level: Concentration of lead or copper in water that determines, in some cases, whether a water system must install corrosion control treatment, monitor source water, replace lead service lines, and undertake a public education program.

Blood Lead Level or PbB Level: The concentration of lead in whole blood. Blood lead is the most common index of lead exposure. Health risks associated with lead have been indexed to blood lead levels, measured in micrograms of lead per deciliter of blood (μg/dL).

Corrosion: Dissolution or eroding of pipe or other plumbing material by water or other physical and chemical parameters.

Distributed Water: Water leaving the water treatment facility and/or entering the distribution system.

Ends of the Distribution System: Those points in the water supply distribution system with low or no flow.

First Draw Sample: A 1-liter sample of tap water that has been standing in the plumbing pipes at least 6 hours and is collected without flushing the tap.

Fully Flushed Sample: Water collected from a tap that has been allowed to flow freely for several minutes.

Galvanic Corrosion: Corrosion of one metal accelerated by the presence of another metal with a different electrochemical potential (e.g., corrosion of lead solder is accelerated by the presence of copper pipe).

Gooseneck or Pigtail: A short section of pipe used to connect the service line to the water main or the service line to the water meter. See Figure 1.

Large Water System (for purposes of this rule only): A water system that serves more than 50,000 persons.

Medium-Size Water System (for purposes of this rule only): A water system that serves greater than 3,300 and less than or equal to 50,000 persons.

Lead Service Line: A service line made of lead which connects the water main to the building inlet and any lead pigtail, gooseneck or other fitting which is connected to such lead line. (See Figure 1.)

Optimal Corrosion Control Treatment (for the purposes of this rule only): Corrosion control treatment that minimizes the lead and copper concentrations at users' taps while ensuring that the treatment does not cause the water system to violate any national primary drinking water regulation.

Service Line Sample: One-liter sample of water that has been standing for at least 6 hours in a service line. This sample may be collected by one of three methods: (1) direct sampling of the service line, (2) tap sample collected based on a temperature change in the water, or (3) tap sample collection after flushing a volume of water equal to that contained in the pipes connecting the tap to the service line.

Single Family Structure (for the purpose of this rule only): A building constructed as a single-family residence that is currently used as either a residence or a place of business.

Small Water System (for purposes of this rule only): A water system that serves 3,300 persons or fewer.

Abbreviations

BAT: Best Available Technology
CASAC: Clean Air Science Advisory Committee
MCL: Maximum Contaminant Level
MCLG: Maximum Contaminant Level Goal
MDL: Method Detection Limit
MGD: Million Gallons per Day
mg/L: Milligram per Liter
μg/L: Microgram per Liter
μg/dL: Microgram per Deciliter
NHANES II: Second National Health and Nutrition Survey
NIRS: National Inorganics and Radionuclide Survey
NOMS: National Organics Monitoring Survey
NPDWR: National Primary Drinking Water Regulation
NSDWR: National Secondary Drinking Water Regulation
NTNCWS: Non-Transient, Non-Community Water System
PbB: Blood Lead Level
PbW: Water Lead Level
PQL: Practical Quantitation Level
PWS: Public Water System
SDWA: Safe Drinking Water Act
TTHM: Total Trihalomethanes
VOC: Volatile Organic Chemical

I. Statutory Requirements

The Safe Drinking Water Act (42 U.S.C. 300f et seq.) (SDWA or the Act) requires EPA to establish maximum contaminant level goals (MCLGs) and national primary drinking water regulations (NPDWRs) for contaminants that, in the judgment of the Administrator, may have any adverse effect on the health of persons and that are known or anticipated to occur in public water systems. Section 1412(b)(3)(A). MCLGs and MCLs are to be proposed and promulgated simultaneously. Section 1412(b)(1).

MCLGs are Non-Enforceable Health Goals

MCLGs do not constitute regulatory requirements which impose any obligations on public water systems. Rather, MCLGs are health goals which are based solely upon considerations of protecting the public from adverse health effects of drinking water contamination. The MCLGs reflect the aspirational health goals of the SDWA which the enforceable requirements of NPDWRs (discussed below) seek to attain to the extent feasible. Section 1412(b)(4) directs that MCLGs be set at a level at which, in the Administrator's judgment, "no known or anticipated adverse effects on the health of persons occur and which allows an adequate margin of safety." Section 1412(b)(4). The House Report on the bill that eventually became the SDWA of 1974 provides congressional guidance on developing MCLGs:

> [T]he recommended maximum contaminant level [renamed maximum contaminant level goal in the 1986 amendments to the SDWA] must be set to prevent the occurrence of any known or anticipated adverse effect. It must include an adequate margin of safety, unless there is no safe threshold for a contaminant. In such a case, the recommended maximum contaminant level should be set at the zero level.

(H.R. Rep. No. 93-1185, Pg. 20, 1974)

NPDWRs Set the Enforceable Standards.

NPDWRs include either MCLs or treatment technique requirements as well as compliance monitoring requirements. Section 1401(1). The MCL for a contaminant must be set as close to the MCLG as is "feasible." Section 1412(b)(4). Feasible means "feasible with the use of the best technology,

treatment techniques and other means which the Administrator finds, after examination for efficacy under field conditions and not solely under laboratory conditions are available (taking costs into consideration)." Section 1412(b)(5). A treatment technique must "prevent known or anticipated adverse effects on the health of persons to the extent feasible." Section 1412(b)(7)(A). A treatment technique requirement can be set only if the Administrator makes a finding that "it is not economically or technologically feasible to ascertain the level of the contaminant." Section 1412(b)(7)(A).

Secondary MCLs.

EPA sets national secondary drinking water regulations (NSDWRs) to control water color, odor, appearance, and other characteristics affecting consumer acceptance of water. The secondary regulations are not federally enforceable, but are considered guidelines for the States. Section 1401(2).

Amendments to the SDWA.

The 1986 amendments to the SDWA established a list of 83 contaminants for which EPA is to develop MCLGs and NPDWRs. Lead and copper are among these contaminants, and this final rule fulfills the statutory requirement.

II. Background

A. Regulatory Background

The current MCL for lead is 0.050 milligrams per liter (mg/L) (see 40 CFR 141.11[b]). EPA promulgated this MCL as an interim drinking water regulation in 1975. For copper, there is currently a NSDWR of 1 mg/L. On November 13, 1985, EPA proposed MCLGs for lead and copper (50 FR 46936). Because the 1986 amendments to the SDWA require that MCLGs and NPDWRs be proposed and promulgated simultaneously, EPA was required to repropose MCLGs for contaminants for which MCLGs were originally proposed in the November 1985 notice, including lead and copper. On August 18, 1988, EPA proposed to set the MCLG for lead at zero and the MCLG for copper at 1.3 mg/L (53 FR 31516). In addition, EPA proposed a lead MCL for source water of 0.005 mg/L and a copper MCL of 1.3 mg/L that would have been measured at each entry point to the distribution system of the public water system (PWS's). The 1988 notice also proposed a treatment technique that would have required a PWS to install optimal corrosion control to minimize the occurrence of lead and copper corrosion by-products and to develop and deliver a public education program that would inform citizens about the risk of exposure to lead and copper in drinking water and thereby allow them to take the necessary steps to reduce their exposure to lead.

Corrosion control would have been triggered if: (1) The average lead levels in targeted tap samples from a system exceeded 0.010 mg/L lead; (2) the copper levels were greater than 1.3 mg/L in more than 5 percent of targeted tap samples; (3) or if pH was less than 6.0 in more than 5 percent of targeted tap samples. The proposed public education requirements would have been triggered if the lead levels exceeded an average of 0.010 mg/L or if more than 5 percent of the targeted tap samples were greater than 0.020 mg/L.

In addition to directing EPA to revise the NPDWR for lead, the SDWA includes other provisions that affect lead contamination of drinking water. Section 1417 of the 1986 SDWA amendments banned the use of lead solder or flux (i.e., solder or flux containing more than 0.2 percent lead) and lead-bearing pipes and fittings (i.e., pipes and fittings containing more than 8 percent lead). The lead ban became effective on June 19, 1986. States have been required to implement and enforce the lead ban as of June 19, 1988. EPA has a program to withhold 5 percent of Federal grants a State receives for drinking water implementation if a State fails to enforce the ban.

The SDWA also imposed special public notification requirements regarding lead in drinking water. Section 1417(a)(2). Public water systems were required to identify and provide notice to persons who may be affected by lead contamination in their drinking water when such contamination results from the use of lead in the construction materials of the system and/or corrosivity of the water supply sufficient to cause lead leaching from plumbing systems. This provision requires notification even if the system is in compliance with the current MCL for lead. EPA published final regulations to implement this requirement of the SDWA on October 28, 1987 (52 FR 41534). Under these regulations, systems were required to provide a one-time notice to consumers by June 19, 1988.

B. Overview of Problem

1. Lead

Lead occurs in drinking water from two sources: (1) Lead in raw water supplies, i.e., source water or distributed water, and (2) corrosion of plumbing materials in the water distribution system (corrosion by-products). Most lead contamination is from corrosion by-products.

a. *Occurrence in Source Water and Distributed Water.* In a national drinking water survey of nearly 1000 randomly chosen groundwater supplies completed in 1987 (the National Inorganics and Radionuclides Survey or NIRS), about 5 percent of the drinking water samples collected from fully flushed taps exceeded 0.005 mg/L of lead (EPA, 1988a). Because lead as a corrosion by-product may enter fully flushed tap samples and be attributed erroneously to source water, EPA resampled the supplies in NIRS that showed positive results for lead. EPA found very few samples above 0.005 mg/L when the sampling point was moved to the entry point to the distribution system. Based on these data, EPA now estimates that approximately 600 groundwater systems may have water leaving the treatment plant with lead levels greater than 0.005 mg/L (EPA, 1991a; EPA, 1990b). The National Organic Monitoring Survey (EPA, 1980) provided data on the quality of fully flushed water from surface water supplies. Based on these data, EPA estimates that about 215 surface suppliers may have water leaving the treatment plant with lead levels greater than 0.005 mg/L (EPA, 1991a). These two sources together indicate that less than 1 percent of the public water systems in the United States have water entering the distribution system with lead levels greater than 0.005 mg/L. These systems serve a population that represents less than 3 percent of the 226 million people in the United States that receive their drinking water from public water systems (EPA, 1991a).

b. *Occurrence as a Corrosion By-Product.* Lead in drinking water results primarily from corrosion of materials located throughout the distribution system containing lead and copper and from lead and copper plumbing materials used to plumb public- and privately-owned structures connected to the distribution system. The amount of lead in drinking water attributable to corrosion by-products depends on a number of factors, including the amount and age of lead and copper bearing materials susceptible to corrosion, how long the water is in contact with the lead containing surfaces, and how corrosive the water in the system is toward these materials.

As illustrated in Figure 1, the potential sources of lead found in a drinking water distribution system (including plumbing in buildings) can include:

- Water service mains (rarely).
- Lead goosenecks or pigtails.

- Lead service lines and interior household pipes.
- Lead solders and fluxes used to connect copper pipes.
- Alloys containing lead, including some faucets made of brass or bronze.

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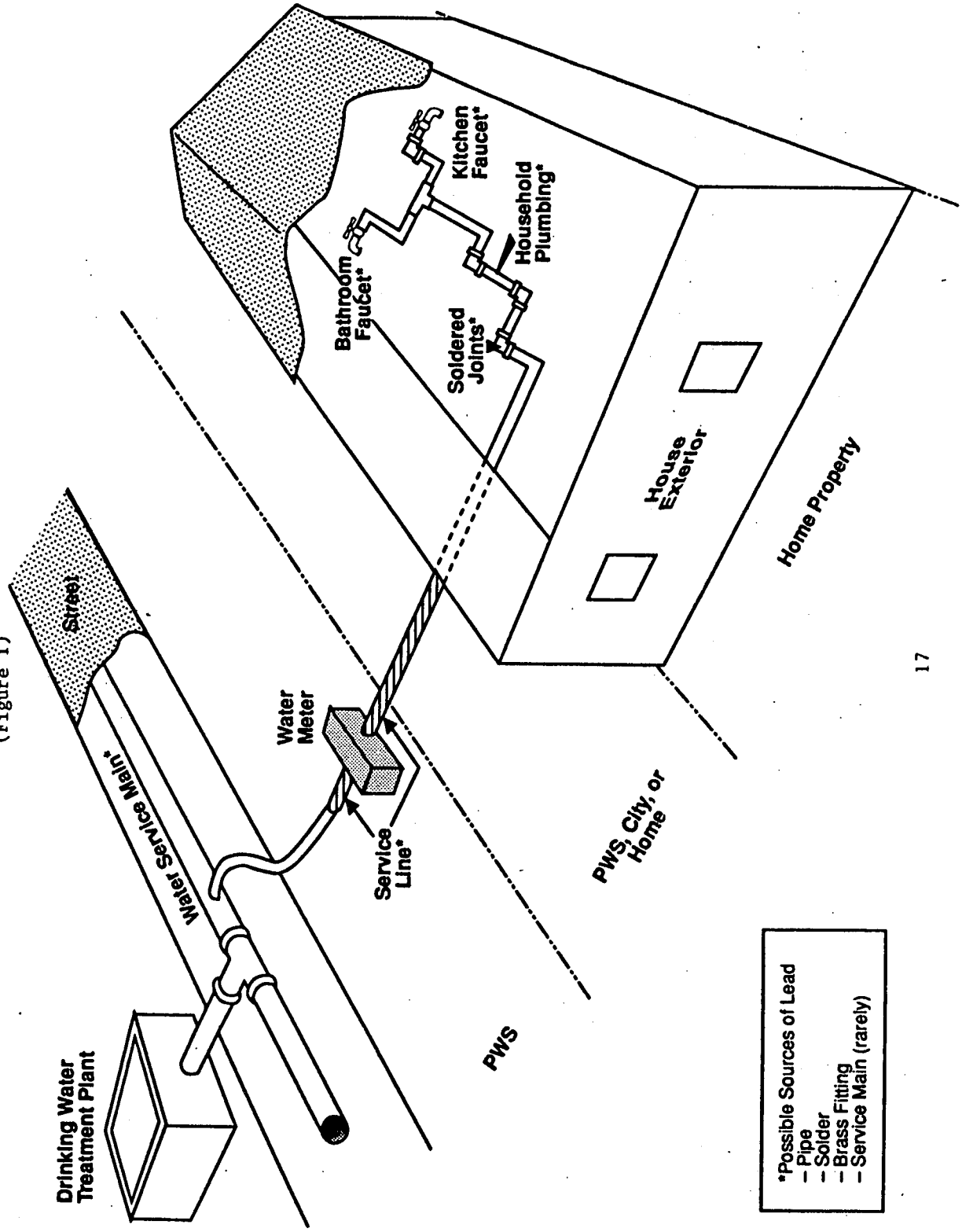
Pub'c Water System (PWS) and Homeowner Plumbing

(Figure 1)



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Most public water systems serve at least some buildings with lead solder and/or lead service lines. Lead solder and fluxes containing up to 50 percent lead were widely used to connect copper pipes throughout the United States until the 1986 Amendments to the SDWA banned the use of lead solder and flux. EPA estimated in the proposed rule that there are approximately 4.4 million lead service lines in the United States and that about 25 percent of all public water systems have at least some lead service connections. Since the proposal, EPA has revised these estimates based on a survey by the American Water Works Association and now estimates that there are about 10 million lead service lines/connections in the United States and that about 20 percent of all public water systems have some lead service lines/connections within their distribution system (EPA, 1991a).

Significant amounts of lead can be dissolved from lead service lines and interior lead pipes indefinitely (Schock 1989, 1990). Lead solder can also contribute significant amounts of lead to water for several years after installation (Oliphant, 1982, 1983) and will continue to contribute to lead levels at the tap after the solder has aged if exposed to corrosive water. In addition, brass and bronze in faucets and fixtures commonly contain lead and may be a major source of lead in drinking water that stands in the faucets or fixtures (Samuels and Meranger, 1984; Schock and Neff, 1988; Gardels and Sorg, 1989). EPA is considering taking a separate action under the Toxic Substance Control Act (TSCA) to further restrict the introduction of any new sources of lead into drinking water supplies.

The amount of lead in drinking water depends heavily on the corrosivity of the water. All water is corrosive to metal plumbing materials to some degree, even water termed noncorrosive or water treated to make it less corrosive. The corrosivity of water to lead is influenced by water quality parameters such as pH, total alkalinity, dissolved inorganic carbonate, calcium, and hardness (Schock, 1980, 1989, 1990: Sheiham and Jackson, 1981; Schock and Gardels, 1983; Gregory and Jackson, 1984; AWWA-RF, 1985, 1990). It cannot be assumed, however, that there are simple associations between each of these parameters and lead levels in drinking water. For example, increasing the hardness of the water will in many cases decrease lead levels; however, there are several studies that could not correlate increased water hardness with lower lead levels (Elzenga and Graveland, 1981; Haring, 1984). Galvanic corrosion of lead into water also occurs with lead-soldered copper pipes, due to differences in the electrochemical potential of the two metals (Oliphant, 1983; AWWA-RF, 1985, 1990). Grounding of household electrical systems to plumbing may also exacerbate galvanic corrosion (Guerrera, 1980; AWWSC, 1989). Other factors that may affect water corrosivity include water temperature (seasonal variations in lead levels are common) and levels of free chlorine, total dissolved solids, and dissolved oxygen (AWWA-RF, 1985, 1990).

Factors that affect lead levels in water in addition to the corrosivity of water include (Kuch and Wagner, 1983; AWWA-RF, 1985; Schock 1990):

- The number and age of lead-soldered joints in the building and the quality of workmanship of the joints (new solder releases higher amounts of lead and joints that have been poorly soldered may expose more lead on interior surfaces and increase the likelihood that it will leach into the water)
- The contact time between the water and the lead (longer contact time results in higher lead levels; this is why first drawn water samples typically have higher lead levels than samples with shorter standing times or flushed water)
- The length and diameter of the lead service line (for example, longer lines generally result in higher lead levels in water at the tap since the water is in contact with more lead; also smaller diameter pipes have a greater ratio of pipe surface to water volume and, thus, greater contact between the lead and water that can result in higher lead levels)

When the rule was proposed in 1988, EPA had limited quantitative data to determine the national distribution of lead levels in drinking water at the tap. The best information available at the time of proposal was a study by Patterson (EPA, 1981) that collected random daytime grab samples flushed for 30 seconds. Flushing for 30 seconds or collecting random daytime grab samples will tend to result in lower lead levels compared with first draw samples because of the shorter standing time in the pipes. The Patterson data are useful because of the large number of samples (782 samples) taken and because the samples were widely distributed geographically across the country (58 cities in 47 States were sampled). The average lead level was 0.013 mg/L, with 90 percent of the values below 0.033 mg/L (EPA, 1991a).

Since the proposal, EPA has received additional data from several sources: (1) Information provided by the American Water Works Service Company (AWWSC) on lead samples collected from 94 water utilities, (2) information submitted from 40 individual water systems during the public comment period, and (3) data collected from 9 water systems by EPA's Office of Drinking Water Technical Support Division (TSD). A detailed presentation and analysis of these data appears in the Treatment and Occurrence Support Document (EPA, 1991b) and in a paper entitled "Influence of Plumbing, Lead Service Lines, and Water Treatment Levels at the Tap" (EPA, 1990e). Public comment on the three major data sets and EPA's analysis of these data were requested in an October 19, 1990, **Federal Register** notice (55 FR 42409). EPA did not receive any specific comments on the analysis. Summary results of EPA's analyses are presented in Table 7. Unfortunately, even with this new data, the quantitative data available is insufficient to determine the national distribution of lead levels in drinking water at the tap.

2. Copper

a. *Occurrence in Source Water and Distributed Water.* Copper levels above the MCLG (1.3 mg/L) are rarely found in raw drinking water supplies or in distributed water. In the NIRS study (EPA, 1988a), 85 percent of all fully flushed tap samples had copper levels below 0.060 mg/L, and 98 percent of samples had copper levels below 0.46 mg/L. Less than 1 percent of the samples had copper levels above 1.0 mg/L. The maximum value found was 2.37 mg/L. EPA estimates that only 66 water systems have copper levels in source water greater than the MCLG (EPA, 1991a).

b. *Occurrence as a Corrosion By-Product.* The primary source of copper in drinking water is corrosion of copper pipes, which are widely used throughout the United States for interior plumbing of residences and other buildings. In some cases, copper is a component of additives to drinking water used by systems to control the growth of algae.

As with lead, all water is corrosive toward copper to some degree. Corrosivity toward copper depends primarily on the pH of the water, with very low pHs associated with the highest levels of copper corrosion by-products (AWWA-RF, 1985; Schock, 1985). Many of the other factors that affect the corrosivity of water toward lead can also be expected to affect the corrosion of copper.

Patterson (EPA, 1981) measured copper levels in the 30-second partially flushed samples taken at random times during the day. Three percent of the samples had copper levels exceeding 1 mg/L and 19 percent exceeded 0.2 mg/L. The national average was 0.221 mg/L (median = 0.04 mg/L). In the 1969 Community Water Supply Survey (CWSS), samples were taken from 678 groundwater supplies, 109 surface water supplies, and 182 supplies of unknown or mixed origin (a total of 969 systems). For the groundwater supplies, the maximum copper level found was 0.47 mg/L and the mean of the positive measurements (i.e., those exceeding the detection limit of 0.010 mg/L) was 0.075 mg/L. For the surface water supplies, the maximum copper value found was 0.304 mg/L and the mean of the positive measurements was 0.066 mg/L. Copper data were also collected in the AWWSC survey and the results indicate that 15 of 93 systems had one or more samples greater than 1.3 mg/L, with only 19 of 1942 total samples collected greater than 1.3 mg/L. The AWWSC data also indicate that elevated copper levels are generally associated with elevated lead levels (AWWSC, 1989).

III. MCLGs for Lead and Copper

The SDWA requires EPA to set MCLGs at concentration levels at which no known or anticipated adverse effects would occur, allowing for an adequate margin of safety. Section 1412(b)(4). Establishment of a specific MCLG usually depends on the evidence of carcinogenicity from drinking water exposure or the Agency's reference dose (RfD), which is calculated for each contaminant.

The RfD is an estimate, with an uncertainty spanning perhaps an order of magnitude, of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious health effects during a lifetime. For chemicals suspected as carcinogens, the Agency has adopted a carcinogenic classification scheme that considers the weight of evidence of carcinogenicity in humans, using bioassays in animals and human epidemiological studies as well as information that provides indirect evidence (i.e., mutagenicity and other short-term test results). Carcinogens are classified as either Group A, B1, B2, C, D, or E and are based on the following:

- Group A—Human carcinogen based on sufficient evidence from epidemiological studies.
- Group B1—Probable human carcinogen based on at least limited evidence of carcinogenicity to humans.
- Group B2—Probable human carcinogen based on a combination of sufficient evidence in animals and inadequate data in humans.
- Group C—Possible human carcinogen based on limited evidence in animals, in the absence of human data.
- Group D—Not classifiable based on lack of data or inadequate evidence of carcinogenicity from animal data.
- Group E—No evidence of carcinogenicity for humans.

The MCLG for a drinking water contaminant is generally established in one of three ways depending on its classification as a Category I, II, or III chemical (see Table 1). The starting point in EPA's analysis is the Agency's cancer classification scheme described above. Each chemical is analyzed for evidence of carcinogenicity via ingestion. In most cases, the Agency places Group A, B1, and B2 contaminants into Category I, Group C into Category II, and Groups D and E into Category III. However, where there is additional information on cancer risks from drinking water ingestion, such as pharmacokinetics and exposure, additional scrutiny is applied which may result in placing the contaminant into a different category. EPA's policy is to set MCLGs for Category I chemicals at zero. The MCLG for Category II contaminants is calculated by using the RfD to account for noncancer effects, with an added margin of safety to account for cancer effects, or is based on a cancer risk range of 10^{-5} to 10^{-6} when noncancer data are inadequate for deriving an RfD. Category III contaminants are calculated using the RfD approach. For a more complete discussion of the methodology for deriving MCLGs, see the January 30, 1991, Federal Register notice (56 FR 3526).

TABLE 1.—EPA'S THREE-CATEGORY APPROACH FOR ESTABLISHING MCLGS

Category	Evidence of carcinogenicity via ingestion	MCLG setting approach
I	Strong evidence considering weight of evidence, pharmacokinetics, and exposure.	Zero.
II	Limited evidence considering weight of evidence, pharmacokinetics, and exposure.	RfD approach with added safety margin or 10^{-5} to 10^{-6} cancer risk range.
III	Inadequate or no animal evidence.	RfD approach.

A. MCLG for Lead

EPA proposed to set the MCLG for lead at zero, based on the following considerations: (1) The occurrence of a variety of low level health effects for which it is currently difficult to identify clear threshold exposure levels below which there are no risks of adverse health effects; (2) the Agency's policy goal that drinking water should contribute minimal lead to total lead exposures because a substantial portion of the sensitive population already exceeds acceptable blood lead levels; and (3) the classification of lead as a Group B2 (probable human) carcinogen.

Several commenters supported the MCLG of zero for lead and agreed with EPA's rationale. Others, however, opposed the MCLG of zero for lead and raised three main issues to support their argument: (1) The concern over blood lead levels at or below 10–15 μg/dl is not supported by the health effects data; (2) an MCLG of zero is not necessary to protect public health, because the relative contribution of lead in drinking water to blood lead levels is minimal; and (3) the carcinogenicity determination for lead is based on unproven and marginal scientific facts and should be reviewed by the U.S. EPA Science Advisory Board.

EPA continues to believe that an MCLG of zero for lead is appropriate (Category I contaminant) for the same reasons cited in the proposal (i.e., no clear threshold for some non-carcinogenic health effects, need to minimize lead in drinking water because a substantial portion of the sensitive population already exceeds acceptable blood lead levels, lead is a B2 carcinogen). Each of the major issues raised by commenters is addressed below.

1. Blood Lead Level of Concern

The concentration of lead in whole blood has been the most widely used index of total lead exposure. As discussed in the 1988 preamble, lead exposure across a broad range of blood lead (PbB) levels has been associated with a spectrum of pathophysiological

effects, including interference with heme synthesis necessary for formation of red blood cells, anemia, kidney damage, impaired reproductive function, interference with vitamin D metabolism, impaired cognitive performance (as measured by IQ tests, performance in school, and other means), delayed neurological and physical development, and elevations in blood pressure (EPA, 1986a). An extensive review of lead toxicity is contained in EPA's 1986 Air Quality Criteria Document and Addendum (EPA, 1986a) and its 1990 Supplement to the Addendum (EPA, 1990a).

Several commenters stated that the concern over blood lead levels at or below 10–15 μg/dL was unsubstantiated. Other commenters argued that the health effects data indicated the appropriate range was 6–10 μg/dL or lower. Still other commenters argued that the MCLG for lead could be above zero because the typical water lead contribution to total lead exposure is about 20 percent, the average population blood lead levels are expected to be only 4–6 μg/dL in 1991 when this rule would take effect, and EPA's level of concern for individuals is 10–15 μg/dL. These commenters argued that water lead levels could be from 0.020 mg/L to as high as 0.050 mg/L and still maintain blood lead levels below the 10–15 μg/dL level of concern.

As stated in the proposal, EPA believes that it is difficult to clearly identify what PbB level is an appropriate criterion or "threshold" below which there are no adverse health effects. Based on the information in the 1986 Air Quality Criteria Document (1986a), and the 1990 Supplement (EPA, 1990a), some of the key findings concerning the relationship between PbB and health effects are:

- Inhibited activity of enzymes involved in red blood cell metabolism, ALA–D and Py–5–N has been associated with PbB levels of 10–15 μg/dL and possibly lower.
- Elevated erythrocyte protoporphyrin (EP) levels, an indication of lead related interference with heme synthesis, have been associated with PbB levels of 12–23 μg/dL depending on iron status.
- Interference with vitamin D hormone synthesis has been detected in children with PbB levels as low as 12 μg/dL.
- Altered electrical brain wave activity has been identified at PbB levels down to 15 μg/dL and possibly lower.
- Deficits in IQ and other measures of cognitive function, such as attention span, have been associated with PbB levels of 15 μg/dL and possibly lower in socially disadvantaged children.
- Slowed peripheral nerve conduction has been detected in children with PbB levels of 20–30 μg/dL.
- Deficits in mental indices have been found in infants with maternal or umbilical cord PbB levels as low as 6–7 μg/dL.
- Low birth weights and decreased gestational age, factors that may influence early neurological development, have been associated with infants having maternal PbB above 12–14 μg/dL and possibly as low as 7 μg/dL.
- Early childhood growth reductions have been associated with PbB levels from 5–35 μg/dL in one study and with PbB levels greater than 40 μg/dL in another.
- Small increases in blood pressure have been related to adults with PbB levels down to 7 μg/dL.

The lack of an apparent exposure threshold for several lead effects is supported by the fact that many of the biochemical changes that appear to underlie lead toxicity (e.g., alterations in enzyme activity, membrane receptors, calcium homeostasis) have been observed at the lowest experimental dosages administered, often with no discernible threshold (EPA, 1986a). There is uncertainty regarding the point at which subtle molecular changes individually or collectively become significant enough that they should be regarded as constituting "adverse" effects. However, such effects clearly become more pronounced (and likely), and broaden to cause more severe disruptions of the normal functioning of many organ systems, as PbB levels increase. This continuum of effects, from biochemical responses, cellular dysfunction, and morphological change, to organ system alterations, clinical symptoms, and toxicity, makes it difficult to clearly identify what PbB level, if any, constitutes an appropriate "threshold", below which there are no significant risks of adverse effects.

The 1986 Air Criteria Document concluded that for children: (1) The collective impact of the effects at PbB levels above 15 μg/dL represents a clear pattern of adverse effects worthy of avoidance; (2) at levels of 10–15 μg/dL, there appears to be a convergence of evidence of lead-induced interference with a diverse set of physiological functions and processes, particularly evident in several independent studies showing impaired neurobehavioral function and development; and (3) the available data do not indicate a clear threshold at 10–15 μg/dL, but rather suggest a continuum of health risks approaching the lowest levels measured. The health effects of lead below this range are less well substantiated.

In reviewing the information presented in the 1986 Air Quality Criteria Document and Addendum, EPA's Clean Air Science Advisory Committee (CASAC) concluded that various effects starting at PbB levels around 10–15 μg/dL or even lower in young children "may be argued as becoming biomedically adverse" (EPA, 1986b).

Additional studies published since the proposal support EPA's earlier conclusions. These studies are reviewed in the 1990 Supplement (EPA, 1990a) to the Addendum of the 1986 Criteria Document, which concluded that "a PbB concentration of 10 15 μg/dL, and possibly lower, remains the level of concern for impaired neurobehavioral development in infants and children." After reviewing the Supplement, as well as the staff position paper of EPA's Office of Air Quality Planning and Standards (EPA, 1989d) on the National Ambient Air Quality Standards for Lead, CASAC concluded that PbB levels above 10 μg/dL clearly warrant avoidance, especially for development of adverse health effects in sensitive populations. The Committee concluded "that EPA should seek to establish an air standard which minimizes the number of children with PbB levels above a target value of 10 μg/dL. In reaching this conclusion, the Committee recognizes that there is no discernible threshold for several lead effects and that biological changes can occur at lower levels" (EPA, 1990f).

Assessment of the more recent health effects data and additional review by EPA's science advisors support EPA's earlier conclusion that blood lead levels of 10–15 μg/dL constitute an appropriate range of concern for health effects that warrant avoidance. In addition, the new data and other reviews (e.g., Davis, 1990) support the conclusion in the proposal that the occurrence of a variety of low level effects makes it difficult to identify a clear threshold blood lead level below which there are no risks of adverse health effects. Moreover, many of these effects at low exposure levels have no obvious symptoms. Lead accumulates in the body and although the resulting health effects are subtle, they can be persistent and cause significant effects on educational attainment and other long-term performance (Needleman et al., 1990).

Many commenters suggested that the MCLG should be based on the water lead levels associated with blood lead levels of 10–15 μg/dL and did not understand why an MCLG of zero was

necessary to meet this goal. EPA has adopted the blood lead level of concern of 10 μg/dL as a benchmark to assist the Agency in evaluating progress in reducing lead exposures. However, EPA does not consider this level to be a threshold below which there are no risks of adverse effects. In establishing MCLGs, the Agency seeks to ascertain the level at which there are no known or anticipated adverse effects on the health of persons and which includes an adequate margin of safety. Section 1412(b)(4). Given the growing body of scientific evidence that risks of adverse effects are present at increasingly lower levels of exposure, and the uncertainty that any blood lead level is free from risk of incurring adverse effects among the sensitive populations, EPA concludes that it would be difficult to identify an adequate margin of safety, and an associated water lead concentration, that would adequately achieve the health goal contained in § 1412(b)(4) of the SDWA.

Based on the available data, EPA believes there are no clearly discernible thresholds for some of the non-carcinogenic adverse health effects associated with lead (EPA, 1990a). Because of the possibility that adverse health effects may occur at blood lead levels below 10 μg/dL, the Agency believes that an MCLG of zero for lead in drinking water complies with the intent of the SDWA.

In addition, comments that average blood lead levels could be maintained below levels of concern with a higher MCLG ignore the distinction between individual blood lead concentrations at the level of concern (i.e., PbB ≥ 10 μg/dl) and population average levels expected when this rule takes effect. There is a wide range of lead levels not only in water but also in house dusts, soils, diets, etc. In addition, there is tremendous variability, especially among children, in behavior patterns (including consumption), physiological sensitivity, and nutritional states. Because of these factors, there is a wide distribution of blood lead levels in the population.

Analysis in the Air Quality Criteria Document (EPA, 1986a) of blood lead distributions measured in the Second National Health and Nutrition Survey (NHANES II), the most recently completed nationwide survey of U.S. blood lead levels, indicates that among a population of U.S. children with an average blood lead level of 5 μg/dl, for example, approximately 2.5 percent would have blood lead levels above 10 μg/dl. It is estimated that several million children have blood lead levels above 10 μg/dL, mainly from lead paint or from old contaminated soils in urban areas (ATSDR, 1988).

Because many children now have blood lead levels above the level of concern, EPA's policy goal continues to be that drinking water should contribute minimal additional lead to existing body burdens of lead. This policy is consistent with the statutory mandate to set MCLGs at a level that provides an "adequate margin of safety," which, as discussed in the legislative history of the SDWA, must consider exposure to contaminants from sources other than drinking water and adverse effects that may be experienced by sensitive sub-populations. For this additional reason, setting a health-based goal of zero for lead in drinking water is consistent with the statutory standard.

2. Contribution of Water Lead to Blood Lead Levels

Several commenters believed that EPA could establish an MCLG above zero and still protect public health because the contribution to blood lead levels from drinking water is minimal. These commenters raised two points: (1) the correlation between blood lead and water lead is questionable; and (2) drinking water comprises only a small proportion of total human lead intake.

a. *Blood Lead to Water Lead Relationship.* At the time of proposal, EPA used a correlation coefficient of 0.20 μg/dL lead in blood per μg/L lead in water, derived from duplicate diet studies by Ryu et al. (1983) and Lacey et al. (1985) (EPA, 1988b). Ryu et al. studied infants in Iowa fed a controlled diet of canned formula or cow's milk. Drinking water was not the source of lead, and use of these data assumes that lead absorption from water is equal to that from formula or diet. The Lacey et al. study collected data in Glasgow on infants' blood lead levels, and lead in a duplicate diet sample, in first-draw, random daytime tap water and in typical water use samples (from tea kettles). Several commenters stated that EPA had not established a clear correlation between water lead and blood lead. Other commenters claimed that the studies used to correlate water lead and blood lead had been improperly evaluated by EPA. One of these commenters stated that EPA had underestimated the blood lead response in the Ryu study because the study did not allow infant blood leads to reach a steady state. This commenter suggested that if the nonequilibrium conditions that existed in the Ryu et al. study are considered, a correlation coefficient of 0.48 μg/dL lead in blood per μg/L lead in water is derived. Another commenter stated that the Ryu study was not a water study but a dietary study involving no drinking water lead impact.

Several studies have examined the contribution that lead levels in drinking water makes to blood lead in children and adults (e.g., Thomas et al., 1979; Worth et al., 1981; Moore, 1977; Moore et al., 1979; Sherlock and Quinn, 1986; Lacey et al., 1985; Raab et al., 1987; Laxen et al., 1987; Maes et al., 1991). These studies have correlated blood lead levels with water lead levels in first-draw water, in random or partially flushed water samples, or in composite samples from first, partially, or fully flushed water. Based on these studies, it is difficult to identify the single measure of water lead that best predicts blood lead (EPA, 1986a).

In response to comments, EPA has reanalyzed the Ryu and Lacey studies, along with a study by Laxen et al. (1987) on school children in Edinburgh in which tap water was sampled after a 5-minute flush and a 30-minute stagnation time. These analyses, summarized in Marcus (1989a; 1989b; 1990b; 1990c), found a nonlinear relationship between children's blood lead and water lead levels and best fit a piece-wise dose-response function with different water lead:blood lead coefficients at different water lead concentrations. This is consistent with the non-linear kinetics of lead transfer from the red blood cell and an apparent saturable transfer mechanism in the gut (EPA, 1986a).

EPA agrees that it is better to rely on studies where drinking water was the source of lead and believes the Lacey study, rather than the Ryu study, is the best study for indicating blood lead responses among infants to lead in drinking water. The Lacey study measured drinking water exposures of children from zero to 6 months of age. Regression analyses of the Lacey study found a slope of 0.26 μg/dL blood per μg/L water at water lead levels below 0.015 mg/L and 0.04 μg/dL blood per μg/L water at water lead levels above 0.015 mg/L. While EPA believes the Lacey study, because of its reliance on exposure through drinking water, is the best available study for estimating water lead:blood lead relationships for infants, the Agency notes that the Ryu study yielded results similar to the Lacey study (0.24 μg/dL blood lead per g/L water lead assuming a water lead intake of 1 liter per day).

For older children, EPA is relying on a recent study by (Maes et al., 1991) of Hawaiians exposed to lead in drinking water across a wide range of levels. Again, a piece-wise linear relationship was found to provide the best fit to the

data with a slope of 0.12 μg/dL blood per μg/L water at water lead levels below 0.015 mg/L and 0.06 μg/dL blood per μg/L water at water lead levels above 0.015 mg/L. Because this study controlled for many different variables, including house dust and food, EPA concludes that it provides the most reliable estimate of blood lead:water lead relationships for children.

For adults, the 1986 Criteria Document identified Pocock et al. (1983) as the most useful study; regression analyses yielded a slope of 0.06 μg/dL blood per μg/L water lead.

In conclusion, EPA disagrees with commenters suggesting that the Agency has not established a clear correlation between blood lead and water lead levels and that additional research is needed to substantiate this relationship. EPA recognizes that differences exist in the correlation coefficients derived from the available studies on water lead/blood lead relationships. These differences can be attributed to such factors as differences in study populations, analytical methods, and potential confounders (e.g., other lead sources, including diet, dust, and air). EPA believes, nonetheless, that the studies reviewed and analyzed in the Air Quality Criteria Document (1986a) and the additional analyses cited above have established a quantitatively consistent relationship between blood lead and lead in drinking water for infants, children, and adults.

While the degree to which lead causes increases in blood lead levels is important for evaluating the degree of health effects associated with various water lead levels, this issue is not directly relevant to the Agency's bases for establishing an MCLG of zero. The first basis (lack of clear threshold for adverse effects) is based upon extensive studies of various health endpoints, and does not depend specifically on any water lead-blood lead relationship. The second basis for the zero MCLG is based on the empirically observed fact that a large number of children have blood leads above the level of concern. Even if there is a disagreement regarding the degree of change in blood lead levels that would be caused by water lead levels, it would always be the case that consumption of lead in water would contribute to some increase in blood lead levels, thereby causing an increased risk of adverse effects for the sensitive sub-population of children with blood lead levels already above 10 μg/dL. The third basis for the MCLG (carcinogenic effects), like the first basis, depends upon the non-threshold nature of lead's health effects, and not upon any particular correlation between water lead and blood lead levels.

b. *Contribution of Drinking Water to Total Lead Intake.* EPA also disagrees with the assertion that drinking water comprises a small proportion of lead intake. EPA estimated in the proposal that the typical drinking water contribution to total lead exposure for an average 2-year-old child is about 20 percent (EPA, 1988c). The proportion of exposure due to lead, however, will vary with different levels of lead in the water and with variations in other lead exposures. For children with high levels of lead exposure from lead paint, contaminated soils and dusts near roadways or lead smelters, or other point sources of airborne lead, drinking water contributes a much lower, although still relevant, proportion of total exposure. For residents of houses and buildings with relatively new lead solder or lead service lines, drinking water can be the primary source of exposure, especially if the water is corrosive. As such, the total drinking water contribution to overall lead levels may range from as little as 5 percent to more than 50 percent of children's total lead exposure. Infants dependent on formula may receive more than 85 percent of their lead from drinking water. As exposures decline to sources of lead other than drinking water, such as gasoline and soldered food cans, drinking water will account for a larger proportion of total intake. The estimate of the relative contribution of drinking water to blood lead levels is not used in any risk assessments for the final rule. As discussed previously, blood lead impacts from different water lead scenarios have been estimated through application of empirical relationships between water lead and blood lead.

3. Carcinogenicity of Lead

As discussed above, the Agency has adopted a carcinogenic classification scheme for chemicals that considers the weight of evidence of carcinogenicity in humans, using bioassays in animals and human epidemiological studies, as well as information that provides indirect evidence (i.e., mutagenicity and other short-term test results). Carcinogens are classified as either Group A, B1, B2, C, D, or E. For known or probably human carcinogens (categories A, B1, or B2), EPA's established policy is to set MCLGs for such contaminants at zero.

EPA determined in the proposal that lead was a Group B2 (probable) human carcinogen. Several commenters disagreed, believing that the data were not adequate to make such a determination. They asked EPA's Science Advisory Board (SAB) to review the data.

In March and April 1989, an ad hoc SAB committee reviewed the data and basis for EPA's classification of lead as a B2 carcinogen. The findings of the committee, consisting of members of the SAB Executive Committee, the SAB Environmental Health Committee, and the Clean Air Scientific Advisory Committee, were presented in a final report submitted to the EPA Administrator on November 21, 1989 (EPA, 1989b). The final report noted that there was limited understanding of the mechanisms of lead-induced tumorigenesis and that limitations in the available data made it inappropriate to develop a potency factor to perform a quantitative risk assessment for lead at this time. The committee, however, agreed with EPA's conclusion that it had been sufficiently established that lead is a probable human carcinogen, appropriately classified as a B2 carcinogen according to EPA's cancer assessment guidelines. Based on the SAB recommendation, a potency factor for lead has not been developed by EPA. If a potency factor for lead is developed, it will be reviewed by the SAB.

When establishing MCLGs, the Agency usually classifies B2 carcinogens as a Category I contaminant unless there is compelling evidence (e.g., exposure, pharmacokinetics) to place the contaminant into a different category. EPA believes the evidence warrants classifying lead as a Category I contaminant. This determination is based on data from over 20 separate ingestion studies that showed an elevated incidence of kidney tumors in rats and mice (EPA, 1988m; EPA, 1989g). In studies where animals were exposed via drinking water, positive results were reported in one experiment with rats exposed to lead acetate (Koller et al., 1985) but not another (Kanisawa and Schroeder, 1969). Possible induction of lymphocytic leukemia occurred in mice dosed with as little as 0.1 g of lead via drinking water (Blakley, 1987). As noted in EPA's evaluation of the data and reiterated in SAB's 1989 report, there is uncertainty regarding lead's mechanism of action on inducing tumors, but these uncertainties do not provide a basis to alter the weight of evidence for human carcinogenicity. It is known that a significant proportion of ingested lead is absorbed; in adults, the absorption of ingested lead has been estimated to range from 10 to 15 percent, with rates as high as 21–63 percent under fasting conditions, which may be more representative of between-meal absorption (EPA, 1986a; EPA, 1989g).

Experimental studies in children measured an average absorption rate of approximately 50 percent for ingested lead. Based on this information, EPA believes that lead should be classified as a category I contaminant and that the MCLG should be zero.

4. Multinational Business Services Petition

EPA has received a petition from Multinational Business Services Incorporated (MBS), to reconsider the Agency's policy of establishing MCLGs of zero for carcinogens and to establish instead MCLGs for carcinogenic contaminants at calculated negligible risk levels. EPA discussed this petition in the preamble to the proposed rule because the Agency proposed a zero MCLG for lead (53 FR 31516). However, MBS specifically requested EPA to consider its petition in the context of MCLG's being established in EPA's "Phase II" rulemaking. The Agency completed that rulemaking and fully addressed MBS's request in that proceeding (56 FR 3526). Since the MBS did not submit its request as part of comments on the proposed lead and copper rule, the Agency is therefore not addressing MBS's request in the context of this rulemaking.

B. MCLG for Copper

EPA proposed an MCLG of 1.3 mg/L for copper in the November 1985 and 1988 notices. No new data that would change the conclusions presented in the two notices have become available. EPA is, therefore, finalizing an MCLG of 1.3 mg/L for copper. This MCLG of 1.3 mg/L is based on a Lowest Observed Adverse Health Effect Level (LOAEL) of 5.3 mg/day from human clinical case studies in which 5.3 mg was the lowest acute oral dose at which gastrointestinal effects were seen (Chuttani et al., 1965). An uncertainty factor of two was applied, and standard daily consumption of 2 liters of water per day by an adult was assumed. Ten-day and longer exposure values were not derived because the data were inadequate (EPA, 1987c).

Several commenters on both the 1985 and 1988 notices believed that an MCLG for copper was unnecessary. The reasons included: (1) Inadequate adverse health effects data, (2) limited occurrence of copper in drinking water, and (3) the fact that copper is present in drinking water because of corrosion of copper pipes; thus, treatment at the water supply plant would not solve the problem of elevated copper concentrations.

EPA disagrees that there are inadequate health effects data for regulating copper. The data indicate that copper, which is beneficial at lower levels, is a health risk at levels above 1.3 mg/L in water. Acute exposure to copper has resulted in gastrointestinal effects, such as nausea and diarrhea, as discussed in the 1985 proposal. EPA agrees that copper is not commonly found above the proposed MCLG, but high levels of copper have occasionally been detected in drinking water supplies across the country, and high levels of copper can dissolve from pipes in areas with corrosive water. Thus, EPA believes an MCLG and NPDWR are justified to protect against adverse health effects. In addition, Congress listed copper as 1 of 83 drinking water contaminants mandated for regulation in the 1986 amendments to the SDWA. Since EPA did not substitute another contaminant in place of copper (as authorized by section 1412(b)(2) of the SDWA), it remains on the list of 83 contaminants for which EPA must promulgate an MCLG and NPDWR.

IV. National Primary Drinking Water Regulations for Lead and Copper

In developing a regulatory approach for controlling lead and copper in drinking water, EPA confronted several problems. As described in the previous section, lead and copper differ from other drinking water contaminants because they generally do not occur in significant amounts in source water, but rather occur as the result of the corrosive action of the water in contact with plumbing materials containing lead and copper. Thus, the traditional regulatory approach, based on removing drinking water contaminants at the treatment plant prior to distribution, will have a marginal effect on lead and copper levels at the consumer's tap (except for the relatively few systems with contaminated source water). Second, much of the lead and copper-bearing plumbing material is privately owned and outside the public water system's control. Third, lead and copper contamination from corrosion of plumbing systems within individual residences and other buildings introduces a large degree of variability in lead and copper levels in water samples taken at customers' taps. These problems make it difficult for EPA to set uniform concentrations for lead and copper that can be met at taps throughout a public water system.

The Agency proposed a two-part approach to address the two sources of lead and copper in drinking water: source water contamination and corrosion by-products. EPA proposed an MCL for lead in distributed water of 0.005 mg/L and an MCL for copper in distributed water of 1.3 mg/L with compliance measured at the entry point to the distribution system. The Agency also proposed a treatment technique requirement to control lead and copper entering water as corrosion by-products. The proposed treatment technique consisted of optimal corrosion control treatment to minimize corrosion, and public education. It was triggered by three "no-action" levels (NALs), as measured in first-draw tap samples from high risk homes (targeted samples): an average lead concentration in targeted samples of less than or equal to 0.010 mg/L, a copper concentration of 1.3 mg/L or less in at least 95 percent of the targeted samples, and pH greater than or equal to 8.0 in at least 95 percent of the targeted samples. If all three levels were met, "no-action" would be needed and the PWS would be deemed in compliance with the treatment technique. If any of these three levels were not met by a system, the system would have been required to install or improve its corrosion control treatment. In addition, if a PWS exceeded the average lead level of 0.010 mg/L or a fourth "no-action" lead level of 0.020 mg/L in at least 95 percent of the targeted samples collected, the system would have been required to conduct a public education program to help consumers reduce their exposures to lead in drinking water.

Systems serving more than 3,300 people that did not meet one or more of the NALs would have been required to develop and submit a treatment plan to the State. The treatment plan was to contain the specific steps that the water system would take to ensure that either the NALs were met or that optimal corrosion control treatment and/or public education were implemented. The State would have been required to review the system's plan and approve it if it would minimize corrosivity of the water. The proposal would have required States to specify the required treatment for systems serving fewer than 3,300 people in which any of the NALs were exceeded. If, after treatment was installed, any system continued to exceed one of the NALs, the system would have been required to demonstrate to the State that its treatment was optimal. In addition, the State would have been required to specify the water quality parameters under which a system would be required to continue to operate.

Water systems (of all sizes) exceeding one or both of the NALs for lead (either the average or the maximum) would have been required under the proposal to conduct a public education program to reduce exposure to lead as a part of

the treatment plan. The proposed public education program differed both from the general public notification requirements under section 1414 and the special lead public notification requirements under section 1417 of the Safe Drinking Water Act. The public education program was conceived as an ongoing requirement for as long as the PWS exceeded one or both of the action levels. Water systems would have been required to design their public education programs to meet three performance standards: program content, program delivery, and program evaluation.

As an alternative to the proposed two-part approach, the Agency solicited comment in the preamble to the proposal on the option of not promulgating an MCL for source water, but instead including source water treatment as a component of the treatment technique requirements. Under this option, systems exceeding the no-action level at the tap could take whatever measures (corrosion control, source water treatment or a combination of both) that would reduce levels at the tap to below the no action levels.

A. Comments on Proposed Two-Part Approach

A few commenters agreed with EPA's proposed two-part approach, but the majority disagreed, stating that the SDWA [1401 (1)(C)] requires EPA to set either an MCL or a treatment technique for the same contaminant, but not both. Other commenters disagreed with the two-part approach, arguing that it would cause numerous difficulties with implementation and enforcement of the rule.

Numerous commenters supported establishing MCLs only, with differences of opinion on the appropriate location for compliance monitoring. The majority of commenters supporting an MCL argued that the point of compliance should be either at the entry point to the distribution system or at the end of the water system's control (e.g., water meter, outside tap). These commenters reasoned that EPA has no authority to set an enforceable MCL at household taps since most lead and/or copper contamination detected at these taps is from sources beyond the control of public water system (e.g., household plumbing). They argued that section 1401(4) of the SDWA defines "public water system" as the "collection, treatment, storage, and distribution facilities under the control of the operator." Commenters interpreted this statutory language to mean that the PWS is responsible for the lead and copper content in water that is delivered through the distribution mains—up to the property line or the water meter—but is not responsible for residential plumbing materials that exist beyond the water system's jurisdiction.

Several commenters supported establishing an MCL at the tap, with some favoring a fully flushed sample and others a first-draw sample. Commenters supporting a fully flushed sample collected at the tap (which would be used to represent water delivered to the home) used the same arguments as those commenters who supported an MCL outside the home: The levels of lead in first-draw tap samples reflect contamination beyond the control of the water system. Commenters arguing for first-draw tap samples stated that the SDWA (1412)(b)(7)(A) requires EPA to set MCLs for lead and copper if "it is economically and technologically feasible to ascertain the level of a contaminant". They argued that it is both economically and technologically feasible to ascertain the level of lead and copper at the tap; thus, MCLs are required to be set. Another commenter argued that while EPA was required by statute to set an MCL at the tap, EPA could address the problem of material corrosion outside the water systems control by incorporating a provision to allow the water system to demonstrate that the MCL exceedance was caused by conditions beyond its control.

Numerous commenters supported the establishment of a treatment technique, stating that the primary source of lead is from home plumbing materials, which are beyond the water system's direct control. These commenters argued that water systems can only control the water quality parameters that affect the corrosivity of the water and should not be held responsible for lead and copper levels at individual taps. They contended that it is infeasible to measure MCLs accurately at taps because corrosion control technology does not guarantee specific or predictable tap water lead levels, as is evident by monitoring programs that have shown significant variability in tap lead levels within a system and even within a tap over time after installation of treatment.

B. Rationale for Treatment Technique Approach

1. Response to Comments on Treatment Technique and MCL

EPA disagrees with commenters' assertions that the Agency would be legally precluded from adopting the dual MCL/treatment technique approach proposed by the Agency. At the same time, EPA agrees with commenters who argued that setting an MCL for levels in source water in addition to the treatment technique requirements for corrosion by-products would result in unnecessary confusion among the public and the regulated community. To minimize such confusion, the Agency has chosen to promulgate a final rule consisting solely of a treatment technique that seeks to remedy all sources of lead and copper contamination caused by both corrosion and contaminated source water. EPA believes that this will be the most effective approach to control lead and copper in drinking water, that this approach will be simpler for the public and regulated community to understand, and that the approach is consistent with the statutory scheme of the SDWA.

As discussed further in Section F below, EPA believes that compared to the proposed approach, the inclusion of source water treatment as a component of the treatment technique better allows systems to choose the most effective means of reducing lead and copper levels at the tap. The proposed rule would have required all systems to conduct source water monitoring, even though EPA estimates that only 1 percent of all systems have lead levels in source water exceeding 0.005 mg/L, and less than 1 percent of systems have copper levels in source water exceeding 1.3 mg/L. The final rule reduces this burden by requiring source water monitoring only where levels measured at the tap exceed the lead or copper action levels and thereby indicate potential source water contamination. Including source water treatment as a component of the treatment technique allows systems the flexibility, in appropriate cases, to select the combination of corrosion control and/or source water treatment that will most effectively reduce lead and/or copper levels at the tap.

Commenters on the proposal pointed out that some source water treatments can actually increase water corrosivity and, therefore, aggravate the problem of lead and copper as corrosion by-products. The final rule, by including both as components of the treatment technique, allows systems to take into account the interrelated nature of source water and corrosion control treatment in implementing the treatment, or combination of treatment, that will minimize lead and copper levels at consumers' taps.

EPA also disagrees with commenters who argued that EPA should only establish MCLs for lead and copper for the water as it leaves the control of the public water system. This approach

would not adequately protect the public from lead and copper introduced by the interaction of corrosive water delivered by the public water system with lead and copper-bearing materials in homeowners' plumbing. While plumbing owned by users of the public water system is physically outside the system's control, the quality of the water delivered to the user (including its corrosivity) can be controlled by the system. Commenters who argued that public water systems have no responsibility for lead and copper levels at the tap ignored the fact that public water systems can affect, at least to some degree, water tap lead and copper levels through adjustment of the corrosivity of water delivered by the system. Similarly, EPA disagrees with commenters who recommended that EPA establish an MCL at the tap based upon a fully flushed sample, since such sampling would not adequately reflect the interaction between water delivered by the system and users' plumbing.

EPA also disagrees with commenters who argued that EPA's adoption of a treatment technique was contrary to the SDWA, which, they argued, mandates the establishment of MCLs for lead and copper. As these commenters noted, the statutory standard for determining whether to establish a treatment technique or MCL for a contaminant is whether it is "economically or technologically feasible to ascertain the level of the contaminant." Sections 1401(1)(C) and 1412(b)(7)(A). EPA disagrees, however, with the assertion by some commenters that the mere availability of analytical methods to monitor for lead and copper in drinking water conclusively resolves this issue and that the Act consequently permits EPA only to establish MCLs for these contaminants. As discussed in the preamble to the proposed rule, regulation of corrosion by-products in drinking water poses unique problems not associated with other contaminants regulated by EPA. These problems include variability of contaminant levels even after treatment and the elevation of levels at the tap even after a system has done everything within its control to remedy the sources of contamination. Because of the unique circumstances posed by these contaminants, EPA concludes that Congress has not spoken specifically to the question of how corrosion by-products should be regulated under the statute. Therefore, EPA believes that it is appropriate to weigh all the technical, legal, and policy issues posed by regulating these contaminants in selecting the regulatory alternative that best achieves Congress's goal of protecting the public from drinking water contamination.

The predominant difficulty in establishing numerical drinking water standards for lead and copper is the variability in the levels of these contaminants at the tap after treatment of the water with BAT (which includes source water treatment, public education, lead service line replacement, and/or corrosion control). As discussed in the preamble to the proposal, this variability is due to many factors, including the amount of lead in the resident's plumbing or in the PWS's distribution system (although under the final rule, some lead service lines controlled by the PWS may be required to be removed over a period of years), temperature, age of plumbing components, chemical and physical characteristics of distributed water, and the length of time water is in contact with those materials. Moreover, the source waters of systems can vary in the degree of their corrosiveness and the extent to which that corrosivity can be reduced through pH, alkalinity adjustment, or other methods. Finally, data indicate that the variability in tap levels can persist even in cases where water quality conditions are kept relatively constant. Thus, the difficulty in establishing numerical standards for lead and copper at the tap results from both the many factors affecting water corrosivity as well as the complexity inherent in developing effective corrosion control treatment for the wide variety of conditions encountered among different systems. For this reason, EPA concluded in the preamble to the proposal that establishment of a treatment technique under the Act was appropriate because it is "technologically infeasible to ascertain whether the lead or copper level at a tap at a single point in time represents effective application of the best available treatment technology." (53 FR 31527).

Some commenters disputed the relevance of this conclusion to the issue of whether, under sections 1401 and 1412 of the SDWA, it is "feasible to ascertain the level of the contaminant." They contended that the plain language of the statute requires only that the contaminant, not the efficacy of treatment, be ascertainable in order that establishment of an MCL be mandated. While the commenters' literal interpretation of the statute is plausible, EPA believes that this constricted reading, if mechanically applied to the unique circumstances posed by corrosion by-products, would yield illogical results that could not have been intended by Congress and that ultimately would fail to achieve the public health goals of the statute.

Read in the context of the statute as whole, the finding that it is "feasible to ascertain the level of the contaminant" is only the first step in establishing an MCL. In determining the actual MCL level, Congress directed EPA to set the MCL "as close as feasible" to the MCLG. Section 1412(b)(5). The legislative history indicates that the level should be achievable by large metropolitan water systems treating relatively clean source water. (see H.R. Rep. No. 93-1185 at 18 [1974] and reaffirmed when the Act was amended in 1986; see 132 Cong. Rec. S6287 [May 21, 1986] [statement of Sen. Durenberger]). Thus, to set an MCL, EPA must determine that it is feasible to measure for the contaminant in drinking water and must select the level that is as close to the MCLG as "feasible." EPA has carefully reviewed all the available data to determine what level would be "feasible" for large systems to meet. Because of the sources of variability described above, however, EPA concludes that there is no precise level at the tap that may generally be considered "feasible" based upon application of BAT in all water systems across the country. In fact, the level that is as close as feasible to the MCLG will vary from system to system depending upon the amount of lead located in the system, the corrosiveness of its water, and the degree to which the water is amenable to corrosion control treatment.

EPA analyzed data from several water systems to evaluate the variability in tap water lead and copper levels over time both within a system (Boston, MA, Bennington, VT, and Seattle, WA) and within a home (Chicago, IL, Newport News, VA, and New Bedford, MA). The data for Boston, Bennington, and Seattle were collected before and after installation of corrosion control treatment and were divided into subgroups that represent samples collected before (group 1) and after (groups 2, 3, 4, etc.) installation of corrosion control treatment. The samples collected after installation of corrosion control treatment were divided into smaller categories to assist in evaluating the effects of treatment on lead levels over time as stabilization of corrosion control treatment may take several months or even years. These systems were analyzed for the variability of lead and copper levels within the system over time.

To assess the variability of repeat samples at individual homes, EPA

evaluated three cities (Chicago, Newport News, and New Bedford) in which no treatment modifications were made during the sampling period that would have altered the aggressiveness of the water. The AWWSC data, discussed earlier, are not analyzed here because they represent single samples from homes and, thus, do not indicate the variability within a house or within systems over time.

As already noted, the wide variability in tap water lead levels is influenced by many factors, such as standing time of the water in the plumbing, age and type of plumbing, volume of the water sample, and the corrosivity of source water (Schock, 1988, 1990). Several of these effects were minimized for the six systems analyzed because each system collected the same type of sample (first-draw with standing time of at least 6 hours) from homes with similar characteristics (either homes with lead service lines or homes with no lead service lines).

EPA has conducted several analyses of the available data in order to characterize the extent of the variability found in lead tap levels after application of corrosion control treatment. One approach utilizes the relationship between the 90th percentile tap level and the median (i.e., 50th percentile) tap level. As illustration, if 100 samples were taken, the 90th percentile level is the concentration in the 10th highest sample, the 50th percentile level is the concentration in the 50th highest sample. The purpose of this analysis was to evaluate the magnitude of the difference between these two points in the distribution of values. A high degree of variability would be reflected in a large difference in the 90th and 50th percentiles. Sufficiently large variability would indicate the inability of treatment to obtain any consistent level of efficacy as reflected in tap samples. The results in Table 2 analyze the variability of tap samples taken in three systems, Boston, Bennington, and Seattle, before and after installation of corrosion control treatment. The ratio of the 90th to the 50th percentile lead values after treatment was quite large, ranging from 2.4 to 5.1. Most notably, application of treatment did not decrease the extent of the variability. The degree of variability actually increased in Boston and Bennington, and remained very large in Seattle.

The results in Table 3 indicate that tap water lead levels in selected Chicago homes varied considerably when collected over a 1 month period. The results for Newport News, New Bedford, Boston, and Bennington also indicate highly variable lead levels in the same house from month to month. Results presented in Tables 2 and 3 are discussed in detail in "Variability of Household Water Lead Levels in American Cities" (Marcus, 1990a). This report was made available to the public through a **Federal Register** notice published on October 19, 1990 (55 FR 42409). EPA received no comments on the report. The results in Table 4 indicate the high degree of variability in tap water copper levels in Boston and Bennington after installation of corrosion control treatment. Results presented in Table 4 are discussed in detail in "Variability of Household Copper Levels in Two American Cities" (Marcus, 1991).

TABLE 2.—WITHIN SYSTEM LEAD VARIABILITY IN FIRST DRAW TAP SAMPLES

City/treatment	Lead levels (mg/L)		
	Number of samples	90th percentile	Q90/Q50 ratio
Boston: [1]			
—No treatment	49	0.110	2.4
—Inhibitor	59	0.139	2.7
—No treatment	26	0.161	2.2
—pH adjustment	61	0.108	3.1
—pH adjustment	49	0.048	2.7
—pH adjustment	50	0.047	2.6
Bennington: [2]			
—No treatment	40	0.148	1.9
—pH adjustment	39	0.082	2.4
—pH adjustment	40	0.066	3.1
—pH adjustment	40	0.026	2.9
Seattle (Cedar River): [3]			
—No treatment	46	0.035	5.1
—No treatment	43	0.023	5.3
—pH adjustment	68	0.006	3.2
—pH adjustment	31	0.009	4.0
—pH adjustment	8	0.003	2.3
Seattle (Tolt River): [4]			
—No treatment	42	0.036	4.6
—No treatment	46	0.016	4.8
—pH adjustment	52	0.006	3.4
—pH adjustment	5	0.006	3.3
—pH adjustment	17	0.004	2.4

[1] Boston samples collected between 2/76–5/76; 7/76–12/76; 3/77–4/77;6/77–11/77; 7/78–1/79; and 8/80–8/81.
[2] Bennington samples collected between 4/77–7/77; 8/77–12/77; 8/78–6/79; and 1/80–11/80.
[3] Seattle (Cedar River) samples collected during 1979; 1981; 1983; 1985; and 1987.
[4] Seattle (Tolt River) samples collected during 1979; 1981; 1983; 1985; and 1986.

TABLE 3.—WITHIN HOUSE VARIABILITY IN LEAD LEVELS IN FIRST DRAW TAP SAMPLES (MG/L)

City/house	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Chicago: [1]					
House 6	0.024	0.012	0.028	0.030	0.013
House 7	0.010	0.009	0.008	0.032	
House 9	0.030	0.017	0.015	<0.003	0.008
House 10	0.008	0.025	0.028	0.027	0.015

TABLE 3.—WITHIN HOUSE VARIABILITY IN LEAD LEVELS IN FIRST DRAW TAP SAMPLES (MG/L)—Continued

City/house	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Newport News: [2]					
House 2	0.001	0.004	0.016	0.012	0.008
House 15	0.011	0.004	0.004	0.005	0.022
House 20	0.005	0.005	0.010	0.004	0.020
House 24	0.006	0.004	0.013	0.005	0.024
New Bedford: [3]					
House 1	0.070	0.038	0.018	0.032	0.032
House 3	0.190	0.100	0.046	0.026	
House 10	0.050	0.044	0.024	0.020	
Boston: [4]					
House 2	0.052	0.051	0.032	0.019	0.027
House 6	0.064	0.008	0.013	0.038	0.027
House 10	0.010	0.040	0.052	0.009	0.023
House 13	0.022	0.075	0.014		0.021
Bennington: [5]					
House 2	0.020	0.007	0.005	0.005	0.005
House 5	0.046	0.018	0.005	0.005	0.009
House 6	0.088	0.018	0.013	0.020	0.028
House 10	0.066	0.025	0.012	0.027	0.025

[1] Chicago samples collected from January 7 to February 5, 1986.
[2] Newport News samples collected once a month from January to May 1989.
[3] New Bedford samples collected from January 1978 to July 1978.
[4] Boston samples collected between February 1980 through August 1981 (about three years after treatment installed).
[5] Bennington samples collected from March 1979 to November 1980 (about 2 years after treatment installed).

TABLE 4.—WITHIN SYSTEM/HOUSE VARIABILITY IN COPPER LEVELS IN FIRST DRAW TAP SAMPLES

City/treatment	Copper levels (mg/L)		
	Number of samples	90th percentile	Q90/Q50 ratio
Boston: [1]			
—No treatment	51	0.71	1.4
—Inhibitor	60	0.75	1.4
—No treatment	26	1.13	1.6
—pH adjustment	57	0.35	2.2
—pH adjustment	43	0.18	2.3
—pH adjustment	53	0.12	2.2
Bennington: [2]			
—No treatment	40	0.90	2.4
—pH adjustment	38	0.29	2.2
—pH adjustment	38	0.36	2.7
—pH adjustment	40	0.10	2.6

[1] Boston samples collected between 2/76–5/76; 7/76–12/76; 3/77–4/77; 6/77–11/77; 7/78–1/79; and 8/80–8/81.
[2] Bennington samples collected between 4/77–7/77; 8/77–12/77; 8/78–6/79; and 1/80–11/80.

House	Within house variability				
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Boston: [1]					
House 2	0.100	0.100	0.100	0.060	0.050
House 6	0.290	0.608	0.070	0.150	0.090
House 10	0.100	0.140	0.120	0.030	0.090
House 13	0.100	0.100	0.020		0.040
Bennington: [2]					
House 2	0.430	0.020	0.040	0.030	0.100
House 5	0.410	0.090	0.020	0.020	0.040
House 6	0.870	0.140	0.060	0.020	0.010
House 10	0.860	0.140	0.110	0.120	0.110

[1] Boston samples collected between February 1980 through August 1981 (about three years after treatment installed).
[2] Bennington samples collected from March 1979 to November 1980 (about 2 years after treatment installed).

Several commenters felt that because a significant portion of the variability is caused by homeowner plumbing, variability in lead level samples could be eliminated or minimized, especially for systems with no lead service lines, by establishing an MCL measured at either the entry point to the distribution system, at the end of a system's control, or at the tap with a fully flushed sample. EPA agrees that this would be one method for minimizing the variability in water samples. However, as discussed earlier, this approach would only identify a small portion of the problem because in most cases lead and copper in drinking water is the result of corrosion of lead and copper bearing materials in household plumbing. EPA agrees that water systems should not be held directly responsible for plumbing

materials within private homes. The Agency believes, however, that water systems can control the main contributor to dissolution of lead and copper plumbing materials—corrosivity of the water. Since there is no single, reliable index for measuring water corrosivity toward lead and copper across the country, the degree to which a system has minimized corrosivity for lead and copper can be assessed adequately only through measuring lead and copper levels at the tap over time, and by correlating those levels and the levels for several water quality parameters (e.g., calcium, pH, alkalinity). Thus, basing an MCL only on samples taken at the source, at the meter, or even with fully flushed samples at the tap would not fully account for consumers' exposure to lead and copper levels in drinking water or provide a means to fully evaluate whether a system is properly implementing optimal corrosion control.

Regulation of lead and copper is also complicated by the fact that a major contributor to contaminant levels at consumers' taps is corrosion of materials not owned or controlled by the public water system. As discussed in the preamble to the proposed rule, section 1401(4) of the SDWA defines public water system to include "(A) any collection, treatment, storage, and distribution facilities under control of" the system, and "(B) any collection or pretreatment facilities not under such control * * *." EPA stated that the listing of distribution facilities in subparagraph (A) of this section, as opposed to paragraph (B), indicated that Congress intended to exclude from the responsibility of PWSs distribution facilities, such as customer's plumbing, which are not under control of the system. EPA concluded that this definition precluded the Agency from promulgating a drinking water regulation that holds a PWS liable for conditions that are beyond its control. Most commenters concurred with this conclusion. Several commenters argued that the definition of public water system contained in the Act was not intended by Congress to limit EPA's regulatory authority over public water systems, but merely to identify the systems that would be subject to regulation under the statute.

The commenter's assertion that the definition of public water system was only intended by Congress to designate who is a PWS (as opposed to what portion of a PWS is subject to EPA's regulatory authority) is not consistent with the plain language of section 1401(4). The first sentence of this section defines public water system as a system for the provision to the public of piped water for human consumption which has at least 15 service connections or regularly serves at least 25 people; the second sentence then lists those components of the public water system which are "included" in the statutory definition of a public water system. The latter provision on its face attempts to distinguish between those facilities associated with a public water system which are subject to the statute and those which are not. If the commenter's argument were correct and this section only was designed to designate which entities are subject to regulation, then Congress would have had no reason to include the second sentence of section 1401(4). Because the commenter's interpretation would effectively read this sentence out of the statute, the Agency does not believe that commenter has reasonably interpreted the statutory language.

Based upon a review of the public comments and further consideration of the statutory language, EPA reaffirms the conclusion presented in the proposal that the definition of public water system in the Act limits systems' responsibility to portions of the distribution system under control of the system. This interpretation is consistent with the plain language of the statute and with the reasonable approach of requiring systems to address only those problems over which they exercise sufficient control for remedial action.

EPA considered whether, notwithstanding the difficulties in setting achievable numerical standards for lead and copper, Congress would have intended to require EPA to establish MCLs for these contaminants. On the one hand, the language contained in sections 1401(1)(C) and 1412(b)(7)(A) appears to indicate that MCLs must be set where monitoring for a contaminant is feasible. On the other hand, section 1412(b)(5) and the legislative history indicate that Congress assumed that where the level of the contaminant could be ascertained, EPA would be capable of establishing MCLs at "feasible" levels that could be met by large systems after application of best available technology taking cost into consideration. Congress does not appear to have anticipated the problem encountered with corrosion by-products, where, despite the availability of analytical methods to ascertain the level of the contaminants, establishment of any one "feasible" level as the sole determinant of systems' compliance is not technically justifiable.

EPA believes that, under these circumstances, the consequences of setting MCLs for lead and copper at the tap would run counter to the purposes and structure of the Act. As discussed in the preamble to the proposal, if a stringent MCL were set that would reflect the public health goals of the statute, the Agency believes that large numbers of water systems would be out of compliance and vulnerable to enforcement actions and citizen suits. The Agency discussed in the preamble to the proposal the possibility of providing relief for these systems from legal liability for exceedances of the MCLs by authorizing variances under section 1415 of the SDWA. EPA pointed out in the proposal, however, that the potential availability of variances would not adequately address this problem because (1) variances were intended by Congress to be temporary and some systems will never be able to come into compliance where the violation is due to lead in homeowners' plumbing; (2) an MCL is not "feasible" under the statute if a significant proportion of systems cannot meet it, and (3) variances are not available under section 1415 for systems that pose an "unreasonable risk to health." Moreover, EPA believes that Congress did not intend for large numbers of systems to be operating pursuant to variances under Section 1415, which would impose a substantial administrative burden on State primacy agencies (and EPA where States have not assumed primacy) to evaluate and grant variances (after notice and opportunity for public hearing provided under section 1415) and to supervise compliance with the variances. Therefore, for the reasons noted above, EPA continues to believe that the potential availability of variances does not adequately address the legal, technical, and administrative problems associated with setting relatively low MCLs for lead and copper that many systems could not meet.

EPA does not believe that establishing stringent MCLs that most systems might not be able to meet would be consistent with the statutory requirement that an MCL be "feasible." While the legislative history indicates that Congress intended that MCLs be set based upon the better performing systems (i.e., large systems applying BAT to "relatively clean source water"), there is no indication that Congress envisioned establishment of MCLs that would result in widespread noncompliance among water systems because of contamination caused by conditions beyond their control.

EPA also does not believe that it would be appropriate to adopt the

suggestion of one commenter that EPA adopt an MCL along with a provision that would allow systems to nonetheless be deemed in compliance if they could demonstrate that an exceedance was beyond their control. First, such an MCL would not in fact be "feasible" to meet, and therefore EPA believes such a standard would not be in line with the statutory requirement applicable to MCLs. Moreover, EPA would anticipate that most water systems exceeding the MCL would likely seek to make such a demonstration. This would impose a substantial administrative burden on States, while large numbers of systems would be out of compliance with the MCL pending State determinations on the requests. Having large numbers of systems out of compliance with the SDWA due potentially to problems outside their control would cause substantial confusion among the public and the water supply industry. Thus, EPA rejects the commenter's approach on both legal and policy grounds.

Alternatively, EPA could set MCLs high enough so that most systems could meet them after they had installed treatment. Such MCLs would not be based upon reliable engineering judgement regarding the levels achievable with BAT (because the levels achieved are so variable), but would instead be based on the principle that sufficiently high MCLs could be met by most systems, taking into account the variability in tap levels found among systems after treatment. EPA believes that such a course of action would be contrary to the purpose of the SDWA to reduce consumer exposure to drinking water contaminants. Under this option, many systems with relatively high contaminant levels (although still below the MCLs) would not have to install any treatment to be in compliance. This situation could lead to unnecessarily high exposures of significant segments of the population and would be inconsistent with the underlying objective of the statute to reduce exposure to the maximum extent feasible.

Taking into account all of the considerations discussed above, EPA concludes that setting MCLs for lead and copper is not feasible within the meaning of the SDWA and would, moreover, not achieve the basic purposes of the statute. The Agency believes that the treatment technique approach contained in the final rule will achieve the public health goals of the SDWA without the problems associated with establishing MCLs. As discussed more fully below, the components of the treatment technique (corrosion control, source water treatment, lead service line replacement, and public education) will be triggered, in large part, if more than 10 percent of targeted tap lead and copper samples in water samples are above 0.015 mg/L for lead and 1.3 mg/L for copper (except that large systems may be required to install optimal corrosion control even if initial tap levels meet the action levels). The action level that will trigger corrosion control for small and medium size systems is more stringent than the corrosion control action level of 0.010 mg/L average, contained in the proposed rule (90th percentile lead level of 0.015 mg/L corresponds to approximately 0.005 mg/L as an average). This relatively stringent action level (which, as discussed in Section E(2)(a) below, is associated with substantial public health protection), is expected to trigger treatment among large numbers of systems nationwide, thereby substantially reducing public exposure to lead in drinking water. All small and medium-size systems that exceed either action level are required to make a detailed demonstration to the State that they have "optimized" corrosion control treatment; that is, they have minimized the lead and copper concentrations at users' taps. The final rule requires all large systems to make this demonstration. All other steps that systems can feasibly take (replacing lead service lines they control and reducing source water contamination so as to minimize lead and copper levels at the tap, as well as public education) are also required where systems exceed the action levels at the tap. While the treatment technique will require systems to take these steps to reduce consumers' exposure to lead and copper to the lowest levels feasible, it does so without the problems associated with establishing MCLs discussed above.

2. Amendment to Definition of MCL

In 1988, EPA proposed to amend the definition of MCL to delete the existing definition and substitute instead the statutory definition of MCL. Existing § 141.2 defines MCL as:

> the maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of a public water system, except in the case of turbidity where the maximum permissible level is measured at the point of entry to the distribution system. Contaminants added to the water under circumstances controlled by the user, except those resulting from corrosion of piping and plumbing caused by water quality, are excluded from this definition.

In evaluating whether to change this definition, the Agency discussed several factors. First, EPA noted that many NPDWRs appeared inconsistent with this definition because they require compliance monitoring to take place in the distribution system, and not at the tap. Second, to the extent the existing definition appeared to hold public water systems responsible for levels at the tap due to conditions in distribution facilities beyond their control, EPA stated that the existing definition was arguably inconsistent with the statutory definition of public water system which, as discussed above, does not include distribution facilities which are outside the system's control. Finally, EPA noted that the definition of MCL in the statute as "the maximum permissible level of a contaminant in water which is delivered to any user of a public water system," (Section 1401(3)) could be interpreted either as applying to the water at the tap or where water passed from the system to the user, but that the legislative history evinced Congressional intent that MCLs apply at the tap.

EPA received public comments both supporting and opposing the proposed change in the regulatory definition of MCL. Commenters supporting the change argued that Congress did not intend for public water systems to be responsible for conditions at the tap over which they did not have control, while commenters opposing the change argued that, in order to be protective of public health, MCLs must apply to the water actually consumed by the public.

EPA has decided to finalize the proposed change to the definition of MCL. Based upon the language and the legislative history of the statute, EPA believes that both the commenters supporting and opposing this approach are, in part, correct. For the reasons discussed below, EPA believes that Congress intended MCLs to apply to water at the tap, but that EPA has discretion to require monitoring at other locations as long as such monitoring is representative of levels at the tap. However, EPA concludes that Congress did not authorize the Agency to hold public water systems liable for tap levels to the extent they are due to conditions in the distribution system which are outside the system's control.

As noted above, the statutory definition of MCL can be interpreted either to favor the view that Congress intended to have MCLs apply at the tap, or the view that they apply at the point where water is delivered from the system to the user. The House Report on the bill that eventually become the SDWA of 1974 states that "[s]ince drinking water regulations are intended to be met at the consumer's tap, the

committee anticipates that monitoring would include tap sampling." (H.R.Rep. No. 93–1185, p. 13, 1974). Thus, while the statutory language is ambiguous, the legislative history indicates clearly that MCLs were intended to be met at the tap. However, the Committee stated only that it "anticipates that monitoring would include tap sampling." (emphasis added). EPA does not construe this language as evincing Congressional intent to mandate monitoring at the tap, as long as other monitoring locations (e.g., in the distribution system) would be representative of contaminant levels at the tap. This is the case with most contaminants, which enter drinking water at the source only and therefore do not increase as they pass through the distribution system and homeowners' plumbing. EPA has established monitoring requirements for inorganic and organic contaminants that require monitoring in the distribution system because this is easier and provides just as accurate an assessment of tap levels as tap sampling itself. See 40 CFR 141.23 and 141.24. EPA therefore construes the definition of MCL in the statute as authorizing, but not requiring, tap sampling, as long as the monitoring established by EPA provides an adequate representation of consumer exposure at the tap.

EPA believes, however, that the definition of MCL in the statute must also be reconciled with the statutory definition of public water system which, as EPA has discussed, precludes the Agency from holding public water systems responsible for contaminant levels at the tap which enter drinking water due to conditions in the distribution system which are beyond the system's control. The existing definition of MCL recognizes this fact by excluding "contaminants added to the water under circumstances controlled by the user." § 141.2. However, to the extent the current definition may be construed as implying that the level of corrosion by-products at the tap is entirely within the ability of public water systems to control, EPA believes that it is necessary to clarify the Agency's position and delete the current language in the current regulation. As discussed at length in this preamble, data indicate that adjustments by the water system to water quality can reduce the corrosivity of water to lead and copper-bearing materials. However, because all water is corrosive to some degree, corrosion of lead and copper materials outside the system's control (i.e., located in the home) cannot be completely eliminated. Thus, the data show that, even in instances where lead materials are not present in the system's distribution facilities and the system has applied corrosion control treatment, tap levels continue to exhibit varying levels of corrosion by-products. In light of the Agency's current judgment that corrosion by-products at the tap can only be controlled in part by public water systems, EPA is therefore deleting the current language in § 141.2 relating to corrosion byproducts. While this change clarifies the Agency's technical judgment regarding systems' responsibility for the levels of corrosion by-products at the tap, this amendment has no actual effect on requirements applicable to public water systems with regard to corrosion by-products, because the Agency has established a treatment technique in lieu of MCLs for lead and copper.

In sum, the Agency is changing the existing definition of MCL so that the regulatory definition tracks exactly the statutory definition. In making this change, the Agency has not altered any requirements applicable to public water systems. Systems will continue to conduct monitoring for compliance with MCLs in accordance with the specific requirements of each NPDWR. This change merely clears up any apparent discrepancies between the existing definition of MCL and the monitoring protocols under a number of NPDWRs. In establishing future MCLs, EPA will exercise the discretion discussed above which the Agency has under the SDWA to require monitoring for compliance with MCLs at any location which will reflect contaminant levels at the tap, except where contamination at the tap reflects conditions outside the control of the public water system as defined in section 1401 of the Act. In such cases, EPA will determine the appropriate approach on a case-by-case basis.

C. Summary of Final Regulatory Approach

The goal of this rule is to provide maximum human health protection by reducing the lead and copper levels at consumers' taps to as close to the MCLG as is feasible. To accomplish this goal, EPA is requiring water systems to: (1) Install or improve corrosion control to minimize lead and copper levels at the tap while ensuring that the treatment does not cause the water system to violate any national primary drinking water regulation (i.e., optimal corrosion control); (2) install treatment, if necessary, to reduce the lead and copper levels in source water entering the distribution system; (3) replace lead service lines that contribute more than 0.015 mg/L to lead in drinking water if corrosion control and/or source water treatment does not bring lead levels below the lead action level, and (4) conduct public education if lead levels are above the action level. Systems that can demonstrate that lead and copper levels are already minimized would not be required to install additional treatment. Unless otherwise stated, each of the provisions in this rule applies to community and non-transient, non-community systems (hereafter referred to as either public water systems, water systems, or systems). The requirements of this rule do not apply to transient, non-community water systems because lead and copper in drinking water are not considered acute contaminants and, therefore, the transient populations affected by these systems would not be at risk from short term exposure (see 52 FR 25690 for a complete discussion on not including transient systems). In making any determinations under this rule, EPA expects that states would provide for public participation in accordance with applicable provisions of state law.

1. Final Action Levels

The "no-action level" concept was introduced in the proposal as a method to limit the number of public water systems that would need to make a detailed demonstration that they have optimal corrosion control treatment. Many commenters thought the term "no-action levels" should be changed to "action levels" as this more accurately portrays the response required of the water systems. The final rule, therefore, use the term "action levels" (ALs) in place of "no-action levels."

The final lead action level is exceeded if the level of lead in more than 10 percent of the targeted tap samples is greater than 0.015 mg/L (90th percentile). The copper action level is exceeded if the level of copper in more than 10 percent of targeted tap samples is greater than 1.3 mg/L (90th percentile). The 90th percentile can be calculated by first arranging the results of all lead and copper samples taken during a monitoring period in ascending order from the sample with the lowest contaminant level to the sample with the highest contaminant level. Each sample should be assigned a number, ascending by single digits from number 1 for the sample with the lowest contaminant level. The number assigned to the sample with the highest contaminant level should be equal to the total number of samples taken. The total number of samples taken during each monitoring period should then be multiplied by 0.9 to arrive at the sample number that represents the 90th

percentile, as indicated in Table 5. Systems required to collect only five samples per monitoring period should average the fourth and fifth samples to arrive at a 90th percentile value.

TABLE 5.—90TH Percentiles for Different Sample Sizes

Number of samples required per monitoring period	Sample indicating 90th percentile value
100	90th highest sample.
60	54th highest sample.
40	36th highest sample.
30	27th highest sample.
20	18th highest sample.
10	9th highest sample.
5	Average of 4th and 5th sample.

Systems required to collect 100 samples per monitoring period, for example, would exceed the lead action level if the level in the 90th sample exceeded 0.015 mg/L. Systems that take more than the minimum number of required samples would determine the 90th percentile value using the following equation:

(Number of samples) × (0.9) = sample corresponding to the 90th percentile

For a system that collects 120 samples, the 90th percentile lead value would be the 108th highest sample (120 × 0.9).

The Agency has decided to adopt the 90th percentile value instead of an average or median value because this method does not require assumptions concerning values less than the lead practical quantitation level (PQL) of 0.005 mg/L. The available data generally indicate that lead in drinking water is log-normally distributed (Schock et al. 1988; Marcus, 1990a, 1990b), resulting in the majority of lead values for a typical system being below the PQL. The assumption regarding values below the PQL (i.e., equal to the PQL, one-half the PQL, or zero) could have a significant impact on whether the system's average value is above or below the action level. Adopting an action level defined as the 90th percentile does not require any assumptions concerning values below the PQL because only values at and above 0.015 mg/L are needed to judge whether the action level is exceeded. In addition, the Agency is concerned about the high lead levels that may be present in some systems and believes an action level using the 90th percentile value is more sensitive to these outliers than an average or median value. Using the 90th percentile is consistent with recommendations by EPA's Science Advisory Board (SAB) (EPA, 1988d), which reviewed the monitoring protocol for the proposed lead and copper rule on October 14, 1988. SAB recommended that EPA consider using percentiles rather than an average value since assumptions regarding the underlying distribution of water lead levels (e.g., normally distributed versus log-normally), or assumptions about values below the maximum detection limit (MDL) or the PQL, would not be required.

a. *Action Level For Lead in School Drinking Water.* In January 1989, EPA published a manual, "Lead in School's Drinking Water", to assist school officials in identifying whether a school had a problem with lead in drinking water, the steps to reduce or eliminate this problem, and information on training personnel in sampling and remedial programs. As a part of this program, EPA recommended that schools collect 250 ml first-draw samples from water fountains and outlets and that the water fountains and/or outlets be taken out of service if the lead level exceeded 0.020 mg/L. The sampling was designed to pinpoint specific fountains and outlets that required remediation (e.g., water cooler replacement).

As discussed above, the final rule establishes a lead action level of 0.015 mg/L at the 90th percentile. The action level in the final rule is based on 1 liter first-draw samples collected from numerous targeted sampling sites throughout a distribution system and is designed to identify system-wide problems and not problems in single outlets. This is quite different from the sampling conducted in schools where EPA is concerned with locating individual outlets that require remediation. The school sampling protocol maximizes the likelihood that the highest concentrations of lead are found because the first 250 ml are analyzed for lead after overnight stagnation (usually much longer than the 6 hour minimum specified for this regulation). Consequently, the two lead action levels differ because of the different problems they seek to detect and the different monitoring protocols used in the two situations.

EPA continues to recommend that schools take action at individual outlets with lead levels greater than 0.020 mg/L. EPA will make an effort to ensure that schools, laboratories, States, and consumers understand the distinction between the action level under this rule and that applicable to public schools. EPA will assess its 1989 guidance regarding the school action level to determine whether revisions are warranted.

2. Corrosion Control Requirements (Sections 141.81 and 141.82)

Since most of the lead and copper found in drinking water is caused by corrosion of materials containing lead and copper in the distribution system and in the plumbing systems of privately owned buildings, the Agency believes that the most important element of the final treatment technique is corrosion control treatment. The proposed rule would have required water systems to install "optimal" corrosion control treatment. The idea of "optimizing" corrosion control treatment, as discussed in the August 1988 proposal, created concern among water systems. They feared that EPA intended to force water systems to reduce the corrosivity of their water toward lead and copper without regard for either the other types of material found in the distribution system (e.g., iron, galvanized steel) or other treatment processes undertaken by water systems (e.g., disinfection, filtration) or other secondary effects (e.g., phosphate problems, zinc in wastewater treatment sludge).

EPA agrees that water systems should design corrosion control in the context of other treatment processes and should consider other materials within the distribution system. Designing treatment processes without considering these factors could cause unintended secondary effects (AWWA-RF, 1990; Schock, 1990). Because of these concerns, the Agency has changed its definition of optimal corrosion control to the corrosion control treatment that minimizes lead and copper levels at users' taps, while ensuring that the treatment does not cause the water system to violate any national primary drinking water regulation. Further, in identifying optimal corrosion control treatment, both the water system and the State are required to consider the constraints that would limit or prohibit the use of alternative corrosion control treatments, and any other potentially adverse effects on other water quality treatment processes. Thus, the final rule allows systems the flexibility to account for other aspects of water quality that can be affected by corrosion control treatment. This will help ensure that public health gains associated with reduced lead exposure are not offset by increased risk of adverse effects due to other contaminants.

Water systems are required to perform various steps to meet the final corrosion control treatment requirements. The specific requirements

and time allotted for achieving each of the steps have been differentiated for large, medium, and small size systems. Dates for each requirement are included in Table 6. Compliance with the corrosion control portion of the treatment technique is determined by whether a system has successfully demonstrated that it optimized corrosion control and has completed the steps outlined below by the dates specified in this table. The corrosion control treatment requirements are contained in two sections of the final rule: §§ 141.81 and 141.82. Section 141.81 contains the timetables for systems to complete corrosion control treatment requirements; the details of each step listed in § 141.81 are described in § 141.82.

TABLE 6.—TIMING FOR CORROSION CONTROL TREATMENT REQUIREMENTS

[System Size (persons served)]

Treatment requirements	>50,000*	3,301 to 50,000	<3,300
Begin initial tap sampling	1/1/92	7/1/92	7/1/93.
System recommends CCT to State	7/1/94	6 months after > AL	6 months after > AL.
Results of CC studies to State	7/1/94	If State requires, 18 months after	If State requires, 18 months after.
State approves/designates treatment	1/1/95	Either 18 months after > AL or 6 months after CC studies completed.	Either 24 months after > AL or 6 months after CC studies completed.
Complete installation of CCT	1/1/97	24 months after State designates treatment	24 months after State designates treatment.
Results of followup monitoring	1/1/98	12 months after CCT installed	12 months after CCT installed.
State review of results and designate WQPs	7/1/98	6 months after follow-up monitoring completed	6 months after follow-up monitoring completed.
Additional monitoring	7/1/99	12 months if > AL after follow-up monitoring	12 months if > AL after follow-up monitoring.

AL—Action Level; CCT—Corrosion Control Treatment; CC—Corrosion Control; WQPs—Water Quality Parameters.

* Dates are included for large systems because they are all required to complete these treatment steps, whereas the timing for smaller systems depends on when the action level is exceeded.

Public water systems are not required to complete the actions described below if they can demonstrate that they have already optimized corrosion control. Water systems can demonstrate that they have optimized corrosion control by satisfying one of the following criteria:

(1) For small and medium-size systems only, if they meet the lead and copper action levels for two consecutive 6 month monitoring periods.

(2) For any size system, demonstrating to the satisfaction of the State that the system has conducted activities equivalent to the corrosion control requirements needed to demonstrate that the system has installed optimal treatment.

(3) For any size system, demonstrating that the difference between the 90th percentile tap water lead level and the highest source water lead concentration is less than the lead PQL (0.005 mg/1) for two consecutive 6 month monitoring periods.

Systems attempting to demonstrate that they have already evaluated the effectiveness of corrosion control and installed optimized corrosion control treatment are required to provide the following information to the State in support of this determination (Section 141.81(b)(2)).

- A report explaining the test methodologies used (i.e., pipe rig/loops, metal coupon tests, pilot-scale studies, or documented analogous treatments with other systems of similar size, water chemistry, and configuration) to evaluate the various corrosion control treatment options, the results of all tests conducted, and the rationale for the system's selection of the optimal corrosion control. The system should have evaluated the effectiveness of minimizing lead and copper levels through adjusting alkalinity and pH, calcium hardness, and/or the addition of phosphate or silicate-based corrosion inhibitors or a combination of the treatments. Systems that have not conducted evaluative tests for all these corrosion control treatments must document why they were unable to evaluate these treatments.
- The results of all test samples collected for lead and copper and for each of the water quality parameters in § 141.87(c) in studies used to evaluate the various corrosion control treatment options.
- A report explaining how the treatment has been installed and how it is being properly maintained and operated to insure minimal lead and copper concentrations at consumers' taps. To satisfy this provision, a system must show that the appropriate chemical dosages indicated by the evaluative studies are being added and that the associated values for the water quality parameters of concern, whether this be pH, alkalinity, calcium and/or orthophosphate or silica residuals, are being maintained throughout the distribution system. To successfully demonstrate that the appropriate water quality parameters are being maintained within an acceptable range of values to minimize lead and copper levels at the tap, the system must collect tap samples in the field before and after installing treatment.
- The results of tap water samples for lead and copper taken at least once every 6 months for 1 year after corrosion control has been installed. The purpose of collecting these samples is to determine whether corrosion control has been effective in reducing lead and copper levels. The samples must be collected at targeted sampling sites as defined in § 141.86(a) and be 1-liter in volume and have stood in the pipes for a minimum of 6 hours.

Systems may also show that they have optimized corrosion control by demonstrating that the difference between the 90th percentile lead and highest source water samples is below the PQL for lead (0.005 mg/L) for two consecutive 6-month monitoring periods. For example, a large system would be deemed to have optimized corrosion control if its 90th percentile tap water lead level is 0.017 mg/L and the highest source water sample is 0.013 mg/L (difference 0.004 mg/L). EPA has included this provision because in these cases, very small amounts of lead will have been contributed by corrosion of distribution system materials, (as discussed in Section V(A)(3), the PQL is the lowest concentration that can be reliably achieved by well-operated laboratories within specified limits of precision and accuracy during routine laboratory operating conditions). Past practice with corrosion control treatment has generally demonstrated the ability to make gross reductions in lead levels, but the Agency doubts whether systems could produce quantifiable improvements in lead levels when corrosion is introducing such small amounts of contamination. In the example noted above, however, the

primary source of contamination is source water, and source water treatment would be necessary to minimize levels at the tap. Thus, lead levels should be adequately reduced at the tap without requiring the system to install corrosion control treatment in an instance where EPA doubts that such treatment could further reduce lead levels.

a. *Water Systems Serving Greater Than 50,000 People (Large Systems).* All public water systems serving more than 50,000 people (large systems) are required to complete all of the actions described below, unless they are deemed to have already optimized corrosion control as discussed in Section IV(C)(2) above.

i. Conduct Initial Tap Sampling (§ 141.81(d)(1)). All large systems are required to collect lead and copper samples for two consecutive 6-month periods, in accordance with the requirements contained in § 141.86(c) of the rule, and submit the results to the State. During the same two 6-month monitoring periods, large systems are also required to sample for pH, alkalinity, calcium, temperature, and conductivity, and phosphate and silica if phosphate or silicate-based inhibitors are used, in accordance with the requirements in § 141.87(b). Initial tap sampling must begin by January 1, 1992, and be completed by January 1, 1993.

ii. Conduct Studies/Recommend Treatment to State (§ 141.81(d)(2)). All large water systems are required to evaluate the effectiveness of each of the following treatments and, if appropriate, combinations of the treatments to identify optimal corrosion control for their system. The results must be submitted for review to the State by July 1, 1994.

(1) Alkalinity and pH adjustment.

(2) Calcium hardness adjustment.

(3) Addition of phosphate- or silica-based inhibitor at a concentration sufficient to maintain an effective residual concentration in test samples.

After analyzing the data generated during each evaluation, the water system shall recommend to the State the treatment option that constitutes optimal corrosion control treatment for that system and shall provide a rationale for its selection.

iii. State Designation of Optimal Corrosion Control (§ 141.81(d)(3)). By January 1, 1995, the State is required to review the different treatments evaluated by the system and either approve the treatment identified by the system as optimal or designate an alternative treatment.

iv. Installation of Optimal Corrosion Control (§ 141.81(d)(4)). By January 1, 1997, large water systems must install and properly operate the State-designated corrosion control treatment.

v. Follow-up Monitoring (§ 141.81(d)(5)). By January 1, 1998, large water systems must conduct follow-up tap sampling for lead and copper and the applicable water quality parameters at the same locations used for initial sampling during two consecutive 6-month monitoring periods.

vi. State Designation of Optimal Water Quality Parameters (§ 141.81(d)(6)). States are given until July 1, 1998 to review the system's installation and operation of corrosion control treatment, and after reviewing the results of tap water and water quality monitoring, the State is required to designate optimal water quality parameters, including:

(1) A minimum value or a range of values for pH measured at each entry point to the distribution system.

(2) A minimum pH value, measured in all tap samples, equal to or greater than 7.0, unless the State determines that meeting such a level is not technologically feasible or is not necessary for the system to optimize corrosion control.

(3) If a corrosion inhibitor is used, a minimum concentration or a range of concentrations for the inhibitor, measured at each entry point to the distribution system and in all tap samples, that the State determines is necessary to form a passivating film on the interior walls of the pipes of the distribution system.

(4) If alkalinity is adjusted as part of optimal corrosion control treatment, a minimum concentration or a range of concentrations for alkalinity, measured at each entry point to the distribution system and in all tap samples.

(5) If calcium carbonate stabilization is used as part of corrosion control, a minimum concentration or a range of concentrations for calcium, measured in all tap samples.

The values for the applicable water quality control parameters listed above shall be those that the State determines reflect optimal corrosion control treatment for the system. The State may designate values for additional water quality control parameters that the State determines to reflect optimal corrosion control for the system. The State shall notify the system in writing of these determinations and explain the basis for its decisions.

vii. Continued Operation and Monitoring (§ 141.81(d)(7)). All systems are required to maintain the water quality parameter values designated by the State in all samples collected under § 141.87(d).

viii. Modification of State Treatment Decisions (§ 141.82(g)). Upon its own initiative or in response to a request by a water system or other interested party, a State may modify its determination of the optimal corrosion control treatment. A request for modification by a system or other interested party is required to be in writing, explain why the modification is appropriate, and provide supporting documentation. The State may modify its determination where it concludes that such change is necessary to ensure that the system continues to optimize corrosion control treatment. A revised determination should be made in writing, set forth the new treatment requirements, explain the basis for the State's decision, and provide an implementation schedule for completing the treatment modifications.

ix. Treatment Decisions by EPA in Lieu of the State (§ 142.19). The final rule allows the EPA Regional Administrator to review treatment determinations made by a State and issue Federal treatment determinations if he or she finds that: (1) A State has failed to issue a treatment determination by the applicable deadlines contained in § 141.81, (2) a State has abused its discretion in a substantial number of cases or in cases affecting a substantial population, or (3) the technical aspects of a State's determination would be indefensible in an expected Federal enforcement action taken against a system.

b. *Water Systems Serving 50,000 or Fewer People (Medium and Small Systems).* All water systems serving 50,000 or fewer people (medium systems—3,301 to 50,000; small systems—3,300 or less) are required to conduct tap sampling and, if they exceed the lead or copper action level, complete the remaining steps outlined below.

i. Initial Tap Sampling (§ 141.81(e)(1)). All medium and small water systems are required to monitor for lead and copper at targeted sampling sites until the system exceeds the action levels or becomes eligible for reduced monitoring. Medium-sized and small systems can demonstrate that they have optimized corrosion control and no further action is required, by meeting the requirements in § 141.81(b) and discussed in Section C(2), above. Medium-size systems are required to begin initial tap monitoring by July 1, 1992. Small systems are required to begin initial tap monitoring by July 1, 1993.

All medium-size and small systems that exceed the lead or copper action levels are also required to sample for the following parameters during the same 6-

month monitoring period in which the action level(s) was exceeded: pH, alkalinity, calcium, temperature, and conductivity, and phosphate and silica if orthophosphate- or silicate-based inhibitors are used, every 6 months in accordance with the requirements in § 141.87 of the rule.

ii. System Recommendation on Optimal Treatment (§ 141.82(a)). Based upon the results of tap sampling, medium and small water systems exceeding the lead or copper action level have 6 months from the date they are above the action levels to recommend to the State installation of one or more of the corrosion control treatments listed in § 141.82(c) that they believe constitute optimal corrosion control for that system:

(1) Alkalinity and pH adjustment.

(2) Calcium hardness adjustment.

(3) Addition of phosphate- or silica-based inhibitor at a concentration sufficient to maintain an effective residual concentration in test samples.

iii. State Decision To Require Corrosion Control Studies or Corrosion Control Treatment (§ 141.81(e)(2)). Within 12 months after a system exceeds the lead or copper action level, the State may require the system to perform corrosion control studies. If the State does not require the system to perform such studies, the State is required to specify optimal corrosion control treatment within 18 months for medium-sized systems and 24 months for small systems from the date the system exceeds the action level(s). States are required to analyze all of the water system's monitoring results and approve the corrosion control option recommended by the system or designate an alternative optimal corrosion control treatment for the system.

iv. Conduct Corrosion Control Studies (§ 141.81(e)(3)). All medium-sized and small water systems required to conduct corrosion control studies have 18 months in which to complete the studies and submit the results to the State for review. Systems required to conduct corrosion control studies are required to follow the same procedures discussed above in Section (a)(ii) with regard to large systems. All medium-sized and small systems required to conduct corrosion control studies must submit their evaluations to the State along with a recommendation on the corrosion control treatment each system will install system-wide.

v. State Designation of Optimal Corrosion Control After Corrosion Control Studies (§ 141.81(e)(4)). If a medium-sized or small system conducts corrosion control studies, the State has 6 months to review the different treatments evaluated by the system and either approve the treatment identified by the system as optimal or specify an alternative treatment.

vi. Installation of Optimal Corrosion Control (§ 141.81(e)(5)). Medium and small water systems must install and properly operate the State-designated corrosion control treatment within 24 months of the State determination.

vii. Follow-up Monitoring (§ 141.81(e)(6)). Water systems must conduct follow-up tap sampling at the same locations used for initial sampling during two consecutive 6-month monitoring periods within 36 months after the State designates optimal corrosion control.

viii. State Designation of Optimal Water Quality Parameters (§ 141.81(e)(7)). States are given 6 months to review the system's installation of corrosion control treatment to determine whether the system has installed the optimal corrosion control treatment designated by the State and to designate values or ranges of values for applicable water quality parameters. The requirements for States are the same as stated for large systems in section (a)(vi), above.

ix. Continued Operation and Monitoring (§ 141.81(e)(8)). All systems are required to maintain the water quality parameter values designated by the State in all samples collected under § 141.87(d).

x. Modification of State Treatment Decisions (§ 141.82(g)). The requirements are the same as for large systems discussed above.

xi. Treatment Decisions by EPA in Lieu of the State (§ 142.19). The requirements are the same as for large systems discussed above.

3. Source Water Treatment Requirements (§ 141.83)

Water systems that exceed the lead or copper action levels are required to perform one or more of the following 6 actions to satisfy the source water treatment requirements:

(1) Monitor for source water lead and copper in accordance with the requirements in § 141.88 of the rule (all systems that exceed the lead or copper action levels) and recommend source water treatment to the State within 6 months after exceeding the lead or copper action level (§ 141.83(b)(1)).

(2) States are required to review the results of all source water samples and determine whether source water treatment is necessary to minimize lead or copper levels in water delivered to users' taps (§ 141.83(b)(2)).

(3) Systems are required to install the State-approved/designated source water treatment (§ 141.83(b)(3)).

(4) Systems are required to conduct follow-up tap water and source water monitoring (§ 141.88).

(5) States are required to review all the source water samples and designate the maximum permissible lead and copper concentrations for finished water entering the distribution system (§ 141.83(b)(4)).

(6) Systems required to maintain the State-designated maximum permissible lead and copper concentrations in source water (§ 141.83(b)(5)).

4. Public Education Requirements (§ 141.85)

All public water systems that exceed the lead action level are required to deliver a public education program as long as the action level is exceeded.

5. Lead Service Line Replacement Requirements (§ 141.84)

All public water systems that exceed the lead action level at the tap after installation or improvement of corrosion control and/or source water treatment are required to replace the lead service lines they control unless the lines are contributing less than 0.015 mg/L to drinking water.

D. Determination of Best Available Technology

The SDWA directs EPA to establish an MCL as close as "feasible" to the MCLG for a contaminant, or a treatment technique that will prevent adverse effects to the extent "feasible." Section 1412(b) (4) and (7). Feasibility for purposes of establishing an MCL or treatment technique means "feasible with the use of the best technology, treatment techniques, and other means, which the Administrator finds, after examination for efficacy under field conditions, and not solely under laboratory conditions, and are available (taking costs into consideration)." Section 1412(b)(5). Thus the Agency is required to demonstrate that the treatment requirement(s) is/are "feasible."

In selecting "best available technology" (BAT), EPA evaluates the ability of the technology to reduce the level of the contaminant, and the technological and economic feasibility of the technologies being considered. In assessing technological feasibility, EPA considers whether a technology has been shown to be effective through demonstrated full-scale use by public water systems, is compatible with other water treatment processes, and is

generally available throughout the United States.

When considering affordability of NPDWRs, EPA assesses whether the technology is reasonably affordable by regional and large metropolitan water systems (EPA is using a system size of 50,000 to 75,000 persons as a size cutoff to define large or regionalized water systems). This standard was established when the SDWA was enacted in 1974 ([see H.R. Rep. No. 93-1185 at 18 [1974] and reaffirmed when the Act was amended in 1986 (see 132 Cong. Rec. S6287 [May 21, 1986] [statement of Sen. Durenberger]). EPA also gives additional consideration to the total national costs to comply with the regulation.

Each of the four treatment technologies (corrosion control, source water reduction, public education, and lead service line replacement) identified as a part of the treatment technique are evaluated below in terms of their technological and economic feasibility and their ability to effectively reduce contaminant levels.

E. Corrosion Control Treatment

1. Available Treatments

The proposal presented three general corrosion control treatments available to public water systems to minimize lead and copper corrosion by-products at the tap: pH adjustment, pH adjustment in conjunction with alkalinity adjustment, and addition of corrosion inhibitors. Commenters raised three general issues with these corrosion control treatments: (1) The effectiveness of the different corrosion control treatments to reduce lead and/or copper levels; (2) the potential adverse secondary effects from corrosion control treatment; and (3) the need for assistance in developing corrosion control strategies.

a. *Cost and Effectiveness of Corrosion Control Treatment.* Many commenters stated that pH and alkalinity adjustment and addition of inhibitors are effective for reducing lead and copper levels at the tap, the treatments are generally available, and the costs are reasonable. Other commenters asserted that EPA had presented limited or unconvincing evidence that the corrosion control treatments cited are effective for reducing tap water lead and copper levels to the proposed action levels (average of 0.010 mg/L for lead and 1.3 mg/L for copper in 95 percent of samples). Several commenters stated that corrosion control may be effective for reducing the corrosion of lead pipes, but there is little evidence that corrosion control is effective in reducing dissolution of lead from solder, fixtures, or faucets.

It is important to recognize that unlike control technologies to treat source water contamination, control of corrosion byproducts does not involve removal of contaminants directly. Rather, corrosion control involves a variety of practices to prevent the contaminants from entering drinking water. The Agency acknowledges that precisely quantifying the effectiveness of corrosion control treatment under different water quality and distribution system configurations is difficult. The complexities involved in determining the appropriate treatment require that treatment decisions take into account the unique properties of the water used by a particular system and the physical configuration and material composition of the distribution system through which the water flows to consumers. These problems are discussed in more detail in section (b) below. Nevertheless, the Agency believes the data presented below demonstrate that proper application of pH adjustment in conjunction with alkalinity adjustment, calcium hardness adjustment, and the addition of corrosion inhibitors is effective for reducing lead and copper levels at the tap and that the cost (see Section X) to large metropolitan water systems to install and maintain the technologies is reasonable.

The Agency disagrees that there is little evidence that corrosion control is effective in reducing the dissolution of lead from lead solder. Data collected in the field and laboratory (Lyon and Lenihan, 1977; Oliphant, 1983; EPA, 1988e; AWWA-RF, 1990) and laboratory (Schock and Wagner, 1985; AWWA-RF, 1990) indicate that increasing Ph can substantially reduce lead dissolution from lead solder. Brass faucets and fixtures have recently been identified as a potentially significant source of lead in drinking water (Schock and Wagner, 1985; Schock and Neff, 1988; Gardels and Sorg, 1989; AWWSC, 1989), and consequently, little research has been conducted on effective treatment methods for minimizing the rate of dissolution from these faucets. Data from a limited number of locations indicate that while new brass faucets can contribute substantial amounts of lead to first-draw water for the first few weeks or months after installation, the rate of lead dissolution will rapidly decline to a low level and ultimately stabilize (PMI, 1990). Until additional data can be collected that provide a clearer indication of the rate of dissolution from brass faucets under a variety of water conditions, the extent to which faucets contribute to total tap water lead levels will remain difficult to quantify. EPA has sought to ensure that lead problems due to faucets are detected and addressed by requiring systems to minimize lead levels in first-flush water. In addition, EPA will shortly publish an Advanced Notice of Proposed Rulemaking for a TSCA Section 6 action to restrict the future use of fixtures with lead.

In addition, EPA has been working with the National Sanitation Foundation (NSF) to establish performance standards for newly manufactured brass faucets and fixtures. Only those faucets that are tested to show minimal leaching of lead will be certified by NSF. Some manufacturers are beginning to investigate lead-free metal alloy faucets, but it appears that it will be several years before these faucets are in widespread use. Until then, EPA believes that compliance with this final rule, as well as with NSF standards, will minimize lead exposure from brass faucets. The NSF standard will be part of a voluntary certification program for manufacturers of plumbing products and is expected to be adopted by most, if not all, States.

The preamble to the proposed rule presented information from several public water systems that collected lead tap samples before and after either raising pH, or raising pH in conjunction with adjusting alkalinity. Several commenters stated that the data presented did not demonstrate that the corrosion control treatments were effective because the majority of the data (Boston and Bennington) were from systems with lead service lines and that the systems had very high lead levels, which are not representative of the lead levels found throughout the country. They stated that the effectiveness of corrosion control in systems with lead levels in the range usually found—0.015 mg/L to 0.030 mg/L—was not proven. In addition, they criticized the use of the Seattle data because the samples were not collected in the same manner as required by the proposed rule.

EPA acknowledges that the Boston and Bennington data presented in the proposal came from homes with lead service lines and that the lead levels in many of the homes had very high lead levels before installation of corrosion control treatment. The data from Boston and Bennington, however, cannot be discounted simply because the systems have lead service lines. EPA estimates that about 20 percent of all public water systems, and about 30 to 35 percent of the systems that will initially exceed the lead action level, have some lead

service lines (EPA, 1991a). Thus, a large number of systems affected by this rule contain lead service lines. Data from other systems with lead service lines such as Fall River, New Bedford, and Chatham, Massachusetts, also had very high lead levels (EPA,1991b).

As has been widely documented, the corrosion control interventions in Boston and Bennington were effective (Karalekas et al., 1976, 1978, 1983; EPA, 1988f, 1991b; AWWA-RF, 1990). The 90th percentile lead levels in Boston were reduced from 0.110 mg/L (average of 0.058 mg/L) before pH and alkalinity adjustment, to 0.047 mg/L (average of 0.030 mg/L) 3 years after installation of treatment (Marcus, 1990a). Bennington reduced its 90th percentile lead levels from 0.148 mg/L (average of 0.105 mg/L) to 0.026 mg/L (average of 0.014 mg/L) 3 years after treatment (Marcus, 1990a). In Fall River, MA, the 90th percentile lead level was reduced from 0.250 mg/L (average 0.091 mg/L) before pH adjustment to 0.176 mg/L (average 0.034 mg/L) after treatment (Marcus, 1990a).

EPA also recognizes that the samples in Seattle were not collected exactly as the sampling protocol in the final rule. The final rule requires a 1000 ml first-draw sample, and Seattle used the first 250 ml for microbacterial analyses and the next 1000 ml for lead analysis. Nevertheless, the data are useful for determining the relative effectiveness of corrosion control treatment. Reductions in lead levels of about 60 percent after installation of treatment were obtained: for the Cedar River supply the 90th percentile lead level was reduced from 0.025 mg/L (average 0.010 mg/L) before treatment to 0.009 mg/L (average 0.004 mg/L) after treatment; the Tolt River supply showed reductions in the 90th percentile lead values from 0.025 mg/L (average 0.010 mg/L) to 0.011 mg/L (average 0.004 mg/L) (EPA, 1991b).

Several water systems have conducted sampling before and after application of inhibitors following initial sampling of 94 water districts in early 1988. The American Water Works Service Company (AWWSC) began an investigation into the effect of zinc orthophosphate on three districts (230, 340, and 130). Nine sites were sampled before and after treatment in District 230, four sites in District 340, and five sites in District 130. Average lead levels in first-draw tap samples in District 230 were reduced from 0.040 to 0.005 mg/L (88 percent reduction), District 340 showed reductions from 0.053 to 0.005 mg/L (87 percent reduction), and average first-draw lead levels in District 130 were reduced from 0.090 to 0.012 mg/L (91 percent reduction) (AWWSC, 1989). In Fairbanks, Alaska, morning first-draw tap samples were collected from 15 sites before, and 1 month after, treatment with sodium polyphosphate. Average lead levels were reduced from 0.077 to 0.035 mg/L (56 percent reduction) (AWWA-RF, 1990). These data and the data in Table 7 indicate that the addition of corrosion inhibitors can be effective for reducing lead levels in drinking water.

TABLE 7.—RELATIVE EFFECTIVENESS OF CORROSION CONTROL TREATMENTS

Corrosion control treatment	No. of systems	Percent of systems with 90th percentile levels below (mg/L)				
		0.005	0.010	0.015	0.020	0.030
Systems without Pb service lines: [1]						
No treatment	6	15	25	37	50	75
pH <8	11	21	34	49	67	87
pH >8	9	36	73	88	94	98
Inhibitors	13	34	65	80	88	95
Systems with Pb service lines [2]						
pH >8	5	16	20	24	28	38
Inhibitors	6	17	22	28	34	48

[1] First-draw samples from the following studies:
—28 systems from the American Water Works Service Company survey
—8 systems for the Technical Support Division (TSD/ODW) survey
—3 systems from public comments on the 1988 proposal.
[2] Data from service line samples from 11 systems, collected prior to proposal.

Several commenters were concerned that the singular reference to zinc orthophosphate in the proposed definition of corrosion inhibitors could be construed as an endorsement of this inhibitor at the expense of excluding many other effective inhibitors (e.g., polyphosphate, orthophosphate, blends of ortho- and polyphosphates, silicates, or sodium and zinc hexametaphosphate). Although the 1988 proposal identified zinc orthophosphate as the most effective inhibitor based on the available data, the Agency did not intend to imply that zinc orthophosphate was the only inhibitor a water system could use. The Agency has, therefore, deleted the reference to zinc orthophosphate for the rule's definition of corrosion inhibitor. To the extent that other inhibitors are able to reduce lead levels, they need to be considered.

Many commenters suggested that silicate-based inhibitors should be allowed, stating that they are effective in reducing lead and copper levels. Little research has been done with silicate-based inhibitors, and EPA is not aware of a water system that has used these inhibitors system-wide to reduce lead and copper levels (AWWA-RF, 1990). Some success was obtained, however, at a relatively high SiO_2 in pipe loop experiments by EPA (Schock, 1989). Water systems are permitted to test the effectiveness of silicate-based inhibitors during their corrosion control studies. Likewise, States are free to approve/designate silicate-based inhibitors if it can be determined that they are the most effective inhibitor for reducing the dissolution of lead and copper bearing materials.

EPA also analyzed data received during the public comment period and data received prior to the 1988 proposal to compare the effectiveness of available corrosion control treatments in reducing lead levels. These data confirm EPA's conclusion at proposal that implementation of corrosion control treatment can effectively reduce lead levels at the tap. The three primary sources for these analyses were the American Water Works Service Company Lead Survey, the EPA Office of Drinking Water's Technical Support Division Lead Survey (TSD), and the pre-proposal and public comment data base. EPA analyzed the three data sets in a paper "Influence of Plumbing, Lead Service Lines, and Water Treatment

Levels at the Tap" (EPA,1990e). This paper was made available for public review and comment through a **Federal Register** notice, published on October 19, 1990 (55 FR 42409). No comments were received on the analyses during the public comment period. The data and analyses are also discussed in the Occurrence and Treatment Support Document (EPA,1991b). A brief summary of the analyses is presented below along with the results in Table 7.

The majority of the systems in these data bases did not collect samples before and after installation of treatment. In an attempt to utilize this information, EPA screened the data that were collected using, as close as possible, the compliance monitoring criteria for the final rule: 1-liter first-flush samples (stagnation time of at least 6 hours) from homes with copper plumbing older than 5 years (to account for the effects of the 1986 ban on lead solder). Only systems with nine or more targeted samples were included in the analyses to increase the confidence in the estimates. Data from homes and systems with lead service lines were assessed separately from those without lead service lines. After applying these criteria to the data, 39 systems without lead service lines and 11 systems with lead service lines remained. Data from dozens of other utilities did not meet the criteria because collection methods consistent with the final rule were not used. For example, some systems did not collect 1-liter samples or collected samples after a standing time of only 2 hours.

The data from the 39 systems without lead service lines were divided into one of four "treatment" strata: (1) use of corrosion inhibitors, (2) pH adjusted to at least 8.0 at the treatment plant, (3) pH adjusted to between 7.0 and 8.0 at the plant, and (4) no treatment but pH was above 7 at the plant. The results given in Table 7 represent comparative estimates of treatment performance rather than precise predictions of systems' ability to meet the action level of 0.015 mg/L. The actual "pass/fail" rates among the entire water supply industry are expected to be different for a number of reasons, among which are the following:

- A relatively small number of systems are represented and are limited to mostly medium (and a few large) size systems, concentrated in the mid-Atlantic and Ohio River Valley.
- Data represent single samples. Other information indicates considerable temporal variability at the same tap. In addition, the majority of data were collected between January and March (AWWSC, 1989). Lead levels are generally lower in cold months; consequently, projected performance based on these data would tend to be overestimated.
- The range of important water quality parameters (e.g., alkalinity, hardness) of the raw water in these systems is relatively narrow. For example, most systems with pH $\geq$ 8.0 had total alkalinities in raw water between 20 and 50 mg/L as $CaCO_3$ (alkalinities can range from less than 10 mg/L to over 500 mg/L). Because the data are not representative of the range of water quality characteristics present throughout the United States, it is difficult to extrapolate, especially to large systems where the variability in pH can be significantly greater than in smaller systems.
- Only data from homes with plumbing older than 5 years at the time samples were taken were analyzed. The "greater than 5 years of age" stratification was used because selecting homes that would match the final targeting criteria exactly (homes with plumbing 5–10 years old) would have limited the analyses to less than 10 systems, which would have been insufficient to generate meaningful results. EPA chose to limit the analysis to houses with plumbing older than 5 years (as opposed to analyzing data from houses with plumbing of any age) to standardize the group of houses analyzed. Moreover, the age range reflects the fact that homes sampled under the final rule will likely have lead solder older than 5 years because of the effects of the 1986 SDWA lead solder ban. Lead levels in homes fitting the targeting criteria in the final rule (homes built after 1982, i.e., plumbing between 5–10 years of age) would be expected to be higher than in homes aggregated in the "older than 5 year" category since this latter category could have included much older homes with dissipated lead solder. This is another factor that tends to make performance projections based on these data optimistic.
- None of these systems were specifically trying to minimize lead or copper levels, although they were trying to reduce corrosion to some degree. This would tend to underestimate system performance projections based on these data.

Despite the data limitations, EPA believes the results in Table 7 represent trends indicative of the efficacy of the different treatments. Among systems with non-lead service lines, the data indicate that systems using corrosion inhibitors and maintaining a pH above 8.0 (at plant) would have a much higher likelihood of meeting the lead action level of 0.015 mg/L compared to systems in the other treatment strata. These data support conclusions discussed earlier that increasing pH and/or alkalinity, or adding a corrosion inhibitor, can effectively reduce lead levels in tap water.

The costs of pH adjustment, alkalinity adjustment, and corrosion inhibitor addition are summarized in Table 8. EPA believes the costs of these methods are reasonable and the methods are generally available for use by water systems. Costs may vary from those shown depending on local circumstances, but based on available information, the costs are representative of typical systems using these corrosion control treatments.

The corrosion control cost estimates were derived using the same assumptions and models as used for the proposed rule (adjusted for the new flow rates) with capital costs amortized over 20 years at a 10 percent interest rate and updated to reflect December 1988 engineering fees, contractor overhead and profit, and power, fuel, labor, and chemical costs. EPA also revised assumptions regarding flow rates to calculate all inorganic technology costs (EPA, 1987d) that result in increased cost estimates for corrosion control. A more detailed discussion on the procedures used in developing the cost estimates for these treatments can be found in the August 1988 proposal and in Lead and Copper in Drinking Water as a Result of Corrosion: Evaluation of Occurrence, Cost, and Technology (EPA, 1991b).

Several commenters submitted information on treatment costs for their systems. Unfortunately, the majority of systems did not present sufficient detail on critical elements, such as system design, flow rate, or chemical dosages, to enable EPA to compare the commenter's costing methodology with EPA's, or for EPA to modify its cost models as suggested by some commenters. The treatment costs from the few systems that did supply sufficient information generally supported EPA's estimates.

TABLE 8.—CORROSION CONTROL TREATMENT COSTS [1]

	Population served			
	<100	3,301–10,000	50,001–75,000	>1 million
Capital Costs ($ millions)				
pH adjustment:				
lime	3	152	518	978
caustic soda	3	44	93	731
calcite beds [2]	13			
Alkalinity adjustment:				
soda ash	3	56	119	1185
sodium bicarbonate	3	54	110	965
Corrosion inhibitor (e.g., zinc orthophosphate)	5	80	119	312
Total Production Costs (cents/1000 gallons or $/household/year) [3]				
pH adjustment:				
lime	86	12	3	1
caustic soda	66	6	3	3
calcite beds	114			
Alkalinity adjustment:				
soda ash	81	8	4	3
sodium bicarbonate	86	9	5	5
Corrosion inhibitor (e.g., zinc orthophosphate)	95	6	1	1

[1] Reference: EPA, 1991b.
[2] Systems serving greater than 500 people do not typically use calcite beds for adjusting pH.
[3] The cost per household per year can be calculated by multiplying production costs by 100. This assumes water consumption of 100,000 gallons per household per year.

Several commenters objected to using tap samples for measuring the effectiveness of corrosion control. These commenters were concerned that it would be difficult to ascertain whether a reduction in lead levels, measured at the tap after installing corrosion control, is a result of treatment or simply due to the aging of solder. They argued that water systems should be allowed alternative methods, such as the use of pilot plant studies or pipe loops to show the effectiveness of corrosion control.

EPA agrees that water systems should use pipe loops, metal coupon, partial system tests, or other evaluative schemes to assist in determining the most effective corrosion control treatment. The Agency encourages water systems investigating different corrosion control treatments to first conduct research in the laboratory, whenever possible, before implementing system-wide corrosion control, and it anticipates that the majority of systems serving greater than 50,000 people will follow such procedures. Although pipe loop and pilot plant studies can assist in planning a treatment strategy and predicting trends, they cannot be expected to predict the precise lead and copper levels at the tap for numerous reasons including: (1) The aging effects of pipe scales, (2) the nature of preexisting pipe deposits not governed by lead or copper chemistry alone, (3) differences in surface chemistry between new and used pipes or faucets, and (4) disturbances of deposits when pipe from the field is pulled and used in the laboratory tests. Thus, relying solely on laboratory studies to predict the effectiveness of corrosion control treatment would not indicate the levels of lead or copper at taps. Because of these problems and because EPA's goal is to reduce exposure to lead or copper in drinking water, it is essential to collect tap samples to determine if lead and copper levels at the tap decrease or increase after application of full-scale treatment and not to rely solely on laboratory studies to determine the effectiveness of treatment. Tap sampling after installation of corrosion control treatment is also necessary to evaluate whether lead service line replacement or additional public education is required.

In terms of commenters concerned with the ability to differentiate between the effects of treatment and the aging of lead solder, the Agency believes that this should not be a problem because the final rule does not require systems to sample at homes with lead solder less than 5 years old, but only requires that lead solder have been installed after 1982. This is 4 years before the enactment of the lead ban in section 1417 of the SDWA and 6 years before the ban was to have been enforced by States. EPA believes that this criterion for monitoring will help assure that sites with the most recently installed lead solder (before the material was banned) are sampled and the potentially higher lead levels associated with these sites are found. However, because these sites will be greater than 5 years old, the effects on lead levels will be more readily associated with treatment as opposed to the aging effects of solder.

The data presented above show that increasing pH, and/or increasing pH in conjunction with alkalinity, or adding corrosion inhibitors can greatly reduce the levels of lead in tap water. These treatments have been used for many years by water systems to reduce corrosion in water distribution systems and the costs of these treatments are reasonable for large water systems (less than $6 per household per year). EPA, therefore, concludes that this treatment technology is feasible within the meaning of 1412(b)(5) of the SDWA. The data also indicate that the precise treatment efficacy of the different treatments will vary considerably between systems and even within systems, thereby reinforcing EPA's conclusion, discussed in Section IV(B), above, that it is not feasible to establish a single number as reflecting application of the best available treatment.

b. *Secondary Effects of Corrosion Control.* Numerous commenters stressed that corrosion control treatment must be designed and implemented to optimize overall water quality, not just to reduce lead and copper corrosion by-products. They contended that pH adjustment may result in a net decrease in public health protection due to increased levels of trihalomethanes and other disinfection by-products, increased precipitation of iron and manganese, and increased corrosion of galvanized piping in some water systems. Other commenters stated that an increase in pH could reduce the effectiveness of corrosion inhibitors. In addition, some commenters stated that phosphate-based inhibitors may promote bacterial and algal growth in reservoirs and other

parts of the water supply system and may have potential impacts on wastewater sludge disposal, especially the accumulation of zinc in wastewater sludge resulting from the use of zinc orthophosphate. Finally, a number of commenters were concerned about the secondary effects associated with adding sodium salts to the water supply to increase alkalinity. They contend that although the amount of sodium would be small, it could have substantial adverse impacts on people who are hypertensive or at high risk of heart attack, heart failure, stroke, and kidney damage.

EPA recognizes that adverse secondary effects on the quality of water and the potential for reduced public health protection can occur in the process of installing corrosion control treatment for lead or copper (AWWA-RF, 1990; Schock, 1990). For example, the adjustment of pH or alkalinity or the addition of phosphates can affect coagulation (a process by which materials suspended in water are concentrated for easy removal). Adverse impacts on coagulation can increase turbidity and impair effective removal of organic matter during sedimentation and filtration, which can interfere with disinfection and increase trihalomethane formation in the distribution system (AWWA-RF, 1985, 1990). Trihalomethanes are formed by the reaction of free chlorine and certain organic precursors (i.e., humic or fulvic acids). To minimize TTHM formation, systems using surface water sources should assure maximum TTHM precursor removal by optimizing the clarification process prior to increasing the pH. Systems using groundwater sources with high concentrations of TTHM precursors may need to install treatment to enhance removal of such precursors (e.g., membrane filtration) or use alternative disinfectants to free chlorine (e.g., chlorine dioxide or ozone followed by chloramines) in order to achieve adequate disinfection, minimize TTHM formation, and control corrosion at the same time.

Adjustment of pH may also alter the effectiveness of disinfectants. For instance, if systems use chlorine for disinfection, elevation of pH should be delayed, to the extent possible, until just prior to when the water enters the distribution system. This will maximize the contact time during which disinfection with chlorine is most efficient (since chlorination is most effective at low pHs), while also optimizing corrosion control in the distribution system.

EPA believes that increased precipitation of iron and manganese may be a problem for some systems, especially those that had precipitation problems before installing corrosion control treatment. Even though there are no NPDWRs for iron and manganese, systems and States should be aware that adjusting pH or increasing hardness, for example, may exacerbate iron and manganese problems and should factor in these problems, if possible, when determining the most appropriate treatment for the system. The Agency does not believe the corrosion of galvanized pipe will be a problem. Available data indicate, in fact, that the corrosion rate from galvanized pipe either decreases as pH is increased from 7.0 to 8.0 or that there is little change in the corrosion rate (Trussels and Wagner, 1985).

EPA agrees that phosphate-based inhibitors may be a problem in certain situations and recommends that water systems use other methods of corrosion control in these situations. The 1990 AWWA-RF Lead Control Strategies lists factors to consider before using phosphate-based inhibitors. For example, systems that have a problem with eutrophication of receiving waters, such as reservoirs, may need to consider whether adding additional phosphate into the system will exacerbate the problem and trigger other associated problems with turbidity, taste, and odor. In addition, the presence of phosphates may be undesirable for selected industrial users and to aquatic ecosystems.

EPA is also aware of potential problems with the use of zinc orthophosphate, such as wastewater treatment effluent guidelines for zinc, or problems with the reuse of wastewater sludge. Restrictions on wastewater treatment discharges and associated costs of removal, even though not the direct responsibility of the public water system, are important considerations. Water systems should be aware of limits on effluent standards and work with local wastewater treatment authorities to protect against any unintended problems that could be avoided with other corrosion control treatment methods, such as using silicate-based inhibitors or adjusting pH or alkalinity. EPA is also aware of limitations caused by precipitation of zinc that could result in turbid water or filter clogging, especially in hot water systems (AWWA-RF, 1990; Schock, 1990). Again, systems should be aware of these problems and attempt to minimize precipitation of zinc whenever possible.

EPA does not believe that the addition of sodium salts at the concentrations required for corrosion control or source water reduction poses a health risk to individuals on a limited sodium diet. The National Inorganics and Radionuclides Survey (EPA, 1988a) indicated that sodium concentrations in drinking water supplies range from 1 mg/L to 1540 mg/L, with a median of 16.6 mg/L and an average of 57 mg/L. The vast majority of sodium intake, however, comes from sources other than drinking water. The typical American diet contains several thousand milligrams per day of sodium.

EPA estimates that typical sodium concentrations average 10 mg/L when either sodium hydroxide or sodium carbonate are used by water systems (EPA, 1990g). This amount of sodium is very small compared to the intake from other dietary sources and, therefore, does not present a public health concern. EPA recommends a sodium limit of 20 mg/L in drinking water (45 FR 57332) because at higher levels it is difficult to maintain a severely restricted sodium diet. Water systems with sodium levels above 20 mg/L are required to inform local health authorities (40 CFR 141.41) so that physicians can advise their patients accordingly. A more detailed discussion of the relationship between sodium in drinking water and elevated blood pressure is included in the **Federal Register** notice that removed sodium from the list of 83 contaminants included in the 1986 amendments to the SDWA (53 FR 1892).

Because of the many problems discussed above, EPA concurs with commenters that corrosion control treatment must be designed and implemented in the context of the other drinking water regulations (e.g., surface water treatment, disinfection by-products) and, when possible, other water treatment processes (wastewater treatment). The regulation takes these problems into account by defining "optimal corrosion control" as the treatment that minimizes the corrosivity of water without causing violations of other NPDWRs. The definition will allow States to take into account the secondary effects of corrosion control treatment that might adversely affect the ability of systems to comply with other MCLs or treatment techniques. Moveover, it is because of these potential site-specific problems that the determination of optimal corrosion control must necessarily be made on a case-by-case basis. The regulation, therefore, provides systems and States with flexibility to take these factors into account in determining and implementing the best treatment approach for each system.

c. *Technical Assistance with Corrosion Control Treatment.* Numerous commenters stated that they do not have the expertise to design and maintain an effective corrosion control program and requested assistance from EPA. EPA understands these concerns, especially for small systems, and is developing a guidance manual to assist water systems in evaluating alternative approaches for corrosion control treatment and in addressing secondary impacts on water quality. When completed, the manual will be available at all EPA Regional Offices and through the National Technical Information Service. In addition, EPA will be working with the Association of Metropolitan Water Agencies, the American Water Works Association, and the National Rural Water Association to assist water systems, especially small water systems, with information, training, seminars, and other guidance on available corrosion control treatments. Finally, the 1990 American Water Works Association Research Foundation has recently published Lead Control Strategies (AWWA-RF, 1990), a manual that should be consulted for strategies for designing an effective corrosion control program and dealing with the secondary impacts of treatment.

2. Rationale for Final Corrosion Control Treatment Approach and Summary of Changes from Proposal

In the proposed rule, the Agency would have required systems serving more than 3,300 persons that exceeded the lead or copper action levels to submit for State approval a treatment plan that would have included schedules for conducting appropriate corrosion control studies and implementing full-scale corrosion control treatment. Systems serving 3,300 or fewer persons exceeding the action level would have been required to implement a treatment plan specified by the State. Like the proposal, the final rule includes system-by-system determination of the appropriate treatment contingent on State review. However, the following changes have been made to assure timely implementation of treatment, provide greater flexibility for States in determining the appropriate course of action for medium and small systems, and assure the greatest feasible public health protection:

(1) The pH action level has been deleted, but systems optimizing corrosion control are required to maintain minimum pH values as a component of optimal corrosion control treatment.

(2) The lead and copper action levels that will trigger corrosion control treatment have been modified.

(3) An alkalinity action level has not been included, but systems adjusting their alkalinity are required to maintain minimum concentrations of alkalinity specified by the State.

(4) Systems using calcium carbonate stabilization as a part of corrosion control are required to maintain a minimum calcium concentration in all tap samples.

(5) Systems using a corrosion inhibitor are required to maintain a residual concentration sufficient to form a passivating film on the interior walls of the pipes in the distribution system.

(6) A schedule for evaluation and implementation of treatment is included in the regulation instead of being established by the States in each treatment plan.

(7) All small and medium-size systems that exceed either action level, in addition to all large water systems required to evaluate alternative corrosion control treatments, must submit a recommendation to the State regarding optimal corrosion control treatment.

(8) Flexibility has been granted to States in determining whether medium-size and small systems perform detailed corrosion control studies.

(9) More detailed guidelines are included to assist States in designating optimal corrosion control.

(10) Authority for EPA to review State corrosion control determinations has been added.

The reasons for each of these changes are discussed below.

a. *Action Levels.* As discussed earlier, action levels were introduced in the proposal as a method to limit the number of public water systems that would need to complete a detailed demonstration that they have installed corrosion control treatment to minimize lead and/or copper levels at taps. Many commenters supported the concept of action levels, but several disagreed on how they should be used in determining compliance. One commenter argued that the action levels function as an MCL and that EPA does not have the authority to establish MCLs, or in this case action levels, at consumer taps. Other commenters supported action levels if they were used as screens or as triggers to evaluate whether corrosion control is needed, but not used to determine compliance with the rule.

EPA disagrees with commenters who argued that the action levels function as MCLs. Under the SDWA, if a water system exceeds an MCL, it is in violation of the NPDWR (unless it has obtained a variance or exemption under section 1415 or 1416), and the system must provide public notification under section 1413. Water systems that exceed the action levels, however, are not in violation of the treatment technique. Rather, exceedance of the action level(s) is merely a trigger for medium and small systems to implement optimal corrosion control (unless they can demonstrate to the State that they have already optimized corrosion control) and systems of all sizes to implement source water monitoring and possible treatment, public education, and possible lead service line replacement. Since the compliance status of a water system depends upon whether it performs the treatment steps established in the rule, and not upon whether it meets the action levels, the action levels are not equivalent to MCLs.

i. *pH Action Level.* The proposed rule would have required water systems to collect pH samples along with lead and copper samples and to install optimal corrosion control treatment if the pH in more than 5 percent of their samples collected at the tap were below 8.0. EPA also solicited comment in the preamble to the proposal on the alternative of deleting the pH action level and using pH of 8.0 as a guidance level. Under this alternative, only systems above the lead or copper action levels would have been required to monitor for pH and would have been required to examine the effect of increasing pH above 8.0 as part of the optimization demonstration.

EPA received comments both for and against retaining the pH requirement. A few commenters supported the pH action level because it would require more systems to install treatment and thus provide greater public health protection. Several commenters supported the use of a pH action level, but argued that a more reasonable minimum pH value would be 6.0, 6.5, or 7.0. Many commenters who disagreed with the pH requirement contended that PWSs should not be required to adjust their pH unless there is a demonstrated lead or copper problem within the system.

Some commenters stated that raising the pH to above 8.0 could have adverse effects on the quality of drinking water, such as causing greater difficulty in meeting the turbidity MCL, reducing the effectiveness of chlorine as a disinfectant, increasing disinfection by-products such as trihalomethanes, and increasing scaling that could damage distribution systems and residential plumbing. In addition, commenters were concerned because corrosion inhibitors

work best at pH below 8.0, and in some cases at pH closer to 7.0.

Other commenters contended that pH below 8.0 can be an indicator of corrosive water, but there is little evidence to support a direct relationship between pH levels and high lead and copper levels. These commenters noted that other factors, such as alkalinity, hardness, temperature, chlorine content, and additional site-specific conditions, must also be considered.

EPA agrees that many systems maintaining a pH below 8.0 will not have a lead problem, especially if the lead solder ban has been enforced, there are no lead service lines in the distribution system, or the system is using corrosion inhibitors. EPA also agrees with commenters that adjustment of pH to greater than 8.0 may, in some cases, result in adverse secondary effects on drinking water quality that could potentially affect public health and that corrosion inhibitors work better when pH is below 8.0. For these reasons, EPA has decided to delete pH as an action level that would, in and of itself, trigger detailed demonstrations of optimal corrosion control treatment regardless of levels at the tap.

EPA noted in the preamble to the proposal that the alternative of deleting pH as an action level and requiring treatment only where the average lead action level was exceeded would likely result in fewer systems' performing treatment than would have been required under the proposed rule, and could potentially result in less public health protection (53 FR 31547). The impact of modifying the use of pH is not substantial under the final regulation as compared with the proposed rule because (1) all large systems are required to optimize treatment regardless of pH levels, and (2) the lead action level of 0.015 mg/L (90th percentile) applicable to small and medium systems contained in the final rule is more stringent than the proposed average of 0.010 mg/L. In addition, as discussed further in section 2(a)(ii), below, the Agency believes that it is appropriate to base treatment requirements for small and medium systems on the actual lead and copper levels. As long as these levels are met by systems of these sizes, the Agency believes that public health is being protected and that the triggering of more detailed demonstrations of optimal corrosion control is not warranted.

EPA continues to believe that pH is an important facet of corrosion control treatment and disagrees with commenters who contend that there is limited evidence linking increased pH with a reduction in lead levels. The corrosivity of acidic water toward lead plumbing materials is well documented (EPA, 1982a; Hoyt et al., 1979; O'Brien et al., 1976; Lyon and Lenihan, 1977; Gregory and Jackson, 1984; AWWA-RF, 1985, 1990). Experience in the field, pilot plants, as well as laboratory tests, indicate that raising pH is an effective method to reduce water corrosivity and lead and copper levels at taps and is often the least costly and most easily implemented method of reducing the corrosivity of water. Data from Boston, Bennington, and Fall River clearly demonstrate that raising pH can significantly reduce lead levels at the tap. The AWWSC survey showed lower average first-draw lead levels at sites with higher pH: 0.019 mg/L for sites with pH below 7.0; 0.013 mg/L at sites with pH between 7.0 and 7.5; 0.012 mg/L at sites with pH between 7.5 and 8.0; and 0.005 mg/L at sites with pH greater than 8.0 (AWWSC, 1989). Finally, the analysis in Table 7 indicates that systems with pH greater than 8.0 at the plant have substantially lower 90th percentile lead levels (0.016 mg/L) than those with pH below 8.0 (0.032 mg/L). These data indicate that increasing pH can reduce tap lead levels, which is consistent with predictions of numerous laboratory investigations.

EPA agrees that other water quality parameters besides pH must be considered when attempting to design a program to control corrosivity (AWWA-RF, 1990; Schock, 1990) and is, therefore, requiring sampling, where appropriate, for alkalinity, calcium, conductivity, water temperature, and inhibitor residuals (phosphate, silica). Sampling for these additional water quality parameters will assist water systems and States when deciding on the best corrosion control strategy and when evaluating the efficacy of corrosion control treatment on overall water quality.

Rather than having pH alone be a factor in determining whether a system must make a detailed optimization demonstration, pH adjustment is required as part of the optimization process for those systems required to install treatment. Specifically, the final rule (§ 141.82(f)) requires that optimal corrosion control approved or designated by the State include pH adjustment to at least 7.0 in all tap samples and that the State establish a minimum value or a range of values for pH measured at each entry point to the distribution system.

EPA selected a level of 7.0 instead of 8.0 because this constitutes only a minimum requirement. EPA anticipates that States will require many systems to adjust their pH to levels higher than 7.0 to optimize treatment and that systems conducting corrosion control studies will find that raising pH above 7.0 will be needed to minimize lead and copper levels at the tap. However, for some small and medium-size systems, the adjustment of pH to greater than 7.0 may alone be sufficient to reduce lead and copper to below the action levels. Requiring pH adjustment to at least 7.0 will ensure that all systems operate at the minimal pH level associated with reduced lead or copper levels at the tap. Adjusting pH to at least 7.0 is a basic step to ensure neutral conditions at a minimum. Such an adjustment generally precedes proper corrosion inhibitor application or other water quality treatment strategies.

Maintaining a pH value above 7.0 at taps will require many water systems to raise the pH at the treatment plant above 7.0. The exact pH level required at the plant will depend on several factors including, but not limited to, configuration of the distribution system, buffering capacity of the water, and temperature. To maintain a pH of 7.0 throughout the distribution system, water systems may be required to adjust the alkalinity of their distributed water to ensure the water is well-buffered and, thus, more resistant to pH change as it travels to the outer reaches of the distribution system.

In recognition of commenters' concerns regarding potential problems associated with pH adjustment, the final rule waives the requirement for pH adjustment to above 7.0 in tap samples if the State determines that this step is not technologically feasible or it is not necessary to optimize corrosion control. EPA included this provision in the final rule because of concerns raised by commenters that raising pH above even 7.0 may, in some cases, be counterproductive to optimizing corrosion control. This may be true for some systems using corrosion inhibitors depending on the overall water chemistry, even though EPA believes that inhibitors for controlling lead and copper require a pH of at least 7.0 and usually somewhat higher (AWWA-RF, 1990). Another potential situation where raising pH above 7.0 may cause problems is when a system has very hard water ($CaCO_3$ > 125 mg/L and total dissolved solids > 200 mg/L). In this situation, raising pH above 7.0 may cause problems with excess calcium carbonate precipitation, which can clog pipes and decrease the effectiveness of disinfection. Finally, pH adjustment may reduce the disinfection efficiency of free chlorine or increase TTHM formation. In these cases, systems will need to

evaluate whether raising pH to 7.0 would cause them to exceed the TTHM standards or reduce their disinfection efficiency. In most cases, however, adjusting pH above 7.0 should not cause the problems described above and waivers will not be necessary.

In addition to maintaining a pH of 7.0 in tap samples, systems that install corrosion control treatment will be required to maintain pH above a minimum value, or within a range of values designated by the State at each entry point to the distribution systems. This requirement is to ensure that systems maintain appropriate pH control in source water and within the distribution system (as identified in corrosion control studies or designated by the State) and that needed adjustments to treatment are routinely monitored.

ii. Lead Action Level. [A]. Action Level of 0.015 mg/L in No More Than 10 Percent of Top Samples for Small and Medium-Sized Systems. EPA proposed two lead action levels: an average lead concentration in targeted tap samples of 0.010 mg/L that would trigger installation or improvement of corrosion control and public education, and an action level of 0.020 mg/L (in more than 5 percent of the targeted samples) that would trigger public education. EPA also solicited comments on alternative lead action levels of 0.020 mg/L and 0.030 mg/L which, if exceeded in 5 percent or more of tap samples, would have triggered treatment. Some commenters agreed with the proposed action levels, but the majority of commenters disagreed for two reasons: (1) two lead action levels were confusing and should be replaced by one number, and (2) EPA had not provided sufficient documentation to justify the action levels from either a technical or a health-based perspective. Several commenters contended that the action levels should be generally achievable by water systems and suggested numbers ranging from an average of 0.015 mg/L, to 0.030 mg/L in at least 95 percent of samples, to a maximum value of 0.050 mg/L.

EPA agrees that two lead action levels are potentially confusing and, therefore, has adopted only one: 0.015 mg/L in no more than 10 percent of tap samples. The lead action level will trigger corrosion control for systems serving fewer than 50,000 people (unless they can demonstrate to the State that they have already optimized corrosion control), as well as source water monitoring and possible treatment, public education, and lead service line replacement requirements for all systems. Systems serving greater than 50,000 people are required to optimize corrosion control regardless of tap lead levels.

In selecting the action level for medium and small systems, EPA has taken into consideration the technical feasibility of achieving this level. In addition, EPA wanted to ensure that more detailed optimization demonstration efforts would be made and appropriate treatment undertaken where necessary to ensure adequate public health protection.

With regard to technical feasibility, EPA evaluated the available data on the ability of corrosion control to reduce lead levels at the tap. In the preamble to the proposed rule, EPA stated that available data indicated that the proposed action level of 0.010 mg/L (average) was achieved by systems with pH greater than 8.0 and total alkalinity greater than 30 mg/L. EPA has obtained additional data, put out for public comment in an October 19, 1990, **Federal Register** notice (55 FR 42409) and discussed below, which the Agency believes supports revising the action level to 0.015 mg/L in no more than 10 percent of first-draw tap samples.

EPA believes that comments that the Agency had not sufficiently demonstrated the achievability of the proposed action level misconstrue the nature of the action level as it functions in the treatment technique. These commenters took the position that EPA is under a legal duty to demonstrate that the action level is "feasible," in the same manner the Agency would be required to demonstrate the feasibility of an MCL for a contaminant. As discussed above, however, an action level does not determine the compliance status of a system as does an MCL, but merely serves as a surrogate for a detailed optimization demonstration. Failure to meet the level only indicates whether further action must be taken by the system to demonstrate that it has optimized corrosion control. If a system, fails to meet the action level (either initially or after installation of treatment), it is not in violation of the rule, as long as corrosion control has been optimized. Therefore, EPA does not believe that the statutory standard that Congress established for MCLs applies to the Agency's selection of an action level. In addition, as discussed in detail in section IV(B), above, EPA has established a treatment technique because it is not feasible to select any precise contaminant level as reflecting optimal corrosion control treatment. Thus, EPA's selection of the lead and copper action levels is not based upon a precise statistical analysis of the effectiveness of treatment as reflected in the available treatment data. Rather, it reflects EPA's assessment of a level that is generally representative of effective corrosion control treatment and that is, therefore, useful as a tool for simplifying the implementation of the treatment technique.

Data collected from 39 medium size systems are summarized in Table 7. These data and EPA's analyses were made available for public comment in an October 19, 1990 **Federal Register** notice (55 FR 42409). Table 7 summarizes the percentage of the systems in the database that would have been able to meet various action levels ranging from 0.005 to 0.030 mg/L in 90 percent of tap samples. While these data are of limited use as a basis for making broad-based estimates of treatment efficacy (discussed above), the data are useful as general indicators of the range of levels systems have achieved with various treatment measures in place. Of those systems without lead service lines that had a pH greater than 8.0, the percentage of systems that would have met action levels between 0.005 and 0.030 mg/L in 90 percent of samples ranged from 36 percent to 98 percent. Systems with lead service lines had substantially higher tap water levels and substantially lower pass rates.

Eighty percent of the systems with pH > 8.0 would have met an action level of 0.015 mg/L. The values for systems using corrosion inhibitors were similar (they ranged from 34 percent to 95 percent; 80 percent would have met a level of 0.015 mg/L). The data show that fewer systems achieved these levels where pH was less than 8.0 (percentages ranged from 21 percent to 87 percent, with 49 percent meeting an action level of 0.015 mg/L). Systems with lead service lines had substantially higher levels at the tap (only 24 percent and 28 percent of systems met action level of 0.015 mg/L with the use of pH/alkalinity adjustment and corrosion inhibitors, respectively).

Based on these data, 90th percentile levels in the range of 0.010 mg/L to 0.020 mg/L appear reasonably representative of the lead levels that can be achieved by systems after installation of corrosion control treatment. These levels were achievable by the majority of systems in this data base with treatment in place. Within the 0.010 mg/L to 0.020 mg/L range, EPA believes that a 90th percentile level of 0.015 mg/L provides the best measure of effective treatment. A large majority of the systems with treatment in place (88 percent with pH adjustment and 80

percent with corrosion inhibitors) are able to achieve 0.015 mg/L. Moreover, approximately one-half of the systems that adjusted their pH but remained below 8.0 (49 percent) were also able to achieve this level. The levels achieved by this subgroup of systems may reflect the performance of those systems for which corrosion control treatment effectiveness is constrained by high alkalinity/low pH conditions, or where the use of corrosion inhibitors is not possible because of water quality constraints.

Systems with optimal treatment were also able to achieve a level of 0.010 mg/L at the 90th percentile (73 percent with pH/alkalinity adjustment and 64 percent with use of corrosion inhibitors), but the number of systems were fewer than those able to achieve a level of 0.015 mg/L. In addition, significantly less than one-half of the systems (34 percent) were able to achieve a 90th percentile lead level of 0.010 mg/L where pH was adjusted to below 8.0. Therefore, a level of 0.010 mg/L may be lower than can generally be achieved by systems where treatment is constrained by high alkalinity/low pH conditions.

While a 90th percentile lead level of 0.020 mg/L was achieved by a large majority of systems operating under a wide variety of conditions, EPA did not believe it was necessary to select this higher level given that an action level of 0.015 mg/L is supported by the available data and would trigger detailed optimization steps and thereby potentially contribute to greater public health protection than a level of 0.020 mg/L.

EPA recognizes the difficulty associated with extrapolating generalized estimates of treatment performance based upon the data cited above, which are collected from relatively few, like-sized systems operating under relatively favorable natural water quality conditions. EPA has data from two large cities (Seattle and Boston) that have measured tap water lead levels before and after corrosion control efforts. These data showed vastly contrasting results (Seattle achieved 0.011 mg/L at the 90th percentile but this level could have been higher if first draw liter samples were analyzed for lead; Boston achieved only 0.047 mg/L at the 90th percentile). Neither was attempting to minimize lead levels to the final lead action levels, so it is possible that additional treatment would reduce lead levels further. Thus, the actual percentage of systems able to meet the action levels after treatment may be lower or higher than the estimates based upon the data summarized in Table 7. Nonetheless, given the information on corrosion control treatment performance at this time, the Agency believes the data provide the best basis for establishing the action level that will trigger treatment for medium and small systems.

EPA also believes that an action level of 0.015 mg/L is appropriate because it will trigger treatment when appropriate to protect public health. EPA's goal is to minimize lead exposures among sensitive populations. Young children are the most susceptible to lead toxicity, and, on a body weight basis, absorb more lead from drinking water than other age groups. As discussed in Section III, one benchmark the Agency is using to measure progress toward the goal of reducing lead exposure among sensitive populations is the number of children with blood lead (PbB) levels above 10 μg/dL from all sources. Among young children not exposed to excessive paint lead hazards from deteriorating older homes, or from highly contaminated soils, EPA estimates that about 3.5 percent have blood lead levels above 10 μg/dL due to lead exposure from air, food, soil, dust, and water. The Agency estimates that efforts by water systems to meet a lead action level of 0.015 mg/L at the 90th percentile will reduce exposures among millions of people nationwide, and specifically reduce the percent of children not exposed to excessive paint lead hazards, or highly contaminated soils, with PbB levels above 10 μg/dL by half, from 3.5 percent to approximately 1.6 percent. This was estimated by assuming that the distribution of blood lead levels is log-normally distributed with a geometric standard deviation of 1.42 (EPA, 1986a) and that the average blood lead level in children not exposed to excessive lead paint or highly contaminated soils will be 4.5 μg/dL to 4.7 μg/dL after the rule is fully implemented (EPA, 1991a). The procedure for deriving these estimates is briefly explained in section X (benefits analysis) of the preamble. A more detailed discussion can be found in the Regulatory Impact Analysis completed for the rule (EPA, 1991a). More extensive efforts to reduce lead levels in drinking water, possible especially among some larger systems, could reduce lead exposures further. The Agency concludes that given these projected exposure reductions, an action level of 0.015 mg/L at the 90th percentile will provide substantial health protection for young children.

It must be recognized that in requiring water systems to minimize lead levels in drinking water to the maximum extent feasible, the problem of excessive exposures among many children will not be solved. Hundreds of thousands, possibly millions, of children will continue to have high level exposures to lead in paint, house dusts, and soils that require continued coordinated efforts by Federal, State, and local governments, as well as medical and public health professionals and parents.

The final action level of 0.015 mg/L in the 90th percentile of tap samples is significantly more stringent than the proposed average level of 0.010 mg/L. EPA estimates that this action level will require about 40,000 systems to install corrosion control treatment as compared to 26,000 systems if the final rule had adopted the proposed average of 0.010 mg/L, and 43,000 systems if the final rule included both the lead and pH action levels proposed by EPA (EPA, 19881, 1991a). The final level is comparable to the level of 0.020 mg/L measured in the 95th percentile. EPA has chosen to express the final action level as a 90th percentile value (as opposed to 95th) to simplify the rule's implementation. It would have been complicated for systems to interpolate the results of monitoring to determine the 95th percentile (e.g., 95th percentile of 30 samples would have been the 28.5 highest sample), whereas the 90th percentile is easily calculated. As discussed further in the relevant sections below, the action level of 0.015 mg/L also operates as a trigger for all systems for source water monitoring and possible treatment (unless they can demonstrate to the State that they have already optimized corrosion control), lead service line replacement, and public education.

[B]. Treatment Requirements for Large Water Systems. Under the proposed rule, the action levels would have been applicable to all systems and would have triggered corrosion control treatment for any system that exceeded such levels. EPA proposed the action levels as a means of limiting the number of systems required to demonstrate that they had optimized corrosion control. After reviewing the public comments on the proposal, EPA published a notice in the **Federal Register** on October 19, 1990, (55 FR 42409) soliciting further public comment on an option that would have continued the action level approach for all systems serving fewer than 50,000 persons but would have required all systems serving greater than 50,000 persons to make a detailed demonstration of optimal corrosion control without regard to whether the system exceeded the action levels.

Because of the potential for substantially increased health benefits, several commenters on the October notice supported the option of requiring all large systems to evaluate whether they can further reduce their lead levels even if they are below the action levels. Other commenters, however, opposed the option. First, they argued that the requirement would constitute differential protection because individuals in small or medium-sized systems would not be afforded the same level of health protection. Second, they argued that requiring all large systems to install treatment would create a number of technical problems and impose a significant financial burden, especially for those systems that either have multiple groundwater sources, blend waters from multiple sources, or provide water to multiple distribution systems. Finally, several commenters maintained that the costs of installing treatment for large systems would outweigh the benefits.

About 800 water systems nationwide serve more than 50,000 people or approximately 56 percent of the U.S. population. As discussed in section III, there is no apparent threshold for several health effects associated with lead, and the Agency's goal is to reduce childhood lead exposure as much as possible. Even small reductions in lead exposures are beneficial, as reflected in the RIA results summarized in section X. While not all large water systems will be able to reduce lead levels if they already meet the action levels, EPA believes it is feasible for these systems to evaluate whether such reductions are possible.

The final rule adopts the option discussed in the October 19, 1990, **Federal Register** notice (55 FR 42409) and requires all large systems serving greater than 50,000 persons, to demonstrate to the satisfaction of the State that they have optimized corrosion control treatment. EPA recognizes that in many cases, requiring these systems to attempt to reduce lead levels even when 90 percent of tap samples are below 0.015 mg/L (90th percentile) is pushing the limits of corrosion control treatment technology. However, of all public water systems, the systems in this size category possess the greatest technological capabilities and access to technical support and other resources that would enable them to perform the sophisticated treatment manipulations that might further reduce lead levels.

EPA believes that it is appropriate to retain a lead action level of 0.015 mg/L for small and medium systems since this level, as discussed above, is reasonably representative of optimal corrosion control treatment and these less sophisticated systems would probably not be capable of further reductions in lead levels. Moreover, the function of an action level as a surrogate for optimal corrosion control to make implementation of the rule administratively workable, is most compelling with regard to small and medium systems because they comprise approximately 99 percent of the community and non-transient, non-community water systems nationwide (78,000 of 79,000). Requiring all of these systems to make detailed corrosion control demonstrations without regard to tap levels would impose an unworkable administrative burden upon States without necessarily increasing public health protection over what would be achieved with the use of the action levels. This burden would be exacerbated by the fact that smaller systems generally will require the most extensive input from States in evaluating, selecting, and overseeing implementation of optimal corrosion control treatment. In fact, abolishing the action level might actually reduce public health protection because the States would be diverted from focusing their limited resources on those systems with higher tap levels, which are most in need of implementing effective treatment.

Large systems, by contrast, comprise a very small portion of the community and non-transient, non-community systems nationwide. Therefore, the administrative burden associated with States' reviewing optimal corrosion control demonstrations for these systems is substantially smaller than would be associated with determining treatment for smaller systems. Moreover, the burden on States for reviewing optimal treatment for large systems is further reduced since these more sophisticated systems generally require less technical support than would smaller systems. For these reasons, as well as the large number of persons served by these systems that might benefit from further lead reductions, EPA believes that it is appropriate to require all large systems to demonstrate to the State that they have optimized corrosion control regardless of their lead levels.

Commenters are incorrect that EPA has established differential treatment requirements based on system size. The approach EPA has taken is simply to establish a presumption, supported by available data, that small and medium systems will have optimized corrosion control treatment if they meet the action levels. For the relatively few large systems, EPA is not establishing a different treatment standard, but is merely requiring these systems to make a more detailed technical showing, based upon their greater technical sophistication and operational expertise, that they have in fact optimized corrosion control treatment. Thus, all size systems are uniformly required to optimize corrosion control treatment. The only difference between large systems and the smaller systems is that large systems are required to make this demonstration based upon a detailed technical study of the circumstances of its system, whereas EPA is allowing medium and small systems to make the demonstration by showing that its tap levels meet the level which the best available data indicated is generally reflective of optimal corrosion control in some systems.

iii. Copper Action Level. The copper action level in the proposal was 1.3 mg/L in no more than 5 percent of samples collected from targeted homes. Several commenters stated that these levels were reasonable and achievable by water systems. Other commenters disagreed with the action level because they did not believe it was needed to protect public health and suggested that copper remain a secondary drinking water standard. Still other commenters suggested that the copper action level be calculated in the same manner as the lead action level (e.g., average, same percentile).

As discussed in section III(B) of the preamble, EPA believes copper is a health concern above 1.3 mg/L. The Agency agrees with commenters that copper and lead action levels should be expressed in the same statistical form to avoid confusion. Therefore, EPA is finalizing the copper action level as proposed at 1.3 mg/L in no more than 10 percent of samples (rather than in 5 percent of the samples as contained in the proposal). This action level will trigger corrosion control for small and medium-size systems. In addition, exceedance of this level triggers source water monitoring and possible treatment.

iv. Alkalinity Action Level. EPA requested comments on the option of including an alkalinity action level in the preamble to the 1988 proposed rule. Under the proposed option, systems would have been required to install corrosion control treatment if the total alkalinity level in 5 percent or more of samples was below 30 mg/L. Systems would have been required to reduce the corrosivity of their water until it was above 30 mg/L or to demonstrate to the

State that they had minimized corrosivity. Many commenters stated that there is a lack of evidence linking alkalinity levels to lead or copper levels at the tap. Many of these commenters suggested that alkalinity be considered in the evaluation of the appropriate corrosion control treatment to install, but that alkalinity not be used as an action level.

EPA agrees that there are insufficient data to directly link high alkalinity levels alone with lower lead and copper levels. The Agency believes, however, that the alkalinity of the water is important to consider when designing a corrosion control treatment program. The final rule, therefore, does not establish a specific alkalinity action level but instead requires water systems to measure for alkalinity before and after installation of treatment (if alkalinity is adjusted). In addition, the rule requires the State to establish a minimum value or range of values for alkalinity measured at each entry point to the distribution system and in all tap samples. Systems would be required to meet these minimum values to be in compliance with the corrosion control portion of the treatment technique. In addition, systems that adjust their hardness as part of corrosion control treatment are required to maintain a minimum or range of concentrations for calcium in all tap samples.

v. Inhibitor Residual Concentration. The proposed rule did not establish any specific requirements for systems to maintain a minimum inhibitor residual concentration, but the proposal did discuss the use of corrosion inhibitors as an alternative to pH and alkalinity adjustment. Inhibitors work by forming a protective film on the surface of a pipe that provides a barrier between the water and the pipe. The 1984 document "Corrosion Manual for Internal Corrosion of Water Distribution Systems" (EPA, 1984) identifies three basic requirements for effective formation and maintenance of a protective film by a corrosion inhibitor. First, it is important to build up a protective coating on the pipes as fast as possible. This may require that the inhibitor dosage start at two to three times the normal inhibitor concentration. Second, the inhibitor should be fed at a constant concentration. Any interruption in the feed could cause the protective film to be re-dissolved. Third, flow rates must be sufficient to continuously transport the inhibitor to all parts of the distribution system.

Because of these basic requirements, EPA decided that it was important for systems using corrosion inhibitors to maintain a minimum residual concentration for the inhibitor that the State determines is necessary to form a passivating film on the interior walls of the pipes in the distribution system. The minimum concentration is important to monitor because of concern, discussed above, with the re-dissolving of the protective film if a sufficient dosage is not maintained and to ensure that the film needed to protect the pipes from the water is being formed throughout the system.

b. *Modification of Treatment Plan Approach.* The proposed rule would have required systems serving 3,300 or more people that failed to meet the lead (0.010 mg/L average) or copper (1.3 mg/L in 95th percentile) action level to develop and submit a treatment plan to the State within 1 year after the end of the initial monitoring period. The treatment plan was to contain the specific steps that a water system would take to ensure that either the action levels were met or optimal corrosion control treatment and/or public education were implemented. These systems would have been required to include in their treatment plan the following steps: (1) Design and implementation of pipe loop, laboratory, pilot scale and/or field studies, (2) analysis of the data generated in these studies to estimate optimal operating conditions to minimize lead and copper corrosion, (3) installation of the treatment in the entire water supply system, (4) monitoring to evaluate the effectiveness of the treatment, (5) additional adjustment of the treatment if action levels continue to be exceeded, and (6) submission to the State of all data collected and an analysis demonstrating that the corrosion control treatment being applied was optimal (i.e., that lead levels were minimized) if after installation and adjustment of treatment any of the action levels continues to be exceeded. Systems would have been required to complete installation of any treatment required by the plan within 3 years after approval of the plan. For systems serving fewer than 3,300 people, States would have been required to specify the required treatment if any of the action levels was exceeded.

Commenters objected to the treatment plan requirements for two general reasons: (1) States should not be required to develop treatment plans for small systems because State engineering staffs would be developing plans and then reviewing, approving, and monitoring the effectiveness of their own treatment plans; and (2) there would be insufficient time or resources to develop and/or implement the corrosion control treatment plans. Other commenters supported EPA's contention that small systems do not have the expertise or resources to develop their own plans and that the States should be given the flexibility to develop treatments that are practical for small systems.

EPA agrees with commenters that States should not have to develop treatment plans for water systems serving fewer than 3,300 people without the benefit of initial recommendations from the systems regarding corrosion control treatment. EPA believes that requiring States to develop treatment plans for small systems could delay implementation of the final rule because of the large volume of treatment plans required and the substantial commitment of time and resources needed to develop the plans. EPA believes the responsibility for initially developing a treatment plan should be placed on the water system because of its familiarity with the system. The Agency believes the appropriate State role is in approving the plan. The final rule, therefore, requires all systems to recommend the corrosion control treatment, if any, that they believe will minimize lead and copper levels at the tap. States may approve the treatment proposed by the water system or require the system to install an alternative treatment that the State, based on data submitted by the system, determines to be optimal treatment.

EPA understands commenters' concerns that many small systems may not have the expertise to develop their own treatment plans. The Agency accordingly plans to develop guidance and conduct workshops across the country to help small systems develop corrosion control treatment strategies that are affordable and will effectively minimize lead and copper levels at the tap. EPA continues to believe that the States' role in approving a system's recommended treatment remains necessary because optimal corrosion control treatment is system-specific and must take into account the unique circumstances of each system. The expertise States develop in reviewing the treatment recommendations of large systems will be useful as they oversee implementation of corrosion control treatment among smaller systems and require necessary modifications to assure that treatment remains optimal.

EPA is sensitive to commenters' concerns that development and implementation of treatment plans can be time-consuming and could potentially

delay implementation of the rule. For this reason, the Agency has made modifications to the final rule that should expedite implementation. Systems serving greater than 50,000 persons are required to conduct corrosion control studies prior to the State taking any action. Moreover, instead of requiring upfront State approval of treatment plans, the final rule sets out timetables for systems and States to perform the various steps involved in evaluating treatment alternatives, selecting the best treatment option, and implementing and evaluating treatment. These schedules are discussed in detail below. EPA believes that breaking out the various steps in the process will enhance prompt implementation of the regulation, since it will not be necessary for systems to await up-front approval of a treatment plan before any action is taken. In addition, the schedules contained in the rule stagger the various steps that States and systems will take, thus reducing the potential for a backlog of unapproved plans.

c. *Schedule for Completing Corrosion Control Steps.* In the proposed rule, the schedule for conducting corrosion control studies and for installing treatment full-scale would have been determined in the context of the treatment plan approved or specified by the State on a system-by-system basis. Comments on the proposal raised concerns about the potential for inequities among systems that might be subject to different schedules depending upon the particular State that was approving or (in the case of small systems) specifying the treatment plan. Based on concerns expressed by commenters, the final rule specifies schedules that must be met by systems and States when implementing the treatment technique requirement. Other than ensuring prompt implementation of treatment and greater assurance of expeditious public health protection, this approach has additional advantages over the proposed approach: (1) it will eliminate potential inequities among systems that might receive different implementation schedules solely because they operate in different States; and (2) milestones provide better oversight by both the States and EPA, enhance enforceability, and will result in the installation of more effective treatment. EPA requested comments in an October 19, 1990, **Federal Register** notice (55 FR 42409) for completing these steps.

Several commenters stated that the time frames in the 1990 notice for completing the different steps were reasonable. Others believed the time frames were far too short and should be extended by another. 2–5 years. Still others believed the compliance schedules were too long and should be shortened considerably. One commenter stated the compliance schedules were in direct violation of the statutory requirement that all NPDWRs shall be effective within 18 months after promulgation and that if EPA intends on establishing extended compliance schedules, it must be accomplished pursuant to a variance or an exemption, or through the process of negotiating Consent Agreements in enforcement cases.

EPA disagrees that the implementation schedule should be extended another 2–5 years. Extending the schedules would expose children to potentially high lead levels in drinking water unnecessarily. EPA also disagrees that the schedules established are too long. The Agency believes the schedules established in the final rule are reasonable considering the complex nature of the treatments for reducing lead in drinking water. Finally, EPA disagrees that the schedules proposed in the October notice contravene the statutory requirements that the final rule must take effect 18 months after the date of its promulgation.

Section 1412(b)(10) states, "National primary drinking water regulations promulgated under this section (and amendments thereto) shall take effect eighteen months after the date of their promulgation." This rule complies with the mandate in this section by making the treatment sections effective eighteen months from the rule's promulgation date. As discussed below, EPA established the treatment schedules in the final rule to reflect the time periods during which it is feasible for systems to take the many complex treatment steps necessary in the evaluation and installation of corrosion control treatment, as well as the feasible schedule for systems to replace lead service lines. EPA does not believe it is reasonable to read section 1412(b)(10) as precluding EPA from establishing schedules for the implementation of a treatment technique where the Agency determines that such schedules are necessary for the treatment to be "feasible" within the meaning of section 1412(b)(5). Corrosion control is by its nature a lengthy and involved process of evaluating, installing, reevaluating, and adjusting the effectiveness of treatment. Based upon the experience of systems that have attempted corrosion control treatment, it would simply not be possible for systems to complete these technically complex steps within eighteen months after promulgation. Moreover, because of the number of lead service connections which can be present in a system, and the cost associated with their removal, EPA does not believe that it would be feasible to require replacement in merely eighteen months from promulgation.

Commenter's constricted reading of section 1412(b)(10) could lead to two anomalous results, which EPA believes could not have been intended by Congress. First, while the commenter's position is presumably based upon the belief that EPA should require the treatment steps to be completed more quickly so as to better protect public health, limiting EPA to adopting treatment requirements that can feasibly be implemented in eighteen months could lead to the anomalous result of precluding the Agency from establishing any treatment technique requirements which would require greater than eighteen months to implement. EPA does not believe that this was Congress's intent. Rather, EPA believes that it is required by the statute to adopt a treatment technique that protects public health to the extent "feasible," and that the Agency is therefore authorized to adopt a NPDWR that includes a series of treatment steps extending beyond eighteen months after promulgation where the Agency determines that such steps will reduce exposure to contaminants and that the treatment steps are feasible within the meaning of the statute. Otherwise, the contaminant problems which are most widespread and complex and which therefore require the greatest time to address would be beyond the Agency's ability to rectify, and this result would be directly at odds with the goals of the SDWA. The alternative implication of the commenter's position is that section 1412(b)(10) was intended by Congress to override the requirement in section 1412(b)(7) that a treatment technique be "feasible" and thereby authorize EPA to require PWSs to implement all treatment steps without regard to feasibility within eighteen months. Such a result would directly contradict the requirement in section 1412(b)(7).

EPA believes the more straightforward reading of section 1412(b)(10) is that Congress intended that EPA should not make MCLs and treatment techniques effective until eighteen months after promulgation in order to provide public water systems sufficient time to take the necessary steps to comply with the rule. This provision effectively constrains the Agency's authority under the

Administrative Procedure Act, 5 U.S.C. 553(d) to make rules effective 30 days after their publication in the **Federal Register**. On its face, the only requirement in section 1412(b)(10) is that the NPDWR become effective eighteen months after promulgation. The rule fulfills this requirement. See § 141.80(a)(1) of the rule.

The schedule specified in the final rule for completing each corrosion control step is summarized in Table 6. The time to complete corrosion control treatment steps varies according to system size (e.g., large, medium, or small). While the actual steps that systems must follow differ in some respects, they can be summarized as follows: (1) The system recommends corrosion control treatment, or conducts corrosion control studies and then submits recommended treatment to the State; (2) the State approves/designates optimal treatment; (3) the system installs treatment and collects follow-up tap samples; and (4) the State reviews results and designates optimal water quality parameters.

i. Time Allowed for Systems to Recommend Treatment to State. Small and medium-sized water systems are given 6 months from the date they exceed the lead and/or copper action levels to recommend to the State what they believe constitutes optimal corrosion control treatment. EPA believes systems will need this time to analyze the monitoring data generated during initial monitoring, document why they have chosen the treatment, and submit the results to the State.

ii. Time Allowed to Conduct Corrosion Control Studies. Systems required to perform corrosion control studies (i.e., large systems, and medium and small systems if required by the State) have 18 months from the date they complete monitoring (large systems) or are instructed by the State to conduct such studies (medium and small systems) to submit the results with recommended treatment options to the State. The Agency believes this provides a reasonable period of time for systems to complete these studies. In addition, since large systems are required to conduct these studies regardless of their lead or copper levels (unless they have already optimized corrosion control), they should begin planning the studies immediately. Such action will provide an additional 20 months before the studies are required to begin.

iii. Time for State Approval/Designation of Treatment. All systems are required to submit the monitoring results from lead and copper tap sampling, for the water quality parameters, and for source water monitoring to the State to assist the State in either approving the treatment suggested by the system or in designating another treatment. States are given different schedules to review and approve the treatment depending on the system size: 6 months for large systems, 18 months after a medium-sized system exceeds one of the action level(s) (or 6 months after corrosion control studies completed), and 24 months after a small system exceeds the action level(s) (or 6 months after corrosion control studies completed). EPA has staggered the schedules for systems of different sizes to account for three factors: (1) The number of systems in each size category (the smaller size categories have more systems, thereby requiring more time for States to specify treatment); (2) the relative technical sophistication of the systems (more time may be required for States to approve or specify treatment for smaller, less sophisticated systems); and (3) the desirability of having States gain experience with larger systems before reviewing treatment for medium and small systems.

For large systems, States are given 6 months to review the data submitted by the systems and either approve the treatment recommended by the system or designate an alternative treatment. EPA believes that a 6-month period is necessary to encourage prompt State action in approving or designating treatment alternatives for large systems. EPA believes this period should be sufficient for State review because the large systems will have already conducted detailed corrosion control studies and have recommended the best treatment option based upon the studies. Moreover, there are only about 800 large systems in the country that potentially will be required to complete such corrosion control studies.

States are given 18 months from the date the system is above the action level to approve/designate treatment for medium-sized systems. This time is more than specified for large systems because there are more medium-size systems (6,800), which often have less technical expertise to make thorough demonstrations or recommendations and to install and maintain corrosion control treatment. For small systems, the rule allows States 24 months after exceedance of an action level to approve/designate treatment. EPA believes this period is appropriate to allow time for States to acquire experience from evaluating the corrosion control treatment alternatives submitted by large and medium-sized systems. Further, there are considerably more small systems (70,000), and the level of technical involvement States will have to provide smaller, less technically capable systems will tend to be much greater.

iv. Time to Install Treatment and Complete Follow-up Monitoring. For all size systems, the rule provides that treatment must be installed within 24 months after the State approves/designates treatment. EPA believes this amount of time is needed to install corrosion control treatment because the effort involves locating funding, obtaining the necessary permits, designing the treatment to integrate into existing treatment processes, purchasing the necessary equipment, construct treatment facilities if needed, and training operators. EPA also believes that this period is necessary to allow sufficient time for treatment to be installed, adjusted as necessary, and for effects on lead and copper levels at the tap to be adequately reflected as demonstrated in cities where the lead levels gradually decreased over 1–2 years after corrosion control treatment was installed (i.e., Boston and Bennington; see section IV(E)(1)).

Systems are required to complete follow-up tap sampling for lead and copper, as well as all other appropriate water quality parameters, after installation of optimal corrosion control treatment during a complete calendar year (two 6-month monitoring periods). Sampling is needed over a complete year to determine the extent to which seasonal variations alter the effectiveness of the treatment and to ensure that treatment has stabilized.

v. Time for State Review of Results and Designation of Optimal Water Quality Parameters. After installation of treatment by a water system, a State has 6 months to review the tap sampling results and specify the optimal water quality parameters under which the system must continue to operate. EPA believes this period is appropriate because States will be familiar with the system and its treatment approach and substantial experience will have been gained by the system during the treatment process.

EPA notes that while the rule establishes uniform periods for States to review the treatment results and specify the optimal water quality conditions, this does not mean that States will be performing their revisions for all systems simultaneously. States will review treatment for medium-size and small systems on a staggered schedule since the treatment requirements start when a system exceeds one of the action levels, and on a fixed date.

d. *Corrosion Control Studies.* The proposed rule would have required systems serving more than 3,300 persons to include in their treatment plan proposed studies (pipe-loop, laboratory, pilot scale and/or field studies) to evaluate the effectiveness of treatment alternatives for reducing lead levels in first-draw samples. The final rule requires large water systems to conduct comparative corrosion control studies and small and medium-sized systems to conduct these studies if required by the State.

EPA has deleted the mandatory requirement that all systems serving more than 3,300 people perform treatment studies. The Agency agrees with concerns raised by commenters that many medium-size systems may not have the technical capabilities to successfully complete such studies. Studies will still be required to be performed by the approximately 800 large systems (the most sophisticated); States can consider on a case-by-case basis whether to require medium and small systems to perform such studies. Without well-trained personnel capable of designing and overseeing proper conduct of the studies, such evaluations may not yield reliable determinations of corrosion control treatment efficacy.

Improperly conducted tests or inappropriate installation and maintenance of corrosion control can result in transient increases in lead levels or increased risks associated with disinfection and disinfection by-products, as well as other adverse water quality conditions. Skilled personnel are required to continually monitor and analyze the results of the research. Some medium and small systems may have limited access to the resources and the specialized professional engineering support needed to conduct these studies. In contrast, systems serving greater than 50,000 people are generally associated with a city or county with an established administrative structure that enables water systems to more easily raise funds for needed personnel and equipment to study and install corrosion control treatment. The technical difficulty associated with conducting detailed corrosion control studies is reflected in their high costs, which can range from $50,000 to $200,000 for laboratory or field studies. EPA believes that large systems have the ability to reliably conduct the necessary studies to minimize lead and copper levels without causing reductions in overall water quality, as is evident by corrosion control studies now underway in Philadelphia, New York, and Los Angeles.

Because improperly conducted studies may not yield meaningful results or could inadvertently contribute to installation of inappropriate treatment, EPA has left it to State discretion whether to require medium-sized and small systems to conduct such studies. States are in the best position to evaluate the technical capabilities of individual systems and determine whether these studies are feasible. EPA anticipates that few small systems will be required to conduct corrosion control studies, but has decided to include this provision for small systems in case future technical innovations make it possible for small systems to simply and inexpensively conduct reliable studies.

The purpose of the studies is to identify the water quality parameters that will produce optimal corrosion control. All large water systems are required to evaluate the effectiveness of each of the following treatments and, if appropriate, combinations of the treatments to identify optimal corrosion control:

(1) Alkalinity and pH adjustment.

(2) Calcium hardness adjustment.

(3) Addition of phosphate- or silica-based inhibitor at a concentration sufficient to maintain an effective residual concentration in test samples.

After analyzing the data generated during each evaluation, the water system shall recommend to the State, with an accompanying rationale, the treatment option that they believe would constitute optimal corrosion control treatment for that system.

Systems must do the following when conducting corrosion control studies to identify optimal corrosion control treatment:

- The system shall collect lead, copper, pH, alkalinity, calcium, temperature, and conductivity samples in the test systems and, depending on the water treatment being applied, phosphate (if a phosphate-based inhibitor is used) or silica (if a silica-based inhibitor is used). To reduce the potential variability in the levels of these constituents, the system should attempt to establish fixed sampling points and fixed volumes for each constituent and to use the same analytical procedures (i.e, instrument, preservation) for each constituent. In addition, the system should collect a sufficient number of samples from the test systems before and after installation of the treatment to enable statistical comparisons between the treatments.
- The water system should identify any chemical or physical constraints that limit or prohibit the use of a particular corrosion control treatment. These constraints should be documented with data that demonstrate that the treatment has adversely affected other water treatment processes when used by another system with comparable water quality characteristics, and/or with data demonstrating that the water system has previously attempted to evaluate the treatment and has found it to be ineffective or has adverse effects on other water quality treatment processes.
- The system shall evaluate the effect of the chemicals used for corrosion control treatment on other water quality treatment processes (i.e., disinfection, trihalomethane formation, potential corrosion of other materials).

The tests comparing the various corrosion control treatment options may consist of: Pipe rig/loop tests, metal coupon tests, or partial-system tests, or evaluation based on documented analogous treatments with other systems of similar size, water chemistry, and configuration. The final rule does not allow a water system to evaluate effectiveness of different corrosion control treatments by installing treatment full-scale because of concern that experimentation within the distribution system could disturb protective coatings on pipe surfaces or otherwise adversely affect water quality.

The 1990 AWWA-RF document (AWWA-RF, 1990) suggests that regardless of what type of test system is chosen for the corrosion control studies, four criteria should be met to provide the greatest likelihood of successfully extrapolating the results of the test data to the field:

- Metal specimens exposed to the water must be representative of the metal piping or material in the actual water system.
- Water quality in the test system must be the same as in the distribution system.
- Flow velocity and residence times should be representative of those found in the full-scale system.
- The duration of the test must allow for development of the pipe films or scales that control corrosion.

The most common methods for assessing pipe loop data include weight loss analysis for corrosion rate measurements, metals uptake evaluations, measurement of corrosion by-products concentrations from pipe loops designed to simulate household plumbing, and examination of pipe scales or films (AWWA-RF, 1990). A more detailed discussion of the methods for evaluating corrosion control alternatives for lead and copper will be

included in EPA's Corrosion Control Guidance Manual.

e. *State Approval/Designation of Corrosion Control Treatment.* Under the final rule, States will review optimal corrosion control treatment in a two-stage process. They will initially determine the treatment or combination of treatments (i.e., pH/alkalinity adjustment, calcium hardness adjustment, and/or addition of corrosion inhibitors) based upon corrosion control studies and other relevant information that constitutes the most appropriate treatment for that system. The level of generality in this initial State determination reflects the fact that systems will in most cases be taking their first steps at adjusting water quality conditions to reduce corrosivity.

The State's initial determination may simply be approval of the system's recommendation for optimal corrosion control. However, if the State determines that an alternative treatment is more appropriate for reducing lead and copper levels, the State shall designate this treatment.

The State shall notify water systems of its decision on optimal corrosion control treatment in writing and explain the basis for this determination. The water systems shall provide any additional information by the date specified by the State.

f. *Installation of Treatment.* As discussed above, all systems are given 24 months to install the corrosion control treatment approved/designated by the State. EPA expects that most water systems will need to fine-tune the treatment to account for normal differences between laboratory pipe loop studies or pilot plant designs and full-scale operations. The installed treatment must also be adjusted for seasonal variations in water quality which can affect water corrosivity. Lead levels are expected to fall gradually as a protective film builds up on the inside of pipes. Systems are encouraged to conduct sampling during this period of stabilization to evaluate whether lead levels are decreasing.

To demonstrate the effectiveness of corrosion control treatment, follow-up monitoring is required at the same sites used for initial monitoring of lead and copper and the appropriate water quality parameters. Similar sites that meet the targeting criteria for lead and copper could be substituted if the original sites become inaccessible.

g. *State Designation of Optimal Water Quality Parameters.* Within 6 months of receipt of the follow-up monitoring data, States are required to determine whether the system has installed optimal corrosion control treatment approved previously by the State and based upon a review of all information regarding a particular system, will specify the values for the water quality parameters under which the system is required to operate. At this point, the State will be making a determination different from its previous action in approving or designating optimal treatment. Initially, States determine the general type of treatment (or combination of treatments), such as pH adjustment or use of corrosion inhibitors, that the data indicate will result in lead and copper reductions at the tap. After the system has installed treatment and collected additional monitoring information, States will have significantly more information on the effects of water quality adjustment on lead and copper levels at the tap. EPA believes that it will be appropriate at this time for States to specify in greater detail the values for water quality parameters that would, based upon the available information, constitute optimal corrosion control for a system. EPA anticipates that States will designate a range of values for many of the water quality parameters instead of designating one minimum value for each. A range for each value is appropriate given the inherent variability in water quality over time and the fact that control of lead corrosion may be optimal within minimum and maximum values of pH, alkalinity, and other interactive parameters. Once the State specifies values of water quality parameters under which a system must continue to operate, these parameter values become the enforceable requirements of the NPDWR. Failure to comply with these State-specified values will constitute a violation of this NPDWR.

The specific requirements required of States have been outlined in section IV(C)(2) of the preamble, and the rationale for each of the requirements has been discussed in section IV(E)(2). A more detailed discussion of each of these requirements will be included in the Corrosion Control Guidance Manual.

h. *Modification of Optimal Water Quality Parameters.* Under the final rule, a State may, on its own initiative or in response to a request from a system or other interested party, modify its determination of the optimal corrosion control parameters under which a system is required to operate. Such modification may become appropriate when a system either changes its water source or uses a new source, other treatments are installed to meet other NPDWRs such as the disinfection by-product rule, or because adjustments to ongoing corrosion control are required to ensure optimal effectiveness.

3. Responsibility for Corrosion Control Treatment

The proposed rule would have required water systems to adjust corrosion control treatment to account for any blending of water from different sources. In addition, because retailers may add or blend sources of water provided by wholesalers, the preamble to the proposal stated that ultimate responsibility for the degree of corrosivity of the water would rest on retailers instead of the wholesalers. Several commenters did not believe EPA should require water systems to adjust corrosion control treatment but instead should allow States to take blending of source water into consideration when approving treatment programs. Several commenters agreed with holding retailers responsible for the corrosivity of the water because they have the option of not purchasing corrosive water from wholesalers. Others disagreed, stating that retailers should not be held responsible for the quality of water obtained from wholesalers because often retailers do not own any treatment equipment, or property where treatment could be performed.

Section 1411 of the SDWA provides an exemption for public water systems from NPDWRs if the system: (1) Consists only of distribution and storage facilities (and does not have any collection and treatment facilities), (2) obtains all of its water from, but is not owned or operated by, a public water system to which such regulations apply, (3) does not sell water to any person, and (4) is not a carrier which conveys passengers in interstate commerce.

The public comments have indicated that the particular logistical problems faced by wholesalers and retailers in designing and implementing effective corrosion control treatment are very fact-specific. Therefore, EPA does not believe that it would be appropriate to establish on a national basis that retailers must in every case be ultimately responsible for effective corrosion control treatment. In most cases, it appears that it will be necessary for wholesalers and retailers to coordinate their efforts in order to optimize corrosion control. Moreover, EPA does not believe that it would be appropriate in this case to exempt categorically an entire class of systems (either wholesalers or retailers) which qualify as public water systems under the SDWA and therefore are subject to this NPDWR. However, under the final rule, States have substantial flexibility

in determining what constitutes optimal corrosion control treatment taking into account the particular circumstances of individual systems. Where necessary, States should therefore approve treatment alternatives that allocate responsibility among retailers and wholesalers according to the steps that each entity performs. Thus, where a system is required to complete the corrosion steps of the final rule (i.e., small or medium-size systems exceeding the action level and all large systems), EPA would anticipate that both the retailer and the wholesaler would submit a treatment recommendation to the State under § 141.82 (a) or (c). EPA encourages retailers and wholesalers to coordinate their technical inquiry so as to ensure that all facets of treatment are addressed in their recommendations. The State can then approve or designate alternative treatment that allocates responsibility among the systems that will result in delivery of minimally corrosive water to the consumer. The Agency believes that it is reasonably clear how other responsibilities besides corrosion control under the final rule should be allocated: tap monitoring and lead service line replacement and public education would be performed by the retailer; source water monitoring and treatment would be performed by the wholesaler.

F. Source Water Treatment Requirements

The proposed rule would have required water systems to meet a lead MCL of 0.005 mg/L and a copper MCL of 1.3 mg/L at entry points to the distribution system. EPA determined that these levels were achievable with application of the following centralized treatment technologies: coagulation/filtration, ion exchange, lime softening, and/or reverse osmosis.

Several commenters questioned the need for an MCL for lead in source water when the major source of lead is from corrosion by-products and argued for establishing a treatment technique only. Other commenters stated that the performance data do not indicate that the proposed treatments would achieve the proposed lead MCL of 0.005 mg/L. They thought the lead MCL was too low and was not needed to protect public health, and they suggested alternatives ranging from 0.010 mg/L to the current MCL of 0.050 mg/L. They contended that several of the treatments have demonstrated effectiveness only in laboratory studies and not under field conditions, which they contended is required by the SDWA. Other commenters argued that several of the treatments (reverse osmosis, ion exchange) will increase water corrosivity, while others stated that several of the treatments are cost-effective only for large systems.

1. Source Water MCL

As discussed earlier, the final rule does not include an MCL for source water, but instead requires water systems exceeding the lead and/or copper action level to collect source water samples and submit these results to the States. Systems are required to recommend whether they will install coagulation plus filtration, ion exchange, lime softening, and/or reverse osmosis, or not install any source water treatment. EPA is adopting this approach based on commenters' concerns that setting both an MCL for levels in source water and treatment technique requirements for corrosion by-products would result in unnecessary confusion without achieving any greater degree of health protection (see discussion in section IV(B)).

2. Technological and Economic Feasibility of BATs

The Agency does not believe that the SDWA requires field testing as a prerequisite to establishing BAT for a contaminant. While the treatments proposed as BAT for source water are not currently in full-scale use to treat specifically lead and copper, they are demonstrated technologies currently in use to treat a variety of drinking water contaminants including inorganics. The 1986 amendments to the SDWA changed the criteria for evaluating feasibility from "best technologies generally available" to the "best available technology" and added the requirement that BAT must be tested for efficacy under field conditions, not just under laboratory conditions. The legislative history explains that Congress removed the term "generally" to assure that MCLs "reflect the full extent of current technology capability." (S. Rep. No. 56, 99th Cong., 1st Sess. at 6 [1985]). Read together with the legislative history, EPA has concluded that the statutory term "best available technology" is a broader standard than "best technologies generally available" and that this standard allows EPA to select a technology that is not necessarily in widespread full-scale use for removing a specific contaminant. As long as it has been tested beyond the laboratory under full-scale conditions for other contaminants, and performance of the technology for lead and copper may reasonably be projected based upon other available treatment data (i.e., laboratory or pilot scale), EPA believes the technology can be established as BAT. The flaw in commenters' interpretation of section 1412(b)(5) is that many of the 83 contaminants for which Congress required EPA to establish NPDWRs by June 19, 1989, had never before been regulated by EPA or treated by public water systems. Thus, for many of the contaminants that Congress required EPA to regulate, the data that commenters assert is a prerequisite to selecting a technology as BAT does not yet exist.

Commenters' arguments suggest that Congress required EPA to regulate many new contaminants within 3 years of the 1986 amendments but effectively precluded EPA from selecting any technologies as BAT as the basis for the regulations. Therefore, EPA believes it is appropriate to rely on pilot plants and laboratory studies to project the removal efficiencies for lead and copper that would be achieved by technologies that have been in full-scale use by public water systems for other similar contaminants. A detailed discussion of the efficiencies of each of the treatments can be found in the 1988 proposal and in the "Technology and Costs for the Removal of Lead and Copper from Potable Water Supplies" (EPA, 1991e).

a. *Effect of BATs on Corrosivity.* EPA recognizes that in some cases reverse osmosis and ion exchange may increase water corrosivity, but does not believe this warrants rejecting them as BATs for source water. Rather, EPA has taken into account the site-specific considerations that may affect which of the BATs is best for a particular system by providing discretion for systems to recommend, and States to determine the technology best suited for a particular system.

States will consider the recommendation made by a system regarding what source water treatment, if any, the system believes will be most effective at reducing contaminant levels. States and systems should consider whether the source water treatment being considered will increase water corrosivity and the impact this may have upon the system's ability to comply with the corrosion control requirements of the rule. Systems should plan their treatment approach carefully to ensure that gains made through reduction of contaminants in source water are not offset by increases in corrosion by-products. EPA believes considerations on whether to install source water treatment are best weighed on a case-by-case basis by each system and State as they develop the best overall treatment approach to reduce lead and copper tap levels to the maximum extent feasible.

b. *Costs of Treatments.* Several commenters stated that only large systems could afford to install source water treatments. While the costs of installing these treatments may be high for some small systems, the SDWA contemplated these situations and established a procedure to allow States to exempt public water systems from treatment technique requirements due to compelling factors (see SDWA section 1416(a) and section VII of the preamble).

The capital and production costs of removing lead and copper from source water and the associated waste disposal costs are summarized in Table 9. It is important to note that the costs for source water treatment are premised on the assumption that a system will be required to construct a new treatment unit. In many cases, especially for large systems, this may not be necessary because they may already have the source water treatment technology in place. The assumptions and procedures for calculating the treatment costs have been slightly modified from the proposal. In September 1989, EPA revised flow assumptions in calculating all inorganic technology costs (EPA, 1987d) to more accurately reflect current industry conditions. The net effect of these changes is to increase the cost to remove lead and copper per gallon of water delivered. The revised costs for selected size systems are summarized in Table 9.

Otherwise, in estimating costs, EPA has used the same assumptions as the proposal. A more detailed discussion of the efficiencies of the treatments and the procedures used in developing the cost estimates for these treatments can be found in the August 1988 proposal, and in the "Technologies and Costs of the Removal of Lead and Copper From Potable Water Supplies" (EPA, 1991e) and in "Technologies and Costs for the Treatment and Disposal of Waste By-products From Water Treatments for Removal of Inorganic and Radioactive Contaminants" (EPA, 1986c).

In evaluating the costs of BAT, EPA has followed the guidance in the legislative history, and considered the costs to regional and large metropolitan water systems (50,000–75,000 people and greater). The Agency has concluded that these treatments are affordable for such systems (household costs are less than $180 per year). The cost estimates in Table 9 include the least cost waste disposal alternative. EPA believes systems will generally choose the least cost alternative, but the Agency recognizes that there may be situations where this may not be possible. EPA therefore also estimated the treatment costs that would be incurred by large systems (50,000–75,000) using the full range of waste disposal alternatives, including the high cost technologies. Incurring such waste disposal costs would increase annual household costs as follows: for coagulation/filtration from $50 to $70; for lime softening from $93 to $120; for reverse osmosis from $180 to $320; and for ion exchange from $54 to $70. Even with these higher costs, EPA concludes that the source water treatment technologies designated in the final rule are affordable.

TABLE 9.—SOURCE WATER TREATMENT COSTS: LEAST COST WASTE DISPOSAL ALTERNATIVE [1]

Population served	Contaminant/technology			
	<100	3,301–10,000	50,001–75,000	>1,000,000
Capital costs (millions of dollars)				
Ion Exchange	0.18	1.0	7	130
Reverse osmosis:				
—Lead	0.12	3.2	23	450
—Copper	0.12	2.7	19	400
Lime softening	0.30	3.6	12	140
Coagulation/filtration	0.28	2.5	10	140
Production costs (cents/1,000 gallons or $/household/year) [2]				
Ion Exchange	1500	100	54	38
Reverse osmosis:				
—Lead	1200	290	180	140
—Copper	1100	240	150	120
Lime softening	2600	260	93	60
Coagulation/filtration:				
—Lead	2400	160	50	24
—Copper	2500	170	52	26

[1] Treatment Costs: EPA, 1991e. Waste Disposal Costs: EPA, 1986c. Least cost waste disposal alternatives assumed to be drying lagoon and land disposal for lime softening, direct discharge to sanitary sewer for coagulation/filtration, discharge to POTW for ion exchange, and direct discharge for reverse osmosis.
[2] Household costs per year calculated by multiplying production costs by 100. This assumes water consumption of 100,000 gallons per household per year.

3. Final Requirements

a. *Monitoring for Source Water/ Treatment Recommendations.* All water systems exceeding the lead or copper action levels after initial tap monitoring are required to collect source water samples in accordance with the requirements in § 141.88 of the rule and submit the results to the State.

Within 6 months of exceeding the lead or copper action level, systems are required to recommend to the State in writing the specific source water treatment, if any, they propose to install and operate (e.g., reverse osmosis, ion exchange, coagulation plus filtration, or lime softening). Systems may recommend that no treatment be installed if it can demonstrate that source water treatment is not necessary to minimize lead and copper levels at users' taps. EPA believes 6 months is sufficient for systems to determine what, if any, source water treatment is needed because the treatment options are well defined and additional sampling or studies are not required.

b. *State Determination of Source Water Treatment.* Within 6 months after submission of the monitoring results, the State should evaluate the results of all source water samples submitted by the water system and the treatment recommendation from the system to determine whether source water treatment is necessary to minimize lead or copper levels in water delivered to users' taps. If the State determines that treatment is needed, the State shall either require installation and operation of the source water treatment recommended by the system (if any) or require the installation and operation of another source water treatment from among the following: ion exchange, reverse osmosis, lime softening, or

coagulation/filtration. Upon request, the water systems shall provide the State with additional information to aid in its review by the date specified by the State in its request. The State shall notify the system in writing of its determination and set forth the basis for its decision.

There may be some cases, however, where a State finds that source water treatment will not result in minimizing lead and copper levels at the tap, such as where source water treatment could actually increase tap levels as a result of increasing water corrosivity. In these cases, EPA would expect the State to first determine whether alternative source water treatment could effectively reduce levels without causing additional corrosion problems. In the rare case where no appropriate source water treatment could be applied, the State could determine that installation of source water treatment was not necessary, and the system would seek reductions through application of corrosion control treatment without source water treatment.

c. *Installation of Treatment.* Water systems that are required to install and operate source water treatment are given 24 months to complete installation of the treatment. EPA believes this will give systems enough time to find the capital, if needed, and complete installation. Water systems are then required to collect follow-up source water samples and tap samples for lead and copper within 12 months of completing the installation of source water treatment.

d. *State Review of Treatment.* All water systems are required to submit their follow-up source water samples to the State for review. The State is required to complete its review of the source water samples and determine whether the system has installed and is operating the source water treatment designated by the State. After reviewing all available information, the State must establish maximum permissible lead and/or copper levels in source water that water systems are required to maintain. States are given 6 months to complete the process and must notify the system in writing and explain the basis for its decision.

e. *Continued Operation and Maintenance.* Water systems are required to maintain the lead and copper levels below the maximum permissible concentrations designated by the State at each sampling point. A water system would be in violation of the treatment technique if the level of lead or copper at any sampling point is greater than the maximum permissible concentration designated by the State.

In conclusion, the Agency believes that ion exchange, reverse osmosis, lime softening, and coagulation/filtration fulfill the requirements of the SDWA as BAT for the removal of lead and copper in source water. These treatment technologies are readily available and have high efficiencies for lead and copper removal from source water, their costs for large public water systems are reasonable, and they are compatible with other water treatment processes in different regions of the United States.

G. Public Education Requirements

The proposed rule would have required water systems that exceeded one or both of the action levels for lead (either the average or the maximum) to conduct a public education program to help people reduce their exposures to lead in drinking water. Water systems would have been required to design public education programs to meet three performance standards: program content, program delivery, and program evaluation. Many commenters supported public education but had suggestions for improvements. Others disagreed with the public education requirements for two general reasons: (1) Public education is not a legitimate treatment technique because it is not effective in reducing lead levels; and (2) responsibility for developing, implementing, and evaluating public education programs should be the responsibility of the States or Federal Government, not water systems.

1. Authority To Require Public Education

Several commenters opposed the public education requirements, stating that public education is not authorized under the SDWA as a legitimate treatment technique because it does not reduce the level of lead and/or copper in drinking water.

EPA believes it has the authority to establish public education as a means to reduce the public's exposure to drinking water contaminants. Section 1412(b)(7)(A) of the SDWA states that "* * * the Administrator shall identify those treatment techniques which, in the Administrator's judgement, would prevent known or anticipated adverse effects on the health of persons to the extent feasible." The public education program included in the final rule can prevent adverse health effects by supplying people with information on ways to reduce the amount of lead in the water consumed. Moreover, section 1412(b)(5) expansively defines "feasible" as "feasible with the use of the best technology, treatment technique and other means which the Administrator finds * * * are available." This statutory language gives the Administrator broad discretion to select any technology, technique, or other means the Agency finds would prevent adverse effects of drinking water contaminants. Given this language, EPA does not believe the statute can reasonably be interpreted so as to preclude EPA from establishing public education as a component of a treatment technique under the Act. A large portion of the lead problem in drinking water will be rectified by water systems in minimizing the corrosivity of their water, controlling source water contamination, and removing problem lead service lines under their control. EPA does not intend the public education program to be a substitute for these actions. However, there are situations where elevated lead levels will persist at consumers' taps during or even after these efforts. In these cases, it will be important for consumers to take actions in their homes (such as flushing tap water or replacing fixtures) to reduce their exposures to lead. The public education requirements are envisioned as a supplemental program either while the PWS is working to reduce lead levels through corrosion control, source water treatment, or lead service line replacement, or after such actions fail to meet the lead action level.

2. Effectiveness of Public Education

Many commenters contended that the proposed public education requirements would not be effective in reducing exposure to excess levels of lead in drinking water. Other commenters were concerned that the public education requirements duplicated the special one-time public notification requirements, which many commenters found ineffective.

To evaluate the effectiveness of public education in reducing consumers' exposure to lead in drinking water, EPA in cooperation with the Raleigh, North Carolina, Department of Public Utilities, conducted a pilot city-wide media campaign in the winter of 1989 (EPA, 1990h). The pilot program used a variety of communication tools, including printed materials, media coverage, and presentations and speeches, to provide members of the community with information on the health effects of lead, possible household sources of lead contamination, and actions that individuals can take to reduce their exposure to lead in drinking water.

Two evaluation studies were conducted to measure the program's success. Study 1 was designed to evaluate the success of the overall

public media information campaign. A pre-test of consumers' attitudes, knowledge, and behavior with respect to lead in drinking water was taken before the public education project began, and a post-test was conducted after completion of the project. Study 2 was designed to evaluate the success of additional educational efforts in targeted Raleigh neighborhoods and to compare the effectiveness of treatments on different socioeconomic groups. Study 2 compared groups in both suburban and urban areas (treated group) receiving the information versus people receiving no information (control group).

Evaluation of the public media campaign indicates that the project successfully provided relevant information to the community and increased reported behaviors that reduce exposure to lead in drinking water. In addition, the Department of Public Utilities reported receiving a large number of requests for tap water lead tests during the period covered by the pilot program. These results indicate that a public education program that both describes the dangers of lead in drinking water and details practical methods of reducing lead ingestion can successfully change behavior that can reduce exposure to lead in drinking water.

In general, the results of both studies suggest that the more frequently an individual is provided with information on lead in drinking water, the more likely he or she will take some action to reduce his or her exposure. Mass media coverage (especially newspaper and television) appeared to be the most efficient and effective method of providing information to the general public, although the evaluation of the media campaign suggests that urban populations may benefit more from radio-based, rather than print-based media. The studies suggest that public community meetings may require more resources than are warranted by the number of people who generally attend such gatherings. The studies also suggest that mail distribution is as effective as door-to-door distribution. The Raleigh pilot project also demonstrated that significant resources are necessary to conduct a public education program because a successful media campaign will require a sustained effort over a long period of time. Overall, it appears that regardless of the specific communication methods used, repeating the message is the best way to ensure that people act to reduce their exposure to lead in drinking water.

EPA does not believe the public education program is redundant with the special lead public notification requirements. The public education program will be an ongoing requirement for as long as the lead action level is exceeded. This is different from the special lead notification requirement, which was a one-time notice. The public education program requires considerably more interaction between the PWS and its customers to educate them about lead in drinking water.

In conclusion, EPA believes public education is an effective method for reducing exposure to lead in drinking water by raising consumers' awareness of the problem and, consequently, modifying behavior that reduces their exposures. The Raleigh project and other programs, such as the State and EPA radon programs and efforts to educate residents near Superfund sites, have shown that well-designed and effectively implemented programs can change the knowledge and/or behavior of audiences and thereby reduce individual exposures. EPA estimates that the annual household costs in systems that are affected will range from $0.08 to $2.24 ($0.37 for systems serving 50,000 to 75,000 people) (EPA, 1991a). EPA believes these costs are reasonable.

3. Responsibility for Development and Evaluation of Program

Several commenters contended that water systems should not be responsible for developing a public education program and do not have the qualified personnel to develop or evaluate such a program. They believed public education should be a joint effort by many parties, with the responsibility for developing a public education program left with Federal or State government, which has trained personnel and resources.

EPA agrees with these comments. To ensure that consistent and accurate information is disseminated to the public across the country, EPA believes that the most effective use of resources is for EPA to work with States and local governments to develop a national public education program, and for the water systems to work with the States, local health departments, and other interested groups to implement such a program.

To help ensure that public education will result in positive behavioral adjustment to reduce lead exposures and the potential cost of such a program to water systems, EPA has developed camera-ready print materials and model public service announcements for radio and newspaper for water systems to use (see § 141.85 (a) and (b)).

EPA also agrees with commenters that the majority of water systems do not have the expertise to conduct an effective evaluation of their public education program. Evaluating the success of a public education program is difficult and requires behavioral and statistical analyses that go beyond normal water system expertise. EPA believes that the resources that would have been spent on evaluating a public education program can be better used for implementing the program. Thus, the final rule does not require water systems to evaluate the effectiveness of the public education program. EPA envisions conducting evaluations of public education programs over time in different areas of the country to assist in revising the public education program if needed.

4. Content of Public Education Program

Many commenters supported using public education as a means to reduce exposure to lead and copper, but suggested various ways to improve the requirements. The content of the public education materials required to be delivered by public water systems are contained in § 141.85 (a) and (b) of the final rule.

a. *Flushing Water.* One area of special interest was whether to advocate flushing of taps as a method of reducing lead levels in water consumed by the public. The majority of commenters were proponents of instructing customers on tap flushing, but others stated that flushing should not be included in the public education program because it contradicts good water conservation practices. These commenters suggested using bottled water while lead is being removed from the distribution system.

EPA shares the concerns of commenters regarding the possible wasting of water when flushing taps but does not believe that these concerns justify requiring the use of bottled water. EPA estimates that about 40,000 public water systems throughout the country may initially exceed the lead action level (see section X). Supplying the 130 million people served by these systems with bottled water during the various stages of treatment would be an exorbitant and unnecessary expense. The public education materials developed by EPA continue to recommend flushing of first-draw water when needed, but are careful to explain the need to utilize the first-flush water for nonconsumptive purposes, such as cleaning, washing dishes, watering

plants, etc. and to keep a bottle of flushed water in the refrigerator.

b. *Supplemental Testing Program.* The proposal would have required water systems to offer a program to sample, or arrange to have sampled by a certified laboratory, the water of any customer who requests such a test. Several commenters supported this requirement, with a few stating that the water test should be free.

EPA continues to believe that such a program is an excellent method to increase the effectiveness of the public education program and, therefore, is requiring water systems to offer all customers the opportunity to have their household water tested for lead or to arrange for testing by a certified laboratory. In this way, customers gain access to reliable water sampling services and are not subject to repeated trial-and-error in finding reasonably priced, qualified sampling services. The system is not required to pay for collecting or analyzing the sample, nor is the system itself required to collect and analyze the samples. EPA has developed a list of certified laboratories to test for lead in each State. This list is available at the EPA Regional Offices and State Health Departments responsible for implementing and enforcing this rule.

EPA disagrees with commenters who believe the testing must be supplied free by water systems. This would entail a substantial cost to water systems, and EPA believes it is better that water systems direct their resources toward minimizing lead and copper levels if a problem has been found in a system, rather than spending money on additional testing. Some systems do provide this service without cost, however, and EPA encourages others to consider it.

5. Delivery of Public Education Program

The proposal would have required a water system to deliver the public education program to the entire population and to target the program to high-risk segments of the population four times per year for as long as the system exceeded the action level. Several commenters stated that a targeted public education program would be more effective than using bill stuffers to inform all customers about lead in drinking water. Others agreed that public education is important, but suggested that the program be repeated either annually or biannually instead of quarterly. Still others complained that the requirements were vague and confusing and requested clarification.

The proposed rule listed several means by which water systems could deliver the public informational materials, including public service announcements on television, radio, and in newspapers, public meetings, notices in water bills, and local telephone hotlines. With the exception of public meetings and hotlines, the final rule retains the program delivery components discussed in the proposal. EPA has not included public meetings in the final delivery requirements given the findings of the Raleigh study, discussed above, that this forum was not the most effective means for disseminating information to the public. Systems are encouraged to hold such meetings if they are felt to be effective in a particular community. While EPA continues to encourage communities to establish local telephone hotlines, this has not been included as a mandatory requirement in the final rule. Given the resources and expertise associated with running such a hotline, such a measure would not be appropriate for all systems.

With regard to the other delivery components, the final rule details more specifically than the proposal the measures which systems must take to deliver public education and the frequency of program delivery. This information will provide clearer guidance to public water systems on what constitutes an acceptable and effective program and will ensure that the public receives uniform and adequate information nationwide.

The proposed rule would have required systems to deliver public education materials at least once per quarter. Many commenters contended that such a frequency would be too burdensome and recommended annual or biannual delivery. In response to these concerns, the frequency of program delivery for each component of the public education program has been reduced to every 6 months or once every year, as discussed further below. The Agency also believes that reducing the frequency of program delivery and concentrating the efforts toward the most effective media could help prevent the public from "tuning out" a message repeated too often. EPA does not believe that this reduced frequency will impair the effectiveness of the program. Rather, because the final rule requires public water systems to deliver public education materials through a variety of means, EPA believes that the overall effectiveness of the program will be enhanced. This approach is consistent with the results of the Raleigh study, which indicated that repetitive exposure to the information through a variety of media was important to program effectiveness.

The final public education program requires water systems to begin delivering the public education program within 60 days of failing to meet the lead action level based on tap samples collected during a single monitoring period. This should provide adequate time for systems to act, because the systems will not have to develop their own materials but can use those prepared by EPA. Water systems are required to deliver the information specified below within 60 days of exceeding the lead action level. (1) Information notices must be inserted in each customer's water utility bill containing the language specified by EPA in section 141.85(a) of the rule, along with the following warning on the water bill itself in large print:

SOME HOMES IN YOUR COMMUNITY HAVE ELEVATED LEAD LEVELS IN DRINKING WATER. LEAD CAN POSE A SIGNIFICANT RISK TO YOUR HEALTH. PLEASE READ THE ENCLOSED NOTICE FOR FURTHER INFORMATION.

This language must be included in all customers' water utility bills at least once every 12 months subsequent to the initial distribution and for as long as the lead action level is exceeded.

(2) The information contained in § 141.85(a) must be sent to the editorial departments of the major daily and weekly newspapers circulated throughout the community and must be sent every 12 months subsequent to the initial distribution, for as long as the lead action level is exceeded.

(3) Pamphlets and/or brochures that contain the information in section 141.85(a) (2) and (4) must be delivered to facilities where children and pregnant women frequently visit (e.g., public schools and/or local school boards; city or county health departments; Women, Infants, and Children programs and/or Head Start programs; public and private hospitals and/or clinics; pediatricians; family planning clinics; and local welfare agencies). The water system is required to deliver the brochures and pamphlets to these locations every 12 months subsequent to the initial distribution for as long as the lead action level is exceeded.

(4) A public service announcement containing the information in § 141.85(b) must be submitted to at least five of the local radio and TV stations with the largest audiences that broadcast to the community served by the water system. The water system is required to submit the public service announcement every 6 months subsequent to the initial distribution for as long as the lead action level is exceeded.

The initial communication is needed to inform the general public of steps they may take to reduce their exposures. Repeating the information every 6 or 12 months is needed to remind homeowners that they should still be aware of potential problems. EPA agrees with commenters that young children and pregnant women should be targeted and, therefore, is requiring water systems to deliver information to locations frequently visited by these sensitive populations as outlined above. Guidance to assist water systems in implementing a successful public education program can be found in "A Primer: Developing a Community-Based Public Education Program on Lead in Drinking Water" (EPA, 1990i). Copies will be available from EPA Regional Offices and State Health Departments.

In communities where a significant proportion of the population speaks a language other than English, public education materials prepared for distribution through print or electronic media must be communicated in the appropriate language. To further facilitate the dissemination of public information concerning lead and copper in drinking water, the PWS should enlist the support of local elected public officials, the professional staff in local departments of public health and environmental protection, and members of both the business and academic communities.

6. Non-Transient, Non-Community Water Systems

The proposed rule would have required NTNCWS to publicly post informational posters on lead in drinking water in a public place, hold at least one public meeting annually to educate water consumers about lead in drinking water to answer any questions on the subject, and distribute brief informational pamphlets at least quarterly.

Several commenters argued that NTNCWS deliver water to different customers than community water systems and that the public education requirements were excessive. They recommended substantial reductions in these requirements. EPA agrees with commenters that NTNCWS deliver water to people whose exposure patterns are different than community water systems and has accordingly modified the public education program to better serve that constituency's needs.

The final rule requires NTNCWS to deliver the information contained in § 141.85(a) (1), (2), and (4) of the final rule within 60 days of exceeding the lead action level. The information is required to be delivered as follows:

(1) Posters hung in a public place or common area in each of the buildings served by the system.

(2) Pamphlets and/or brochures distributed to each person served by the NTNCWS.

NTNCWS are required to deliver the materials at least once during each calendar year in which the system exceeds the lead action level for as long as the lead action level is exceeded.

H. Lead Service Line Replacement

While the proposed rule did not contain provisions that would have required the replacement of lead service lines, the preamble to the proposal discussed in some detail, and solicited comment on, a lead service line replacement program that the Agency was considering adopting. The program adopted in the final rule resembles in large part the program discussed in the preamble to the proposal. The Agency did not formally propose lead service line replacement because of difficulties with quantifying on a national basis the contributions of lead service lines to lead levels at the tap, because of difficulties in estimating changes in lead levels after corrosion control treatment and lead service line replacement, and because of the potential risks associated with partial pipe replacement.

While there continues to be limited quantitative information regarding contributions from lead service lines to levels at the tap, EPA believes that a lead service line replacement program, as structured in the final regulation, will be an effective means for reducing excessive lead exposures. As discussed further below, the final rule requires systems to institute a replacement program if, after installing optimal corrosion control treatment (and when applicable, source water treatment), the system continues to exceed the lead action level. Replacement of individual lines in the system may be waived where the lead concentration in the service line sample is below 0.015 mg/L. EPA believes that the current lack of extensive data should not delay implementation of the lead service line replacement program. This is because information necessary to determine levels at the tap attributable to lead service lines will be collected on a case-by-case basis, and replacement of service lines will occur where lines are shown to contribute to elevated levels at the tap.

1. Comments on Lead Service Line Program

Numerous commenters supported a removal program proposing different ideas on how it should be implemented. Some commenters suggested requiring the removal of only those service lines that contribute lead above a specific level, such as 0.020 mg/L. Other commenters supported the removal of lead lines if the removal program was extended over 20–30 years, while others advocated removal as lead services are encountered during routine replacement of water lines.

Numerous commenters opposed requiring lead service lines replacement based on one or more of the following beliefs: (1) EPA does not have the authority to require replacement of lead service lines that are not under the water system's ownership or control; (2) the costs derived from lead service line replacement would outweigh the benefits, especially considering that water systems can only replace the portion of the line that they own/control and that may vary from system to system; (3) other methods, such as corrosion control, public education, or enforcing the lead ban, would be more effective for reducing an individual's exposure to lead from drinking water compared to partial lead line replacement; and (4) implementation would be a burden because records do not exist to locate lead lines and because monitoring lead lines will be difficult.

2. Authority to Replace Service Lines

EPA acknowledges that ownership and/or control of lead service lines is often split between the public water system and the property owner. Depending on State law or regulations, or local ordinances, some public water systems control and/or own connections up to the property line, others control and/or own the service line and other connections up to the building (especially if the water meter is located inside the building), and still others control and/or own the service connections only up to the curb.

A recent survey conducted by the American Water Works Association (AWWA, 1989, 1990) indicates that there are approximately 10 million lead service connections currently in use in the United States and that about 20 percent of all public water systems have some lead service connections. The actual number of lead service lines as a percentage of total service connections varies from system to system. EPA estimates, based on the AWWA survey,

that the average length of a lead service line is 42 feet. About 70 percent of systems indicated that they own part of the service connection, 20 percent reported they owned no part, 9 percent reported ownership over only the gooseneck/pigtail, and 1 percent reported ownership over the entire service connection. According to the survey, ownership is determined in the majority of systems by ordinance (72 percent), with about 10 percent determined by informal agreements, 6 percent by contract, and 6 percent by either building codes or building codes and ordinance (EPA, 1990c).

A study discussed in the preamble to the proposal evaluated the extent of authority over service connections in publicly owned water systems in Boston, Chicago, Dallas, Denver, the District of Columbia, Los Angeles, New York, Pittsburgh, San Diego, and San Francisco, and other investor-owned utilities in various States. In the majority of cases evaluated, the water system was found to retain access to virtually all property serviced by the system and to reserve the right to perform work on privately owned service lines (usually at the expense of the property owner). To varying degrees, most of the systems also require property owners to meet certain specifications relating to service line location, size, and material composition. For investor-owned utilities, access to privately owned service connections is often restricted by municipal ordinance.

The study concluded that to the extent public water systems prescribe standards for construction, repair, and maintenance of service lines and reserve the right of entry onto private property to perform necessary work, it could be argued that the entire service line is under the system's control.

As discussed in the preamble to the proposal, requiring lead service line replacement involves determining the obligation of the public water system where jurisdiction over the service line is split between the water system and the user. Because the SDWA defines "public water system" as including "distribution facilities under the control of the operator" (SDWA section 1401(4)), the Agency concluded that it had the authority to hold public water systems responsible only for conditions under their "control." As noted above and discussed in the preamble to the proposal, where ownership is split between the utility and the user, utilities sometimes retain authority to prescribe the standards for construction, repair, and maintenance of service lines, and a right of entry to perform work deemed necessary (usually billing the user for the work on its portion of the line). Based upon this authority of public water systems, the preamble to the proposal discussed the option of establishing a rebuttable presumption that the entire lead service line was owned or controlled by the water system and, therefore, could be replaced by the system. This presumption could have been rebutted by the public water systems' citing appropriate legal authority (such as local ordinances, State statutes, or contractual provisions) limiting its control or ownership.

As noted elsewhere in today's notice, EPA believes its authority to impose regulatory requirements on public water systems extends only to those distribution facilities under the control of the system. Therefore, under the final rule, systems replacing lead service lines are required to replace the portions of lines that are under their control. Control is defined in § 141.84(e) of the final rule as being indicated by one of the following forms of authority: authority to set standards for construction, repair, or maintenance of the line, authority of the system to replace, repair, or maintain the service line, or ownership of the line. The final rule includes essentially the same substantive criteria for determining control as was discussed at proposal, including the "rebuttable presumption" procedure. The rebuttable presumption assumes that the water system controls and, therefore, can replace the lead components up to the wall of the building served (building inlet). As in the proposal, this presumption could be rebutted by the water systems by citing local ordinances or State statutes, or in the case of private systems, the contract between the systems and their customers, that limit the extent of control of the water system.

EPA decided to include a definition of "control" in the final rule to explain clearly the extent of public water systems' responsibilities under the lead service line replacement program. The statutory term, "control," is not defined in the SDWA, and the legislative history does not contain any guidance as to what Congress intended by the use of this term. EPA believes that, in the context of lead service line replacement, it is reasonable to interpret "control" to include those authorities listed in § 141.84(e) of the final regulation. Water systems generally retain authority to specify standards for construction, maintenance, and composition of service lines to be able to safeguard the integrity of the distribution system and, thereby to ensure the delivery of safe water to the consumer. Where a lead service line is demonstrated to be contributing to elevated lead levels at the tap, such a condition is similarly threatening the quality of the water consumed by the public. The Agency believes, moreover, that it is reasonable to interpret "control" as being present in cases where a system has authority to replace or repair or maintain the line since lead service line replacement under the final rule is a form of "repair" or "maintenance" which is necessary to prevent further exposures to elevated levels of lead. Thus, EPA believes that requiring public water systems to replace problem lead service lines that the systems "control" (as the term is defined in the rule) is consistent with the underlying purpose of the SDWA to protect public health as well as with practices of the water supply industry designed to maintain the integrity of water distribution systems.

Systems that do not replace the entire service line are required to submit to the State within the first year of their replacement schedule a letter demonstrating that their control is limited (see section VI(C)(1) of the preamble), so that States can review whether the system's interpretation correctly interprets relevant legal authority (see § 141.90(e)(4)). EPA believes that allowing States to review a system's basis for contending that its control is limited is important to ensure that systems apply correctly the regulatory definition of control to the specific facts of their system. In order not to delay prompt implementation of service line replacement and not to burden the States unduly, the final rule does not require States to affirmatively approve the system's interpretation of its legal authority prior to commencement of replacement. However, the State may determine that a system has incorrectly interpreted the extent of its "control" over lead service lines as the term is defined in the final rule. In these cases, the State is required to make its determination in writing and explain the basis for its decision. The system is then required to replace the portion of the lead line under the system's control as determined by the State.

Where a system's control does not extend to the entire service line, the rule requires systems to offer to replace the portion of the line controlled by the homeowner. The rule, however, does not explicitly address how the costs of replacing the homeowner's portion of the service line should be allocated. In the study discussed above, most cities charged the customer for work on

privately owned piping. Systems may choose to incur the costs of replacing the entire line and spread the costs across the ratepayers, if the system believes that this would be appropriate. The incremental cost of replacing the privately controlled portion of the service line should not be substantial, however, since the largest component of the cost is the expense of mobilizing the equipment and labor to the replacement site, a cost that would be incurred by the system anyway. Because this provision of the rule does not impose any additional costs upon the system, and systems are required to replace only portions of lines they control, the Agency believes that the requirement for systems to offer assistance with replacement of privately controlled service lines is an efficient and effective means of maximizing the public health benefits achieved by the rule.

EPA has also adopted a second rebuttable presumption, discussed in the preamble to the proposal, that lead service lines must be replaced unless they contribute less than a specified amount of lead, although, as discussed below, the level requiring replacement has changed.

3. Cost and Effectiveness of Lead Service Line Replacement

EPA believes that corrosion control will remain the primary method for the majority of water systems to reduce lead levels. Although corrosion control has been shown to be effective in minimizing the corrosion of lead service lines by "insulating" the interior surface of the lines, the chemical reactions responsible for formation of these protective deposits are reversible (over days-months) if the passivation layers on the lines are not maintained. The buildup of these protective films can vary from one house to another depending on plumbing age, physical disturbances such as ground freezing or nearby road repair, and the length and diameter of the pipe.

a. *Contributions of Service Lines to Lead Levels at the Tap.* While corrosion control can be an effective treatment for preventing or slowing the dissolution of lead from lead service, in many cases it will not be sufficient to reduce lead levels below the action levels. Data from Boston, MA, Bennington, VT, and Fall River, MA, cities that contain relatively large numbers of lead service lines, illustrate that high levels that would not be protective of public health persisted despite significant reductions in lead levels achieved with corrosion control treatment. Results summarized in Table 7 also indicate that systems with lead service lines have substantially higher lead levels than those without. These results further suggest that many systems with lead service lines may not be able to reduce lead at the tap to levels below the action level using corrosion control alone. In addition, Table 10 indicates that lead levels in homes with lead service lines compared to homes without lead service lines, in the same system, had higher lead levels. EPA believes that the information presented in Tables 7 and 10 suggests that lead service lines can contribute significant amounts of lead at consumers' taps.

TABLE 10.—AVERAGE LEAD LEVELS (MG/L) BY TYPE OF SERVICE LINE (EPA, 1990d)

City	Pipe type	Number of samples	First draw	Fully flushed
Bridgeport.	Lead	10	12	7
	Non-Lead	12	7	5
Champaign.	Lead	6	18	16
	Non-Lead	16	3	4
Chicago	Lead	512 (FD)	13	9
		466 (FF)		
	Non-Lead	110	5	4
Fairfield	Lead	19	15	7
	Non-Lead	19	7	5
Louisville.	Lead	51 (FD)	11	11
		49 (FF)		
	Non-Lead	10 (FD)	10	2
		18 (FF)		
New Haven.	Lead	5	215	34
	Non-Lead	14	10	34
Newport News.	Lead	41	10	
	Non-Lead	448	11	
Phila/Suburb.	Lead	290	12	
	Non-Lead	22	6	

FD—First-draw, FF—fully flushed

b. *Partial Lead Service Line Replacement.* As discussed above, only that portion of the lead service line controlled by the PWS is required to be replaced by the system. Many commenters did not believe that replacing only that portion of the lead service line under their control would be an effective method for reducing lead levels at the tap and that replacing only part of the service line could actually increase the lead levels at the tap because of the disruption of the protective coating on the inside of the pipe.

In practice, EPA believes that many systems required to replace lead lines will receive consent to remove any privately controlled portions since it is in homeowners' interest to remedy completely this source of lead in their drinking water. In those cases where the water system cannot obtain permission to remove the entire line, EPA still believes there are benefits to partial replacement.

Partial removal of a lead service line will reduce the likelihood of exposure to lead from drinking water because there will be a smaller volume of water in contact with the lead service line. For example, a lead service line 40 feet in length and 3/4 inch in diameter will contain about 4 liters of water, and a service line 20 feet in length and 3/4 inch diameter will contain about 2 liters of water. If the lead concentrations in the service line are the same (i.e., 0.020 mg/L), consumers are more likely to consume water with elevated lead levels from longer lines because a larger volume of water will have elevated lead levels. Data collected by Pocock (1980) from over 2,000 homes in the United Kingdom support the view that the likelihood of elevated lead levels varies in relation to the length of the lead service line. The study found that within pH ranges reflecting relatively low corrosive water, tap water lead levels were significantly related not only to the presence of lead piping, but to the length of the piping as well. These findings are also consistent with Kuch and Wagner's (1983) mass transfer modeling, which predicted the dependence of lead levels on the length and diameter of a lead pipe (i.e., higher lead with longer lead pipe).

EPA shares the concern of commenters that partial replacement could increase lead levels, but believes that increased levels, if they occur, will be temporary and will decrease over time. One study cited in the proposal (Britton and Richards, 1980) showed a temporary rise in lead levels at the tap. One week after service line replacement the lead levels were as low as 0.1 mg/L and as high as 4.25 mg/L. Of the 10 samples collected, only one measured (4.25 mg/L) was above 0.1 mg/L; two were above 0.05 mg/L; and the remaining seven were below 0.05 mg/L. Two months after replacement, lead levels further declined to concentrations ranging from 0.05 mg/L to 0.2 mg/L. Four months after replacement, lead levels declined even further; 9 of the 10 samples were below 0.05 mg/L, and the 10th was below 0.09 mg/L. The Agency believes that the temporary rise in lead levels indicates not only the presence of lead materials in the distribution system (i.e., service lines, probably lead pipe), but also poor corrosion control. As noted by the authors, pH adjustment had only recently been implemented in the area and any passivation films on the interior walls of the pipe were probably thin. By the time replacement would be required under the final rule, corrosion control will have been fully implemented and should therefore

reduce the potential for temporary increases in lead levels. This provides another justification for requiring lead service line replacement only after corrosion control treatment has been optimized.

Data collected since the proposal from Newport News as reported in the American Water Works Association report "Lead Service Line Replacement: Benefit-to Cost Analysis" (AWWA, 1990), indicate that replacement of service lines can result in temporary increases in lead levels. However, these increases lasted only 1–2 weeks and followed replacement of lines that initially had low levels (indicating an effective passivation film). Replacement of lead service lines with lead levels above 0.015 mg/L generally resulted in decreased levels immediately after removal, followed by substantial decreases after 2 weeks.

Newport News Waterworks began a program in 1987 to replace existing lead service lines in their system. Samples were collected at the meter, before and immediately after the service line was replaced, and 2 weeks after the replacement. The results in Table 11 indicate that of the nine locations sampled, four sites had initial lead levels above 0.015 mg/L, one site had lead levels between 0.010 to 0.015 mg/L, and four sites had lead levels below 0.005 mg/L. Immediately after removal of the lead lines, the lead levels in three of the four locations with initial lead levels above 0.015 mg/L declined, and all four locations showed substantial reductions when sampled 2 weeks after replacement.

TABLE 11.—LEAD LEVELS IN HOMES BEFORE AND AFTER REPLACEMENT OF LEAD SERVICE LINES IN NEWPORT NEWS, VA (AWWA, 1990)

Location	Lead levels (ppb)		
	Before replacement	Immediately after replacement	1–2 weeks after replacement
7	4	88	1
10	4	16	2
11	1050	6	4
14	2	106	2
16	4	10	4
18	37	44	<1
19	2350	45	6
21	76	66	13
25	13	27	6

EPA conducted a study on the effects of partial lead service line replacement on seven homes in Oakwood, Ohio (EPA, 1991c). First-draw samples and service line samples were taken before and after replacement. First-draw and service line samples were taken (two to four samples collected at each home) during a 1 week period before the service lines were replaced, and follow-up samples were collected over a 2 week period (one to three samples were collected at each home), after service line replacement. Only that portion of the lead service line owned by the water utility, main to curb, was replaced, even though four homes had lead service materials from the main to the house. The water system offered to replace the section of the service line owned by the homeowner, curb to house, but all four homeowners declined the offer. The results presented in Table 12 indicate that the lead levels in service line samples before and after replacement were very similar, and were below 0.015 mg/L, with one exception. Even though the results indicate very little change in lead levels before and after service line replacement and some increases in some cases, these data are not directly relevant to the replacement requirements in the final rule since levels at these lines were already below the replacement level in the final rule of 0.015 mg/L and would not be required to be removed under the final rule. These data do appear to indicate, however, that requiring replacement of lines where tap levels are already low (i.e., below 0.015 mg/1) might not result in improvements in lead levels.

TABLE 12.—LEAD LEVELS IN HOMES BEFORE AND AFTER REPLACEMENT OF LEAD SERVICE LINES IN OAKWOOD, OH (EPA, 1991c)

Location	Lead levels (ppb)	
	Before replacement	1–2 Weeks after replacement
4	9	6
5	6	3
6	10	4
7	8	22
8	9	11
11	10	7
12	6	8

To ensure that increased exposures do not occur because of partial line replacement, systems are required to notify affected residents that the system is replacing the lead line and that the potential exists for increased lead levels during an interim period after removal. Systems are also required to collect a lead service line sample from the consumer's tap within 14 days after replacing the line to determine whether any increase has occurred. The purpose of collecting the follow-up sample is to inform residents of precautions that may be needed temporarily such as flushing water at taps to avoid potential increases in lead levels.

In conclusion, while partial replacement could in some cases result in transitory increases in lead levels at the tap, EPA believes that such increases will be minimized due to the fact that effective corrosion control should be in place by that time, and because homeowners will be informed of necessary precautions. Finally, even if temporary increases do occur, EPA believes that such concerns are outweighed by the importance of having lead levels reduced over the long term. Except at extremely high exposure levels not found in drinking water (exceptions may occur where there is stagnant water in a lead-lined water cooler), lead is primarily of concern because of its capacity to accumulate in the body and result in chronic health effects, rather than acute toxicity. Thus, EPA believes that it is most important that longterm exposures to elevated levels due to lead service lines are avoided, even if this can mean short-term exposures in some cases to higher levels immediately after partial replacement.

c. *Current Replacement Programs and Cost.* EPA estimates that about 8,300 of the 15,000 water systems with lead service lines will be required to replace some lead service lines after corrosion control has been installed. Costs are estimated to range from about $900 to $1800 dollars per line depending on the local circumstances and the replacement method (EPA, 1991a). Most of these expenses will be fixed costs associated with mobilizing utility work crews and preparing the site to replace the line. Consequently, the costs of replacing lead service lines of different lengths will be comparable. The annual increase in household water bills for large metropolitan water systems (over 50,000) is estimated to range from $2 to $9 (EPA, 1991a). EPA believes that these costs are reasonable.

Costs for lead service line replacement could be substantially lower in the future than those estimated above with more widespread use of low cost pipe replacement technology currently available. This new technology can pull old pipes out without excavating entire streets. The only constraint on the use of this technology is that it cannot be used in clay soils or "river rock." EPA estimates that such conditions exist in less than 25% of the U.S. Assuming that such technology will be used for replacement of 75% of the problem lead service lines, annual

household costs estimated for large systems would be reduced to as low as <$1 to $4 (EPA, 1991d).

Several cities currently have programs to accelerate the replacement of lead service lines. Since the early 1960s San Francisco, California, has replaced about 10,000 lines, representing 95 percent of the lead service lines at a cost of approximately $1200–1400/line. The service line from the water main to the water meter is replaced with polybutylene, copper, or ductile iron, depending on line diameter. In 1964, Akron, Ohio, began replacing each year about 1,000 lead and galvanized steel service lines from the water main to the curb. In all of these cases, the service line replacement was funded by operating revenues paid by the customers. Washington, D.C., has replaced an estimated 500 service lines with a program in which the city will replace its portion of the lead service lines provided that the building owner pays for replacement of his or her portion (AWWA-RF, 1990).

EPA believes corrosion control will reduce the leaching of lead from lead service lines in many cases, but high lead levels will persist in some cases and service lines will need to be replaced. EPA believes that available information suggests that the replacement of lead service lines is effective in reducing lead levels at the tap and that the costs are reasonable for large metropolitan water systems. The technology to replace lead service lines is available, and many cities across the country have been implementing lead service line replacement programs. The Agency will, during the next 3 years, use the data from these systems to assess fully the effectiveness (i.e., in terms of lead levels at the tap or other potential effects) of the lead service line replacement requirements in this regulation, and consistent with this review, make changes, if appropriate, to the service line replacement requirements described below.

4. Final Replacement Program

The lead service line program discussed in the preamble to the proposal would have required systems to replace all lead service lines that contribute measurable lead levels (i.e., 0.003 mg/L) after corrosion control was implemented where the levels of lead in 5 percent of service line samples collected at the tap exceeded 0.020 mg/L. All lead services would have been required to be replaced within 15 years from the date the replacement program was triggered.

The lead service line replacement program in the final rule is premised on five principles: (1) Corrosion control can reduce lead levels from lead service lines in some instances, but high lead levels may persist after treatment; (2) water systems should only be responsible for removing that portion of the lead lines they control; (3) a system is triggered into a lead service line replacement program if the system exceeds the lead action level after installing corrosion control and/or source water treatment; (4) a system is not required to replace individual lead service lines if the service line sample is 0.015 mg/L or less; and (5) water systems must each year replace 7 percent of their total number of lead service lines in place at the beginning of the program (i.e., complete replacement over 15 years). The first two principles have been discussed in the previous section. The final three requirements and the rationale for the remaining components are discussed below.

a. *Criteria for Triggering Replacement Program.* All public water systems that exceed the lead action level in tap water samples after installation or improvement of corrosion control or source treatment (whichever treatment is installed later), or during any subsequent monitoring period, are required to initiate a lead service line replacement program. Obviously, no such program would be required in communities where no lead service lines have been used.

The Agency decided to use the lead action level to trigger lead service line replacement for consistency with other components of the treatment technique (i.e., corrosion control for small and medium systems, source water treatment, and public education). Given the technical complexity of this regulation, and the large number of water systems possessing varying degrees of technical expertise subject to these regulatory requirements, the Agency believes it is extremely important that the requirements be easily implemented by the industry and understood by the public. Use of a single action level for all the regulatory requirements helps achieve this objective. Moreover, for reasons explained elsewhere in this preamble, the Agency believes that use of 0.015 mg/L as a trigger for action will ensure substantial public health protection.

After a water system is triggered into the lead service line replacement program, it is required to take three steps: (1) Complete a materials evaluation, if this has not already been done, to identify all homes or buildings served by lead service lines, (2) establish a replacement schedule for replacing lead service lines, and (3) replace all lead service lines controlled by the system except for those that do not contribute more than 0.015 mg/L. Water systems with lead service lines may simply choose to remove them without conducting any monitoring. This could reduce the monitoring costs for systems, especially if a system believes that lead levels from the service lines are likely to exceed 0.015 mg/L.

b. *Materials Evaluation.* One year after a water system is triggered into the replacement program, it is required to submit to the State a revised materials evaluation identifying the total number of lead service lines in its distribution system. EPA believes that 1 year is more than an adequate period of time since water systems should have obtained this type of information either when they were required to determine whether their distribution system contained lead or copper pipes (§ 141.42(d)), or when they established their sampling pool for tap monitoring under this rule (see § 141.86(a)). EPA understands that some cities may have very poor records of lead service line location and may not be able to initially identify each line. However, systems are not required by the final rule to provide this information until 8–10 years from today (i.e., after installation of corrosion control and/or source water). Given this extended period, EPA anticipates that even those systems with poor records initially should be able to locate their lead service lines and that systems with monitoring results indicating that lead service lines may be a problem should plan this work accordingly.

c. *Replacement Schedule.* The lead service line replacement program discussed in the preamble to the proposed rule would have required replacement of all lead service lines on a schedule to be determined in each system's treatment plan, but in no case more than 15 years. Some commenters argued that the maximum period was too short and that lines should only be replaced in accordance with system's routine maintenance activities. EPA does not believe it would be appropriate to allow systems to replace lines as part of normal maintenance since this could take as long as 50 years before all the problem lead lines are replaced in some systems. EPA believes that it is necessary to accelerate the rate at which systems would otherwise replace lead service lines in order to ensure that public health will be adequately protected.

EPA received other comments arguing that the maximum replacement schedule discussed in the proposal was either too short or too long. Commenters suggested

alternative schedules ranging from 10 years to 30 years. While these commenters disagreed with a maximum 15-year replacement schedule, they did not articulate why it would be feasible for systems to replace lines in a shorter period of time, or why it would only be feasible for systems to replace lines on a longer schedule. Indeed, it is difficult to determine a uniform, national replacement schedule applicable to all public water systems because the circumstances faced by systems can vary substantially, depending upon the number of lead lines in a system and system size. EPA estimates that lead service lines can comprise between 10 and 50% of the total service lines in systems which have them. In some systems, this percentage may be even higher. Large systems with few lines would be capable of replacing the lines on the fastest schedule, whereas a system comprised of a high percentage of lead lines would take the longest period of time to complete replacement. A city like Chicago, which required use of lead service lines until 1986, would require the longest period of time to feasibly replace all of its lead lines.

EPA considered alternative ways of taking into account both system size and the number of lead service lines in establishing a replacement schedule. One such alternative would have required systems to replace the number of lead service lines each year which corresponds to a fixed percentage of the total number of lines (lead and non-lead) in the system. For example, if 10% of the total number of lines were required to be replaced each year, a system with a total of 10,000 lines and 5,000 lead lines would be required to replace 1,000 lines per year (10% of 10,000), leading to replacement of all lines within 5 years. A system of the same size with all lead lines would be given a longer period of time (10 years) to complete replacement under the above scenario. While such an approach would take into account the various factors affecting the feasibility of replacement schedules for individual systems, it can yield inappropriate results in the case of the larger systems, which may be required to complete replacement on an inordinantly fast schedule which would not be feasible (e.g., a city containing a total of 200,000 lines and 50,000 lead lines would be required to replace all the lead lines within only 2 and 1/2 years).

After considering the public comments and the difficulties associated with establishing a uniform replacement requirement for all systems, EPA has decided to retain the approach discussed in the proposal of establishing a maximum replacement schedule of 15 years for all systems. Under the proposed rule, the exact schedule for each system would have been established by the State in each treatment plan for the system. The final rule does not provide for the establishment of treatment plans, as discussed above; the rule simply requires States, and EPA in states without primacy, to place systems on a replacement schedule shorter than 15 years where this is feasible. States will be in the best position to assess the factual circumstances of each individual system to determine the schedule which the system can feasibly meet. In no case, however, can a system take more than the maximum 15-year schedule contained in the final rule.

Water systems required to conduct a lead service line replacement program are therefore required to replace each year at least 7 percent of the total number of lead service lines with lead concentrations above 0.015 mg/L. For example, a system that has a total of 10,000 lead service lines would be required, at a minimum, to replace 700 lead service lines per year (unless the systems could demonstrate that specific lines had concentrations less than 0.015 mg/L, as discussed below). Addressing and, if necessary, replacing all lead lines would, therefore, take 15 years unless the State specified a shorter schedule.

d. *Replacement of Individual Service Lines.* In the preamble to the proposed rule, the Agency considered a lead service line replacement program that would have contained a rebuttable presumption that all lead service lines contribute measurable amounts of lead to the tap and, therefore, should be replaced. That presumption could have been rebutted if the system conducted monitoring that compared a lead service line sample with a fully flushed sample and found that the service line contributed to no measurable increase in lead levels at the tap. The Agency continues to believe that a rebuttable presumption that all lines should be removed is appropriate, but has changed the lead level at which systems will be allowed to avoid replacing specific service lines.

The proposal would have required the replacement of a service line if it contributed lead levels of 0.003 mg/L or more. Several commenters stated that this was unreasonable and that a higher trigger level should be established. EPA agrees that a higher trigger level is appropriate and has selected 0.015 mg/L for an individual line for three reasons: (1) It is consistent with the lead action level that triggers the system into lead service line replacement, as well as other components of the treatment technique; (2) use of a low trigger level may not reliably indicate whether the source of the lead contamination is the service line versus other components of the distribution system; (3) some data indicates that partial replacement of lines where the levels are already below 0.015 mg/L may not consistently reduce those levels; and (4) replacing lines where the level is above 0.015 mg/L provides substantial public health protection.

The first reason for requiring replacement of only those lines contributing above 0.015 mg/L is administrative simplicity. The lead service line replacement program, as well as public education, source water monitoring, and corrosion control for small and medium-sized systems, are triggered by exceedance of the action level of 0.015 mg/L at the 90th percentile. The Agency believes that using the same number as a trigger for removing lead service lines will be less confusing to the public and the regulated community and will enhance expeditious compliance with the rule, thereby improving the rule's effectiveness in protecting public health.

The second reason for using 0.015 mg/L as a trigger for lead service line replacement is recognition of the difficulties in ascertaining whether the service line is actually a significant source of lead contamination. Determining the concentration of lead in drinking water attributable to service lines on a case-by-case basis is complicated by differences in interior plumbing configurations and varying lengths of lead service lines. EPA believes that a trigger level as low as 0.003 mg/L (which is lower than the PQL for lead), and even somewhat higher values, would not provide a reliable indication that the service line (as opposed to other components of the distribution system, such as interior plumbing or brass faucets) was contributing lead to tap levels. The Agency believes it is appropriate to have a reasonable degree of certainty that the service line is, in fact, contributing to elevated levels of lead at the tap (after corrosion control and source water treatment have addressed all other sources of contamination within the PWS's control) before requiring systems to incur the costs of replacing the line. The higher the amount of lead detected in a service line sample, the greater certainty that the line is the source of the lead problem. Also, as noted above, EPA conducted a

study on lead levels before and after partial pipe replacement which showed inconsistent results when the initial levels were below 0.015 mg/L. In sum, given the uncertainties associated with determining whether low levels of lead in service line samples are attributable to service line contamination and whether replacement can further reduce already low tap levels, the benefits in terms of ease of implementation associated with a consistent action level, as well as the substantial public health protection provided by an action level of 0.015 mg/L (see discussion in section IV(E)(2)(a), above), the Agency has selected 0.015 mg/L to trigger replacement of individual lead service lines.

Thus, under the final rule, the rebuttable presumption in favor of replacing lead service lines would operate as follows. As discussed above, a system is required to replace annually the number of lead service lines equal to seven percent of the total number of such lines identified in the system's materials evaluation. The system may seek to rebut the presumption requiring replacement of this number of lines by taking a service line sample at each site scheduled for replacement. If the concentration in the service line sample is less than or equal to 0.015 mg/L, then the system is not required to replace that individual line. However, the system may count that service line towards the seven percent replacement requirement which it is required to meet that year. Thus, in effect, the rule requires systems either to replace and/or rebut the presumption for replacement (by demonstrating that levels are below 0.015 mg/L) for a total of seven percent of its lead service lines each year.

e. *Discontinuing Replacement Program.* Under the final rule, water systems can discontinue the lead service line program if they can demonstrate that the lead levels in first-draw water at the tap are below the lead action level for two consecutive 6 month monitoring periods. It is conceivable that systems, through improvement of corrosion control or source water treatment, or because they obtain an alternative source of water that is naturally less corrosive, can achieve the action level even though they had previously exceeded it. The Agency decided to require systems to meet the action level during the monitoring periods conducted over the course of an entire year in order to ensure that the lower levels genuinely reflect a lowering of lead levels and not normal variability in lead levels at the tap. If a system subsequently exceeds the action level again during any single monitoring period, then it would have to recommence the replacement program.

f. *Annual Letter Certification Process.* For each year of the lead service line replacement program, each water system must submit a letter certifying that they have completed replacement, or monitored lead levels to rebut the replacement presumption, for at least seven percent of their service lines. The annual letter must include information on the number and location of each lead service line scheduled to be replaced during the most recent year, the service lines that were replaced, and the lines where service line samples were collected. The information must include the lead concentrations and the date and methods used to collect the samples. EPA believes that this information is necessary to ensure that the system is properly conducting the lead service line program.

V. MONITORING

A. Analytical Methods

1. Analytical Methods for Lead and Copper

The 1988 notice proposed the graphite furnace atomic absorption technique (GFAA) for conducting compliance monitoring for lead and either the GFAA, direct aspiration atomic absorption technique (DAAA), or the inductively coupled plasma (ICP) technique for conducting compliance monitoring for copper. Neither the DAAA nor the ICP technique were proposed for lead because the method detection limits for these two techniques were too high. All of these analytical methods were considered technically and economically feasible. On October 19, 1990, EPA published a **Federal Register** notice (55 FR 42409) soliciting comment on several new methods for lead and copper along with updates on the methods in the proposal. The new methods for lead and copper included a new inductively coupled plasma mass spectrometry (ICPMS) technique and the graphite furnace platform atomic absorption technique (GFPAA). In addition, the notice proposed analytical methods for calcium, conductivity, alkalinity, orthophosphate, silica, and water temperature and updated methods for pH, which are discussed in section 6, below.

Several commenters supported EPA's decision not to approve the DAAA or the ICP technique for lead in the proposal. Other commenters expressed concern that very few laboratories, other than State laboratories, currently had the analytical equipment or capability to test for lead at the MDL or PQL and that the costs for these lead analyses would be excessive. EPA received no substantive comments on the new methods proposed in the October 19, 1990, **Federal Register** notice (55 FR 42409).

EPA is concerned that the increase in the number of samples requiring analyses may require certification of more laboratories. Based on EPA's most recent Water Supply Performance Evaluation Studies (WS #22 and 23) EPA estimates that there are about 400 laboratories nationwide that currently have the capability to analyze for lead using the GFAA technique within #30 of the Practical Quantitation Level (PQL). However, a large majority of these systems are not EPA- or State-certified laboratories and some may need to obtain certification before completing analysis for lead. Because of this concern, the final rule is phasing in the monitoring requirements by system size to ease the burden on analytical laboratories and to allow some States the opportunity either to expand their current laboratory capacity or initiate a program to certify independent laboratories to analyze for lead (see section C(1)(c) below for a discussion of phased-in monitoring).

The cost for analyzing lead and copper is estimated at about $15 per metal per sample, with collection costs of $20. The proposal estimated the cost of analyzing lead and copper samples at about $6 to $30 per metal per sample. EPA changed its cost estimates based on public comments, although contacts with several school districts and laboratories across the country indicate that lead samples can be analyzed for as low as $5. EPA concludes that the analytic methods listed in table 13 are both technically and economically feasible for routine use in compliance monitoring for lead and copper. These methods are therefore designated as the prescribed analytical methods for conducting monitoring under the final rule.

TABLE 13.—ANALYTICAL METHODS

Contaminant	Methodology [9]	Reference (Method Number)			
		EPA [1]	ASTM [2]	SM [3]	USGS [4]
Lead	Atomic absorption; furnace technique	239.2	D3559-85D	3113	
	Inductively-coupled plasma; mass spectrometry	[6] 200.8			
	Atomic absorption; platform furnace technique	[7] 200.9			
Copper	Atomic absorption; furnace technique	220.2	D1688-90C	3113	
	Atomic absorption; direct aspiration	220.1	D1688-90A	3111-B	
	Inductively-coupled plasma	[5] 200.7		3120	
	Inductively-coupled plasma; mass spectrometry	[6] 200.8			
	Atomic absorption; platform furnace	[7] 200.9			
pH	Electrometric	150.1	D1293-84B	4500-H	
		150.2			
Conductivity	Conductance	120.1	D1125-82B	2510	
Calcium	EDTA titrimetric	215.2	D511-88A	3500-Ca-D	
	Atomic absorption; direct aspiration	215.1	D511-88B	3111-B	
	Inductively-coupled plasma	[5] 200.7		3120	
Alkalinity	Titrimetric	310.1	D1067-88B	2320	
	Electrometric titration				I-1030-85
Orthophosphate, unfiltered, no digestion or hydrolysis.	Colorimetric, automated, ascorbic acid	365.1		4500-P-F	
	Colorimetric, ascorbic acid, two reagent	365.3			
	Colorimetric, ascorbic acid, single reagent	365.2	D515-88A	4500-P-E	
	Colorimetric, phosphomolybdate; automated-segmented flow; automated discrete.				I-1601-85 I-2601-85 I-2598-85
	Ion Chromatography	[8] 300.0	D4327-88	4100	
Silica, filtered	Colorimetric, molybdate blue; automated-segmented flow				I-1700-85 I-2700-85
	Colorimetric	370.1	D859-88		
	Molybdosilicate			4500-Si-D	
	Heteropoly blue			4500-Si-E	
	Automated method for molybdate-reactive silica			4500-Si-F	
	Inductively-coupled plasma	[5] 200.7		3120	
Temperature	Thermometric			2550	

[1] "Methods of Chemical Analysis of Water and Wastes," EPA Environmental Monitoring and Support Laboratory, Cincinnati, OH (EPA-600/4-79-020), Revised March 1983. Available from ORD Publications, CERI, EPA, Cincinnati, OH 45268.
[2] Annual Book of ASTM Standards, Vol. 11.01, American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.
[3] "Standard Methods for the Examination of Water and Wastewater," 17th edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1989.
[4] "Methods for the Determination of Inorganic Substances in Water and Fluvial Sediments," 3rd edition, U.S. Department of Interior, U.S. Geological Survey, 1989.
[5] "Determination of Metals and Trace Elements in Water and Wastes by Inductively-Coupled Plasma Atomic Emission Spectrometry," Revision 3.2, August 1990, U.S. EPA, EMSL Cincinnati, OH 45268.
[6] "Determination of Trace Elements in Water snd Wastes by Inductively-Coupled Plasma-Mass Spectrometry," Method 200.8, August 1990, Revision 4.3, U.S. EPA EMSL, Cincinnati, OH 45268.
[7] "Determination of Trace Elements by Stabilized Temperature Graphite Furnace Atomic Absorption Spectrometry," Method 200.9, August 1990, U.S. EPA EMSL, Cincinnati, OH 45268.
[8] "Determination of Inorganic Ions in Water by Ion Chromatography," Method 300.0, December 1989, U.S. EPA EMSL, Cincinnati, OH 45268.
[9] For analyzing lead and copper, the technique applicable to total metals must be used and the samples must not be filtered.

2. Method Detection Limits for Lead and Copper

The 1988 proposal and the October 19, 1990, **Federal Register** notice (55 FR 42409) estimated Method Detection Limits (MDL) for lead and copper. Generally, the MDL is defined as the minimum concentration of a substance that can be measured and reported with 99-percent confidence that the true value is greater than zero. The MDL approach involves the determination of method detection limits using a procedure defined in Appendix B to 40 CFR Part 136.

The MDLs for the approved methods in the proposal were estimated to be 0.001 mg/L for GFAA (lead and copper), 0.020 mg/L for DAAA (copper only), and 0.002 mg/L for ICP (copper only). The MDLs for the new methods proposed in the 1990 notice were estimated to be 0.001 mg/L for GFPAA (lead and copper) and 0.001 mg/L for ICPMS (lead and copper).

There were no comments on the method detection limit for copper discussed at proposal. Some commenters supported the MDL for lead stating that it is technically feasible to measure lead in drinking water down to a level at or below 0.001 mg/L using the GFAA technique. Other commenters, however, indicated that the MDL of 0.001 mg/L was derived in a single laboratory and should be developed using laboratories representative of those actually performing lead analyses on a routine basis.

EPA believes commenters are confused on the purpose of the MDLs. Unlike Practical Quantitation Levels (PQLs), the MDLs established by EPA are not designed to be met by routine laboratory analysis and are not necessarily reproducible over time in a given laboratory. The MDL is a result of measurements made by an experienced laboratory under controlled research-type conditions. In contrast, the PQL represents a level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

In general, MDLs are used for two purposes: (1) When estimating PQLs if data from interlaboratory studies, such as performance evaluation studies are not available and (2) when States allow compositing of samples. The 1988 proposal used the MDL for lead to establish the PQL and allowed compositing of five source water samples only if the laboratory completing the analyses was able to measure down to the lead and copper MDLs. As discussed in more detail

below, the PQL estimated at proposal of 0.005 mg/L, using the "5 times the MDL" method, was confirmed by performance evaluation studies published in an October 19, 1990, **Federal Register** notice (55 FR 42409). The final rule continues to require systems that are compositing five samples to have the samples analyzed in laboratories that are able to measure levels down to the MDLs.

Another commenter stated that it was impossible to provide meaningful comment on the MDL for lead because EPA had failed to provide an adequate description of how the MDL was derived. This same commenter argued that EPA did not consider other studies indicating that the MDL for lead should be 0.003 mg/L. In addition, several commenters stated that the MDL for lead was derived using a different acid cleaning procedure and digestion procedure than required by the analytical method proposed for approval (Method 239.2–GFAA).

Contrary to commenters' claim, EPA did use Method 239.2 (GFAA) correctly in the MDL study. The samples were digested as required by this method, and the acid cleaning procedures were consistent with the requirements of Method 239.2. Note 5 of Method 239.2 states "since glassware contamination is a severe problem in lead analysis, all glassware should be cleaned immediately prior to use, and once cleaned, should not be open to the atmosphere except when necessary." The glassware was soaked for 2 hours before being used in the MDL study. This does not represent a modification of the method; this is merely a recommendation and clarification for laboratories where low-level contamination could be a problem.

EPA believes that an adequate description of how the MDL was derived in the proposal was available in the docket material supporting the proposal (EPA, 1988i). However, to ensure that all interested parties had an opportunity to adequately comment on the derivation of the MDL, notice of the availability of the memorandum describing the analysis was published in an October 19, 1990, **Federal Register** notice (55 FR 42409). EPA received no substantive comments on this memorandum in the October 1990 notice.

EPA disagrees with the commenter who stated that an MDL of 0.003 mg/L is more appropriate. The studies cited by the commenter were designed to provide information on the accuracy and precision of the GFAA and were not intended for calculating an MDL for lead. Both studies used spiked lead concentrations not within the range needed to calculate an MDL using the procedure listed in 40 CFR part 136, appendix B. The MDL for lead in the proposal was calculated using this procedure and was derived using samples containing 0.002 mg/L and 0.004 mg/L and analyzed using Method 239.2 (GFAA). Using the procedures in 40 CFR part 136, appendix B resulted in a calculated MDL in the range of 0.0007 mg/L to 0.0008 mg/L. Since the MDL was determined by a single laboratory, the MDL for using Method 239.2 (GFAA) was conservatively rounded to 0.001 mg/L (EPA, 1988i).

After reviewing all comments and evaluating the available data, EPA continues to believe that the detection limits listed in Table 14 are appropriate.

TABLE 14.—DETECTION LIMITS FOR LEAD AND COPPER

Contaminant and analytic method	Detection limit (mg/L)
Copper	
Atomic absorption; furnace	0.001
Atomic absorption; direct aspiration	0.020
Atomic absorption; platform furnace	0.001
Inductively coupled plasma	0.001
Inductively coupled plasma; mass spectrometry	0.001
Lead	
Atomic absorption; furnace	0.001
Atomic absorption; platform furnace	0.001
Inductively coupled plasma; mass spectrometry	0.001

3. Practical Quantitation Levels for Lead and Copper

The 1988 proposal estimated PQLs for lead and copper of 0.005 mg/L for lead and 0.050 mg/L for copper. The PQL is the lowest concentration that can be reliably achieved by well-operated laboratories (EPA and State laboratories) within specified limits of precision and accuracy during routine laboratory operating conditions. The PQL may be determined through either interlaboratory performance evaluation studies (PE studies) or it may be estimated if adequate data are not available from interlaboratory studies. If data from PE studies are available, the PQLs are set at a concentration where at least three-quarters of the EPA and State laboratories involved in the PE studies are able to measure within a specified acceptance range of the true value. In cases where PE studies are unavailable or inadequate, EPA believes that a PQL set at "5 to 10 times" the MDL achieved by good laboratories is generally a fair expectation for routine operation of most qualified State and commercial laboratories. The use of "5 times the MDL" instead of "10 times the MDL" to set the PQL may be appropriate when other considerations suggest that the PQL should be lower (see EPA, 1987a and 50 FR 46902, November 13, 1985, for a detailed discussion of MDLs and PQLs). EPA estimated the copper PQL at proposal at 0.050 mg/L, based on performance evaluation data. The proposed PQL of 0.005 mg/L for lead was estimated by multiplying the MDL by 5 (EPA 1988j).

There were no major comments on the PQL for copper. Several commenters opposed the PQL for lead, stating that multiplying the MDL by 5 to estimate the PQL is both unsubstantiated and arbitrary. Other commenters opposed the lead PQL because they claim that the majority of laboratories, especially commercial laboratories, cannot reliably achieve 0.005 mg/L within the specified acceptance limits (± 30 percent) and that EPA should consider the capabilities of commercial laboratories when deriving the PQLs and not rely solely on EPA and State laboratories. Another commenter stated that EPA had not provided adequate information to comment properly on how the PQL was derived and that EPA had not considered performance data from three studies (MS 31, WP #12–17, and EPRI RP1851) that indicate the appropriate PQL is approximately 11 to 30 times the MDL (0.011 mg/L to 0.030 mg/L; MDL assumed to be 0.003 mg/L).

The PQL in the proposal was estimated using the "5 to 10 times the MDL" criterion because the lowest lead value tested in the available PE studies at the time of the proposal was 0.0117 mg/L. Since the proposal, two Water Supply PE studies (WS #22 and 23) have confirmed the proposed lead PQL of 0.005 mg/L. The analysis of these studies was included in a paper "Use of Water Supply Performance Evaluation Data to Calculate Laboratory Certification Criteria and Practical Quantitation Limits for Inorganic Contaminants" (EPA,1990j) that was included in an October 19, 1990 **Federal Register** notice (55 FR 42409). The two PE studies evaluated the ability of EPA and State laboratories and non-EPA and State laboratories to analyze low-level lead samples (0.00528 mg/L and 0.0088 mg/L) using the GFAA. The results of these studies are summarized in Table 15.

TABLE 15.—PERFORMANCE OF LABORATORIES USING GRAPHITE FURNACE ATOMIC ABSORPTION FOR LEAD (WS #22 AND 23)

True/value (mg/L)	Number of laboratories	Percentage of labs within ± 30 percent of the true value using graphite furnace AA
EPA/State Laboratories		
0.00528	46	85
0.00880	33	94
Non-EPA/State Laboratories		
0.00528	457	74
0.00880	363	86

The Agency believes that the results of these new PE studies confirm the appropriateness of the proposed PQL of 0.005 mg/L; more than 80 percent of the approved EPA and State laboratories were within ±30 percent of 0.00528 mg/L using GFAA. In addition, almost 75 percent of the nonapproved EPA and State laboratories came within ±30 percent of 0.00528 mg/L. Based on this information, EPA does not agree with commenters' claims that laboratories will not be able to reliably achieve the PQL of 0.005 mg/L within the specified acceptance limits (±30 percent).

EPA also disagrees that the PQLs should be based on data from all laboratories rather than just EPA or State laboratories. EPA and State laboratory data have been used to calculate the PQL because they represent a stable group of laboratories. The use of data from EPA and State laboratories possible bias by results from laboratories that are not yet certified for drinking water (see 52 FR 25699–700, 53 FR 31550–51, and 54 FR 22100–01 for more complete discussion on using EPA and State laboratories).

In addition, EPA does not believe that the studies cited by the commenter claiming the PQL should be between 0.011 to 0.030 mg/L are adequate to establish PQLs. The values calculated from the data in MS #31 and WP #12–17 required extrapolation of the regression equations since the lowest concentrations evaluated in these data sources were 0.0109 mg/L and 0.0433 mg/L, respectively. The EPRI Study (RP 1851) had different problems. First, the only value below 0.010 mg/L was a blank value. The incorporation of the results at this concentration (0.0 mg/L) significantly biased the regression equations. Also, the EPRI study for lead by GFAA involved only 26 laboratories. The participants were generally utility companies which may, or may not, meet EPA's drinking water certification criteria. Finally, three of these laboratories dropped out during Round 2 and did not submit data on the analysis of lead samples in reagent grade water. For these reasons, the PQLs calculated by the commenter cannot be viewed with any degree of reliability since they involved either extrapolation of regression equations or the use of data that biased the regression equations.

EPA also disagrees with commenters who stated that using the "5 to 10 times the MDL" criterion to estimate the PQL for drinking water contaminants is arbitrary and unsubstantiated. EPA continues to believe that for some contaminants it is valid to set the PQLs at "5 to 10 times" the MDL. In fact, a PQL for lead 5 times the MDL is supported by the data discussed above.

After careful review of all comments and in light of the additional PE studies that confirm the PQL discussed for lead at proposal, EPA continues to estimate the PQLs at 0.005 mg/L for lead and 0.050 mg/L for copper.

4. pH Methods

The 1988 rule proposed approval of the electrometric method for measuring the pH of drinking water in field samples. pH meters would have been required to provide accurate results within ±0.1 pH units, and the pH analyses were to be conducted by certified samplers. The preamble to the proposal stated that the pH meter must provide accurate and reproducible results within ±1 pH unit. This was a typographical error and should have read +0.1 pH unit. The proposed rule, however, correctly indicated ±0.1 pH units as the acceptance limits to be achieved by this method. See proposed § 141.86(a) (4) (i) (C).

Several commenters agreed that the electrometric method for measuring pH is the most precise and accurate method for measuring pH but indicated that it requires careful calibration of the equipment, which may be beyond the capabilities of many technicians responsible for field analysis. These commenters suggested that colorimetric methods be allowed, arguing that it is sufficient for potable water analysis, because the interference of sample color and turbidity are normally not present. Other commenters expressed concern with requiring field measurements of pH samples because of the difficulty in obtaining accurate pH readings, especially with low alkalinity waters. They suggested that pH analysis should only be conducted at approved laboratories and not in the field.

EPA agrees that accurate field measurements of pH can be difficult for many of these reasons, but believes that the pH measurements should be as accurate as possible since compliance status for some systems depends upon precise measurements of pH levels at the tap (i.e., where the State has specified a pH range as representative of optimal corrosion control under § 141.82(f) of the final rule and the requirement that all systems have raised their pH above 7.0 in all tap samples after installation of treatment). Calibration of the pH meter, even though difficult, should be a basic element in any operator certification program or program for field technicians. The use of colorimetric methods, as suggested by several commenters, is suitable for rough estimation, but because of potential problems with interferences due to color, turbidity, salinity, colloidal matter, various oxidants and reductants, it may not be accurate. Contrary to commenters' statements, it cannot be assumed that sample color and turbidity will not interfere with potable water analysis. Many systems continue to have intermittent problems with "red water" due to corrosion of iron pipes or presence of iron in raw water and have difficulties meeting the current turbidity limits. The major cost to a system for pH measurements is associated with purchasing the pH meter, which can range from $100 to $1,000.

EPA believes pH measurements should be made in the field because of the potential for chemical changes to the sample if it is either cooled or warmed. If pH samples are not analyzed soon after collection, especially in warmer temperatures, there may be carbonate or bicarbonate precipitation that would tend to increase the pH. Temperature differences of more than 5 to 10° C cause significant pH changes (AWWA–RF, 1990). It is possible to correct for temperature changes experienced between the field and laboratory, but it is not possible to compensate for any associated chemical changes. Because of the importance of accurate and reliable methods, the Agency continues to believe that the electrometric method is the best method for measuring pH and that the colorimetric methods, although simpler and less expensive, would not provide accurate results. Therefore, the final rule requires pH samples to be measured by the electrometric method in the field.

The final rule also requires large systems and those small- and medium-sized systems that fail the action level to measure for pH at each entry point to the distribution system. EPA is recommending, but not requiring, that

systems use EPA Method 150.2 (pH, Continuous Monitoring [Electrometric]) for measuring samples at the entry points. This method offers the advantage of a continuous measure of pH, which could dramatically reduce the time and resources needed to measure for pH.

5. Total Alkalinity Methods

The titrimetric method to measure total alkalinity was not in the 1988 proposal, but EPA requested comment on the methods in the preamble and requested comment on these methods and the electrometric titration method in an October 19, 1990, **Federal Register** notice (55 FR 42409). There were no comments on the use of this method in the 1988 proposal nor on the methods in the October 1990 notice. Therefore, the methods for total alkalinity described in Table 13 is finalized.

6. Methods For Other Water Quality Parameters

Several methods for measuring calcium, conductivity, orthophosphate, silica, and water temperature were proposed in an October 19, 1990, **Federal Register** notice (55 FR 42409). A list of the methods are included in Table 13. There were no substantive comments on the methods proposed in the October 1990 notice, and therefore, EPA is requiring systems to use the methods listed in Table 13 to complete analyses for conductivity, calcium, orthophosphate, silica, and temperature.

B. Laboratory Approval

The 1988 proposal requested comment on acceptance limits for laboratory approval for lead and copper. In order to be approved for lead and copper analysis, laboratories would have been required to be within ±30 percent at ≥0.005 mg/L for lead and ±10 percent at ≥0.05 mg/L for copper. EPA did not receive any comments opposing the proposed laboratory certification requirements for copper and, therefore, is finalizing these requirements, as listed in Table 16.

Several commenters expressed a concern that the acceptance limits for lead were very narrow. EPA believes that the results from the two PE studies described previously indicate that the majority of laboratories participating in the PE studies are able to reliably achieve the ±30 percent acceptance limits for lead. Therefore, EPA is finalizing the acceptance limits of ±30 percent for lead.

The proposed rule would have required pH samplers to be certified. Several commenters did not believe that this was necessary because the calibration and use of a pH meter is relatively simple and certification efforts should be handled by the State as a part of existing program training. EPA agrees with these commenters and, therefore, is not requiring pH samplers to be certified.

TABLE 16.—LABORATORY CERTIFICATION CRITERIA FOR LEAD AND COPPER

Contaminant	Acceptance limits
Copper	±10 percent at ≥0.050 mg/L.
Lead	±30 percent at >0.005 mg/L.

The final rule does not require laboratories to be certified to test for pH and water temperature because they are measured in the field. Laboratories are also not required to be certified to test for calcium, orthophosphate, silica, alkalinity, or conductivity because these parameters are generally used to assist water systems and States in determining the best corrosion control treatment to install.

C. Tap Water Monitoring

The final rule requires water systems to (1) monitor for lead and copper in household tap water; (2) monitor for lead and copper at each entry point to the distribution system to determine the potential for source water contamination if tap lead or copper levels are above either action level; and (3) monitor lead service lines to determine whether they need to be removed. In some cases, monitoring for water quality parameters such as pH, calcium, and alkalinity at taps within the distribution system (e.g., coliform sites) and at the entry point(s) to the distribution system are required to help determine compliance with the treatment technique requirements and to assist in evaluating the effectiveness of corrosion treatment. The tap monitoring protocol for lead and copper is designed to identify the contributions of different sources of lead and copper to drinking water: source water, lead service lines, lead and copper interior piping, lead solder, and fixtures and faucets. As discussed below, the monitoring requirements for community and non-transient, non-community water systems vary slightly to reflect the circumstances and capabilities of these systems.

EPA notes that 40 CFR 141.29 allows a State to modify the monitoring requirements imposed by specific regulations when a public water system supplies water to one or more other public water systems if the interconnection of the systems justifies treating them as a single system for monitoring purposes. EPA does not believe that modification by States of the monitoring requirements of this rule, as provided in # 141.29, would be appropriate because the primary source of high lead or copper levels at the tap is materials within the distribution system itself. Treating multiple water suppliers as one system would not distinguish between the different systems that may have different amounts of lead or copper materials in the distribution system and thus require different treatment strategies to reduce these levels. This contrasts with other contaminants where the contaminant level is uniform throughout the distribution system. EPA does not envision situations where multiple water systems should be considered as one system for purposes of § 141.29 and, therefore strongly discourages States from allowing this modification to the monitoring requirements.

One commenter argued that the proposed monitoring requirements would fail to meet the statutory standard of "assur[ing] a supply of drinking water which dependably complies with" maximum contaminant levels [SDWA section 1401(l)(D)] and that the Agency would violate the SDWA by taking into account the cost and ease of implementation of the monitoring requirements. EPA believes that this commenter inaccurately characterizes the monitoring protocol adopted in this rule and incorrectly construes the Agency's authority to establish monitoring requirements under the Safe Drinking Water Act.

The monitoring provisions of the final rule impose comprehensive and substantial new requirements on public water systems, both in terms of the extent and frequency of monitoring and the rigorous protocol that must be followed in selecting sample sites and collecting samples. In establishing these requirements, EPA sought to ensure that they were reasonable and implementable but were also rigorous enough to identify water systems with significant lead and copper problems. While the monitoring requirements in this rule are, in general, significantly more comprehensive than requirements established for other drinking water contaminants, EPA believes this approach is justified by the unique nature in which corrosion by-products enter drinking water and the significance of lead and copper as contaminants of public health concern.

EPA's approach is fully consistent with the letter and intent of the SDWA. While the language in section 1401(1)(D) relied upon by the commenter refers to

monitoring in conjunction with establishment of an MCL and not a treatment technique, the rule nonetheless contains "criteria and procedures to assure a supply of drinking water which dependably complies with" the requirements of this NPDWR. As discussed elsewhere in this preamble, the rule helps assure that systems are performing "optimal corrosion control" in part by requiring systems to conduct comprehensive tap sampling at homes specifically targeted for their potential to contain elevated levels of lead and copper. Moreover, the rule contains other procedures to ensure that excessive lead and/or copper levels would be detected in monitoring by requiring, for example, sampling of the first liter of water from the tap after water has been standing for at least 6 hours, conditions under which higher than average contaminant levels are likely to occur. Targeting monitoring to worst-case conditions will help systems and States evaluate the reductions in contaminant levels achieved through treatment and determine when "optimal" treatment is being maintained to the degree most protective of public health. EPA believes that given the difficulties associated with accurately characterizing lead and copper levels at the tap, the final monitoring protocol will "assure a supply of drinking water which dependably complies with" the treatment components of this rule.

The commenter is also incorrect in arguing that the statute and legislative history of the SDWA do not support the notion that monitoring requirements are to be determined taking into account their cost. Section 1445 of the SDWA authorizes the Agency to require public water systems to "conduct such monitoring * * * as the Administrator may reasonably require by regulation." In discussing the Administrator's authority under this provision, Congress stated that "[s]uch requirements must, of course, be reasonable." H.Rep. No. 93, 93rd Cong., 2d Sess., reprinted in A Legislative History of the Safe Drinking Water Act, Senate Committee on Environment and Public Works, No. 97–9, 97th Cong., 2d Sess., at 573. EPA believes that it would be unreasonable to impose monitoring requirements on public water systems without consideration of their cost or other practical considerations limiting the systems' ability to implement them effectively. In addition to being contrary to the language and legislative history of section 1445 of the statute, the commenter's approach would be inconsistent with section 1412, which provides that EPA shall establish "feasible" national primary drinking water regulations, taking into account the costs of such requirements. See section 1412(b)(5). Since monitoring requirements are part of national primary drinking water regulations (see Section 1401(1)(D)), it would be incorrect to argue that Congress required consideration of cost in establishing certain components of NPDWRs, yet intended to preclude consideration of cost with regard to other components.

EPA also wishes to clarify, as requested by this commenter, that the Agency is promulgating the monitoring and analytical methods requirements contained in §§ 141.86 through 141.89 of this rule (as well as the reporting and recordkeeping requirements in sections 141.90 through 141.91) pursuant to both sections 1445 and 1412 of the SDWA. Although Section 1412(b) provides that NPDWRs (as described in Section 1401) shall take effect 18 months after their promulgation, under Section 1445, there is no such limitation for monitoring, reporting, and recordkeeping compliance. To allow these requirements to be effective 30 days after promulgation of this rule, EPA is promulgating these provisions of the rule under section 1445. Effective 18 months after promulgation, these requirements will also be deemed effective under section 1412.

1. Sample Site Location

The proposed rule would have required water systems to collect samples from high-risk residences most likely to have lead problems. High-risk residences were defined to include those residences that were at the ends of the distribution system and either (1) had lead service connections and/or lead interior plumbing or (2) had lead solder that was less than 5 years old.

The proposal would have required water systems to conduct a materials evaluation to identify an adequate number of these high-risk residences. The materials evaluation would have included review of records to identify materials installed in the water distribution system and individual homes, existing water quality information, and design plans of the distribution systems. EPA has adopted essentially the same approach for selecting sampling sites as contained in the proposed rule.

a. *Sampling at High-Risk Houses.* Numerous commenters disagreed with the proposed requirement to monitor at high-risk residences. They argued that these locations would not represent system-wide lead problems and that system-wide treatment would be required based on one or two samples exceeding the action levels. Commenters suggested that samples should be collected at representative sites throughout the distribution system as determined by the State. Other commenters suggested that EPA should target high-risk populations instead of high-risk sites.

EPA acknowledges that the requirement to monitor at high-risk locations is different from the monitoring requirements specified in most other NPDWRs. Nevertheless, EPA believes that the requirement to collect samples from locations that are most likely to have high concentrations of lead and copper in drinking water is reasonable and necessary given the nature of the problem of corrosion by-products. Other contaminants regulated under the SDWA usually do not require monitoring at high-risk locations or at residential taps, since the occurrence of the contaminant will usually not change as it travels through the distribution system. In contrast, lead and copper levels in drinking water are not distributed uniformly. If random samples throughout the distribution systems were allowed to be collected, or if samples were collected from outdoor taps (e.g., fire hydrants) or at the end of a system's control (e.g., water meter), areas with serious lead and copper problems in household drinking water could be missed. EPA believes that these high-risk locations should be accounted for in a monitoring plan to better ensure that high levels of lead are detected and that the system institutes treatment that provides uniform and adequate levels of public health protection throughout the distribution system. EPA emphasizes, moreover, that the purpose of monitoring at taps before and after corrosion control treatment is to identify the need for additional treatment and to ensure that adequate treatment is installed. Targeting monitoring towards high-risk locations means that the detected levels will likely be higher than if sampling were randomly distributed. This does not mean, however, that systems are "disadvantaged" by detection of these higher levels because compliance with the rule is not based on whether a system achieves any particular tap levels of lead and copper. Rather, the requirement of the rule in terms of corrosion control treatment is that systems "optimize" such treatment. Targeting monitoring to locations likely to have higher lead and copper levels will help systems and States determine when levels have been reduced to an optimal extent.

Numerous commenters expressed concern with a system being required to install expensive treatment based on one or two samples, from unrepresentative sites, exceeding the action level. They believed it was unfair to require the majority of customers to pay to correct problems that were not system-wide but instead concentrated in a relatively small part of the distribution system. They were also concerned that installing treatment based on samples from high-risk sites could cause other unintended problems in other sections of the distribution system.

As discussed in section IV(E), the action levels in the final rule are based on the 90th percentile lead or copper level. Basing the action level on the 90th percentile allows systems to have several sample values above the action level and still not trigger system-wide treatment (systems over 100,000 people can have 10 samples above the action level, while systems serving less than 500 people can have 1 sample above the action level without triggering action). More importantly, EPA believes any lead and copper problems found in the sites selected for sampling represent a wider problem within the system. This is especially true in light of several changes to the proposed site selection procedures, described below, which increase the number of eligible sites for sampling. EPA acknowledges that the number of high-risk sites within different systems will vary, but in many systems, they can comprise a substantial proportion of the sites, especially for systems with lead service lines. EPA estimates that about 20 percent of all public systems have some lead service lines and that lead service lines comprise between 15 percent to 80 percent of all service lines in these systems (EPA, 1991a).

There will be situations where the system is not able to locate sufficient number of high-risk homes. For example, EPA estimates that about 16 percent of public water systems are mobile home parks (EPA, 1991a), which, in many cases, use plastic pipes and will not have used either lead solder or lead service lines. Another case may be in systems where there has been no new construction or renovations within the past 5 to 10 years and no lead service lines were used. In these situations, the system is required to collect samples from public buildings or from homes with lead solder installed prior to 1983, or in the case of mobile homes, from any site within the distribution system (Section (d) contains a complete discussion on alternative sampling sites).

Finally, EPA believes that customers who do not benefit directly from reduced exposure to lead and copper will still realize indirect benefits from decreased health costs within the community and direct material benefits from corrosion control treatment (see section X for discussion on benefits).

Other commenters suggested that the sampling program should be targeted towards high-risk populations (i.e., infants, pregnant women) and not high-risk sites. EPA agrees that high-risk populations should be protected but believes targeting high-risk sites is a more effective approach for reducing exposure to these high-risk populations. EPA has no reason to believe that people at greatest risk are not distributed equally among high-risk sites. By selecting high-risk sites, EPA is ensuring that action is taken if there is a lead or copper problem within the system. Targeting populations would not guarantee that a lead or copper problem within the system is identified and corrective action is taken. Also, high-risk populations are continually changing (pregnant women give birth, infants grow up), making it necessary to continually change the sampling group. This would be impractical and would increase the difficulties with the implementation of the final rule.

For the reasons discussed above, EPA believes that the use of high-risk sites is reasonable and will generally reflect problems not only in the small subset of sites used to determine if treatment is necessary but also will reflect wider problems in the distribution system.

b. *Targeting Criteria.* High-risk locations for the final rule include (1) those locations that contain copper pipes with lead solder installed after, 1982 or lead pipes and/or (2) locations with lead service lines. The changes from the proposal and the reasons are discussed in the subsequent sections.

i. End-of-Distribution System. Many commenters disagreed with the requirement in the proposal that samples had to be collected from sites at the end of the distribution system. They stated that requiring sampling at these locations could exclude problem areas, such as older inner cities, which have lead service lines but would not qualify as sample sites because they are not located at the end of the distribution system. Other commenters contended that only under certain conditions and in certain systems will there be any differences in water quality at the end of the distribution system and that requiring monitoring at these points complicates sample collection with no obvious benefits.

At the time of proposal, EPA did not have any field data demonstrating that sites at the ends of the distribution had higher lead levels than other sites. However, the Agency decided to propose this requirement because of concern that it may be difficult to maintain elevated pH levels at the farthest reaches of the distribution system, and, in the absence of sufficiently high doses of corrosion inhibitors, it may be difficult to maintain an adequate coating on the interior surface of service lines and pipes throughout the distribution system. Consequently, it was thought that sites at the ends of the distribution system may be more likely to receive water that is more corrosive.

The Agency still does not have any specific data indicating that sites at the ends of the distribution system will necessarily have higher lead levels than other sites. In fact, data from Seattle, Washington, demonstrates that lead levels at the ends of the distribution system can actually be lower than in other areas of the distribution system (EPA, 199 lb). EPA believes that for the majority of systems with well buffered water, the requirement to colllect samples at the ends of the distribution system simply complicates locating sampling sites and could result in water systems overlooking sites that should be targeted (e.g., inner city dwellings and buildings). Also, several commenters on the proposal stated that for systems with asbestos-cement or cement-mortar lined pipes, pH might rise toward the ends of the distribution systems. Given these uncertainties, EPA believes it is a better use of limited public water systems resources to concentrate their efforts on identifying sites that contain leaded materials (including lead service lines in older, urban areas) rather than locating sites at the ends of the distribution system. Therefore, EPA has decided to eliminate the requirement to collect samples at the ends of the distribution system and is allowing water systems to select sites throughout the distribution system that meet the targeting criteria described above.

ii. Lead Solder/Lead Pipes. Several commenters disagreed with the requirement in the proposal to collect samples from homes with lead solder less than 5 years old. They argued that when the rule becomes effective, there would be very few, if any, homes with legally installed lead solder because of the 1986 lead ban; any lead solder less than 5 years old would have been installed illegally and water systems should not be the de facto enforcer of the lead ban. Other commenters were

concerned that they would need to continually substitute new sample sites when the age of the initial sample sites passed 5 years or when homeowners change their plumbing in an attempt to rectify a lead or copper problem.

EPA agrees that very few sites will have lead solder less than 5 years old when the rule becomes effective because of the lead solder ban of 1986, because EPA is planning to reinforce that ban with a Federal ban on solder under section 6 of the Toxic Substance Control Act (TSCA), and because systems are not required to begin monitoring until 1992 (large systems begin January 1992, medium systems begin July 1992, and small systems begin July 1993). The final rule takes this into account by requiring systems to collect samples from locations that contain copper pipes with lead solder installed after 1982. EPA believes that this will give the majority of water systems a large enough pool of sites from which to collect samples yet still target sampling to those locations which had lead solder installed in the period just preceding enactment of the lead solder ban. For example, if a State's lead ban became effective in January 1988, the water, system could include homes with lead solder installed between January 1983 and January 1988. If the lead ban was effective in the State prior to 1983, the water system could collect samples from homes with lead solder installed as close as possible to the effective date. Of the 54 States and Territories, two had a lead ban in effect prior to 1986, 11 prior to 1987, 23 prior to 1988, 47 prior to 1989, and 53 by 1990 (EPA, 1990k). Thus, for the majority of States (43), water systems will be able to select sampling sites built between January 1983 and January 1988, which EPA believes will provide an adequate number of high-risk homes.

EPA does not believe it would be appropriate to require systems to target sampling exclusively to those sites where lead solder has been installed illegally after the lead ban was enacted. Requiring the collection of samples from sites with illegally installed lead solder would require the water system to inspect every site built after the effective date of the lead ban to determine if the site had lead solder. This would be impractical and could significantly delay the implementation of the final rule. In contrast, the majority of homes constructed between 1983 and the effective date of the lead ban in the State will more than likely have used lead solder. EPA encourages water systems to inspect sites constructed after the effective date of the lead ban in the State if they suspect that these homes have illegally installed lead solder, but is not now requiring PWS to include these types of sites in their sample pool.

Finally, requiring sytems to collect samples from locations with lead solder installed after 1982 will eliminate the problem of constantly substituting homes with lead solder less than 5 years old. In terms of homeowners replacing their plumbing to rectify problems, EPA encourages homeowners to rectify problems if present, but believes that the majority of homeowners will opt to flush their water to protect themselves instead of replacing their plumbing while they wait for centralized treatment to take effect. EPA requires systems to identify more sample sites than needed to complete their initial sampling poll in case the system cannot gain access to enough homes or because homes may drop out of the sample pool.

The proposed rule would have required water systems with lead service connections to collect 50 percent of the system's samples from sites served by lead service connections and 50 percent from sites with interior lead plumbing or lead solder. If a system had no lead service connections, then 100 percent of the samples were required to be collected from sites with interior lead plumbing or lead solder. Many commenters were confused about this requirement and requested clarification. Other commenters argued that the percent of lead service connections sampled should be proportional to the number of lead service connections within the system.

To comply with this component of the monitoring requirements, water systems should first determine if they have lead service lines. If a system does not contain lead service lines, it should collect 100 percent of its samples from sites with either lead solder or lead interior pipes. EPA estimates that about 75 percent of all public water systems will fall into this category. If a system contains lead service lines, it is required to collect 50 percent of its samples from sites with lead service lines and 50 percent of its samples from sites with lead solder or interior lead pipes. Water systems unable to locate enough sites with lead solder or lead interior pipes to comprise 50 percent of their sample pool are required to complete their sample pool with sites served by lead service lines. Likewise, water systems unable to locate enough sites served by lead service lines to make up 50 percent of their sample pool are required to complete their pool with sites that contain lead solder or lead interior pipes. For example, if a system is required to sample at 100 sites but can only locate 20 sites that have lead solder or interior lead pipes, they should collect the remaining 80 samples from sites served by lead service lines. Water systems are required to exhaust possible sample sites from these categories before they select Tier 2 sites (discussed below).

EPA considered requiring water systems to collect samples at sites served by lead service lines in relative proportion to the total number of lead service lines within the system, but does not believe this is necessary or practical. Where lead service lines are present, EPA estimates that the percent of these lines as a percentage of the total number of service lines range from almost 90 percent for the very small systems to about 15 percent for larger systems (EPA, 1991a). This indicates that systems containing lead service lines will have a sufficient number of these sites to complete their sampling pool. Determining the percentage of lead service lines would require systems that have not completed a materials evaluation of their entire system to complete a survey prior to collecting the samples. This could take at least 1 year and could consequently postpone implementation of the final rule. As will be discussed, water systems are only required to identify a sufficient number of sites to perform the required tap sampling and do not have to conduct a complete materials evaluation of the entire system.

c. *Materials Evaluation/Phased-In Monitoring.* The proposed rule would have required water systems to complete their materials evaluation and to begin monitoring at different times depending on system size. Systems serving more than 3,300 people would have been required to complete their materials evaluation and begin monitoring 3 months after publication of the final rule; those serving from 500 to 3,300 people were to begin 15 months after publication, and those serving less than 500 people were required to begin 27 months after publication. Also, systems would have been required to identify a sampling pool that included 50 percent more sites than the number required for monitoring each monitoring period.

Several commenters supported phasing-in monitoring, especially for small systems. Others believed that it is unrealistic for systems serving more than 3,300 people to obtain an adequate pool of high-risk sites in the time allotted because the records to identify these sites are missing or inadequate.

Other commenters stated that a materials evaluation, regardless of the time allowed, was impossible because the records to identify high-risk locations do not exist.

EPA understands commenters concern with the potential inadequacy of records needed to identify high-risk locations and the need for additional time to locate these sites. EPA has maintained the phased-in monitoring by system size but has changed the system size categories to be consistent with the corrosion control treatment requirements and has increased the time allowed for systems to complete the materials evaluation. The time allowed for large systems to complete the materials evaluation has been changed from 3 months to 8 months, for medium systems from 3 months to 14 months, and for small systems from 15 months (systems serving between 500 to 3,300 people) or from 27 months (systems serving fewer than 500 people) to 26 months. The only group of systems that will have a shorter time frame to complete their materials evaluation and begin monitoring are those systems serving less than 500 people (26 months instead of 27 months in the proposal). The time was shortened for these systems to be consistent with the size divisions adopted for corrosion control. The Agency believed adopting different system size categories for monitoring and treatment would be confusing and cause problems in implementation. EPA does not believe this minor change will cause problems for these systems in locating the required number of sites.

The Agency believes that the additional time for locating monitoring sites provided by the final rule should be adequate. It should be clarified that the materials evaluation is not required for the entire system but only to identify a sufficient number of sites to perform the required tap sampling. For example, the largest size systems (those serving more than 100,000 persons) are only required to identify a sufficient number of sites so that they can sample at 100 locations. Smaller size systems are required to sample at fewer sites (see Table 18). While systems will likely need to identify more sites than these in order to assure that the number of available sites (taking into account any difficulties in entering sites) is sufficient, the total number of sites to be located is still relatively small. Given the relatively few sites that need to be located, EPA believes that the time periods for systems to obtain this information are reasonable. Moreover, community water systems have been required to obtain this information under 40 CFR 141.42(d) since 1980. Larger systems are given less time to identify the required number of sites, because larger systems have more staff to help identify sampling sites. In addition, larger systems have generally been more involved in the rulemaking process and are therefore more prepared to implement the regulations in a shorter time period. Some larger systems have, in fact, completed much of this preliminary work and are moving ahead in advance of the final rule.

The Agency also recognizes that some systems have not maintained adequate records of lead service lines or lead solder. In these cases, systems can use other simple methods for gathering information. Systems can begin to look at the material composition of service lines during the course of their normal activities such as reading of water meters or other maintenance or repair work. Sometimes, neighborhoods with houses built at the same time will have similar materials used in service lines. If the system discovers that a lead line in one neighborhood, it may be worthwhile to check on the composition of service lines in nearby houses. Another method for identifying potential sites when no records exist is to ask for volunteers in the community whose homes were built after 1982 or who believe they may have a lead service line. The water system can then arrange a time to visit these sites to determine whether they have lead solder or lead service lines. To assist these systems further, EPA is developing a guidance manual that provides information for identifying high-risk sites. The manual will describe where systems can obtain the needed information to assist in identifying high-risk sites, methods for locating these sites, and procedures for establishing a reliable and accurate recordkeeping system to catalog the sites.

EPA also decided to phase-in monitoring because of concerns expressed by commenters with the lack of certified laboratories for analyzing inorganic samples (lead) in some areas of the country. For example, several States (i.e., Mississippi, Indiana, Texas, Louisiana, Arkansas, South Carolina, and Oklahoma) have only one State-certified laboratory to complete all drinking water analysis of inorganic samples (ASDWA, 1991). It is estimated that in EPA Region VI alone (Texas, Arkansas, Louisiana, New Mexico, Oklahoma), the number of samples required over the 3 year implementation period to complete initial monitoring will increase from 4,000 inorganic samples to almost 300,000 inorganic samples. Nationally, it is estimated that about 400,000 lead and copper samples are required to be collected by community water systems the first year after publication of the rule, 1 milllion samples the second year, and 570,000 samples the third year (EPA, 1991a). Because of this enormous increase in the number of samples required to be collected, it is necessary that States be given time to determine whether to increase their laboratory capacity or develop a laboratory certification program, both of which will take time. In addition, the final rule requires water systems to collect samples for other water quality parameters, such as alkalinity, calcium, and orthophosphate, which will cause further pressure on these laboratories.

d. *Sampling Tiers.* The proposd rule would have required systems to collect samples from one of three tiers of sampling sites depending on the ability of the water system to locate the required number of sites in each tier. The first tier required all samples to be collected at single family residences located at the ends of the distribution systems with either lead solder less than 5 years old or with lead interior pipes or lead service lines. Water systems that could not locate enough sampling sites meeting these targeting criteria were allowed to include sites located elsewhere within the distribution system (not only from locations at the ends of distribution system) that had lead solder less than 5 years old or sites that had lead interior pipes or were served by lead service lines (Tier 2). If the system could still not locate enough sampling sites using these criteria, they were required to add to the sampling group residences at the ends of the distribution system irrespective of the age of the lead solder (Tier 3). Finally, the proposed rule requested comment on allowing systems to include non-residential locations in their sample pool as a last resort. These non-residential locations would have been required to have plumbing with a configuration and daily water use patterns similar to those found in single-family residences.

i. *Tier 1 Samping Sites.* Several commenters disagreed with the requirement to monitor only at private homes and argued that water systems should be allowed to collect samples at non-residential locations, such as libraries, fire stations, or public buildings. They were concerned with collecting samples from private residences early in the morning and argued that including non-residential sites would make sample collection easier without eliminating the requirement to collect first-draw samples.

EPA has maintained the three-tiered approach for collecting samples but has changed the requirements for each tier. The first tier in the proposal required all samples to be collected at single family residences located at the ends of the distribution systems with either lead solder less than 5 years old or with lead interior pipes or lead service lines. As discussed previously, the requirement to collect samples from sites at the ends of the distribution system has been eliminated, and systems are required to collect samples from sites with lead solder installed after 1982. EPA is also changing the requirement that only sites being used as single-family residences be included in the sampling pool. EPA agrees that certain non-residential locations can be included in the Tier 1 sampling pool at the discretion of the water system, as long as the non-residential locations have been constructed as single-family residences, and the water system can ensure that the standing time of water at the non-residential location is at least 6 hours. Locations such as libraries, for example, should be excluded if they were not constructed as single-family residences.

EPA believes that allowing these alternative non-residential sites to be included in the sampling pool will ease sample collection while retaining the approach of targeting high-risk locations. Ensuring a standing time of at least 6 hours will be easier in these non-residential sites since the majority of non-residential locations will be closed during the night-time hours. Water utility personnel can meet individuals in these non-residential locations upon their arrival at work.

ii. *Tier 2 Sampling Sites.* Other commenters complained that they could not locate enough high-risk locations because of no new construction or no history of lead service lines in the system. EPA believes that the majority of water systems will be able to locate enough sites meeting the Tier 1 targeting criteria, especially since certain non-residential locations will be allowed in the sampling pool. Water systems asserting that they cannot locate enough sites to meet the Tier 1 targeting criteria are required to report this finding to the State as follows:

(1) The system must document via the materials evaluation that lead service lines, or interior lead piping was never used in the system or have all been replaced, or enough sites with these characteristics cannot be located.

(2) The system must demonstrate that lead solder was never used in construction of residences and other buildings in the system or that the system cannot locate enough homes with lead solder installed after 1982.

Water systems are then required to add to the sampling pool, as equally distributed as possible, buildings, including multiple-family residences, that contain either (1) lead interior pipes or have had lead solder installed after 1982 and/or (2) are served by a lead service line.

The Tier 2 requirements in the final rule are different than those in the proposal. The proposal would have required water systems to add residences within the distribution system not located at the ends of the distribution system. This does not apply to the final rule, as discussed previously. Instead of requiring systems to select these sites, EPA decided to require systems to select sites from buildings, including multi-family residences that comply with the targeting criteria for Tier 1 locations. When sampling at these sites, water systems should refer to the document "Suggested Sampling Procedures to Determine Lead in Drinking Water in Buildings Other Than Single Family Homes" (EPA, 1988k). Such buildings were selected for Tier 2 sampling because they can represent high-risk sites. They are not included in Tier 1 sampling (except for those communities where more than 20 percent of buildings were multiple-family dwellings) because of the wide variation in the plumbing configurations of multiple-family dwellings and other buildings. Systems might find it convenient to conduct such sampling at public buildings where they can gain easy access.

iii. *Tier 3 Sampling Sites.* The proposal would have allowed systems that could not locate enough Tier 2 sampling sites to add residences at the ends of the distribution systems irrespective of the age of the lead solder. There were no major comments on this provision. Since the final rule does not require water systems to collect samples at the ends of the distribution system, it requires water systems that still cannot locate enough sample sites in Tiers 1 and 2 to select single-family residences with lead solder installed prior, to January 1983.

e. *State Review of Monitoring Results.* The proposal did not require State approval of monitoring plans, but States would have had the authority to disapprove any monitoring plan that did not meet the targeting requirements. A number of commenters suggested that this requirement should be changed and that States should be required to review and approve sampling sites to ensure that they are selected properly. EPA does not agree that States should be required to approve monitoring plans prior to initiating sampling. Requiring States to review each plan would entail an inspection of each site to determine that the water supplier has chosen the correct sites. EPA does not think this is an effective use of limited resources and would detract from other important tasks that the State needs to complete, such as review of the corrosion control efforts of the water suppliers. Such up-front review could also result in delays in monitoring and implementation of the treatment technique. Water systems are, however, required to submit a letter to the State certifying that all samples are collected at targeted sites or document why they cannot collect samples from targeted sites. After review of the monitoring data, States may require systems to conduct additional monitoring if they find the systems have not conducted sampling correctly. Samples collected at sites not meeting the targeting criteria may not be used in calculating the 90th percentile lead and copper levels.

2. Sample Collection

The 1988 proposal would have required systems to collect either a 1-liter morning first-draw (MFD) sample and/or a 1-liter service line (SC) sample. An MFD sample was defined as a sample collected at a consumer's tap that had been standing in the interior plumbing for 8 to 18 hours and was collected without prior flushing. The SC sample was defined as a water sample that had been standing for 8 to 18 hours in a lead service line and collected in any one of the following ways: (1) Direct sampling of the service line, (2) tap sampling based on a temperature change in the water or, (3) a tap sample after flushing a volume of water equal to that contained in the pipes leading from the tap to the service line. In a residence with both lead solder less than 5 years old and a lead service line, both types of samples could have been collected and counted as two sites. The samples were required to be collected by the water system.

To ensure that a system could collect an adequate number of samples from high-risk locations, the proposal would have required that the system's sampling pool contain a number of eligible sample sites at least 50 percent greater than the number of samples that must be collected during each monitoring period. For example, if a system was required to collect 100 samples during each monitoring period, they would have needed 150 eligible sampling sites in the sampling pool.

Systems were allowed to include apartments and other multiple family dwellings where these comprised more than 20 percent of the housing served by the community.

Many commenters disagreed with first-draw tap sampling stating that (1) they should not be held responsible for the elevated lead and copper levels found in first-draw tap samples because such levels are caused by conditions beyond their control (e.g., homeowner plumbing), (2) water systems have no authority to enter homes to collect tap samples and face the potential liabilities of utility personnel entering homes, (3) customers would not cooperate with first-draw tap sampling, and water systems could not verify whether the samples were first-draw, (4) first-draw water is not representative of the water consumed by individuals, and (5) collection of service connection samples is not reliable.

a. *Responsibility for Lead Levels at the Tap.* EPA agrees with commenters, as stated previously, that the Agency cannot promulgate a rule that holds water systems responsible for conditions in those portions of the distribution system that are outside of the systems control (e.g., homeowner plumbing). However, as discussed earlier, if water systems do not collect first-draw tap samples for lead and copper, they would have no indication of the lead and copper levels to which their users are being exposed and thus could not rectify that portion of the problem that is under their control (corrosivity of the water, lead service lines). For the majority of contaminants, monitoring at consumer's taps is not critical since the level of the contaminants leaving the water treatment plant will not change as it travels through the distribution system. In fact, for some contaminants, the level at the tap may even be lower than at the entry point to the distribution system because of dilution or volatilization of contaminants from water. Also, as discussed previously, simply because the rule requires tap sampling does not mean that public water systems are being held responsible for conditions beyond their control. Tap sampling is necessary to ensure that public water systems are optimizing corrosion control, which is within their control.

b. *Authority and Liability for Entering Homes To Collect Tap Samples.* Many commenters stated that they had no authority to enter homes to collect tap samples. EPA agrees that water systems do not have the authority to enter homes without the homeowner's consent. Many commenters erroneously assumed that the proposal gave water systems the authority to enter homes unannounced. The rule in no way gives the water system the authority to enter a private residence without obtaining homeowner permission.

Numerous commenters expressed concern with the potential liability of utility personnel entering homes to collect samples. As discussed below, water systems can use homeowners to collect samples, eliminating the need for utility personnel to enter homes. Even if utility personnel do enter homes to collect samples, however, EPA believes the concern with utility personnel liability is unfounded. As discussed above, utility personnel are only allowed in a private residence to collect samples with the consent of the homeowner. After gaining entry into a home, EPA has no reason to presume that utility personnel will act inappropriately. It has been customary for decades for gas and water utility personnel to enter homes with homeowner permission.

c. *Cooperation With First-Draw Tap Sampling.* A major concern expressed by commenters was that customers would not cooperate in collecting first-draw tap samples because of homeowners' apprehension in allowing water utility personnel to enter their homes early in the morning to collect samples. To avoid this problem, several commenters suggested that homeowners be allowed to collect the first-draw tap samples. These commenters contended that participants could be trained in the proper collection methodology and that the reliability of the lead and copper samples would not be jeopardized. In addition, they suggested that there would not be a significant reduction in accuracy if the samples were acidified after collection by utility personnel. Other commenters, however, did not believe customers should be allowed to collect samples because the water system could not verify if the samples were collected properly (e.g., minimum standing time, collection point) and because of potential problems with customers handling the nitric acid needed to stabilize the samples.

i. *Collection of Samples.* EPA agrees with those commenters who believe that water systems should be given the option to allow customers to assist in collecting lead and copper samples as this will help ensure that sampling will occur at targeted, high-risk locations. EPA believes customers can be easily instructed on how to properly collect samples, as is evident by the numerous sample collection programs that have successfully used customers. For example, the data from Boston, Bennington, and the AWWSC survey discussed earlier were from samples collected by customers; after collecting the sample in accordance with the procedure provided by the water supplier, the customer placed the sample outside for collection by water utility personnel. This reduces the potential inconvenience of entering homes. In addition, as discussed later, first-draw samples do not necessarily have to be collected in the morning but can be collected in the afternoon upon returning from work. The customer can arrange with the water utility personnel to meet them at their home at a prearranged time to collect the sample. Finally, EPA understands commenters concerned with ensuring that customers have properly collected samples but anticipates that customers willing to participate will collect the samples correctly, if given proper instruction, because they want to know their tap water lead and copper levels. If a system is concerned about this, then they can collect the samples themselves.

EPA also agrees with commenters that acidifying samples after collection by water utility personnel does not significantly reduce the accuracy of the samples. EPA has recently completed work that corroborates an earlier study by Miller (1985). The samples in the EPA study were collected in previously unused, high-density polyethylene containers with polyethylene or polypropylene caps and held up to 14 days. The samples were then acidified with reagent grade nitric acid (0.5 mL acid per 100 mL samples), mixed, and held an additional 28 hours and then analyzed. The results indicate that the lead samples may be held up to 14 days prior to acidification with no loss of lead recovery (EPA, 19901). If a water system chooses to allow homeowners to collect lead and copper samples, the system must certify that it has supplied the customer with detailed instructions on the required collection procedure.

Also, in cases where a system chooses to have customers perform sampling, the rule provides that the results shall be accepted by the systems as valid and may not be challenged in any subsequent administrative or civil enforcement proceeding or citizen suit on the grounds that errors were committed by the customer during sampling. EPA believes that this provision will assure finality to sampling results and will prevent systems from questioning results in an enforcement proceeding even though the systems had chosen to have customers conduct the sampling. This provision does not

constrain the discretion or authority of systems since they can choose to conduct the sampling themselves if they are concerned about the accuracy of customer sampling.

ii. *Standing Time.* Numerous commenters were critical of the 8 to 18 hour standing time requirement proposed by EPA and suggested eliminating the standing time requirement. They indicated that the 8 to 18 hour standing time would be impossible to verify because of leaking faucets, home ice makers, sprinkler systems, or the unintended use of water during the evening, and the only way to ensure an 8 to 18 hour standing time would be to shut off service to the customer. Others were concerned with the costs of overtime pay for utility personnel as they would be required to be at customers' homes early in the morning to collect the standing samples.

The Agency agrees that the 8 to 18 hour standing time requirement may have made it more difficult for some systems to collect samples and, thus, is reducing the minimum required standing time to 6 hours. The change of the minimum standing time to 6 hours is based on data received that indicates a negligible difference in lead levels at the tap between standing times of 6 versus 8 hours (AWWSC, 1989). The Agency, does not believe that eliminating the standing time requirement would be prudent because the standing time of the water in plumbing pipes is one of the most important determinants of lead and copper levels found at the tap and because a significant portion of drinking water consumption is standing water. Controlling the standing time of the water in the pipes is also important for reducing the variability in tap samples. Lead levels show a rapid increase within the first few hours of standing in the pipes and then a slower increase until the equilibrium solubility is approached (Kuch and Wagner, 1983; Schock and Wagner, 1985). Thus, controlling the standing time of the water in pipes for all sites will further decrease variability in lead and copper levels.

Several commenters were also concerned about difficulties in verifying if the samples had been standing in the pipes for 8 to 18 hours. EPA understands commenters concerns, but based on information from numerous water systems that have successfully collected first-draw tap samples from residences during the last 10 years, EPA believes that most systems can find a sufficient number of volunteers who are willing to participate and who, if properly instructed, will conform to the standing time requirement of 6 hours. The Agency anticipates that individuals willing to participate will welcome information about the quality of drinking water in their individual homes. Reduction in the standing time requirement will also help alleviate potential problems with customers conforming to the sampling requirements. EPA believes that systems will not need to shut off the customers' service to ensure a standing time of 6 hours.

Systems concerned about the overtime costs of collecting samples should consider allowing homeowners to collect samples and for utility personnel to pick up the samples outside the homes during their normal working hours. Systems using nonresidential locations can have their water utility personnel meet individuals at these locations upon their arrival at work to collect the samples. In both cases, utility personnel could collect the samples during their normal working hours and avoid the costs of overtime pay.

d. *First-Draw Samples.* The proposal would have required water systems to collect 1-liter morning first-draw and, if required, lead service line samples from the cold water kitchen tap of each residence monitored in the sampling group during each monitoring period. Several commenters suggested deleting the word morning from the definition, because it places an unnecessary restriction on the time of day that the sample can be collected. EPA agrees with these commenters and has changed the definition to first-draw sample. This allows flexibility to obtain samples either in the morning or in the evening.

Many commenters argued that EPA should not use first-draw water because it is not representative of the water consumed by individuals. EPA considered a variety, of approaches for the tap sampling protocol, including first-draw and partially flushed samples. While EPA recognizes that the levels of lead and copper in first-draw water may not be representative of the levels in all water consumed by people, the Agency decided to adopt this sampling protocol for several reasons.

First, as discussed above, EPA believes that the best measure to adequately assess the degree to which a system has minimized corrosivity for lead and copper is through measurement of firstdraw lead and copper levels at the tap over time and the correlation between these levels and the values for associated water quality parameters (e.g., calcium, pH, alkalinity). Lead and copper levels in first-draw samples are likely to be higher than in partially or fully flushed tap samples. EPA believes it is critical, however, to collect first-draw samples to better ensure that high lead and copper levels are detected if they occur and that the system institutes treatment that provides uniform and adequate levels of public health protection to all people within the system.

Second, even though there are no precise estimates of how much first-draw water is consumed by individuals, there is the potential for consumption of first draw water both in the morning and in the evenings upon returning from work or school. Moreover, the absorption of lead in drinking water is highest when taken on an empty stomach (James et al., 1985), which could very likely be the case for individuals consuming first-draw water in the morning or upon returning from work. This is of special concern for young children who absorb a much higher percentage of lead than adults and who drink more water as a body-weight basis, especially infants dependent on formula. Also, studies have documented a high correlation between first-draw water lead levels and blood lead, indicating that first draw sampling is a reasonable surrogate for peoples exposure to corrosion by-products in drinking water. Because of this, EPA believes it is prudent to assess the likelihood of this exposure when determining if action by water systems is needed. Finally, most of the data obtained by EPA with which to select appropriate action levels and estimate treatment performance is based upon first-draw sampling, making use of this sampling protocol under the rule appropriate.

The proposed rule solicited comment on whether 1 liter or 500 ml was the appropriate sample volume. In addition, the proposal requested comment on an alternative approach of collecting a 1 liter sample and then transferring the sample to a 500 ml bottle for shipment and analysis. Many commenters supported the 1 liter volume requirement, stating that it provides a better characterization of the home plumbing system, including the faucet, and because the health effects data are based on a 1 liter daily consumption by a child. Others supported reducing the sample size to 500 ml to alleviate problems both in the distribution and pickup of samples. Others supported the alternative of collecting a 1 liter tap sample but shipping a 500 ml or 125 ml sample for analysis to decrease the shipping and laboratory storage costs. Others, suggested collecting a 125 ml sample to obtain data on lead leaching

of faucets, followed immediately by a 1-liter sample.

EPA decided to retain the 1 liter sample volume because compared to a 125 or 500 ml sample, a 1 liter sample volume provides a better representation of typical drinking water consumption for an individual and a more accurate portrayal of an individuals exposure to lead and copper in drinking water. Also, a 1 liter sample represents the lead and copper contribution from not only the faucet but also from the interior plumbing of the home. This is important when evaluating the effectiveness of corrosion control because a smaller water volume would only be representative of a small portion of the household plumbing and would not indicate if corrosion control treatment was more generally effective. EPA decided not to require a 125 ml sample followed by a 1 liter sample because of concern with the added burden of collecting another sample without any demonstrated benefits. EPA decided not to allow the alternative of collecting a 1 liter sample and transferring it to a 500 ml bottle for shipment and analysis because of continued concern with lead adhering to containers and because of potential problems with errors when transferring the sample to a smaller bottle.

e. *Lead Service Line Samples.* Several commenters questioned the reliability of collecting samples from lead service connection, particularly goosenecks and pigtails, from the tap using either the temperature change method or flushing a volume of water equal to that contained in pipes leading from the tap to the service connection and collecting the next 1 liter sample. They stated that the temperature change technique is a crude method with only limited application (i.e., the method is unreliable during warmer seasons and in warmer climates; unheated or cold basements with exposed plumbing would also introduce error). Others stated that it would be impossible to accurately estimate the volume of water needed to be flushed to collect a service connection sample, especially in situations where there are only pigtails or goosenecks. Finally, other commenters stated that even though direct sampling of the connection would be more accurate, it is not feasible because it could involve digging in the street, which would be costly, or in the case of tapping, could introduce fresh lead into the connection.

EPA agrees that there may be problems in collecting service connection samples and has decided to eliminate the requirement that systems initially collect service connection samples along with first-draw samples. EPA believes that this will make sample collection easier and will allow homeowners to more easily participate in sample collection while still ensuring that systems with lead or copper problems are identified. The rule retains the requirement that homes with lead service lines be included in the targeted monitoring. Samples from these homes would have to be first flush. Data from numerous systems with lead service lines indicate that the first-draw samples are as high or higher than service line samples in the majority of systems with lead service lines (EPA, 1991b; Marcus, 1990a). For example, in Louisville, Kentucky, the 90th percentile lead level in first-draw samples was 0.013 mg/L while the 90th percentille lead level in service line samples was 0.012 mg/L. In Bennington, Vermont, the 90th percentile lead level in first-draw samples three years after installation of corrosion control treatment was 0.026 mg/L while the 90th percentile lead level in service line samples was 0.021 mg/L. In Boston, Massachusetts, the 90th percentille lead level in first-draw samples 3 years after installation of corrosion control treatment was 0.047 mg/L, while the 90th percentile lead level in service line samples was 0.038 mg/L.

Data also show that first draw samples at taps served by lead service lines are higher than those that are not served by lead service lines (see Table 10 and EPA, 1991b). Thus, it appears that contributions from lead service lines are reflected in first-draw samples. Because of this, and because first-draw sampling is logisticallly more practical, EPA is requiring that the action level for lead service line replacement be triggered based on first-draw samples. First-draw samples will provide an indication of whether lead levels are above a level of concern and whether lead service line replacement is warranted.

EPA continues to believe, however, that systems required to conduct a lead service line replacement program should collect service line samples to determine whether replacement of individual lines is required. EPA believes it is critical to accurately characterize the lead levels in individual service lines to avoid replacing lines unnecessarily and to avoid allowing lines that are above 0.015 mg/L to remain in the ground. For this reason, it is important that utilities carefully consider the most appropriate sampling approach for characterizing the lead levels in service lines. With the exception of multifamily structures, the final rule allows service line samples to be collected using any one of the methods described in the following paragraphs.

EPA acknowledges that there may be problems with collecting samples using the temperature change method, especially in situations described by commenters previously or when only goosenecks or pigtails are present. EPA continues to allow the temperature change method to be used for collecting service line samples, but systems and States should be aware of the limitations of this method (to be discussed in more detail in the corrosion control guidance manual) and act accordingly. The temperature change method is only allowed in single-family structures since EPA believes that this method can provide a fairly reliable representation of the lead service line contribution to drinking water in such structures with limited plumbing connections. In multifamily dwellings or other buildings, however, the temperature change of water is not always easy to detect and cannot be used as a reliable method to isolate lead service lines.

The Agency believes that the best method for collecting service line samples in most cases is to directly sample the service line. However, direct sampling may not be possible where there is no direct access to the line; in these situations, the other two collection methods are recommended. In addition, installation of a tap directly into the service line could disturb the pipe conditions and induce additional corrosion activity due to galvanic reactions.

EPA agrees with commenters that sampling of lead goosenecks and pigtails, where no lead service line is present, is particularly problematic. Such connections are generally two feet in length and only hold approximately 200 ml of water (in contrast to lead service lines, which average 40 feet in length and can hold much larger volumes of water). Because such a small volume of water is held in these connections, it would be difficult for tap sampling to pinpoint the contribution of lead, if any, which goosenecks and pigtails make to levels at the tap. Tapping directly into a gooseneck or pigtaill is not advisable because it could dislodge lead materials and, unlike lead service lines, there is generally not an accessible tap into the connection. In addition to the problems associated with monitoring lead contributions from goosenecks and pigtails, the Agency has not identified any data to indicate that such connections, independent of actual

lead service lines, contribute measurably to lead levels at the tap. All data discussed in previous sections regarding elevated lead levels in homes and in systems with lead service lines were from sites with actual lead lines rather than lead goosenecks or pigtails alone.

Because of these concerns, the final rule does not require monitoring or replacement of lead goosenecks and pigtails that are not used in conjunction with a lead service line. EPA does not believe that such locations would in fact reflect "high risk" sites where EPA anticipates elevated levels might be present and where monitoring should therefore take place. EPA has concluded that it would not be appropriate to require systems to replace lead goosenecks and pigtails which are not connected to, or are not used in conjunction with a lead service line because available information does not document that they contribute measurably to tap lead levels. However, where such connections are associated with a lead service line which is required to be replaced under the rule, systems will also be required to replace the gooseneck or pigtail connected to the line. EPA is concerned that failure to replace the gooseneck and pigtail in these instances would result in dislodged lead where the line is severed from the gooseneck or pigtail. Such an additional step also involves minimal additional cost to the system, since it is already replacing the service line itself.

f. *Use of Multifamily Residences.* The proposal would have allowed water systems to include apartments and other multifamily housing where such housing constitutes more than 20 percent of the housing served by the community and if these locations conformed to the targeting criteria. Several commenters supported this provision stating that including these locations may make sampling easier in locations where there are very few single-family residences.

EPA continues to believe that this provision is appropriate in areas where a large percentage (more than 20 percent) of the structures served by the system consist of multi-family housing. It is important to ascertain the exposure and effects of corrosion control on these populations where they constitute a sizable portion of the community and not simply concentrate the efforts on single-family residences.

3. Frequency and Number of Samples

The frequency and number of samples required in the proposal varied on the basis of system size. States would have been allowed to reduce the monitoring frequency and the number of samples collected during each monitoring period for systems serving more than 3,300 people that met the action levels for 4 quarters or had not departed from the operating parameters specified by the State after implementation of a State-approved treatment plan. Systems serving fewer than 3,300 people would not have been eligible for reduced monitoring. The proposal also would have phased in monitoring over several years, depending on system size. A discussion of the phased-in monitoring requirements is included in section C(1)(c), above.

After reviewing all public comments and available data, EPA has changed the dates for beginning initial monitoring, the sampling frequencies, and the number of samples collected during each monitoring period (Tables 17 and 18). The specific changes from the proposal and the rationale for the changes are explained below.

TABLE 17.—STARTING DATES FOR MONITORING

System size	Monitoring to begin no later than
>50,000	January 1, 1992.
3,301-50,000	July 1, 1992.
<3,300	July 1, 1993.

TABLE 18.—NUMBER OF SAMPLES AND FREQUENCY OF SAMPLING FOR LEAD AND COPPER [1]

Population	Initial/followup monitoring (Minimum # samples/6 months)	Reduced monitoring [2] (Minimum # samples/year or 3 years)
>100,000	100	50
10,001 to 100,000	60	30
3,301 to 10,000	40	20
501 to 3,300	20	10
101 to 500	10	5
<100	5	5

[1] Systems are not required to conduct sampling (unless required by the State) during State review of treatment, corrosion control evaluations, or installation of corrosion control or source water treatment.

[2] Systems are allowed to reduce the number of samples collected and the frequency of collecting the samples to once a year if they meet the lead and copper action levels for two consecutive 6 month monitoring periods (small- and medium-sized systems only) or if they can demonstrate that they have optimized corrosion control and are maintaining the water quality parameters established by the State under § 141.82(f) (all systems). Systems are allowed to reduce the frequency of sampling to once every 3 years if they meet the lead and copper action levels for three consecutive, 1 year monitoring periods (small- and medium-sized systems only) or if they can demonstrate that they have optimized corrosion control and are maintaining the water quality parameters established by the State under § 141.82(f) for three consecutive, 1 year monitoring periods (all systems).

a. *Frequency of Initial Tap Sampling (§ 141.86(c)).* The proposed rule would have required systems serving more than 3,300 people to collect samples from targeted sites once every 3 months (quarterly) until the system met all action levels for at least 1 year or until the system completed implementation of a State-approved treatment plan. Systems serving between 500 and 3,000 people would have been required to collect samples from each targeted site for 1 year during July, August, or September and then repeat the sampling every 2 years. Systems serving less than 500 people would have been required to collect samples from each targeted site for 1 year during July, August, or September and then repeat the sampling every 5 years.

Several commenters agreed with the proposed requirements for frequency of sampling while others stated that the sampling frequency should be changed. They suggested sampling frequencies ranging from one sample per month, to coincide with bacteria tests, to once every 5 years. Several other commenters noted that cooperation by consumers will decrease with repeated sampling. One water system stated that, based on their experience, they can get 90 percent customer cooperation for home sampling on a one-time basis, but the participation rate drops to 50 percent if they must take repeat samples, and well below 20 percent if sampling continues. Other commenters stated that the reduced frequency of sampling for small systems puts a lesser premium on the health of residences and users of these systems, relative to the larger systems.

EPA is concerned that customer participation might drop the more frequently they are asked to repeat sampling. Therefore, the final rule requires all water systems to collect initial samples from targeted sites once every 6 months (twice a year), rather than the proposed quarterly frequencies for systems serving more than 3,300 people. EPA does not believe that requiring less frequent sampling for systems serving more than 3,300 people compromises the monitoring program because the number of samples required to be collected remains the same. The difference from the proposal is that the number of sample sites has been doubled. Doubling the number of sample sites will increase the representativeness of the sampling program while ensuring that any seasonal differences in lead and copper levels are captured by the twice a year sampling. EPA also agrees that for systems serving fewer than 3,300 people, more frequent monitoring than proposed

will provide a better indication of the lead and copper problem. Therefore, the final rule increases monitoring frequencies for these size systems from annually to twice per year. Increasing the frequency of sampling for systems serving less than 3,300 people will better ensure that these systems accurately measure the lead or copper levels in their drinking water.

b. *Monitoring During and After Completion of Corrosion Control Treatment Requirements.* Several commenters argued that systems should not be required to conduct monitoring during the period in which they are installing corrosion control treatment. EPA agrees with these comments (for the reasons discussed below) and, therefore, does not require systems to collect samples once they begin performing the corrosion control treatment requirements of the rule (i.e., recommend treatment to State, State review, installation of treatment). Systems completing the corrosion control treatment requirements are allowed to cease monitoring until after the system has installed the optimal corrosion control treatment specified by the State. EPA does not believe that it would be appropriate to require systems to perform monitoring during the initial stages of researching and installing corrosion control treatment. The initial stage in corrosion control treatment for large systems and those medium-sized systems designated by the State is the completion of corrosion control studies (see § 141.82(c)). Since these studies will generally occur in the laboratory or on a pilot-plant scale, tap monitoring would not aid the system or the State in deciding the optimal treatment for that system. For those systems not required to perform corrosion control studies, the State will approve or designate treatment for the system based upon other available information, including the initial tap monitoring results and a system's proposed treatment (see § 141.82(d)). EPA believes that the monitoring data yielded by initial tap monitoring required by the rule should provide the State adequate information to approve or designate optimal corrosion control treatment in most cases. Any State that needs additional monitoring data to decide upon optimal corrosion control treatment can require the system to provide it (see § 141.86(g)).

Additionally, the Agency does not believe that it would be appropriate to require all systems to continue conducting monitoring while the system is in the process of installing the corrosion control treatment specified by the State. Experience has shown that it generally takes several months after treatment has been installed and adjusted for the lead and copper levels to stabilize. Therefore, after corrosion control treatment is installed, systems are required to conduct monitoring during two 6 month monitoring periods. In any case, some systems may find it advantageous, and States may require systems, to collect additional tap samples during the course of installing treatment in order to gauge the effectiveness of treatment.

Based upon the results of the follow-up monitoring conducted by systems, States will be reviewing the data and specifying the range of water quality parameter values that constitute optimal corrosion control treatment (see § 141.82 (f)). The rule does not require systems to continue monitoring while States are making this determination, unless required to do so by the State, since States are in the best position to determine whether additional monitoring information would be useful.

After the State designates optimal corrosion control treatment, systems are required to continue monitoring on a biannual basis (i.e., during each 6 month monitoring period beginning on the date on which the State specifies optimal water quality parameters). Systems are required to continue this monitoring until they are eligible for reduced monitoring frequency under § 141.86(d)(4).

c. *Number of Samples.* The proposal would have required water systems to collect the following number of samples: 50 per quarter (200 per year) for systems serving more than 100,000 people; 30 per quarter (120 per year) for systems serving between 10,001 and 100,000 people; 20 per quarter (80 per year) for systems serving between 3,301 to 10,000 people; 10 per year repeated every 2 years for systems serving between 501 to 3,300; and 10 per year repeated every 5 years for systems serving less than 500 people.

Many commenters stated that they would not be able to locate enough sample sites because of difficulties in gaining access to targeted high-risk homes and because consumers would either not participate or their participation would dramatically drop if asked for repeated samples. EPA believes that water systems will be able to locate a sufficient number of tap sampling sites, especially since the final rule, as discussed previously, provides greater flexibility than the proposal in the sites that are allowed to be included in the sample pool.

Some commenters suggested that a much smaller number of samples would indicate if a problem existed and that the large number of samples will require an excessive amount of time to schedule and collect and be too costly for small systems. Other commenters, however, believed that the number of sampling sites required was inadequate to accurately detect a lead problem, especially for small systems, and suggested that the number of samples required for all systems should be at least 30 samples per sampling period to ensure that the monitoring accurately reflects tap lead levels. One commenter argued that EPA needed to require more samples to ensure that the results would, based on statistical confidence limits, reliably predict whether the levels found in sampling accurately reflected the tap levels throughout the system.

Table 18, presented previously, lists the number and frequency of samples that are required. EPA understands commenters' concerns with the number of samples but believes there is a sound basis for requiring the specified numbers. There is a high degree of variability in lead levels between and within systems as well as between individual taps. As a result, a sufficient number of samples is required in order to be confident that the measured lead levels are accurately assessed. This contrasts with other contaminants where variability is relatively small, and large numbers of samples are not required.

EPA believes that the number of samples required in the final rule sufficiently accounts for the variability in lead and copper levels, and reflects system-wide contaminant level distributions. Where contaminant levels are highly variable, as with lead and copper, it is impossible to design a selective monitoring protocol that will reflect with complete confidence the levels throughout the entire system. By its very nature, requiring sampling at fewer than all households means that there may be some high levels that are not reflected by those houses sampled. Similarly, the greater the number of samples, the greater the degree to which variability among all households will be reflected. However, requiring sampling at every household is not feasible, and increasing the number of samples has costs in terms of identification of sampling sites as well as sampling and testing. The costs of monitoring for lead and copper are relatively high, compared to other drinking water contaminants (EPA is estimating that the typical sample collection costs for a lead and copper sample is $20 per sample), because the majority of

samples for lead and copper must be collected in the field. Further, some water systems may not be able to take advantage of economies of scale by pooling samples when conducting analysis, because lead and copper samples must be first-draw and as such the number of samples collected each day will be small. This limits the number of samples that can be analyzed together, thus limiting the water system's ability to decrease costs. Another concern is the limits of available analytical capacity among certified laboratories.

The requirements of the final rule seek to strike a balance between the competing needs of ensuring the representativeness of sampling results and the ensuring that the sampling requirements are reasonable and implementable by public water systems. EPA has analyzed whether the number of samples required in the final rule is sufficient and is satisfied that sufficient monitoring will be conducted to reflect, with a reasonable level of confidence, the levels throughout the system (EPA 1991g). Moreover, EPA has sought to increase the degree to which the sampling will "catch" high levels in the system by requiring sampling at high-risk sites. The number of samples required by the final rule will, in EPAs judgement, sufficiently account for variability at taps while at the same time being reasonable for systems to implement.

After considering all these factors, EPA believes that the sampling scheme developed for the final rule requires sufficient sampling to take into account the variability in lead tap levels and the cost of sampling. The total number of samples per year that systems serving more 3,300 people must collect is the same as the proposal. However, the number of sites each system must sample has doubled because, as explained above, the sampling frequency has been reduced from quarterly to once every 6 months (e.g., 200 samples are required per year (from 100 sites) for systems serving more 100,000 people).

EPA agrees that the number of samples required for small systems in the proposal would have been inadequate to accurately characterize a lead or copper problem if it existed and has increased the number of samples for systems serving between 501 and 3,300 people from 10 per year to 40 per year (20 samples during each 6 month monitoring period). In addition, the "less than 500" system size category in the proposal has been broken into two system sizes: those serving between 100 and 501 people and those serving less than 100 people. The number of samples required for systems serving from 101 to 500 people has been increased from 10 samples per year to 20 samples per year (10 samples during each 6 month monitoring period). The number of samples required for systems serving less than 100 people has remained at 10 per year (5 per 6 month monitoring period). EPA understands commenter's concerns with the potentially high costs of sampling for small systems but believes the increased number of samples is necessary to ensure that lead and copper levels are reasonably well represented. Given the relatively high degree of variability in lead levels, collection of too few samples can result in false conclusions regarding the need for treatment. Increased sampling helps increase the likelihood that the true need for treatment is accurately characterized. For most systems, collecting more samples will be far less expensive than undertaking corrosion control and/or source water treatment, which they could otherwise be required to install based on an inappropriately small sample size.

Finally, several commenters requested clarification of the procedure for collecting samples when the system has multiple treatment plants. Commenters were concerned that they would be required to collect the required number of samples for each treatment plant, which they believed would be very expensive and time consuming. The final rule requires a system to collect the specified number of samples (see Table 18) from the entire system and not from each individual treatment plant. The system should, however, collect samples from locations that are representative of the distribution system.

d. *Reduced Monitoring* (§ 141.86(d)(4)). The proposal would have allowed States the discretion to reduce the monitoring frequency for systems serving more than 3,300 people to a minimum of one sample set per year taken during July, August, or September. Systems serving more than 100,000 people would have been required to collect 50 samples during this 3 month period, systems serving between 10,001 to 100,000 people would have been required to collect 30 samples: and systems serving between 3,301 and 10,000 would have been required to collect 20 samples. Reduced monitoring would not have been allowed for systems serving fewer than 3,300 people.

Many commenters believed that the number and frequency of samples should be reduced or totally discontinued if the action levels for lead and copper are met. Other commenters believed that States should be given the flexibility to determine when to reduce monitoring for systems. Still others believed systems serving fewer than 3,300 people should be allowed to reduce the number and frequency of sampling. Several other commenters asked for clarification of the requirement to collect reduced samples during July, August, or September.

EPA agrees that water systems should be allowed to reduce the number of samples and frequency of sampling if certain conditions are met, but under no circumstances should a system be allowed to entirely discontinue sampling. The Agency believes that continued monitoring is required to ensure that low levels of lead and copper are maintained after installation of treatment. If levels of these contaminants increase, the water system as well as the consumer should be aware of this increase and take appropriate actions to remedy the problem.

Regarding the timing of reduced sampling, the proposal would have required that sampling occur during July, August, or September. This proposed requirement was based on studies that showed an increase in lead solubility at increased temperatures (Moore, 1973; Britton and Richards, 1981). The field data at the time of proposal were equivocal regarding whether lead levels were higher in the summer months compared to the winter. For example, the average tap lead levels in New Bedford, Massachusetts, were higher during January and March compared to July and August: 0.067 mg/L during January and March 1978, 0.034 mg/L during April and May 1978, and 0.035 mg/L during July and August 1978. In contrast, data from Chicago indicate that little change was seen in the average tap lead levels between the summer and winter months: 0.012 mg/L from October to December 1985, 0.009 from January to March 1986, 0.011 mg/L from April to June 1986, and 0.014 mg/L during July 1986. Data received since the proposal from Newport News, Virginia, indicate the average lead levels were slightly higher during July, August, and September than other periods: 0.016 mg/L from July to September 1988, 0.006 mg/L from October to December 1988, 0.007 mg/L from January to March 1989, 0.010 mg/L from April to June 1989, and 0.012 from July to September 1989 (Marcus, 1990a). Although the field data regarding the effects of temperature on tap lead levels are inconclusive, several studies indicate a potential increase in the solubility of lead at increased

temperatures. Therefore, the Agency has decided to retain the requirement that tap samples collected during reduced monitoring must be collected during the summer months. To help ensure that adequate time is available to collect samples during this period, EPA has decided to add June as an acceptable month for reduced monitoring. Requiring sample collection during this set time period should control some of the seasonal variability in lead and copper levels at the tap, which will allow more reliable comparisons of data from different years.

The final rule allows systems to reduce monitoring under two circumstances. First, small- and medium-size systems may reduce the frequency of monitoring if they meet the lead and copper action levels during each of two consecutive 6-month monitoring periods (see § 141.86(d)(4)(i)). EPA has modified this provision from the proposal, which would have required systems that met the action levels to request that the State reduce the required monitoring frequency. EPA received comments by the States generally arguing that the proposed rule would place too great a strain on limited State resources. Since small- and medium-sized systems meeting the action levels during a year of monitoring are believed to have optimized treatment and thereby are providing effective public health protection, the Agency believes that requiring State approval prior to reducing monitoring frequency would not be a constructive use of limited State resources.

The second instance in which systems may reduce monitoring frequency is where the system can demonstrate that it has maintained the range of water quality parameters reflecting optimal corrosion control treatment designated by the State during each of two 6 month monitoring periods (see § 141.86(d)(4)(ii)). Any system, including large systems, may reduce monitoring under this provision contingent upon State approval. EPA believes that State approval in this instance is appropriate because a system would be eligible for reduced monitoring even if it exceeds the lead or copper action level. EPA believes the State should review the request in order to ensure that the system has installed optimal treatment and that public health is being adequately protected.

Finally, § 141.86(d)(4)(iii) of the rule allows systems to further reduce the frequency of monitoring from annually to once every 3 years if the system meets the criteria discussed above during 3 consecutive years of annual monitoring. This further reduction would be allowed under the same conditions discussed above (i.e., small- or medium-sized systems that meet the action level, or any size system that maintains the optimal water quality parameters and obtains approval from the State). The Agency believes that systems that meet the action levels and/or the optimal range of water quality parameters over an extended period of time should be allowed the opportunity to further reduce monitoring frequency in order to avoid incurring unnecessary monitoring costs.

e. *Two-Stage Sampling Plan.* EPA requested comment on an alternative sampling plan based on a double sampling scheme developed by Dodge and Romig (1959). The plan used a two-tiered approach and would have required systems to first obtain a small number of samples and then, based on the outcome of the initial sampling, the systems would have been either relieved of further sampling for that monitoring period or required to obtain additional samples during that monitoring period to determine whether the system needed to take further action.

Several commenters supported the two-tiered approach, stating that it would reduce the number of samples required to be collected, while others argued that States should be given the discretion to determine whether to use the two-tiered approach or the proposed monitoring scheme. Other commenters opposed the two-tiered approach on the grounds that the number of required samples would increase for most small systems and that the small reduction in the number of samples for large systems would not be worth the complications, which would cause implementation and enforcement problems for primacy agencies and significantly increase the burden on limited State resources.

EPA agrees with the concerns expressed by commenters opposed to the two-tiered sampling scheme and, therefore, the Agency has decided not to adopt this approach in the final rule. While the two-tiered monitoring scheme may have reduced the number of samples required for some systems, the Agency does not believe it would be wise to adopt an approach that many systems and States would find too complicated to implement and enforce.

4. Monitoring for Water Quality Parameters

The proposal would have required water systems to collect the same number of pH samples at the same location and time as lead and copper samples, and would have required pH samples to be analyzed in the field by certified pH samplers. The proposal requested comment on allowing systems serving fewer than 3,300 people to collect pH samples and send them to a certified laboratory for analysis instead of performing the analysis in the field. The proposal also requested comments on the requirement that water systems meet a specific alkalinity value in their water. In addition, in an October 19, 1990, **Federal Register** notice (55 FR 42409) the Agency solicited comment on requiring water systems to measure several other water quality parameters to assist in the determination of corrosion control treatment, including calcium, conductivity, orthophosphate, and silica.

Many commenters on the 1988 proposal supported the collection of pH samples, but were concerned with the requirement that pH samples be collected at each sample site as this would preclude homeowners from assisting in the collection of lead and copper samples because of the requirement for certified pH samplers. As discussed earlier, the proposed pH action level has been eliminated along with the requirement for certified pH samplers. Systems are still required to collect pH samples (but not at sites targeted for lead and copper monitoring), as discussed below, and are required to measure pH in the field immediately upon collection of the sample for the reasons stated in section V(A)(4), above.

Several commenters on the 1988 proposal did not support an alkalinity action level but did state that alkalinity was important to consider when evaluating what corrosion control treatment to install. EPA has not included an alkalinity action level in the final rule for the reasons discussed in section IV(E)(2) of the preamble. EPA agrees with commenters that it is important to measure alkalinity to assist in determining what corrosion control treatment to install and, therefore, has included alkalinity monitoring during initial monitoring and, if a water system adjusts alkalinity as part of treatment, during subsequent monitoring.

Many commenters on the August 1988 proposal and the October 1990 notice of data availability argued that many factors influence water corrosivity and suggested that parameters, such as alkalinity and calcium, are important to consider when designing a corrosion control program. Other commenters on the October 1990 notice opposed the

requirement to collect the additional water quality parameters because this would increase sampling costs without a well-defined purpose. They suggested that the decision whether to require additional sampling should be at the discretion of the State.

EPA recognizes that many factors influence water corrosivity and because of this has decided to require all large water systems, and small and medium-sized water systems above the lead and/or copper action level, to measure for several water quality parameters, in addition to lead and copper, at each entry point to the distribution system and at taps.

EPA understands that requiring sampling of these additional parameters will increase the costs of sampling but believes this cost is small given the amount of information it will provide to water systems and States when evaluating the most appropriate corrosion control treatment to install. EPA has attempted to reduce the costs of monitoring for these parameters by not requiring small and medium-sized systems to collect any water quality parameters unless they are above the action levels. Also, water systems are required to sample for all the water quality parameters listed in § 141.87(b) only during initial monitoring. After initial monitoring, systems are only required to collect those samples that are relevant to their specific treatment.

EPA agrees that States should be given some discretion in deciding what water quality parameters are to be sampled. However, EPA believes certain parameters, such as pH, alkalinity (if adjusted as part of corrosion control), inhibitor residuals (if inhibitors are used), and calcium (if calcium carbonate stabilization is used), are critical to measure in evaluating the performance of systems and for determining compliance with the treatment requirements of the final rule.

EPA believes there are several reasons for requiring systems to measure these water quality parameters as discussed in the following paragraphs:

(1) The values for the water quality parameters will assist water systems and States in determining the most appropriate corrosion control treatment for a system. For those systems conducting corrosion control studies, the information will provide valuable insight into the corrosion control treatments to be evaluated by the system. Also, as with any study evaluating the effectiveness of alternative interventions, it is important to establish baseline values with which to compare the various alternatives. The final rule requires systems conducting corrosion control studies to evaluate the effectiveness of the existing treatment program along with several different alternative treatments. The establishment of the baseline values will assist in this process.

For those small and medium-sized water systems that exceed the lead or copper action level but are not required to conduct corrosion control studies, the measurement of these values is critical for determining what corrosion control treatment they will install. Without this information, water systems, and eventually States evaluating whether the treatment is appropriate, would have no idea of the existing water quality conditions within the system and what treatment limitations may exist.

(2) The water quality parameters are also needed to determine compliance with the final rule. After installation of optimal corrosion control treatment, States are required to designate, and systems are required to maintain, at each entry point to the distribution system: (a) a minimum value or a range of values for pH, (b) a minimum concentration or a range of concentrations for alkalinity (if alkalinity is adjusted as part of optimal corrosion control treatment), and (c) a minimum concentration or a range of concentrations for orthophosphate or silica (if a phosphate-based or silica-based inhibitor is used, respectively).

In addition, after installation of optimal corrosion control treatment, States are required to designate, and systems are required to maintain at taps: (a) A pH of 7 or greater in all tap samples collected, (b) a minimum concentration or a range of concentrations for alkalinity (if alkalinity is adjusted as part of corrosion control), (c) a minimum concentration or a range of concentrations for orthophosphate or silica that the State determines is necessary to form a passivating film on the interior walls of the pipe (if a phosphate-based or silica-based corrosion inhibitor is used), and (d) a minimum concentration or range of concentrations of calcium measured in the field (if calcium carbonate stabilization is used as part of corrosion control).

a. *Initial Monitoring for Water Quality Parameters.* All large water systems, and those small and medium-sized systems that exceed the lead or copper action level, are required to measure for pH, alkalinity, conductivity, temperature, and calcium at each entry point to the distribution system and at taps. These systems are also required to measure for orthophosphate if an inhibitor containing a phosphate compound is used and silica when an inhibitor containing a silicate compound is used. Systems are required to collect two samples from each entry point to the distribution system once every 6 months. The sample points should be representative of each source after treatment. Systems are required to collect two samples every 6 months from taps that are representative of the water quality throughout the distribution system taking into account the number of persons served, the different sources of water, and the different treatment methods employed by the system. Systems should attempt to collect the two samples as far apart in time as possible to capture any seasonal changes that may occur. The tap samples are not required to be collected from sites targeted for lead and copper sampling or from first-draw water. Water systems are encouraged to collect these samples from the same sites used for coliform sampling. These sites offer the advantage of being located throughout the distribution system and do not require water systems to find additional sites for collecting pH samples. Water systems are also encouraged to collect tap samples and entry point samples at the same approximate time within the monitoring period so that correlations can be drawn that are not distorted by seasonal effects.

EPA is requiring that pH and temperature be analyzed in the field at the time of sampling (see discussion in section V(A)(4)). The other measurements can be analyzed in the laboratory. The number of samples required for the water quality parameters are fewer than for lead and copper, given that these parameters do not vary within a distribution system to the same extent as lead and copper and therefore fewer samples are required to accurately characterize their distribution in a system (EPA, 1991b). The number of water quality parameter samples required to be collected in the field are shown in Table 19. For example, systems serving more than 100,000 people are required to locate 25 sites and collect two samples per site every 6 months.

TABLE 19.—NUMBER OF SITES AND SAMPLING FREQUENCY FOR WATER QUALITY PARAMETERS COLLECTED AT TAPS [1]

Population	Initial and followup monitoring (Minimum # sites/ Minimum # samples every 6 months)	Reduced monitoring (Minimum # sites/ Minimum # samples every year or every 3 years)
>100,000	25/50	10/20
10,001 to 100,000	10/20	7/14
3,301 to 10,000	3/6	3/6
501 to 3,300	2/4	2/4
101 to 500	1/2	1/2
≤100	1/2	1/2

[1] Water systems are required to collect different water quality parameters depending on whether it is initial or follow-up/reduced monitoring. For initial monitoring, systems are required to measure pH, alkalinity, conductivity, water temperature, calcium, orthophosphate when an inhibitor containing a phosphate compound is used, and silica when an inhibitor containing a silicate compound is used. For followup/reduced monitoring, systems are required to measure for pH and alkalinity, calcium if calcium carbonate stabilization is used as part of corrosion control, orthophosphate when an inhibitor containing a phosphate compound is used, and silica when an inhibitor containing a silicate compound is used.

EPA believes it is important that systems measure the water quality parameters from each entry point to the distribution system and at the tap as close together in time as feasible to ensure that factors, such as changes in temperature or flow rates, do not interfere with the results. The purpose of sampling at both locations is for a system and the State to have an indication of water quality changes as water travels throughout the system. If the difference in the values between the plant and the field is small, it is a good indication that the levels for the parameters are being maintained throughout the system. On the other hand, if there is a large difference in the values or if they are volatile over time, this could indicate that the system may need to adjust its treatment to stabilize water quality or maintain higher values for parameters at the treatment plant. For example, if the pH in the water entering the distribution system is 7.8 but the average pH value in the field is only 6.8, this may require a system to raise its pH or adjust the alkalinity or calcium to provide more buffered water to reduce the fluctuations in the pH levels. Also, if a phosphate-based inhibitor is being used and there is little or no detectable phosphate residual in field measurements, this may indicate that the dosage rate for the inhibitor may need to be increased or a supplemental treatment station may need to be located in those areas that have low residuals.

b. *After Installation of Corrosion Control Treatment.* All large systems and those medium and small systems continuing to exceed the action level after installation of corrosion control treatment must collect follow-up water quality samples within 36 months from the date the State designates the optimal corrosion control treatment to install. Systems installing the State-designated treatment are required to collect the following water quality parameters at taps twice every 6 months: pH and alkalinity, calcium if calcium carbonate stabilization is used as part of corrosion control, orthophosphate when an inhibitor containing a phosphate compound is used, and silica when an inhibitor containing a silicate compound is used. The number of samples and sampling frequency required to be collected are the same as for initial monitoring (see Table 19). EPA believes that these samples, in conjunction with the lead and copper samples, are necessary to determine the effectiveness of corrosion control treatment and to determine whether additional adjustments in treatment are necessary or feasible. States can require systems to measure for additional water quality parameters, such as conductivity, but the Agency believes the decision to measure these additional parameters is better made by the State on a case-by-case basis.

All systems are required to conduct biweekly measurements at each entry point to the distribution system for the following: (1) pH, (2) alkalinity concentration and a reading of the dosage rate of the chemical used to adjust alkalinity when alkalinity is adjusted, and (3) a reading of the dosage rate of the corrosion inhibitor if used, and the concentration of orthophosphate or silica (whichever is applicable). EPA believes requiring biweekly measurements is important to evaluate the fluctuations of these parameters and to assist in establishing the minimum values or range of values at each entry point that systems are required to maintain to be in compliance with the treatment technique (§ 141.82(f)). To reduce the burden of collecting daily measurements, EPA recommends that systems install a continuous pH monitoring device and dosage meters for alkalinity and inhibitors. The devices can be mounted to provide easy access and produce accurate and reliable results for an extended period of time.

c. *After State Specifies Optimal Water Quality Parameters.* All large systems, and those small and medium-sized systems still above the lead and/or copper action levels after follow-up monitoring are required to continue monitoring for lead and copper and for the same water quality parameters at the same locations and frequencies as for follow-up monitoring. EPA believes it is important for systems to continue monitoring at the same frequencies for one more year after the State designates the optimal water quality parameters (except where a small or medium-size system meets the action levels) to ensure the system is maintaining the values determined to be optimal for that system.

d. *Reduced Monitoring.* As noted above, small or medium-sized system below the lead or copper action levels are not required to monitor for other water quality parameters as long as the action levels are met and may begin reduced monitoring for lead and copper after meeting the action levels for 1 year. All other systems must continue to monitor for the same water quality parameters at each entry point to the distribution system and at taps at the same frequencies, as discussed in Section (a), previously, and in § 141.87(e) of the final rule. Water systems that maintain the range of values in the field for the water quality parameters reflecting optimal corrosion control during each of two consecutive 6-month monitoring periods after the State specifies optimal corrosion control can reduce the frequency of field sampling as specified in Table 19. Water systems can further reduce the frequency of field monitoring for the optimal water quality parameters to once every 3 years if they maintain the range of values designated by the State during 3 consecutive years of monitoring.

5. Monitoring for Lead and Copper in Source Water

The proposed rule would have required water systems to sample source water as it enters the distribution system after treatment to determine compliance with the MCLs for lead and copper. As discussed earlier, the final rule does not specify MCLs for lead and copper at the entry points to the distribution system but is still requiring water systems exceeding the lead or copper action levels measured at the tap to monitor at entry points to the distribution system. The purpose of sampling at the entry point is to assist systems in designing an overall treatment plan for reducing lead and copper levels at the tap and to assist the State in determining whether source water treatment is necessary to minimize lead and copper levels at the tap. The final rule adopts the same approach as the proposal in terms of sample location and number of samples. Changes have been made to sampling frequency requirements in order to integrate sampling timing with the

treatment technique approach contained in the final rule and to make the final monitoring requirements as consistent as possible with existing protocols for other inorganic contaminants.

The proposal would have required groundwater systems to monitor annually at each entry point to the distribution system and surface water systems to monitor quarterly at each entry point to the distribution system. To reduce the number of samples required to be collected, States would have had the discretion to identify representative wells for sampling (if there is no treatment or blending) for systems with multiple wells drawing from the same aquifer. In addition, systems would have been allowed to composite samples from up to five sources. Finally, the proposal would have allowed States the discretion to allow one additional sample to be collected within 2 weeks from the date the MCLs were exceeded.

Several commenters suggested that the monitoring frequencies were excessive and that EPA should adopt the same sampling frequencies as for other inorganics (i.e., once every 3 years for groundwater systems and annually for surface water systems). EPA agrees and has adopted these sampling frequencies, as discussed below, for those systems that are above the lead or copper action levels at the tap but are not required to install source water treatment or for those systems that have installed treatment and meet the State-specified permissible levels.

Commenters generally supported the idea of reducing the number of samples required by allowing States to identify representative wells for sampling (if there is no treatment or blending) for systems with multiple wells drawing from the same aquifer. EPA has eliminated this provision in the final rule to be consistent with the monitoring requirements for the other inorganic contaminants (§ 141.23(a)(3)). The provisions in this section allow systems that blend water from different sources to reduce the number of samples by sampling at an entry point to the distribution systems after the different sources are combined.

Commenters also supported the idea of allowing composite samples from a maximum of five sampling points. The final rule gives States the discretion to reduce the number of samples that must be analyzed by allowing compositing in the laboratory of up to five samples. However, States and systems should be aware that if the lead or copper level in the composite sample indicates that one or more of the samples is greater than or equal to the MDL for lead or copper, then each of the entry points represented in the composite sample must be resampled individually for whichever contaminant exceeded the MDL. For compositing to be allowed, the laboratory must be able to measure levels down to 0.001 mg/L for lead and 0.050 mg/L for copper.

Numerous commenters stated that EPA should allow additional samples if the initial sample is above the MCL. These commenters stated that it is unreasonable to find an entire water system in non-compliance based on one sample and that the potential for laboratory error is increased because the MCL was proposed at the PQL. Even though EPA is not promulgating MCLs for lead or copper, systems are still required to collect source water samples, and therefore the Agency believes that where results of sampling indicate an exceedance of maximum permissible source water levels established under § 141.83(b)(4), the State should be allowed to require that one additional source water sample be collected as soon as possible after the initial sample was taken (but not to exceed 2 weeks) at the same sampling point. If a State-required confirmation sample is taken for lead or copper, then the results of the initial and confirmation sample shall be averaged. In addition, States have the discretion to delete results of obvious sampling errors.

a. *Final Requirements.* The requirements regarding sample location, collection methods and the number of samples are the same as those applicable to other inorganic source water contaminants (see § 141.88(a) of the final rule, incorporating by reference the general inorganic sampling requirements of § 141.23). Systems required to collect source water samples should collect the samples at every entry point to the distribution system that is representative of each well after treatment. The system shall take each sample at the same sampling point unless conditions make another sampling point more representative of each source or treatment plant. Systems that draw water from more than one source and combine the sources before distribution must sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water is representative of all sources being used).

By making the source water monitoring consistent with existing requirements for other inorganics, the Agency has sought to minimize any confusion and keep the sampling protocols for all of the inorganic contaminants regulated by EPA as simple as possible. This approach is consistent with suggestions by commenters.

With regard to sampling frequency, the monitoring provisions in the final rule require source water monitoring under the following circumstances: (1) Initial monitoring after the system exceeds the lead or copper action level at the tap (§ 141.88(b)), (2) follow-up monitoring after the system installs source water treatment (if such treatment is required by the State) (§ 141.88(c), (3) routine monitoring after the State specifies maximum permissible source water levels (§ 141.88(d)) or if a system is above the lead or copper action level at the tap but is not required to install source water treatment, and (4) reduced monitoring frequency for systems complying with the State-specified maximum levels (§ 141.88(e)). The Agency has structured monitoring in this way to provide the system and the State with the monitoring data necessary to make the treatment determinations called for during each step in the source water treatment requirements of the final rule. The Agency believes that requiring monitoring at the specified intervals (instead of the continuous monitoring contained in the proposed rule) will provide sufficient information on source water levels to assure that drinking water systems comply with the source water treatment requirements without imposing unnecessary monitoring requirements on systems. States retain the discretion to require any additional monitoring where it deems it necessary to designate or evaluate the system's source water treatment.

i. Initial Monitoring. Initial monitoring of source water is triggered if the system exceeds the lead or copper action level in tap samples. Systems that are below the action levels are not required to conduct source water sampling. Systems above the action levels are required to collect one sample from every entry point to the distribution system and make a recommendation to the State within 6 months after the action level was exceeded. Based upon the levels of lead and/or copper found during this monitoring, the State will make the determination under § 141.83 of the rule whether installation of source water treatment is required. The Agency believes that requiring collection of additional data is not warranted since source water lead and copper levels, unlike levels at the tap due to corrosion in the distribution system, are likely to be consistent over time. In cases where the State believes that more information would be useful, it may require the

system to perform additional monitoring.

ii. Follow-up Monitoring. If the State requires a system to install source water treatment, the rule requires the system to conduct two additional rounds of monitoring after installation of treatment is completed. The Agency does not believe that it is necessary to require monitoring during the period when treatment is being installed, since the effectiveness of treatment can only be gauged after installation is completed. However, systems may wish to conduct additional monitoring if they find this would be helpful in their design and installation of treatment.

iii. Routine Monitoring. Systems that are above the lead or copper action level at the tap but are not required by the State to install source water treatment, or systems where the State has specified maximum permissible source water levels, must continue source water monitoring (as long as the action level is exceeded) in accordance with § 141.88(d)(1). This provision requires systems using only groundwater sources to conduct sampling once during a 3-year "compliance period" (i.e., the compliance period which is in effect when the State specifies maximum permissible levels or makes the determination not to require source water treatment), and requires systems using surface water (or a combination of surface and groundwater) to conduct sampling annually. This monitoring is identical to that specified by the Agency for other inorganic contaminants in the "Phase II" rulemaking promulgated on January 30, 1991, (56 FR 3526). That regulation adopted a standardized monitoring framework to synchronize monitoring schedules for all systems within a 9-year compliance cycle (the first of which begins on January 1, 1993, and ends on December 31, 2001), which consists of three, 3-year compliance periods. Including the ongoing lead and copper source water monitoring frequency within the framework established for other inorganics is consistent with many commenters' recommendation that monitoring for lead and copper be consistent with existing monitoring protocols. A system that is subject to the general inorganic monitoring frequency requirements is not required to conduct source water monitoring if it meets the lead and copper action levels at the tap during the entire source water sampling period applicable to the system (i.e., during an entire compliance period for a system using only groundwater sources, and during an entire year for all other systems). If the system exceeds the lead and copper action levels measured at the tap in some future sampling period, it is required to begin monitoring for source water again.

iv. Reduced Monitoring As with other inorganics, if appropriately low levels have been maintained over an extended period of time, the Agency believes that systems should be allowed to reduce monitoring frequency accordingly. Systems become eligible for reduced source water monitoring frequency if they maintain levels below the maximum permissible concentrations specified by the State during three consecutive compliance periods (for groundwater systems) or 3 consecutive years (for surface water systems). Systems may reduce monitoring frequency to no less than once during each 9-year compliance cycle. A water system using a new source of water is not eligible for reduced monitoring until the levels are maintained below the maximum concentrations specified by the State during three consecutive monitoring periods (i.e., 3 years for groundwater systems and three compliance periods for other systems).

6. Monitoring Requirements for Non-Transient, Non-community Water Systems

a. *Source Water.* The proposed rule would have required non-transient, noncommunity water systems (NTNCWS) to monitor source water once every 5 years to determine compliance with the MCLs for lead and copper. NTNCWS were not eligible for reduced monitoring. Several commenters agreed with the requirements in the proposal for source water monitoring, while others stated that the requirements should follow the same requirements as for community water systems. EPA agrees with these latter comments and is requiring NTNCWS to follow the same sampling requirements as those for community water systems (§ 141.88). EPA believes this change is needed to provide individuals in NTNCWS the same level of assurance as those individuals in community systems that the lead and copper levels in their source water are accurately assessed. Also, the inorganic monitoring requirements for both community and NTNCWS are identical in the "Phase II" rulemaking promulgated on January 30, 1991 (56 FR 3526). The Agency believes it is important to be as consistent as possible with the monitoring requirements for other inorganic contaminants to reduce confusion and ease implementation of the final rule. This includes the requirements for initial, followup, routine, and reduced monitoring.

b. *Corrosion By-Products.* To demonstrate compliance with the proposed treatment technique requirement, NTNCWS would have been required to monitor lead, copper, and pH at one tap annually during the months of July, August, or September in each building served by the NTNCWS. The monitored tap would have been required to be the tap most frequently used for water consumption, such as a kitchen tap. Under the proposal, NTNCWS would not have been eligible for reduced monitoring.

Many commenters stated that the monitoring requirements for NTNCWS should be the same as for a community water system. EPA agrees with these commenters. EPA believes it is important that NTNCWS accurately characterize the extent of lead or copper problems in their system and believes the sampling protocol for community systems will ensure that this is accomplished. Also, as stated above for source water, the Agency believes it is important that the final rule minimize potential confusion without compromising public health protection. Making the monitoring requirements the same for NTNCWS and community water systems simplifies the rule while insuring that the lead and copper levels are accurately characterized. The only difference between community water systems and NTNCWS is with regard to the targeting criteria for high risk sites. The criterion for NTNCWSs has two tiers instead of three because the majority of these systems are composed of buildings and not private residences.

NTNCWS are required to begin initial monitoring in accordance with Table 17 in the preamble and § 141.86(c) in the rule. The number of samples required and the frequency of sampling for NTNCS are included in Table 18 in the preamble and § 141.86(c) in the rule. Systems should, if possible, sample at no more than one tap in each building. This will prevent oversampling at a small number of buildings that may have much lower lead or copper levels compared to other buildings in the NTNCWS.

VI. Public Notification and System Reporting and Recordkeeping Requirements

A. Introduction

Under the SDWA, public water systems are required to provide public notification for lead and/or copper under two situations. The first was a special one-time notification

requirement under section 1417(a)(2) of the SDWA. Public water systems were required to identify and provide notice to persons who may be affected by lead contamination in their drinking water, when such contamination resulted from either the use of lead in the construction materials of the system and/or corrosivity of the water supply sufficient to cause lead leaching from plumbing systems. This provision required notification even if the system was in compliance with the current MCL for lead. EPA published final regulations to implement this requirement of the SDWA on October 28, 1987 (52 FR 41534). Under those regulations, systems were required to begin providing notice to consumers by June 19, 1988.

The second type of public notification informs customers of violations of NPDWRs. On October 28, 1987, (52 FR 41534) EPA promulgated regulations to revise the public notification requirements (40 CFR 14.32). These regulations specify general notification requirements, including frequency, manner, and content of notices, and require the inclusion of EPA-specified health effects information in each public notice. The new public notification requirements divide violations into two categories (Tier 1 and Tier 2) based on the seriousness of the violations, with each tier having different public notification requirements. Tier #1 violations include violations of an MCL, a treatment technique requirement, or a variance or exemption schedule. Tier I violations contain mandatory health effects language specifying concisely, in nontechnical terms, the adverse health effects that may occur as a result of the violation. States and water utilities are free to add additional information to each notice, as deemed appropriate for specific situations. Community water systems with Tier I violations must notify the public by newspaper, mail, or hand delivery. Tier 2 violations include violating a monitoring requirement, failing to comply with a testing procedure prescribed by a NPDWR, and operating under a variance or exemption. Community water systems with Tier 2 violations are required to give newspaper notice repeated quarterly by mail or hand delivery, with additional notice required at State discretion. Non-transient, non-community systems may either notify in the same manner as CWSs or post a notice continuously.

B. Comments on Proposed Public Notification Reqirements and EPA's Response

The 1988 proposal classified all violations of the lead or copper MCL or the treatment technique requirements as Tier I violations. For Tier I violations, EPA proposed specific language that water systems would be required to deliver. Many commenters objected, stating that they have already complied with the proposed public notification requirements by providing the special one-time public notification requirements pursuant to the 1986 Amendments to the Safe Drinking Water Act and that they received little or no response to the public notice. Other commenters stated they should only be required to perform the public notification for violations of the MCL or treatment technique and not the action levels. Other commenters disagreed with the content of the lead notice stating that it is overly complex and would alarm, confuse, or otherwise elicit an adverse public reaction or would undermine PWS's credibility.

EPA believes these commenters confused the special one-time lead notification program with the mandatory public notification program for Tier 1 or Tier 2 violations. The 1988 proposal was addressing only the notification requirements for Tier 1 and Tier 2 violations. The special one-time notification requirements specified under section 1417(a)(2) of the SDWA have already been completed by most systems. Reporting Tier 1 and Tier 2 violations is required for all contaminants, not just lead and copper.

Many commenters were also confused regarding what would have constituted a violation of the proposed rule. The proposal would have required Tier I public notification only if the MCL or treatment technique were violated. It would not have required notification if the action levels were exceeded.

Accordingly, the final rule requires only Tier 1 notification for violations of the treatment technique requirements and not the action levels. The failure of a system to meet any of the requirements of sections § 141.81 through § 141.85, including the failure to comply with deadlines in those sections or with any requirements established by the State under those sections, is a Tier 1 violation and would require public notification in accordance with 40 CFR 141.32.

(1) Recommend the corrosion control treatment to be installed (§ 141.82(a)).

(2) Complete corrosion control studies (all large systems and small and medium-sized systems if required by the State) (§ 141.82(c)).

(3) Install State-designated corrosion control treatment (§ 141.82(e)).

(4) Maintain the State-designated water quality control parameters after installation of corrosion control treatment (§ 141.82(f)).

(5) Recommend the source water treatment to be installed (§ 141.83(b)(1)).

(6) Install source water treatment, if required, (§ 141.83(b)(3)).

(7) Maintain the maximum permissible levels in source water (§ 141.83(b)(5)).

(8) Deliver a public education program, if required (§ 141.85).

(9) Implement a lead service line replacement program, if required (§ 141.84).

Failure to comply with the testing procedures and monitoring requirements in § 141.86, § 141.87, § 141.88, and § 141.89, are classified as Tier 2 violations. Violations of the reporting requirements (§§ 141.90 and 141.91) do not require public notification (52 FR 41534, October 28, 1987). All of the requirements of § 141.32 (the general public notification requirements, including the manner and frequency of notification) apply to violations of this final rule. The mandatory language to be included in the public notices for violations of the requirements of the lead and copper rule is specified in § 141.32.

Finally, many commenters were concerned that the content of the lead notice would alarm people and was overly complex. EPA agrees that the lead notification should not unduly alarm people, but believes that people should be aware of the potential health effects from lead. The Agency believes the language in the lead notice accurately portrays the health effects from lead, but has changed the lead notice from the proposal slightly by simplifying the language, deleting the reference to the MCL and adding information on the requirement to remove lead service lines.

C. System Reporting and Recordkeeping Requirements

The proposed rule would have required public water systems to maintain and report to the State the following information: (1) Results of all monitoring within 10 days from the end of each calendar quarter or year, whichever was applicable; (2) identification and location of sampling sites and the rationale for choosing the site; (3) progress in completing the treatment plan; (4) progress in completing the public education program; and (5) any other records, reports, or information as the Administrator deems necessary.

There were no substantial comments on the system reporting or recordkeeping requirements; therefore, the substance of the reporting and

recordkeeping requirements have not changed significantly. They have been modified in accord with the changes that have been made to the treatment section of the final rule, and are presented in greater detail to minimize confusion on the precise requirements. EPA has attempted to limit the required reporting to States to only information necessary in determining whether water systems are complying with the final rule.

1. System Reporting Requirements

The reporting requirements for all public water systems are specified in § 141.90 of the final rule. These reports are designed to document compliance with the treatment and monitoring requirements in § 141.81–141.89.

a. *Tap Monitoring.* The proposed rule would have required water systems serving more than 500 persons to report to the State the results of all required monitoring within 10 days of the end of each calendar quarter the system is in operation. Systems serving 500 or fewer persons would have been required to report the results of monitoring to the State within 10 days of the end of each calendar year. The proposal would have also required all systems to certify that the information submitted was accurate.

The final rule continues to require systems to report all the monitoring results within 10 days following the end of each applicable monitoring period, whether this is every 6 months, every year, or every 3 years. Systems are also required to calculate and report the 90th percentile lead and copper levels. The procedure for calculating the 90th percentile is included in section 141.80(c) of the rule. Reporting the 90th percentile levels will relieve the States from the burden of calculating these values from the large volume of monitoring data that will be reported and will consequently provide the States with the information regarding whether a system exceeds the action levels. In addition, the final rule requires systems to certify that each tap sample is 1 liter in volume and, to the best of their knowledge, has stood motionless in the service line or in the interior plumbing of a site for at least 6 hours. If residents collected samples, the water system must certify that they have informed those residents of the required sample collection procedures.

The Agency included these certification requirements to help ensure use of the proper sampling protocol contained in section 141.86 of the final rule. Where a system allows customers to perform tap sampling, the system obviously cannot certify as to the actual circumstances of the customer sampling. However, the Agency believes it is important to ensure that the systems inform customers of the proper sampling methods. Therefore, the rule requires systems to certify that they have provided this information to all customers performing such sampling. As discussed previously (Section V(C)(2)), systems choosing to allow customers to perform sampling cannot challenge the sampling results based upon alleged errors by the customer in taking the samples. This provision will encourage systems to ensure the customer sampling is performed accurately and provide finality to sampling results in cases where the system has chosen to allow customers to perform the sampling.

The proposed rule would have required systems to report the identification and location of sampling sites, the first time the site is sampled, and the rationale for choosing the site. The final rule (§ 141.90(a)(1)(i)) adopts the same approach and requires all water systems to submit, along with the sampling results, the locations of each sampling site and the required criteria under which the site was selected. Any time the system samples a new location that has not been sampled previously, the system must designate the new site and explain why the sampling site has changed (e.g., inability to gain access to a previously sampled site).

The proposed rule would have also required water systems that could not identify a sufficient number of residences with the specified targeting criteria to submit a report documenting that lead pipe was never used or had been replaced and/or demonstrating that the community had effectively implemented and enforced for a minimum of 5 years a ban on lead solder or that no lead solder was ever used in the construction of residences. The final rule contains essentially the same provisions as the proposed rule in this respect.

Section 141.90(a)(2)–(4) requires community and non-transient, non-community water systems that have to select sampling sites for their targeted sampling pool from Tier 2 or Tier 3 sampling sites, to justify their selection. Valid reasons can include those which were contained in the proposed rule (e.g., that lead pipe was never used in the system and/or the lead solder ban has been effectively enforced for a minimum of 5 years, or that lead solder was never used). The final rule does not explicitly enumerate these bases because the Agency determined it was nearly impossible to identify every possible reason why a system could not collect a sufficient number of samples from Tier 1 or 2 sites.

Because systems are now required to measure certain water quality parameters, the final rule requires them to report the results of all tap samples for pH, alkalinity, and, where applicable, calcium, orthophosphate or silica, temperature, and conductivity within the first 10 days following the end of each applicable monitoring period. Systems are also required to report the results from all water quality samples collected at the entry points to the distribution system.

b. *Corrosion Control Treatment.* The proposed rule would have required systems to report their progress in completing the steps in the State-approved treatment plan. The corrosion control treatment requirements in the final rule are structured differently than the proposal, as explained earlier, and the final reporting requirements reflect the final treatment requirements. There are four major corrosion control reporting requirements for systems.

First, systems attempting to demonstrate that they have already optimized corrosion control and are therefore not required to complete the corrosion control steps in the rule must submit the information contained in § 141.81(b) (2) or (3), systems required to optimize corrosion control treatment must submit their recommendation regarding the treatment that they propose to install. Third, systems required to conduct corrosion control studies must submit the information required under § 141.82(c) (the required information is discussed in section IV(E)(2)(d) of the preamble). Fourth, systems are required to submit a letter certifying that the system has installed the State-designated corrosion control treatment.

c. *Source Water Monitoring for Lead and Copper.* The proposal would have required systems to report all source water monitoring results within 10 days after sampling was completed. The final rule adopts the same requirement. In addition, systems must report to the State if a source water sampling point has changed and the reasons for the change.

d. *Source Water Treatment for Lead and Copper.* The proposed rule did not have any reporting requirements for source water treatment. Because the final rule does not include MCLs for source water, it is necessary to include some reporting requirements to ensure that source water treatment, if required, is installed and maintained properly. There are two source water treatment reporting requirements for systems.

First, all water systems exceeding the lead or copper action level are required

to recommend in writing the source water treatment, if any, they will install and operate. Second, systems required to install source water treatment are required to submit to the State a letter certifying that the system has properly installed and is operating the State-designated source water treatment.

e. *Lead Service Line Replacement.* The proposed rule did not contain any specific reporting requirements for lead service line replacement, but the preamble generally discussed the requirements of such a program. The final rule expands on these reporting requirements. A system is required to report the following information within 12 months after it exceeds the lead action level and every 12 months thereafter for Items 3 and 4 below:

(1) Demonstration in writing that it has identified the initial number of lead service lines in its distribution system at the time the replacement program begins.

(2) A schedule for replacing annually at least 7 percent of the initial number of lead service lines in its distribution system.

(3) Demonstration that it has replaced at least 7 percent of the initial number of lead service lines during the previous year in its distribution system.

(4) Demonstration that the individual lines not replaced have lead levels in the line of less than or equal to 0.015 mg/L.

The annual letter submitted to the State shall contain the following information:

(1) The number of lead service lines scheduled to be replaced during the previous year of the system's replacement schedule.

(2) The number and location of each lead service line replaced during the previous year.

(3) If measured, the water lead concentration measured and location for each lead service line sampled.

(4) The collection methods used to collect each sample.

(5) The date on which each lead service line sample was collected.

Systems that are not replacing the entire lead service line are required to describe to the State in writing the specific legal authority under which the water system claims that the lead service lines or portions of the lead service lines are beyond its control. This must be submitted to the State within 3 months after it exceeds the lead action level.

f. *Public Education.* The proposed rule would have required systems operating under an approved public education program to detail the system's progress in completing the public education requirements (content, delivery, evaluation). The report was to include data indicating that as a result of the public education program, the user's knowledge about lead in drinking water enabled them to alter voluntarily their water use patterns to reduce consumption of lead-contaminated water. This information was to be collected during the evaluation stage of public education. Since the final rule does not require systems to either develop the content or evaluate the public education program, as discussed in section IV(G), the requirements to detail systems' progress in regard to the content and the evaluation of the public education program are not relevant.

The final rule does require water systems to submit a letter to the State by December 31st of each year demonstrating that the system has delivered the public education materials that meet the content and delivery requirements, as long as the system exceeds the lead action level. This list should include a list of all the newspapers, radio stations, television stations, and facilities and organizations to which the system delivered public education materials during the previous year.

2. Recordkeeping Reqirements for Systems

The proposed rule required systems to maintain records of all information submitted to the State. The final rule also requires systems to retain for 12 years all sampling data and analyses, reports, surveys, letters, evaluations, schedules, State determinations, and any other information required by the rule.

VII. Variances and Exemptions

Under the Safe Drinking Water Act, States with primacy have authority to grant variances and exemptions from treatment technique requirements.

A. Variances and Exemptions From MCLs

Since the final rule does not establish an MCL for lead or copper, the rule and preamble do not address variances and exemptions from MCLs.

B. Variances From the Treatment Technique

Variances from treatment techniques may be granted to water systems that demonstrate to the State that treatment is not necessary to protect public health because of the nature of the raw water sources available to the system. Section 1415(a)(1)(B). In addition, the Administrator of EPA may grant variances from a treatment technique upon a showing that an alternative treatment technique is as effective at reducing contaminant levels as the one promulgated by EPA. Section 1415(c)(3). The proposed rule would have allowed water systems to obtain a variance from the treatment technique requirements from the States under section 1415(a)(1)(B) if they could demonstrate that no plumbing materials containing lead had been used in the construction of any homes in the community or in any distribution facilities. Examples of these circumstances include new residential developments exclusively using plastic plumbing. EPA asked for comments on other conditions under which variances from the treatment technique might be appropriate.

Commenters generally agreed that systems should be given variances from the treatment technique if they could demonstrate that their system is lead-free. After further consideration, EPA continues to believe that because of the design of the final rule, the need for variances will be rare, and the only case where a variance from a treatment technique may be appropriate is when a system can demonstrate it is "lead-free." The Agency anticipates that few systems, however, would be able to make this demonstration, because even systems with plastic plumbing still use brass faucets, which can leach significant amounts of lead (Schock and Wagner, 1985; Schock and Neff, 1988; Gardels and Sorg, 1989; AWWSC, 1989). As discussed earlier, EPA is working to further restrict use of lead solder and to limit the amount of lead leached from fixtures and faucets, and prevent the introduction of new lead into the system. As these restrictions become effective, it may enable more systems to qualify for variances based on the lead-free demonstration. Some systems, such as newly created water systems, trailer parks or other small developments, as well as new facilities that treat their own water (e.g., factories, schools, hotels, recreation complexes) could be deemed by the State to be "lead-free." In any case, States continue to have the discretion under the SDWA to grant variances from the treatment technique.

Commenters suggested additional situations that they contended would warrant variances, including small systems subject to financial hardship, and variances from additional monitoring or treatment requirements if the action levels are met.

EPA believes many commenters were confused regarding the statutory standard for variances from treatment techniques as compared to exemptions from treatment techniques. The SDWA

does not allow variances for financial hardship, but instead provides water systems with the opportunity to apply for an exemption based on economic factors.

EPA disagrees that water systems should be allowed to receive a variance from monitoring if they meet the action levels. Systems are allowed to reduce the number of samples and frequency of sampling if they meet the action levels or can demonstrate that they have installed optimal corrosion control, but EPA does not believe it would be appropriate to allow systems to completely discontinue sampling. Because of seasonal effects or changes in other water treatment processes, corrosion control often requires adjustment to maintain stable performance. Variability in conditions could also cause a system that meets the action levels during one round of monitoring to subsequently exceed them. Continued monitoring is necessary to help systems maintain optimal corrosion control and to ensure that if a system subsequently exceeds the action level, corrective action is taken.

C. Exemptions From the Treatment Technique

Under section 1416(a), a State or EPA may grant an exemption extending deadlines for compliance with a treatment technique if it finds that (1) due to compelling factors (which may include economic factors), the water system is unable to comply with the requirement; (2) the exemption will not result in an unreasonable risk to human health; and (3) no reasonable alternative source of drinking water is available to the new system. A system granted an exemption may receive up to 3 years to install the required treatment technique if the system makes certain showings. Sections 1416(b)(2) (A) and (B). Systems with fewer than 500 service connections may obtain renewable 2 year extensions under certain conditions. Section 1416(b)(2)(C). As with variances, exemptions must include a compliance schedule and requirements for implementing necessary interim control measures.

In determining whether to grant an exemption, EPA expects the State to determine whether the facility could be consolidated with another system or whether an alternative source could be developed. Another compelling factor is the affordability of the required treatments. It is possible that very small systems may not be able to consolidate or find a low-cost treatment. EPA anticipates that States may wish to consider granting an exemption when the requisite treatment is not affordable.

Under section 1416(c)(3), States may not grant an exemption from the treatment technique if it will result in an unreasonable risk to health (URTH). The States determine the URTH level. EPA published a **Federal Register** notice on October 2, 1990, (55 FR 41205) requesting comment on "Guidance in Developing Health Criteria for Determining Unreasonable Risks to Health" (EPA, 1990n).

D. Point-of-Use (POU) and Point-of-Entry (POE) Devices and Bottled Water

The proposed rule would have given States discretion to allow the use of POU devices or bottled water to avoid an unreasonable risk to health, as a condition of receiving a variance or exemption from an MCL or treatment technique. Public water systems that used bottled water or POU devices as a condition of obtaining a variance or exemption would have been required to meet the requirements similar to those set out in § 142.62(g) and § 142.62(h), respectively. Several commenters supported the concept of allowing POU devices or bottled water as a means to avoid an unreasonable risk to health, but believed the requirements were so restrictive as to preclude the use of these methods.

Since the final rule does not contain an MCL, the use of POU/POE devices and bottled water as a condition for receiving a variance or exemption from an MCL is no longer relevant. With regard to the treatment technique contained in the final rule, EPA continues to believe that centralized corrosion control and/or source water treatment should be the primary means of reducing lead or copper levels, since these treatments most effectively reduce contaminant levels throughout the water system. EPA continues to believe, however, that States should have the discretion to require the use of POU/POE devices or bottled water, in appropriate circumstances, as a means of preventing an unreasonable risk to health through the granting of an exemption from the treatment technique.

The proposed rule would not have allowed the use of POE devices as a method to achieve compliance with the proposed rule because it was thought that (a) they do not prevent lead or copper from entering the water after it leaves the device; and (b) several of the treatment devices (reverse osmosis or ion exchange) can make water more corrosive, potentially resulting in higher lead levels at the tap.

EPA received a comment that asserted that POE devices should be allowed in certain circumstances such as where contamination enters drinking water before the device (i.e., through source water or lead materials within the public water system's distribution system). EPA agrees and have changed the final rule to allow the use of POE devices as a condition for granting an exemption from the requirements for lead and copper in source water (§ 141.83) and lead service line replacement (§ 141.84). However, POE devices are not allowed in granting an exemption from the requirements in § 141.81 and § 141.82 because POE devices do not prevent lead or copper from entering the water as a result of corrosion of plumbing inside the building (i.e., after the device, which is installed at the entry point of the building). EPA remains concerned, however, that such devices could increase corrosion of materials inside buildings and has therefore included an additional provision in the rule that requires States to be assured that use of the device will not cause increased corrosion in buildings and thereby increase tap levels.

EPA does not believe that it would be appropriate for States to grant exemptions from the public education component of the treatment technique, since it is extremely important that the public get this information so that they can take appropriate measures to reduce their exposure if the system exceeds the action level. Moreover, EPA cannot envision why a system would be unable to comply with these requirements, the cost of which are small, and as a result be eligible for an exemption under the statutory standard in § 1416(a).

The use of bottled water may be especially relevant for very small systems (i.e., systems with less than 500 connections), where extensions may be granted for one or more 2-year periods and where bottled water or POU/POE devices protecting all users might be practicable. Public water systems that use bottled water or POU devices as a condition of obtaining an exemption are required to meet the requirements set out in § 142.62(f) and § 141.62(g). Public water systems that use POE devices as a condition for obtaining an exemption from the requirements in § 141.83 or § 141.84 are required to meet the requirements set out in § 141.62(h). EPA does not agree with some commenters who argued that the conditions for using bottled water and POU/POE devices are overly restrictive. The requirements in § 142.62(f) and § 141.62(g) are intended to ensure that use of these alternatives will continue to protect public health and to provide water of equivalent quality to that would be provided by a

traditional well-operated central treatment facility.

VIII. State Implementation (40 CFR Part 142)

Section 1413 of the Safe Drinking Water Act establishes requirements that a State must meet to have primary enforcement responsibility for public water systems ("primacy"). These include (1) adopting drinking water regulations no less stringent than the NPDWRs in effect under sections 1412(a) and 1412(b) of the Act; (2) adopting and implementing adequate procedures for enforcement; (3) keeping records and making reports available with respect to its activities as EPA may require by regulation; (4) issuing variances and exemptions (if allowed at all by the State) under conditions no less stringent than allowed by sections 1415 and 1416; and (5) adopting and being capable of implementing an adequate plan for the provision of safe drinking water under emergency situations.

40 CFR part 142 sets out the specific program implementation requirements for States to obtain primacy for the public water supply supervision (PWSS) program, as authorized under Section 1413 of the SDWA. Fifty-four out of 57 jurisdictions have applied for and received primary enforcement responsibility for this program. On December 20, 1989, EPA promulgated revisions to 40 CFR part 142 (54 FR 52126). The revisions established procedures and deadlines for: State submission of program changes; EPA review and approval or disapproval of State program changes; and the actions to be taken if States with primacy do not adopt new requirements pursuant to the schedule identified in the rule. The revision also changed the frequency of some State reporting requirements from annually to quarterly.

In addition to adopting the basic primacy requirements, States may be required to adopt special primacy provisions pertaining to a specific regulation. These regulation-specific provisions may be necessary where implementation of the NPDWR involves activities beyond those in the generic rule. States are required to include these regulation-specific provisions in an application for approval of their program revisions. The revisions to the State primacy requirements discussed in the December 20, 1989, notice apply to the final lead and copper rule, along with the special primacy requirements outlined below.

A. State Recordkeeping Requirements (§ 142.14)

The proposal would have required States to retain records of the following:

(1) Analytical results of tests, measurements and analyses to determine compliance, set forth in a form facilitating comparison with applicable operating parameters for source water treatment and corrosion control.

(2) Any State approvals, including approvals of treatment plans and the reasons for the treatment plans.

(3) Systems that have reduced their monitoring frequency for compliance with the MCLs and/or action levels.

(4) Systems required to increase the frequency of their monitoring and the new frequency of that monitoring.

(5) Determinations that systems have minimized the corrosivity of their water and the evidence supporting this determination, and the final approved operating parameters.

(6) Evaluations of public education programs and of any determination that a system is required to modify its public education program.

The majority of commenters recommended that the recordkeeping requirements be substantially reduced or eliminated. EPA disagrees. The Agency believes that the recordkeeping requirements in the proposal are essential for an effective State program and to facilitate effective Federal overview of State programs. The records document the progress of systems in complying with the rule and document the State determinations that are crucial for the effective implementation of the final rule. The recordkeeping requirements have been changed slightly to conform to the changes to the proposed part 141 requirements. Specifically, the final rule requires States to retain records of the most recent decision, determination, or designation that they have issued for the following:

(1) Records of the currently applicable or most recent State decisions, including all supporting information and an explanation of the technical basis for each decision, made under the following provisions of 40 CFR part 141, subpart I for the control of lead and copper.

Section 141.82(b)—Decisions to require water systems to conduct corrosion control treatment studies.

—Section 141.82(d)—Designation of optimal corrosion control treatment.

—Section 141.82(f)— Designation of optimal water quality parameters.

—Section 141.82(h)—Decisions to modify a public water system's optimal corrosion control treatment or water quality parameters.

—Section 141.83(b)(2)—Determinations of source water treatment;

—Section 141.83(b)(4)—Designations of maximum permissible lead and copper concentrations in source water.

—Section 141.84(e)—Determinations that a system does not control the entire lead service line.

—Section 141.84(f)—Determinations establishing a shorter lead service line replacement schedule than required by § 141.84.

(2) Records of reports and any other information submitted by water systems under § 141.90.

(3) Records of State activities and the results verifying compliance with State determinations issued under §§ 141.82(f), 141.82(h), 141.83(b)(2), and 141.83(b)(4) and compliance with lead service line replacement schedules under § 141.84.

(4) Records of each system's currently applicable or most recently designated monitoring requirements. States are required to maintain the records in §§ 142.14(d)(8)(i) through 142.14(d)(8)(viii) until a new decision, determination, or designation has been issued.

EPA believes that it is important to retain records of the most recent monitoring results, because monitoring results are essential to Federal overview functions, such as onsite program management audits and data management verification efforts. The requirements that States provide documentation on the technical basis for each determination is essential to assist EPA compliance tracking systems and in coordinating technical assistance to States.

States are required to keep all records and reports and any other information submitted by public water systems pursuant to § 141.90 along with records of State activities to verify compliance with the water quality parameters issued under §§ 141.82(f), 141.82(h), 141.83(b)(2), and 141.83(b)(4) and compliance with lead service line replacement schedules under § 141.84. These records are also essential to Federal overview and verification of State program compliance status reports. Finally, the rule deletes the requirement to maintain records of State evaluations of public education programs, because a record of program violations, including violations of public education requirements, is the only aspect of public education needed by EPA in its overview role and that is

addressed in the generic violations reporting requirements.

B. State Reporting Requirements (§ 142.15)

The proposal would have added to basic State reporting requirements under the primacy rule (54 FR 52126) special requirements to provide quarterly lists of systems that:

(1) Were allowed to reduce their monitoring frequency.

(2) Were required to increase their monitoring frequency.

(3) Have demonstrated to the State that an insufficient number of residences were available for tap sampling.

(4) Exceeded one or more action level(s) and the level(s) exceeded.

(5) Received State approval for a corrosion control treatment plan, or have received a treatment plan from the State.

(6) Successfully demonstrated that they have minimized the corrosivity of their water and the new operating parameters with which the system must comply.

(7) Results of any evaluations of public education programs.

The majority of commenters claimed that the number of reports to be sent to EPA was excessive and should be either reduced or eliminated. One commenter suggested that the list of reports should be reduced to systems exceeding an action level and systems that have minimized corrosivity of their water.

EPA's role in State program oversight is to assure that States are generally managing their primacy responsibilities effectively. The overview process entails periodic reporting by States of basic program information and annual onsite management audits of State performance. The general primacy reporting provisions apply to all NPDWRs and include requirements to report violations of NPDWRs, enforcement actions against those violations, the issuance of variances and exemptions and a periodic summary of their status, and changes to the State inventory of public water systems. The program management audits include reviewing a sample of State case files and interviews with program managers and operations personnel at all levels. Information is obtained during these annual audits, which might otherwise need to be reported.

After reviewing its information needs and in response to public comments, EPA has determined that, except for several reporting requirements discussed below, the basic reporting requirements of the primacy rule (54 FR 52126) and program management audits summarized previously are generally sufficient for purposes of routine program oversight. Accordingly, the Agency has deleted the first, second, and third reporting requirements described above, but has retained the remainder of the requirements from the proposal, though slightly modified, along with additional reporting requirements to conform to the changes in the Section 141 requirements from the proposal. The first reporting requirement is not necessary because the final rule establishes the minimum monitoring frequencies for systems conducting reduced monitoring. The second reporting requirement is not needed because the only situation that would have required increased monitoring under the proposed rule was when systems violated an MCL. Since the MCLs have been eliminated in the final rule, the need for this requirement is no longer necessary. The third reporting requirement is not needed because this information can be obtained during annual onsite audits of State programs. Finally, EPA has dropped the requirement for the State to report the results of evaluations of public education programs because the final rule does not include a requirement for systems to evaluate the effectiveness of such a program, for the reasons discussed in Section IV(G)(3).

States are required to report quarterly, through the Federal Reporting Data System (FRDS), the name and PWS identification number of each public water system:

(1) That exceeds the lead and copper action levels and the date upon which the exceedance occurred.

(2) That is required to complete the corrosion control evaluations specified in § 141.82(c) and the date the State received the results of the evaluations from each system.

(3) For which the State has designated optimal corrosion control treatment, the date of the determination, and each system that has completed installation of treatment.

(4) For which the State has designated optimal water quality parameters as required in § 141.82(f) and the date of the determination.

(5) For which the State has required to install source water treatment under § 141.83(b)(2), the date of the determination, and each system that has completed installation of treatment.

(6) For which the State has specified maximum permissible source water levels under § 141.83(b)(4).

(7) That is required to begin replacing their lead service lines as specified in § 141.84 and the systems that reported compliance with their replacement schedule under § 141.90(e)(2).

Because the success of this rule depends largely on the States' timely review and approval of corrosion control and/or source water treatment and operating parameters for systems, it is important for EPA to know when the State is having problems meeting the time frames for issuing those decisions. The purpose of these seven special reports is to provide timely tracking of corrosion control implementation by identifying, at each step of the treatment implementation process, which systems have met the implementation deadlines. Without these special reports, EPA would be unable to routinely track the rule's implementation.

C. Special State Primacy Requirements (§ 142.16)

The proposed rule would have required State program revision applications to contain the text of the State statute or regulation describing the procedures and criteria each State would use to:

(1) Determine the increased monitoring frequency with which a system must monitor, including the frequency after a system has exceeded the lead or copper MCL, and to include a procedure for notifying the system of the new monitoring requirements.

(2) Specify the elements that must be included in a materials evaluation to identify monitoring locations and specify how a system can demonstrate to the State that sufficient residences with the required characteristics for monitoring are not available.

(3) Evaluate treatment plans submitted by systems serving more than 3,300 persons to develop treatment plans for small systems (serving fewer than 3,300 persons), to approve treatment plans, and to evaluate treatment and public education performed by systems under the treatment plans.

(4) Determine that corrosivity has been minimized if the system is still not meeting the action levels after installing or improving treatment and a method of informing the system of its new approved operating parameters.

(5) Evaluate data submitted by a system on the effectiveness of its public education program and to determine whether the system must modify subsequent public education efforts.

(6) Provide PWSs serving 3,300 or fewer persons with treatment plans.

Section 142.19(c)(1) of the proposed rule was incorrect. The Section should have read "* * * determining increased monitoring frequency (in accordance with § 141.86(c)(6) of this chapter)

* * *" instead of "* * * determining increased monitoring frequency (in accordance with § 141.86(c)(4) and/or § 141.86(d)(4) of this chapter)." Section 141.86(c)(4) of the proposal pertained to reduced monitoring frequency if no violation of the MCL had occurred within the last 2 years, whereas § 141.86(c)(6) dealt with systems performing increased monitoring if they were in violation of the MCL. EPA's intention was to require States to have procedures or criteria for determining the increased monitoring frequency required of systems violating the MCLs because they were given flexibility to establish these frequencies. The Agency did not believe it was necessary to require States to have criteria or procedures for determining reduced monitoring as EPA established the monitoring frequencies that States, at a minimum, must follow. In addition, § 141.86(d)(4) of the proposed rule addressed reduced monitoring from the treatment technique portion of the rule. Again, the Agency did not believe it was necessary that the criteria or procedures for reducing monitoring were necessary because the rule established the minimum frequencies that systems must monitor for reduced monitoring.

Several commenters objected to requiring States to include specific procedures and criteria in statutes or rules. They proposed that States incorporate the procedures and criteria in guidance, which could still be approved by EPA. Other commenters stated that the special primacy requirements, in combination with the proposed primacy rule (now final), would be overly burdensome and impractical.

EPA agrees with commenters that it would impose unnecessary administrative burdens on States to require that criteria and procedures submitted with the primacy application be in the form of State statutes and/or regulations. The purpose of the special primacy requirements in § 142.16 of the final rule is to ensure that States implement the treatment technique requirements consistent with the requirements of the rule. EPA can exercise this oversight function equally effectively if the State's criteria and procedures are in the form of guidance as opposed to regulatory or statutory provisions. The Agency plans to review State submissions to ensure that they properly follow the requirements of the regulation. If a State subsequently fails to implement its program in accordance with the criteria and procedures upon which the Agency approved primacy to implement the lead and copper rule, then the Agency can take appropriate action under its primacy regulations. Requiring States to adopt criteria and procedures by statute and regulation, therefore, would not advance the effectiveness of EPA oversight, while it would impose substantial additional burden upon States to obtain approval of authority to administer the lead and copper rule. Finally, for States that have not obtained primacy (Wyoming, Indiana), the Agency plans to make case-by-case treatment determinations based upon the regulatory provisions of part 141 as well as guidance documents discussed in section (IV)(E). Since the Agency will not be adopting criteria and procedures for implementing this rule in the form of regulations, the Agency does not believe that it is necessary or appropriate to require States to do so.

EPA has modified the special primacy requirements based on public comments and to conform to the changes in Part 141 from the proposed rule. The rule eliminates the proposed requirements for States to specify the procedures and criteria to determine the frequency with which a system must monitor after a system has exceeded the MCL, because the final rule does not include an MCL. EPA has also deleted the requirement for States to describe the elements of a materials evaluation and the method by which systems must demonstrate an insufficient number of residences with the required characteristics for monitoring, because the rule provides sufficient specification for water systems on the criteria to be followed in locating appropriate monitoring sites and the procedures for demonstrating why they are unable to locate a sufficient number of Tier 1 targeted sites. Finally, because the final rule does not include a requirement for systems to evaluate the effectiveness of their public education program, EPA has dropped the requirement that States provide procedures and criteria for evaluating data submitted by systems on the effectiveness of public education and determining if the system must modify subsequent public education efforts.

EPA believes that some special primacy requirements are needed to ensure the effectiveness of State programs. These requirements are especially important for lead and copper, since States are given discretion to make system-specific determinations regarding corrosion control and source water treatment. Therefore, the other requirements in the proposal have been retained, though slightly modified, to conform to the changes that have been made to Part 141 requirements in the proposal.

An application for approval of a State's program revisions must include a description of how the State will accomplish the following program requirements:

(1) Sections 141.82(d), 141.82(f), and 141.82(h)—Designating optimal corrosion control treatments, optimal water quality parameters, and modifications.

(2) Sections 141.83(b)(2) and 141.83(b)(4)—Designating source water treatments, maximum permissible source water concentrations of lead and copper, and modifications.

(3) Section 141.90(e)—Verifying compliance with lead service line replacement schedules and the water systems' demonstrations of limited control over lead service lines.

These procedures and criteria are methods of program implementation, which apply directly to the State, and are not enforceable provisions of the NPDWR. They represent conditions of State primacy, upon approval by EPA.

D. EPA Review of State Determinations (§ 142.19)

An October 19, 1990, **Federal Register** notice (55 FR 42409) requested comment on a procedure that would have given EPA the authority to review State determinations of what constitutes optimal corrosion control and source water treatment under limited circumstances. EPA Regional Administrators would have been authorized to rescind State treatment determinations and issue new or revised determinations with which the system must comply where (1) a State had failed to specify treatment requirements by deadlines specified in the regulation, (2) the Regional Administrator determined that a State had seriously abused its discretion in a substantial number of cases or in cases affecting a substantial population, or (3) EPA concluded that the technical aspects of a State's determination would be indefensible in an expected Federal enforcement action taken against a system. In each case, the Regional Administrator would have been required to provide an opportunity for the State, the affected system(s), and the public to review and comment upon EPA's proposed decision. EPA would have exercised this authority only where a State could not demonstrate that its determination(s) is(are) reasonable, based upon the provisions of the approved State program.

Commenters raised several objections to this proposal including the following (1) the provision would encourage EPA Regional Offices to become involved in activities that are part of State primacy,

(2) State resources would be diverted from program implementation to respond to EPA rescission notices, (3) the provision would put a burden of proof on States to defend their decisions against a subjective standard of reasonableness, (4) water systems that had already installed treatment could be required to adjust or install a different treatment that could be expensive and time consuming, (5) there would be conflict in implementation and enforcement between State determinations and EPA-revised determinations, and (6) EPA determinations to overturn State decisions should occur immediately following issuance of the State determination.

1. Current Regulatory Provisions Relating to EPA Review of State Decisions

Under the SDWA, States may grant variances to National Primary Drinking Water Regulations if water systems can meet certain conditions described in section 1415(1). To assure that States exercise the discretion within the limits of section 1415(a)(1)(F), EPA is authorized to revoke State issued variances and to reissue new variances, based on a finding that the State has abused its discretion in a substantial number of instances. EPA also conducts annual program management audits of each State program and may recommend adjustments to a State's program operations based on the results of that audit.

The Surface Water Treatment Rule (54 FR 27486) provides States with discretion in deciding which systems are required to install filtration treatment and establishing compliance schedules for these systems. To assure that States apply the decision criteria as described by the rule, § 142.80 establishes a process in which EPA can review State decisions and § 142.81 establishes a procedure for EPA to revoke State decisions and issue modified decisions, based on a finding that the State has abused its discretion. The "Phase II" rule (56 FR 3526) provides States with discretion based on a vulnerability assessment to grant waivers allowing water systems to reduce monitoring under the Standardized Monitoring Framework. To assure that States apply the waiver decision criteria as required by the regulation and as described in their federally approved primacy revision application, § 142.16(f) establishes a procedure for EPA to rescind State monitoring waiver determinations and require the affected systems to return to the uniform monitoring requirements.

The purpose of these procedures is also to provide EPA the option of taking corrective action, short of primacy withdrawal, where EPA believes the State program has abused the discretionary powers provided by EPA in specific regulations.

2. Response to Comments on October 19, 1990, Federal Register Notice

EPA understands commenters' concern with the Agency becoming unnecessarily involved with State decisions but believes EPA will rarely use this review procedure and that the availability of the procedure will not encourage Regional Offices to constantly question State decisions. EPA does not foresee reviewing State determinations unless the State decisions are unreasonable or if the State fails to make a credible demonstration that the decision was correct. States will be required to show that their designated application of the treatment technique is reasonable for the circumstances of the system to which it has been issued on the basis of the data and recommendations submitted by the system. So long as a State can make this demonstration, EPA will not exercise discretionary authority to review it. Although State resources will be diverted from other activities when a rescission notice is issued, EPA believes that the State resource diversion should rarely occur and in the appropriate cases, would be necessary to assure proper implementation of this rule.

EPA does not envision requiring systems to spend large amounts of resources to modify the State-approved/designated treatment or install entirely new treatment. The review provisions are mainly for when a State has failed to specify treatment requirements by the deadlines in the final rule or when State determinations on the appropriate treatment clearly fail to implement regulatory requirements. As noted above, if a State's application of the treatment technique is reasonable, EPA does not envision attempting to improve it. Review of State decisions will most likely occur when a backlog of determinations occur (i.e., a significant number of determinations have not been made within the regulatory time frames). Any Federal treatment decision will be made taking into account the existing treatment practices of a system.

EPA recognizes that different treatment decisions issued by States and Regional Administrators could confuse an individual water system as to which requirements must be met. Because of this potential ambiguity, the final order issued by the Regional Administrator will supersede any inconsistent requirements established by the State with regard to the NPDWRs for lead and copper. In other words, the decision by the Regional Administrator on either the appropriate corrosion control or source water treatment will constitute the requirements of the NPDWRs for lead and/or copper until such time as the Regional Administrator issues a new order. The State primacy agency will still be responsible for all aspects of program implementation and enforcement, including the Regional Administrator's designated application of a treatment technique.

Several commenters suggested limiting the period of review and rescission to avoid wasted investments and confusion on the part of affected water systems. EPA agrees partially. The Agency believes it is impractical to limit the time required for initial review of the State determinations, because EPA will generally review State treatment decisions during the annual review procedure. Further, program guidance will instruct the Regional Administrators to encourage State administrators to consult with them regularly on problem corrosion control issues to resolve issues before they progress into formal EPA reviews. EPA does agree, however, that once the review process begins, a time limit within which EPA is required to act is warranted. The final rule requires the Regional Administrator to issue a final review order to rescind a State decision within 120 days after issuance of the proposed rescission order. This time period may be extended only for good cause.

Finally, the Regional Administrator and the State will have time to consult on a proposed rescission before EPA's final decision is issued. EPA guidance will instruct the Regional Administrators to initiate action only in those cases where the State determination(s) is(are) unwarranted and incorrect and to resolve the issues through negotiation if possible. Since the Regional Administrators will make every effort to reach an accord with State agencies, EPA believes that there will be few instances in which a Regional Administrator actually overturns a State decision.

3. Requirements for EPA Review of State Decisions on Corrosion Control and Source Water Treatment

Because the final rule provides States with discretion in designating the appropriate corrosion control and source water treatment, EPA wants to assure that State determinations fall

within the guidelines of the treatment technique. Consequently, the final requirements for EPA review of State decisions are basically unchanged from the October 19, 1990, proposal. Section 142.19 establishes a process for EPA to review and, if necessary, issue Federal corrosion control and source water treatment determinations, based on one of the three findings in Section 141.19(a)

a. *Proposed Review of State Determinations (§ 142.19(c)).* If the Regional Administrator finds that review of a State determination is warranted, he/she should issue a proposed review order containing the material cited in § 142.19(c)(1), provide notice of the proposal to the affected parties by publishing a copy of the proposed order in a newspaper of general circulation in the affected communities (§ 142.19(c)(2)(ii)), and mailing the proposed order to the affected water system(s) (142.19(c)(2)(i)). The Regional Administrator should also make available for public inspection all information submitted by the State to EPA and all other information or data used by EPA in developing the proposed order (§ 142.19(3)). EPA believes that this procedure is needed to ensure that all interested parties are given an opportunity to review all the pertinent information and to provide comments.

b. *Final Review Order (§ 142.19(d)).* Based upon a review of all information obtained on the proposed review order, including public comments, the Regional Administrator is required to issue a final review order within 120 days after issuance of the proposed order. EPA believes that 120 days are needed to provide for meaningful State and public input and to adequately evaluate all the public comments and develop a final order. In some circumstances, it may be necessary to extend this time period. Thus, the rule provides that it can be extended for good cause.

The final order should contain a complete record of all the information supporting the determination, including all public comments and responses to those comments and any new points raised or new material supplied during the public comment period. The notice of the final order must be sent to the affected system(s), the State, and all parties who commented on the proposed order. As stated above, the final order from the Regional Administrator supersedes any inconsistent requirements established by the State with regard to the NPDWRs for lead and copper and cannot be less stringent than those imposed by the State.

IX. Review by the Science Advisory and National Drinking Water Advisory Council

As required by Section 1412 (d) and (e) of the SDWA, EPA consulted with the National Drinking Water Advisory Council (NDWAC) and requested comments from EPA's Science Advisory Board (SAB) in the course of developing these MCLGs and NPDWRs. The NDWAC met several times during development of the final rule and endorsed the general approach adopted by EPA. SAB met on June 2 and 3, 1988, in Cincinnati, Ohio, to review the proposed rule. The SAB's comments have been considered and incorporated into the final rule together with the public comments received during the comment period. In addition, the SAB reviewed the data on the carcinogenicity of lead and submitted a report to the EPA Administrator on November 21, 1989 (EPA, 1989b). The report agreed with the Agency determination that lead was a Group B2 (probable) human carcinogen.

X. Impact of This Regulation

A. Regulatory Impact Analysis

Under Executive Order 12291, EPA must determine whether a regulation is "major" and therefore subject to the requirement of performing a Regulatory Impact Analysis (RIA). This action is a major regulatory action, because it will have a major financial impact on the regulated community (i.e., more than $100 million per year). Therefore, EPA completed an RIA that is available for review as part of the record for this rulemaking (EPA, 1991a). This regulation has been reviewed by the Office of Management and Budget, as required by Executive Order 12291.

1. Costs.

The proposal included estimated costs associated with treatment of source water and corrosion by-products, monitoring, public education, and State implementation. Numerous commenters argued that EPA's cost estimates were inaccurate and that EPA greatly underestimated the potential financial burden on water systems and their customers. Numerous water systems commented that they will not be able to raise the needed revenue to comply with the proposed regulations because of high unemployment in the area and/or a high proportion of elderly and/or poor people on fixed incomes. They stated that they will either be forced out of business or have to raise water rates beyond the means of their customers. Other commenters claimed that the proposed regulation was not cost effective, stating that the rule would have a significant impact on water systems in terms of personnel and financial resources and would result in a minimal improvement in water quality and health.

In response to comments on the proposed rule, EPA made several changes in its analytical methodology which resulted in increased compliance cost estimates. These changes are highlighted below in the discussion of the individual components of the rule; a complete discussion on the changes is included in the RIA completed for the final rule (EPA, 1991a). Table 20 summarizes the estimated costs of the final rule. EPA understands commenters' concern with the potential financial burdens, especially for small systems and those with customers on fixed incomes, but believes the costs associated with the rule are reasonable. The Agency has reduced the costs of this regulation from the proposal by including the following provisions in the final rule.

1. Systems are only required to monitor source water if they are above the lead or copper action levels. Also, the source water monitoring has been coordinated, whenever possible, with monitoring for other inorganic contaminants.

2. Source water treatment is only necessary for those systems above the action levels at the tap and if treatment is deemed necessary by the State to reduce lead and/or copper below the action levels.

3. The initial tap monitoring frequency has been reduced from four times a year to twice a year.

4. pH and alkalinity action levels are not included in the final rule.

5. Systems are not required to develop their own public education materials or evaluate public education program as would have been required in the proposed rule.

6. The criteria for selecting sampling sites are more flexible than the proposal (i.e., homeowners can collect samples; sampling is allowed at nonresidential sites; minimum standing time has been reduced to 6 hours; and the requirement to collect samples from the ends of the distribution system has been eliminated).

7. Implementation of monitoring and treatment will be phased in over several years.

Table 20.—Summary Cost of Impacts of Final Lead and Copper Treatment Requirements (EPA, 1991a)

	National Costs ($M)			Average Annual Cost per family ($/year) by System Size (people served)			
	No.of systems affected	Total capital	Total annual	25-100	1K-3.3K	50K-75K	<1M
Source water [1]	880	450	90	1,250	118	19	11
Corrosion control	40,000	990	220	217	16	3	<1
Lead line [2] replacement	8,300	1,500-6,250	80-370	18-46	3-6	1-3	4-9
Public education [3]	40,000		30	2	<1	<1	<1
State implementation		50 (initial)	40				
Monitoring [4]							
—Source water	40,000		<1	<1	<1	<1	<1
—Corrosion control	79,000		27	9	<1	<1	<1
—Lead line replacement	8,300		12	10	<1	<1	<1

Costs have been rounded to the nearest significant figure.

[1] Costs assume all systems with lead levels greater than 0.005 mg/L and/or copper levels greater than 1.3 mg/L in source water will be required to complete source water treatment. (see RIA for complete discussion)

[2] Range in costs reflect uncertainty in the number of lines that will be removed and costs for replacing an individual line (see RIA and EPA, 1991(d) for detailed discussion).

[3] Household public education costs have been rounded to the nearest dollar.

[4] Monitoring costs have been rounded to the nearest dollar.

a. *Source Water Treatment Costs.* The proposal estimated that about 950 systems would have been required to treat their source water to reduce lead and copper levels below the proposed MCLs of 0.005 mg/L for lead and 1.3 mg/L for copper. The capital cost of treatment was estimated at $350 million with an annualized cost of $60 million (EPA, 19881). These cost estimates were based on an analysis of the NIRS data (EPA, 1988a). Commenters did not provide any substantive comments on revising these cost estimates.

Based on a reanalysis of the NIRS data (EPA, 1990b, 1991a) in conjunction with the NOMS Survey (EPA, 1980), EPA now estimates that approximately 200 to 900 systems will be required to treat their source water at a national capital cost of between $96 to $447 million, total annualized national cost of between $17 and $94 million, and average annual household costs ranging from less than $10 to over $1,200, depending on system size. The reanalysis of the NIRS data was included in an October 19, 1990, **Federal Register** notice (55 FR 42409). EPA received no comments on the reanalysis.

The range of costs for source water treatment reflects the structure of the final rule, which allows States the discretion to determine if source water treatment is necessary. The upper bound costs and number of systems affected assume that States require all systems to install source water treatment if their lead levels are above 0.005 mg/L or copper levels are above 1.3 mg/L in source water. The lower bound costs and number of systems affected assumes that States require all systems to install source water treatment if their lead levels in source water are above 0.015 mg/L or copper levels are above 1.3 mg/L.

b. *Corrosion Control Treatment Costs.* The proposed rule estimated that about 53,000 systems would be expected to incur costs associated with corrosion control treatment (this included systems required to install treatment because they exceeded the lead, copper, or pH action level). The total capital cost for corrosion control treatment was estimated to be $630 million and the annualized cost was estimated at about $210 million (EPA, 19881). Several commenters submitted information on treatment costs for their systems. Unfortunately, the majority of these systems did not provide sufficient detail on critical elements, such as system design, flow rate, or chemical dosages, which would enable EPA to compare the commenters' asserted costs with EPA's or to modify the Agency's cost models. The treatment costs from the few systems that did supply sufficient information generally supported EPA's estimates of treatment costs. Several commenters stated that the original cost projections were underestimated because they did not include costs for maintenance and repair of clogged lines and increased pumping costs due to excessive scale formation due to excessive calcium carbonate precipitation associated with the proposed requirement for pH 8. Other commenters believed that the costs were underestimated because the costs of other treatments that would be needed as a result of changes in water chemistry, such as removal of TTHM precursors and iron and manganese removal, were not included.

The proposed rule did not require systems to raise their pH above 8 if they could demonstrate that it would cause precipitation problems. This demonstration, however, would have required water systems to spend significant resources to demonstrate why raising the pH would cause precipitation problems even though the system may not have had a lead or copper problem. For this reason and for others discussed in section IV(2)(a) of the preamble, EPA has eliminated the pH action level. The Agency believes that eliminating the pH action level will reduce the likelihood of increased clogging of lines and scaling because systems are only required to raise their pH if they have a documented lead or copper problem. Also, the final rule requires systems and States to consider the effects of implementing corrosion control treatment on other water quality treatment processes when determining the most appropriate treatment strategy. EPA believes that the majority of systems and States are aware that excessive calcium carbonate precipitation can not only cause clogged pipes and scaling but can also increase turbidity and may reduce disinfection efficiency. Consequently, systems and States should consider this when evaluating what constitutes optimal corrosion control treatment. The costs of TTHM precursor removal and removal of iron and manganese were not included, because systems concerned with increased TTHM precursor formation, or precipitation of iron or manganese caused by increasing their pH, could avoid this problem by using corrosion inhibitors instead, which generally work at lower pH levels.

The proposed rule estimated that corrosion control studies would cost $50,000. EPA increased the costs of corrosion control studies based on data from several water systems currently conducting such studies. Costs to conduct corrosion control studies are assumed to be $200,000 for systems

serving more than 1 million people, $100,000 for systems serving between 50,000 to 1 million people, and $50,000 for systems serving less than 50,000 people. In addition, EPA has used data received prior to the proposal along with data received during the public comment period from the American Water Works Service Company, 40 individual water systems, and data collected from nine systems by EPA's Office of Drinking Water Technical Support Division to revise its estimates of the number of systems required to conduct corrosion control. These data were discussed previously in section IV(E)(2) of the preamble to this rule, and included in the Treatment and Occurrence Support Document (EPA, 1991b). EPA now estimates that about 40,000 water systems would incur costs for corrosion control treatment at an estimated national capital cost of about $990 million, a national annualized cost of about $220 million per year, and annual household costs ranging from less than $1 to $217, depending on system size. These costs include the costs of corrosion control studies and the costs for installing corrosion control for solder and lead pipes.

c. *Monitoring Costs.* The proposal estimated that all 79,000 community and non-transient, non-community systems would incur monitoring costs. EPA estimated a national annualized cost for monitoring of about $12 million per year (EPA, 1988l). Several commenters stated that the costs of collecting first-draw samples and analyses of the samples would be more expensive than EPA assumed. Other commenters stated that EPA had not considered the costs of the materials survey and the costs for planning the monitoring and training staff.

EPA agrees that the cost estimates were underestimated and has revised its monitoring cost estimates. The proposed rule estimated that the cost for collection would be about $5.50 per sample and $8 to complete each analysis. Based on commenter's estimates, EPA has revised the costs to $20 for collection of each sample and $15 for the analysis of each sample for lead and $15 per sample for copper. (These estimates are likely overestimates, especially for large systems. Informal communications with schools indicate that collection and laboratory analysis of water samples for lead costs between $5 and $10 per sample). EPA has also added the costs of monitoring the other water quality parameters required to be analyzed for the final rule (e.g., pH, calcium, alkalinity) along with the monitoring costs associated with the lead service line replacement program, since these were not required in the proposal. Finally, EPA has added the costs for the materials evaluation, planning monitoring activities, and training staffs on the proper procedures for sample collection. Including these costs increases the annual monitoring costs to about $39 million ($0.5 for source water; $20 million for tap monitoring; $12 million for monitoring for lead service lines; and $7 million to train staff and conduct a materials evaluation). The range of annual household costs varies depending on system size from $0.01 to $0.37 for source water monitoring, from $0.01 to $8.60 for tap monitoring, and from $0.01 to $9.81 for lead service line monitoring.

d. *Public Education Costs.* The proposed rule estimated that about 39,000 systems would have been required to conduct a public education program at an annualized cost of about $12 million (EPA, 1988l). Thirteen commenters provided their own cost estimates of conducting a public education program; the estimates ranged from $0.01 to $1.12 per person. The majority of these costs were estimated using information from the 1987 special lead public notification requirements and therefore are not appropriate for estimating costs for the final rule because public notifications were one-time costs and the public notification program was not as focused or demanding as the public education requirements in the final rule.

The national annualized costs of the public education program are now estimated to be $30 million with the per household costs per year ranging from $0.08 to $2.24. As noted above, EPA estimates that about 40,000 systems will initially fail the lead action level and be required to conduct a public education program. After installation of corrosion control, EPA estimates that about 12,000 systems (8,000 with lead service lines) will remain above the lead action level and be required to continue the public education program. As discussed earlier, the final rule does not require water systems to develop nor evaluate the public education program, thus the costs for public education only include costs associated with the distribution of the public education materials. However, even though the requirements for public education have been reduced from the proposal, the estimated costs have increased. The proposal estimated that the public education program would continue for 10 years while the final rule assumes public education will continue for 25 years for those systems required to conduct lead service line replacement and those that continue to exceed the lead or copper action levels. Also, the proposed rule assumed that systems would only be required to mail inserts in water bills, while the final rule assumes that systems would be required to mail inserts in water bills, provide public service announcements, and distribute brochures to locations identified as being high-risk. EPA believes these estimates better reflect the costs of a public education program.

e. *Lead Service Line Replacement Costs.* The proposed rule requested information on the cost of lead service line replacement and received comments from 17 water systems. The range of cost estimates from these commenters for replacing lead service lines ranged from $400 to more than $4,800 per line. On January 11, 1989, the American Water Works Association submitted a report and data to EPA from a nationwide survey on the occurrence of lead service lines and connections in water systems throughout the United States (AWWA, 1989).

Based on the AWWA survey, EPA estimates that about 8,300 systems will be required to replace some lead service lines (EPA, 1991a). The projected national capital cost of the lead service line replacement program is estimated to range from $1.5 to $6.2 billion, the national annualized costs range from about $80 to $370 million per year, and the annual household costs range from less than $1 to $46, depending on system size. The range of costs reflects uncertainty regarding the number of lead service lines that will ultimately be removed and the amount of lead that leaches from lead pipes, as well as the unit cost for replacing a lead service line. Lower bound cost estimates assume relatively widespread use of newly developed pipe replacement technology which can lower costs of replacing an individual pipe by as much as 75 percent. Depending on the assumptions regarding lead contributions from individual lines and the costs of replacing individual lines, the estimated monetized health benefits were either smaller or larger than estimated costs. A detailed discussion of the assumptions used to derive these costs can be found in the RIA supporting the final rule and EPA, 1991d.

The AWWA submitted a report "Lead Service Line Replacement: Benefit-to-Cost Analysis" (AWWA, 1990) as a public comment on an October 19, 1990, **Federal Register** notice (55 FR 42409). In its report, AWWA estimated that the present value costs of a 15-year mandatory lead service line replacement

program would be $4.4 billion and the expected present value benefits would be $104 million. They concluded:

> * * * that there should NOT be an overall mandate from EPA or Congress to remove lead service lines. Rather, what is warranted is a systematic approach utilizing more cost effect (sic) approaches first (such as corrosion control). As a last resort, where the service line actually contributes to an elevated lead level, the lead service line should be replaced.

EPA agrees that a lead service line replacement program should not be initiated before corrosion control and/or source water treatment has/have been installed. In addition, EPA agrees that only those lead service lines contributing to elevated lead levels (above 0.015 mg/L) should be replaced (see section IV(H) in the preamble for a complete discussion of lead service line replacement program).

f. *State Implementation Costs.* The proposed rule estimated that State implementation costs would increase by about $16 million as a result of the proposed rule. To derive the final cost estimates, EPA used information supplied by nine States during the public comment period, along with a 1988 survey of State primacy program resource needs, which was jointly conducted by the Association of State Drinking Water Administrators and EPA (EPA, 1989c). The latter survey consisted of sending a detailed 18-page questionnaire and a 38-page supplement to each State and territory in August 1988 to obtain an estimate of the staff and funding resources needed both to implement current drinking water programs and to meet the new requirements of the 1986 amendments to the SDWA. States were asked to estimate both resources needed on a temporary basis during the initial phase of implementation and resource needs on a permanent basis. Total State resource needs across the Nation were extrapolated from the States responding to the survey. The results from this survey were made available for public comment in an October 19, 1990, **Federal Register** notice (55 FR 42409). EPA received no substantive comments on the survey and therefore used the survey to predict the final State implementation costs of $47 million (initial costs) and $38 million (annual on-going costs) (EPA, 1991a).

2. Benefits

The SDWA does not direct EPA to consider benefits in establishing NPDWRs. EPA has established the requirements of the rule based upon the criteria contained in § 1412 of the statute. EPA is directed by Executive Order 12291 to estimate both the benefits and costs of the rules that it promulgates. Accordingly, the Agency has estimated the benefits associated with this regulation.

In 1988, EPA estimated that corrosion control and source water treatment associated with the proposed regulation would reduce lead exposures for millions of people. The effects of the proposed rule were measured in terms of changes in blood lead levels among young children between the ages of 6 months and 5 years. According to these estimates, between 264,000 and 704,000 children would have had their blood lead levels reduced to below 10 μg/dL; between 88,000 and 176,000 would have had their blood lead levels reduced to below 15 μg/dL; and between 3,500 and 5,300 would have had their blood lead levels reduced to below 25 μg/dL (Marcus and Holtzman, 1988). In addition, the Agency estimated that the material benefits of the regulation may be as high as $500 million per year.

Several commenters claimed that EPA overestimated the health benefits. They maintained that there were significant problems with the model that EPA used to predict the magnitude of blood lead improvement, including the following: (1) The blood lead coefficient of 0.20 μg/dL per μg/L of drinking water was based on infants aged zero to 6 months, yet EPA used this coefficient for children aged 6 months to 5 years, (2) use of worst-case lead occurrence data that are not representative of people's exposure, and (3) use of a questionable adjustment factor of 1.7 to convert national water data from partially-flushed daytime samples to first-draw samples. In response to public comments, EPA has made several changes in the methodology for estimating benefits and has monetized the health benefits for corrosion control, source water reduction, and lead service line replacement. The assumptions used in the benefits analysis are summarized below and are discussed in greater detail in the RIA supporting this rule.

a. *Health Benefits From Corrosion Control/Source Water Reduction.* EPA has made the following changes based on commenters' concerns: (1) Separate blood lead coefficients for infants up to 6 months of age, and for children aged 6 months to 7 years instead of using the same coefficients for all children, (2) data from partially-flushed taps to predict consumer exposure and the resulting benefits of the final rule are used instead of first-draw water, and (3) the adjustment factor to convert partially-flushed water to first-draw samples has been eliminated.

The methodology to predict health benefits has been improved substantially from the proposal by using the methodologies developed for other EPA regulatory reviews on lead (i.e., the lead-in gasoline phasedown (EPA, 1985), revisions to the lead NAAQS under the Clean Air Act (EPA, 1987b), and the regulation under the Clean Water Act for disposal of sewage sludge (EPA, 1989f). The model estimates the benefits of changing the nationwide blood lead distribution after installation, where necessary, of corrosion control and source water treatment.

Estimating benefits of the final rule requires assumptions about the pre- and post-water lead distributions. Pre-regulatory water lead exposures in the proposed rule were calculated using a survey conducted by Patterson (EPA, 1981). Several commenters criticized EPA for using this survey in the proposal to represent the nationwide water lead distribution because they claimed the data are not representative of population exposure. They stated that the survey was flawed because the sample homes had extremely hard water and that EPA had admitted that the data portray higher levels of lead than are found from other data sources. EPA decided to continue to use the Patterson data because the samples collected (partially flushed) are reasonably representative of average water consumption. The fact that the survey collected data from sites with hard water would, if anything, tend to produce lower lead levels. Most of the available literature indicates that harder water tends to produce lower lead levels (AWWA-RF, 1990).

The post-regulatory distribution of water lead levels was calculated by assuming that about 80 percent of water systems serving less than 50,000 people would be able to reduce their lead levels to 0.015 mg/L at the 90th percentile. This assumption was based on the data presented in Table 7 of the preamble, which indicates that about 80 percent of water systems with pH over 8.0, or that used corrosion inhibitors, were able to meet the lead action level. For those systems serving less than 50,000 people who are unable to achieve a 90th percentile water lead below 0.015 mg/L, it was assumed that their lead-reducing efforts would result on average, in a reduction of 0.010 mg/L of lead. This was based on experience in Seattle, Washington where the 90th percentile lead level started at approximately 0.025 mg/L, and after installation of corrosion control, dropped to about 0.010 mg/L to 0.015 mg/L. Two scenarios were developed for systems serving more

than 50,000 people because of the uncertainty in the number of large systems that meet the action level that would install treatment and the reduction in lead levels for those systems that did install treatment. Scenario I assumed that all large systems would be able to reduce their 90th percentile lead levels to 0.005 mg/L. Scenario II assumed that 50 percent of large systems would be able to reduce their 90th percentile lead levels to 0.015 mg/L, 25 percent to 0.10 mg/L, and 25 percent to 0.005 mg/L.

Changes in blood lead levels between the pre- and post-regulatory drinking water lead levels were calculated using water lead-blood lead relationships developed by EPA (EPA, 1986a) and updated by Marcus (1989a, 1989b, 1990b, 1990c) and Maes et al. (1991). Section III(A)(2) of the preamble discusses these studies.

The model first calculates blood lead levels among children and adult populations in the United States associated with the pre- and post-regulatory level of lead exposure from drinking water, along with exposures from other sources, such as air, food, soil, and dust. The results do not explicitly reflect children living in deteriorating old houses exposed to lead paint hazards and children with excessive exposure to soils highly contaminated by lead (e.g., from 50 years of deposition from automotive emissions). These children were not included in the analysis because a change in the lead NPDWR would not by itself eliminate their overwhelming risks from non-drinking lead sources. Nonetheless, these children would receive a marginal benefit from the reductions achieved by this rule.

Exposure to nondrinking water sources of lead was estimated by (1) adjusting mean blood lead levels in children and adults measured in the 1976–1980 NHANES II survey downward to account for the gasoline lead phasedown and the reduction of lead in the diet, and (2) subtracting the estimated contribution to blood lead levels from drinking water. EPA estimates that the geometric mean or average "baseline" blood lead levels attributable to sources other than drinking water is about 4.0 μg/dL for children and adults. Blood lead levels vary widely among individuals due to differences in exposure levels, behavioral patterns, physiological sensitivity, and nutrition. Capturing all of this variability is impossible in blood lead modeling; therefore, the Agency has established an approach that uses empirical, or measured, descriptions of blood lead variability and applies it to average blood leads estimated under different regulatory scenarios. The variability of log-normal distributions can be represented by the geometric standard deviation (GSD). Nationwide population surveys (e.g., NHANES II) of blood lead distributions provide the best possible GSDs, which are estimated as 1.39 for adults and 1.42 for children (EPA, 1986a).

The second step in calculating benefits is to estimate the effects that the blood lead changes will have on different health endpoints that can be valued in monetary terms. The endpoints modeled for this analysis include benefits associated with changes in adult men's blood pressure (medication costs) and associated changes in risks of more serious cardiovascular outcomes: heart attack, stroke, and death. Low-level lead exposure is associated with various health effects in women and the fetus, which were not quantified. These effects include reduced gestational age and birthweight and slight increases in blood pressure. While reduced lead levels in drinking water will benefit women and their newborns, benefits were not estimated in this analysis because of (1) existing uncertainties in the dose-response relationship between blood lead and blood pressure in women, and (2) uncertainties in physiological transfer rates (i.e., biokinetics) of lead during pregnancy. The endpoints modeled for children include benefits associated with avoidance of elevation in children's erythrocyte protoporphyrin (screening costs and medical treatment) and deficits in IQ (costs associated with remedial education/lost earnings). It is important to note that the health endpoints valued in the benefits analyses do not include other serious effects associated with low-level lead exposures in children. Quantitative analysis of these effects was not conducted because of either incomplete biokinetic models to estimate exposures (e.g., early developmental delays associated with prenatal exposures) or because of a lack of monetized functions (e.g., deficits in auditory function and attention span, alterations in vitamin D metabolism).

EPA estimates that the annual health benefits of corrosion control and source water using Scenario I are approximately $4.3 billion. The annual health benefits for Scenario II are approximately $2.8 billion. EPA estimates that less than 1 percent of water systems will need to control source water lead levels. The benefits attributable to source water treatment comprise a very small portion of the total estimates (see RIA for complete discussion).

Several assumptions regarding water lead exposure may tend to overestimate health benefits in this analysis: (1) starting baseline exposures do not account for the 1986 lead solder ban, which, despite current uncertainties regarding the extent of its implementation, will eventually and substantially reduce exposures independent of this rule; (2) standing, first-flush samples taken in "high-risk" houses (e.g., relatively new lead solder, lead service lines) will be required in this rule to determine compliance (this analysis assumes that PbW levels measured in high-risk homes will be found in all homes; and (3) it was assumed that 80 percent of small and medium systems can meet the lead action level, which, as discussed in section IV(E)(2) is probably optimistic given that these were well-managed, medium-sized systems with relatively non-corrosive or easily controlled source waters.

In contrast, health benefits may be underestimated in this analysis because several health effects associated with lead exposure were not quantified because of the lack of quantitative dose-response functions (i.e., reduced growth and impaired hearing for children, maternal lead effects on fetal and infant development). Also, benefits to children exposed to lead paint hazards and highly contaminated soils are not included in the main analysis.

Of the adult benefits, roughly 40 percent are attributable to reduced risk of death from heart disease associated with lead-induced blood pressure elevations. There is general agreement that the available data support a small but positive association between PbB levels and increases in blood pressure in adults. As discussed in the 1990 update to the Addendum to the 1986 Air Quality Criteria Document for lead (EPA, 1990a), * * * with regard to the effects of lead on blood pressure, the new information emerging since the preparation of the 1986 Addendum, overall, substantiates further the main conclusions stated in that Addendum. Sufficient evidence exists from both the four large-scale general population studies discussed above (NHANES II, BRHS, and the two Welsh studies) and numerous smaller-scale studies to conclude that a small but positive association exists between blood lead levels and increases in blood pressure.

Recent EPA regulatory analyses on lead have extended the blood lead/blood pressure relationship to quantify

consequent risks for these cardiovascular outcomes. The 1990 update to the Addendum (EPA, 1990a) concludes that:

* * * the implications of lead-induced blood pressure increases with regard to potential increased risk for other, more serious cardiovascular outcomes still remain to be more clearly delineated * * * essentially any increase in blood pressure carries with it likely increased risk (albeit however small) for stroke, heart attack, and/or associated mortality * * * projections of potential lead effects on such outcomes * * * are not unreasonable in view of the very large public health impacts; however, much caution must be exercised in accepting the validity of any specific quantitative estimates derived from such projections in view of the uncertainties associated with selection of the specific coefficients used for (1) blood lead blood-pressure relationships and (2) relationships between blood pressure increases and more serious cardiovascular outcomes.

b. *Health Benefits From Lead Service Line Replacement.* The proposed rule did not estimate the benefits of lead service line replacement. Many commenters, however, stated that the health benefits of lead service line replacement would be minimal because water systems can only replace that portion of the line under their control, which in most cases will be less than the full line. They contend that the limited data indicate that partial lead service line replacement may actually increase the lead levels at the tap and that it is highly unlikely that people actually drink the water standing in the line.

Because of the uncertainty in the available data, EPA estimated the benefits of lead service line replacement under a range of possible scenarios. Assumptions were made that 1) lead levels in water from a lead service line ("partially-flushed") would range between 20 and 40 ppb (after corrosion control), 2) lead levels in water from the main ("fully-flushed") passing through the lead service line would average approximately 10 ppb, and 3) people drink between 125 to 333 ml of partially-flushed and/or fully-flushed water per day. Reductions in exposures and monetized health benefits that would be expected to occur in those systems replacing lead service lines are estimated using the same methodology used to calculate benefits attributable to corrosion control. The results indicate that the national annualized benefits range from $70 to $171 million. The range in estimates reflects the use of combinations of the different assumptions described above. If children with high paint lead exposures were included in the analysis of houses whose lead service lines are replaced, the national annualized benefits increase to $80 to $240 million (EPA, 1991d).

c. *Material Benefits.* The proposed rule cited several studies indicating that the material benefits of corrosion control alone would exceed the costs of implementing corrosion control treatment by more than two times. EPA continues to believe that both systems and customers will derive direct material benefit from corrosion control treatment. The systems will benefit from extended pipe life in the distribution systems, reduced leakage, and decreased pumping costs due to reduced tuberculation. Customers will also benefit from the extended pipe life in their portion of the service line, extended life of water-using appliances, decreased sewage treatment costs due to reduced metals in influent and sludge, reduced damage from leakage, reduced interim repairs, and reduced staining of clothing and fixtures.

The American Water Works Association Research Foundation recently evaluated the economic benefits of extended life of distribution and premise piping associated with general corrosion control (AWWA-RF, 1989). One case study evaluated by AWWA-RF (Vancouver, B.C.) indicated that under "reasonably conservative assumptions," net economic benefits derived from corrosion control would exceed costs by a factor of 4 to 13. Another study conducted in Seattle, Washington, found a benefit:cost ratio of about 5:1, based on several conservative assumptions. The majority of benefits in both studies were estimated to accrue to customers in terms of extended life of premise piping. Another case study in Northern Illinois evaluated by AWWA-RF indicated no expected material benefits of corrosion control because of existing noncorrosive water and a preponderance of cement line distribution pipes and copper or galvanized service/plumbing pipes.

B. Regulatory Flexibility Analysis

The Regulatory Flexibility Act (RFA) requires EPA to consider the effect of regulations on small entities. If there is a significant effect on a substantial number of small systems, the Agency must seek to minimize the effects. The Agency found in the preamble to the proposed rule that the rule would not have a significant effect on a substantial number of small entities. Several commenters disagreed with this characterization, stating that the proposed rule would severely impact small systems.

EPA has re-evaluated the impacts to small systems consistent with the requirements of the Regulatory Flexibility Act, 5 U.S.C. 602 *et seq.*, and finds that today's action will not significantly affect a substantial number of small entities. Using the Small Business Administration's definition, a small water utility is one that serves fewer than 50,000 people. There are about 200,000 community and non-community water systems serving fewer than 50,000 people. This total includes approximately 120,000 systems that are classified as transient, non-community systems which include for example, restaurants, gas stations, etc. and which are not subject to the monitoring and treatment requirements of this regulation. In the preamble to the 1988 proposal, EPA incorrectly cited the total number of small water utilities as 78,000. Rather, this number represented the total community and non-transient, non-community water systems serving fewer than 50,000 people that are subject to the requirements of the final rule. This subset of systems affected by the rule was correctly analyzed in the RIA and identified in the RFA. Approximately 40,000 small community and non-community, non-transient water systems are likely to have contamination levels greater than the action levels and thus are required to treat their water. While this represents a substantial fraction of the total number of small systems (greater than 20 percent), the impacts of the regulation on them will not be significant.

Under the RFA, annual costs of compliance are to be compared to the existing cost of production. EPA has generally considered an increase in production cost of five percent or more as a significant impact. The approximate cost of producing water by all systems serving fewer than 50,000 people is $9.6 billion per year, and the maximum annualized cost of the final rule will be about $410 million, including monitoring. This amounts to 4.27 percent of water production costs for small systems. Therefore, although the rule will affect a substantial number of small systems, the average effect on small systems, as defined by the Small Business Administration, is not significant.

Nevertheless, EPA recognizes that, due to their inability to benefit from economies of scale, the cost impact of regulations tends to increase as the size of a system decreases. To prevent these regulations from placing an onerous burden on smaller systems, EPA has included numerous provisions that would reduce their costs and enhance their ability to comply. Among these provisions are the following:

1. The monitoring requirements of the rule are phased in over an extra 6 to 18 months for small systems.

2. Fewer samples are required for smaller systems than for large systems.

3. Systems serving less than 50,000 people are not required to conduct corrosion control studies except where specified by the State.

4. Systems under 50,000 are required to make detailed demonstrations of optimal corrosion treatment only if they exceed the action levels.

The Agency encourages States to provide technical assistance to small systems that need to install or improve corrosion control. The assistance could include tailoring the treatments they designate for small systems to the circumstances of individual public water systems. EPA will also assist systems through pollution prevention programs and the Agency's overall effort to reduce lead levels. Further, under the SDWA, exemptions are available for systems if they cannot afford to install best available technology to meet the requirements of the treatment technique requirement, provided there is no unreasonable risk to health. These exemptions may be extended for one or more two-year periods for systems with less than 500 connections.

C. Paperwork Reduction Act

The information collection requirements in this rule will be submitted to the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.* The information collection requirements are not effective until OMB approves them and a technical amendment to that effect is published in the **Federal Register**.

The public reporting burden on public water systems for this collection of information is estimated to average 3.9 hours per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. This represents an increase from the 1–1.4 hours per response estimated in the preamble to the 1988 proposal. The increase is attributable to changes to the monitoring, reporting, and recordkeeping requirements.

Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Chief, Information Policy Branch, PM-223Y, U.S. Environmental Protection Agency, 401 M Street SW., Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503, marked "Attention: Desk Officer for EPA."

X. References

The following references are referred to in this notice and are included in the public docket together with other correspondence and information. The public docket is available as described at the beginning of this notice. All public comments received on the proposal are included in the public docket.

Agency for Toxic Substances and Disease Registry (ATSDR). Nature and Extent of Childhood Lead Poisoning in Children in the U.S.: A Report to Congress. U.S. Dept. of Health and Human Services (July 1988). [ATSDR, 1988]

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Dated: May 6, 1991.

F. Henry Habicht,

Acting Administrator.

List of Subjects in 40 CFR Parts 141 and 142

Administrative practice and procedure, chemicals, Incorporation by reference, Intergovernmental relations, Reporting and recordkeeping requirements and water supply.

For the reasons set forth in the preamble, title 40 of the Code of Federal Regulations is amended as follows:

PART 141— NATIONAL PRIMARY DRINKING WATER REGULATIONS

1. The authority for part 141 continues to read as follows:

Authority: 42 U.S.C. 300f, 300g–1, 300g–2, 300g–3, 300–4, 300g–5 300g–6, 300j–4, and 300j–9.

2. Section 141.2 is amended by adding the following new definitions in alphabetical order and removing the existing definition of "maximum contaminant level" to read as follows:

* * * * *

§ 141.2 Definitions.

* * * * *

Action level, is the concentration of lead or copper in water specified in § 141.80(c) which determines, in some cases, the treatment requirements contained in subpart I of this part that a water system is required to complete.

* * * * *

Corrosion inhibitor, means a substance capable of reducing the corrosivity of water toward metal plumbing materials, especially lead and copper, by forming a protective film on the interior surface of those materials.

* * * * *

Effective corrosion inhibitor residual, for the purpose of subpart I of this part only, means a concentration sufficient to form a passivating film on the interior walls of a pipe.

* * * * *

First draw sample, means a one-liter sample of tap water, collected in accordance with § 141.86(b)(2), that has been standing in plumbing pipes at least 6 hours and is collected without flushing the tap.

* * * * *

Large water system, for the purpose of subpart I of this part only, means a water system that serves more than 50,000 persons.

* * * * *

Lead service line, means a service line made of lead which connects the water main to the building inlet and any

lead pigtail, gooseneck or other fitting which is connected to such lead line.

* * * * *

Maximum contaminant level, means the maximum permissable level of a contaminant in water which is delivered to any user of a public water system.

* * * * *

Medium-size water system, for the purpose of subpart I of this part only, means a water system that serves greater than 3,300 and less than or equal to 50,000 persons.

* * * * *

Optimal corrosion control treatment, for the purpose of subpart I of this part only, means the corrosion control treatment that minimizes the lead and copper concentrations at users' taps while insuring that the treatment does not cause the water system to violate any national primary drinking water regulations.

* * * * *

Service line sample, means a one-liter sample of water collected in accordance with § 141.86(b)(3), that has been standing for at least 6 hours in a service line.

* * * * *

Single family structure, for the purpose of subpart I of this part only, means a building constructed as a single-family residence that is currently used as either a residence or a place of business.

* * * * *

Small water system, for the purpose of subpart I of this part only, means a water system that serves 3,300 persons or fewer.

* * * * *

3. In § 141.11, the introductory text of paragraph (b) is revised to read as follows:

§ 141.11 Maximum contaminant levels for inorganic chemicals.

* * * * *

(b) The following maximum contaminant levels for cadmium, chromium, mercury, nitrate, and selenium shall remain effective until July 30, 1992. The following maximum contaminant level for lead shall remain effective until November 9, 1992.

* * * * *

4. Section 141.32 is amended by adding paragraphs (e) (13) and (14) to read as follows:

* * * * *

§ 141.32 Public notification.

* * * * *

(e) * * *

(13) *Lead.* The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that lead is a health concern at certain exposure levels. Materials that contain lead have frequently been used in the construction of water supply distribution systems, and plumbing systems in private homes and other buildings. The most commonly found materials include service lines, pipes, brass and bronze fixtures, and solders and fluxes. Lead in these materials can contaminate drinking water as a result of the corrosion that takes place when water comes into contact with those materials. Lead can cause a variety of adverse health effects in humans. At relatively low levels of exposure, these effects may include interference with red blood cell chemistry, delays in normal physical and mental development in babies and young children, slight deficits in the attention span, hearing, and learning abilities of children, and slight increases in the blood pressure of some adults. EPA's national primary drinking water regulation requires all public water systems to optimize corrosion control to minimize lead contamination resulting from the corrosion of plumbing materials. Public water systems serving 50,000 people or fewer that have lead concentrations below 15 parts per billion (ppb) in more than 90% of tap water samples (the EPA "action level") have optimized their corrosion control treatment. Any water system that exceeds the action level must also monitor their source water to determine whether treatment to remove lead in source water is needed. Any water system that continues to exceed the action level after installation of corrosion control and/or source water treatment must eventually replace all lead service lines contributing in excess of 15 (ppb) of lead to drinking water. Any water system that exceeds the action level must also undertake a public education program to inform consumers of ways they can reduce their exposure to potentially high levels of lead in drinking water.

(14) *Copper.* The United States Environmental Protection Agency (EPA) sets drinking water standards and has determined that copper is a health concern at certain exposure levels. Copper, a reddish-brown metal, is often used to plumb residential and commercial structures that are connected to water distribution systems. Copper contaminating drinking water as a corrosion byproduct occurs as the result of the corrosion of copper pipes that remain in contact with water for a prolonged period of time. Copper is an essential nutrient, but at high doses it has been shown to cause stomach and intestinal distress, liver and kidney damage, and anemia. Persons with Wilson's disease may be at a higher risk of health effects due to copper than the general public. EPA's national primary drinking water regulation requires all public water systems to install optimal corrosion control to minimize copper contamination resulting from the corrosion of plumbing materials. Public water systems serving 50,000 people or fewer that have copper concentrations below 1.3 parts per million (ppm) in more than 90% of tap water samples (the EPA "action level") are not required to install or improve their treatment. Any water system that exceeds the action level must also monitor their source water to determine whether treatment to remove copper in source water is needed.

* * * * *

5. The table in § 141.51(b) is amended by removing the paragraph designations, placing the contaminants in alphabetical order, and adding the following entries for copper and lead in alphabetical order:

§ 141.51 Maximum contaminant level goals for inorganic contaminants.

* * * * *

(b) * * *

Contaminant and MCLG in mg/L

* * * * *

Copper	1.3
Lead	zero

* * * * *

6. A new subpart I is added to read as follows:

Subpart I—Control of Lead and Copper

Sec.

141.80 General requirements.
141.81 Applicability of corrosion control treatment steps to small, medium-size and large water systems.
141.82 Description of corrosion control treatment requirements.
141.83 Source water treatment requirements.
141.84 Lead service line replacement requirements.
141.85 Public education and supplemental monitoring requirements.
141.86 Monitoring requirements for lead and copper in tap water.
141.87 Monitoring requirements for water quality parameters.
141.88 Monitoring requirements for lead and copper in source water.
141.89 Analytical methods.
141.90 Reporting requirements.
141.91 Recordkeeping requirements.

Subpart I—Control of Lead and Copper

§ 141.80 General requirements.

(a) *Applicability and effective dates.* (1) The requirements of this subpart I constitute the national primary drinking water regulations for lead and copper. Unless otherwise indicated, each of the provisions of this subpart applies to community water systems and non-transient, non-community water systems (hereinafter referred to as "water systems" or "systems").

(2) The requirements set forth in §§ 141.86–141.91 shall take effect. The requirements in §§ 141.81–141.85 shall take effect November 9, 1992.

(b) *Scope.* These regulations establish a treatment technique that includes requirements for corrosion control treatment, source water treatment, lead service line replacement, and public education. These requirements are triggered, in some cases, by lead and copper action levels measured in samples collected at consumers' taps.

(c) *Lead and copper action levels.* (1) The lead action level is exceeded if the concentration of lead in more than 10 percent of tap water samples collected during any monitoring period conducted in accordance with § 141.86 is greater than 0.015 mg/L (i.e., if the "90th percentile" lead level is greater than 0.015 mg/L).

(2) The copper action level is exceeded if the concentration of copper in more than 10 percent of tap water samples collected during any monitoring period conducted in accordance with § 141.86 is greater than 1.3 mg/L (i.e., if the "90th percentile" copper level is greater than 1.3 mg/L).

(3) The 90th percentile lead and copper levels shall be computed as follows:

(i) The results of all lead or copper samples taken during a monitoring period shall be placed in ascending order from the sample with the lowest concentration to the sample with the highest concentration. Each sampling result shall be assigned a number, ascending by single integers beginning with the number 1 for the sample with the lowest contaminant level. The number assigned to the sample with the highest contaminant level shall be equal to the total number of samples taken.

(ii) The number of samples taken during the monitoring period shall be multiplied by 0.9.

(iii) The contaminant concentration in the numbered sample yielded by the calculation in paragraph (c)(3)(ii) is the 90th percentile contaminant level.

(iv) For water systems serving fewer than 100 people that collect 5 samples per monitoring period, the 90th percentile is computed by taking the average of the highest and second highest concentrations.

(d) *Corrosion control treatment requirements.* (1) All water systems shall install and operate optimal corrosion control treatment as defined in § 141.2.

(2) Any water system that complies with the applicable corrosion control treatment requirements specified by the State under §§ 141.81 and 141.82 shall be deemed in compliance with the treatment requirement contained in paragraph (d)(1) of this section.

(e) *Source water treatment requirements.* Any system exceeding the lead or copper action level shall implement all applicable source water treatment requirements specified by the State under § 141.83.

(f) *Lead service line replacement requirements.* Any system exceeding the lead action level after implementation of applicable corrosion control and source water treatment requirements shall complete the lead service line replacement requirements contained in § 141.84.

(g) *Public education requirements.* Any system exceeding the lead action level shall implement the public education requirements contained in § 141.85.

(h) *Monitoring and analytical requirements.* Tap water monitoring for lead and copper, monitoring for water quality parameters, source water monitoring for lead and copper, and analyses of the monitoring results under this subpart shall be completed in compliance with §§ 141.86, 141.87, 141.88, and 141.89.

(i) *Reporting requirements.* Systems shall report to the State any information required by the treatment provisions of this subpart and § 141.90.

(j) *Recordkeeping requirements.* Systems shall maintain records in accordance with § 141.91.

(k) *Violation of national primary drinking water regulations.* Failure to comply with the applicable requirements of §§ 141.80–141.91, including requirements established by the State pursuant to these provisions, shall constitute a violation of the national primary drinking water regulations for lead and/or copper.

§ 141.81 Applicability of corrosion control treatment steps to small, medium-size and large water systems.

(a) Systems shall complete the applicable corrosion control treatment requirements described in § 141.82 by the deadlines established in this section.

(1) A large system (serving >50,000 persons) shall complete the corrosion control treatment steps specified in paragraph (d) of this section, unless it is deemed to have optimized corrosion control under paragraph (b)(2) or (b)(3) of this section.

(2) A small system (serving ≤3300 persons) and a medium-size system (serving >3,300 and ≤50,000 persons) shall complete the corrosion control treatment steps specified in paragraph (e) of this section, unless it is deemed to have optimized corrosion control under paragraph (b)(1), (b)(2), or (b)(3) of this section.

(b) A system is deemed to have optimized corrosion control and is not required to complete the applicable corrosion control treatment steps identified in this section if the system satisfies one of the following criteria:

(1) A small or medium-size water system is deemed to have optimized corrosion control if the system meets the lead and copper action levels during each of two consecutive six-month monitoring periods conducted in accordance with § 141.86.

(2) Any water system may be deemed by the State to have optimized corrosion control treatment if the system demonstrates to the satisfaction of the State that it has conducted activities equivalent to the corrosion control steps applicable to such system under this section. If the State makes this determination, it shall provide the system with written notice explaining the basis for its decision and shall specify the water quality control parameters representing optimal corrosion control in accordance with § 141.82(f). A system shall provide the State with the following information in order to support a determination under this paragraph:

(i) The results of all test samples collected for each of the water quality parameters in § 141.82(c)(3).

(ii) A report explaining the test methods used by the water system to evaluate the corrosion control treatments listed in § 141.82(c)(1), the results of all tests conducted, and the basis for the system's selection of optimal corrosion control treatment;

(iii) A report explaining how corrosion control has been installed and how it is being maintained to insure minimal lead and copper concentrations at consumers' taps; and

(iv) The results of tap water samples collected in accordance with § 141.86 at least once every six months for one year after corrosion control has been installed.

(3) Any water system is deemed to have optimized corrosion control if it submits results of tap water monitoring conducted in accordance with § 141.86 and source water monitoring conducted in accordance with § 141.88 that demonstrates for two consecutive six-month monitoring periods that the difference between the 90th percentile tap water lead level computed under § 141.80(c)(3), and the highest source water lead concentration, is less than the Practical Quantitation Level for lead specified in § 141.89(a)(1)(ii).

(c) Any small or medium-size water system that is required to complete the corrosion control steps due to its exceedance of the lead or copper action level may cease completing the treatment steps whenever the system meets both action levels during each of two consecutive monitoring periods conducted pursuant to § 141.86 and submits the results to the State. If any such water system thereafter exceeds the lead or copper action level during any monitoring period, the system (or the State, as the case may be) shall recommence completion of the applicable treatment steps, beginning with the first treatment step which was not previously completed in its entirety. The State may require a system to repeat treatment steps previously completed by the system where the State determines that this is necessary to implement properly the treatment requirements of this section. The State shall notify the system in writing of such a determination and explain the basis for its decision.

(d) *Treatment steps and deadlines for large systems.* Except as provided in paragraph (b) (2) and (3) of this section, large systems shall complete the following corrosion control treatment steps (described in the referenced portions of §§ 141.82, 141.86, and 141.87) by the indicated dates.

(1) *Step 1:* The system shall conduct initial monitoring (§ 141.86(d)(1) and § 141.87(b)) during two consecutive six-month monitoring periods by January 1, 1993.

(2) *Step 2:* The system shall complete corrosion control studies (§ 141.82(c)) by July 1, 1994.

(3) *Step 3:* The State shall designate optimal corrosion control treatment (§ 141.82(d)) by January 1, 1995.

(4) *Step 4:* The system shall install optimal corrosion control treatment (§ 141.82(e)) by January 1, 1997.

(5) *Step 5:* The system shall complete follow-up sampling (§ 141.86(d)(2) and § 141.87(c)) by January 1, 1998.

(6) *Step 6:* The State shall review installation of treatment and designate optimal water quality control parameters (§ 141.82(f)) by July 1, 1998.

(7) *Step 7:* The system shall operate in compliance with the State-specified optimal water quality control parameters (§ 141.82(g)) and continue to conduct tap sampling (§ 141.86(d)(3) and § 141.87(d)).

(e) *Treatment Steps and deadlines for small and medium-size systems.* Except as provided in paragraph (b) of this section, small and medium-size systems shall complete the following corrosion control treatment steps (described in the referenced portions of §§ 141.82, 141.86 and 141.87) by the indicated time periods.

(1) *Step 1:* The system shall conduct initial tap sampling (§ 141.86(d)(1) and § 141.87(b)) until the system either exceeds the lead or copper action level or becomes eligible for reduced monitoring under § 141.86(d)(4). A system exceeding the lead or copper action level shall recommend optimal corrosion control treatment (§ 141.82(a)) within six months after it exceeds one of the action levels.

(2) *Step 2:* Within 12 months after a system exceeds the lead or copper action level, the State may require the system to perform corrosion control studies (§ 141.82(b)). If the State does not require the system to perform such studies, the State shall specify optimal corrosion control treatment (§ 141.82(d)) within the following timeframes:

(i) for medium-size systems, within 18 months after such system exceeds the lead or copper action level,

(ii) for small systems, within 24 months after such system exceeds the lead or copper action level.

(3) *Step 3:* If the State requires a system to perform corrosion control studies under step 2, the system shall complete the studies (§ 141.82(c)) within 18 months after the State requires that such studies be conducted.

(4) *Step 4:* If the system has performed corrosion control studies under step 2, the State shall designate optimal corrosion control treatment (§ 141.82(d)) within 6 months after completion of step 3.

(5) *Step 5:* The system shall install optimal corrosion control treatment (§ 141.82(e)) within 24 months after the State designates such treatment.

(6) *Step 6:* The system shall complete follow-up sampling (§ 141.86(d)(2) and § 141.87(c)) within 36 months after the State designates optimal corrosion control treatment.

(7) *Step 7:* The State shall review the system's installation of treatment and designate optimal water quality control parameters (§ 141.82(f)) within 6 months after completion of step 6.

(8) *Step 8:* The system shall operate in compliance with the State-designated optimal water quality control parameters (§ 141.82(g)) and continue to conduct tap sampling (§ 141.86(d)(3) and § 141.87(d)).

§ 141.82 Description of corrosion control treatment requirements.

Each system shall complete the corrosion control treatment requirements described below which are applicable to such system under § 141.81.

(a) *System recommendation regarding corrosion control treatment.* Based upon the results of lead and copper tap monitoring and water quality parameter monitoring, small and medium-size water systems exceeding the lead or copper action level shall recommend installation of one or more of the corrosion control treatments listed in paragraph (c)(1) of this section which the system believes constitutes optimal corrosion control for that system. The State may require the system to conduct additional water quality parameter monitoring in accordance with § 141.87(b) to assist the State in reviewing the system's recommendation.

(b) *State decision to require studies of corrosion control treatment (applicable to small and medium-size systems).* The State may require any small or medium-size system that exceeds the lead or copper action level to perform corrosion control studies under paragraph (c) of this section to identify optimal corrosion control treatment for the system.

(c) *Performance of corrosion control studies.* (1) Any public water system performing corrosion control studies shall evaluate the effectiveness of each of the following treatments, and, if appropriate, combinations of the following treatments to identify the optimal corrosion control treatment for that system:

(i) Alkalinity and pH adjustment;

(ii) Calcium hardness adjustment; and

(iii) The addition of a phosphate or silicate based corrosion inhibitor at a concentration sufficient to maintain an effective residual concentration in all test tap samples.

(2) The water system shall evaluate each of the corrosion control treatments using either pipe rig/loop tests, metal coupon tests, partial-system tests, or analyses based on documented analogous treatments with other systems of similar size, water chemistry and distribution system configuration.

(3) The water system shall measure the following water quality parameters in any tests conducted under this paragraph before and after evaluating

the corrosion control treatments listed above:

(i) Lead;

(ii) Copper;

(iii) pH;

(iv) Alkalinity;

(v) Calcium;

(vi) Conductivity;

(vii) Orthophosphate (when an inhibitor containing a phosphate compound is used);

(viii) Silicate (when an inhibitor containing a silicate compound is used);

(ix) Water temperature.

(4) The water system shall identify all chemical or physical constraints that limit or prohibit the use of a particular corrosion control treatment and document such constraints with at least one of the following:

(i) Data and documentation showing that a particular corrosion control treatment has adversely affected other water treatment processes when used by another water system with comparable water quality characteristics; and/or

(ii) Data and documentation demonstrating that the water system has previously attempted to evaluate a particular corrosion control treatment and has found that the treatment is ineffective or adversely affects other water quality treatment processes.

(5) The water system shall evaluate the effect of the chemicals used for corrosion control treatment on other water quality treatment processes.

(6) On the basis of an analysis of the data generated during each evaluation, the water system shall recommend to the State in writing the treatment option that the corrosion control studies indicate constitutes optimal corrosion control treatment for that system. The water system shall provide a rationale for its recommendation along with all supporting documentation specified in paragraphs (c)(1) through (5) of this section.

(d) *State designation of optimal corrosion control treatment.* (1) Based upon consideration of available information including, where applicable, studies performed under paragraph (c) of this section and a system's recommended treatment alternative, the State shall either approve the corrosion control treatment option recommended by the system, or designate alternative corrosion control treatment(s) from among those listed in paragraph (c)(1) of this section. When designating optimal treatment the State shall consider the effects that additional corrosion control treatment will have on water quality parameters and on other water quality treatment processes.

(2) The State shall notify the system of its decision on optimal corrosion control treatment in writing and explain the basis for this determination. If the State requests additional information to aid its review, the water system shall provide the information.

(e) *Installation of optimal corrosion control.* Each system shall properly install and operate throughout its distribution system the optimal corrosion control treatment designated by the State under paragraph (d) of this section.

(f) *State review of treatment and specification of optimal water quality control parameters.* The State shall evaluate the results of all lead and copper tap samples and water quality parameter samples submitted by the water system and determine whether the system has properly installed and operated the optimal corrosion control treatment designated by the State in paragraph (d) of this section. Upon reviewing the results of tap water and water quality parameter monitoring by the system, both before and after the system installs optimal corrosion control treatment, the State shall designate:

(1) A minimum value or a range of values for pH measured at each entry point to the distribution system;

(2) A minimum pH value, measured in all tap samples. Such value shall be equal to or greater than 7.0, unless the State determines that meeting a pH level of 7.0 is not technologically feasible or is not necessary for the system to optimize corrosion control;

(3) If a corrosion inhibitor is used, a minimum concentration or a range of concentrations for the inhibitor, measured at each entry point to the distribution system and in all tap samples, that the State determines is necessary to form a passivating film on the interior walls of the pipes of the distribution system;

(4) If alkalinity is adjusted as part of optimal corrosion control treatment, a minimum concentration or a range of concentrations for alkalinity, measured at each entry point to the distribution system and in all tap samples;

(5) If calcium carbonate stabilization is used as part of corrosion control, a minimum concentration or a range of concentrations for calcium, measured in all tap samples.

The values for the applicable water quality control parameters listed above shall be those that the State determines to reflect optimal corrosion control treatment for the system. The State may designate values for additional water quality control parameters determined by the State to reflect optimal corrosion control for the system. The State shall notify the system in writing of these determinations and explain the basis for its decisions.

(g) *Continued Operation and Monitoring.* All systems shall maintain water quality parameter values at or above minimum values or within ranges designated by the State under paragraph (f) of this section in each sample collected under § 141.87(d). If the water quality parameter value of any sample is below the minimum value or outside the range designated by the State, then the system is out of compliance with this paragraph. As specified in § 141.87(d), the system may take a confirmation sample for any water quality parameter value no later than 3 days after the first sample. If a confirmation sample is taken, the result must be averaged with the first sampling result and the average must be used for any compliance determinations under this paragraph. States have discretion to delete results of obvious sampling errors from this calculation.

(h) *Modification of State treatment decisions.* Upon its own initiative or in response to a request by a water system or other interested party, a State may modify its determination of the optimal corrosion control treatment under paragraph (d) of this section or optimal water quality control parameters under paragraph (f) of this section. A request for modification by a system or other interested party shall be in writing, explain why the modification is appropriate, and provide supporting documentation. The State may modify its determination where it concludes that such change is necessary to ensure that the system continues to optimize corrosion control treatment. A revised determination shall be made in writing, set forth the new treatment requirements, explain the basis for the State's decision, and provide an implementation schedule for completing the treatment modifications.

(i) *Treatment decisions bv EPA in lieu of the State.* Pursuant to the procedures in § 142.19, the EPA Regional Administrator may review treatment determinations made by a State under paragraphs (d), (f), or (h) of this section and issue federal treatment determinations consistent with the requirements of those paragraphs where the Regional Administrator finds that:

(1) a State has failed to issue a treatment determination by the applicable deadlines contained in § 141.81,

(2) a State has abused its discretion in a substantial number of cases or in

cases affecting a substantial population, or

(3) the technical aspects of a State's determination would be indefensible in an expected Federal enforcement action taken against a system.

§ 141.83 Source water treatment requirements.

Systems shall complete the applicable source water monitoring and treatment requirements (described in the referenced portions of paragraph (b) of this section, and in §§ 141.86, and 141.88) by the following deadlines.

(a) *Deadlines for Completing Source Water Treatment Steps—(1) Step 1:* A system exceeding the lead or copper action level shall complete lead and copper source water monitoring (§ 141.88(b)) and make a treatment recommendation to the State (§ 141.83(b)(1)) within 6 months after exceeding the lead or copper action level.

(2) *Step 2:* The State shall make a determination regarding source water treatment (§ 141.83(b)(2)) within 6 months after submission of monitoring results under step 1.

(3) *Step 3:* If the State requires installation of source water treatment, the system shall install the treatment (§ 141.83(b)(3)) within 24 months after completion of step 2.

(4) *Step 4:* The system shall complete follow-up tap water monitoring (§ 141.86(d)(2) and source water monitoring (§ 141.88(c)) within 36 months after completion of step 2.

(5) *Step 5:* The State shall review the system's installation and operation of source water treatment and specify maximum permissible source water levels (§ 141.83(b)(4)) within 6 months after completion of step 4.

(6) *Step 6:* The system shall operate in compliance with the State-specified maximum permissible lead and copper source water levels (§ 141.83(b)(4)) and continue source water monitoring (§ 141.88(d)).

(b) *Description of Source Water Treatment Requirements*— (1) *System treatment recommendation.* Any system which exceeds the lead or copper action level shall recommend in writing to the State the installation and operation of one of the source water treatments listed in paragraph (b)(2) of this section. A system may recommend that no treatment be installed based upon a demonstration that source water treatment is not necessary to minimize lead and copper levels at users' taps.

(2) *State determination regarding source water treatment.* The State shall complete an evaluation of the results of all source water samples submitted by the water system to determine whether source water treatment is necessary to minimize lead or copper levels in water delivered to users' taps. If the State determines that treatment is needed, the State shall either require installation and operation of the source water treatment recommended by the system (if any) or require the installation and operation of another source water treatment from among the following: ion exchange, reverse osmosis, lime softening or coagulation/filtration. If the State requests additional information to aid in its review, the water system shall provide the information by the date specified by the State in its request. The State shall notify the system in writing of its determination and set forth the basis for its decision.

(3) *Installation of source water treatment.* Each system shall properly install and operate the source water treatment designated by the State under paragraph (b)(2) of this section.

(4) *State review of source water treatment and specification of maximum permissible source water levels.* The State shall review the source water samples taken by the water system both before and after the system installs source water treatment, and determine whether the system has properly installed and operated the source water treatment designated by the State. Based upon its review, the State shall designate the maximum permissible lead and copper concentrations for finished water entering the distribution system. Such levels shall reflect the contaminant removal capability of the treatment properly operated and maintained. The State shall notify the system in writing and explain the basis for its decision.

(5) *Continued operation and maintenance.* Each water system shall maintain lead and copper levels below the maximum permissible concentrations designated by the State at each sampling point monitored in accordance with § 141.88. The system is out of compliance with this paragraph if the level of lead or copper at any sampling point is greater than the maximum permissible concentration designated by the State.

(6) *Modification of State treatment decisions.* Upon its own initiative or in response to a request by a water system or other interested party, a State may modify its determination of the source water treatment under paragraph (b)(2) of this section, or maximum permissible lead and copper concentrations for finished water entering the distribution system under paragraph (b)(4) of this section. A request for modification by a system or other interested party shall be in writing, explain why the modification is appropriate, and provide supporting documentation. The State may modify its determination where it concludes that such change is necessary to ensure that the system continues to minimize lead and copper concentrations in source water. A revised determination shall be made in writing, set forth the new treatment requirements, explain the basis for the State's decision, and provide an implementation schedule for completing the treatment modifications.

(7) *Treatment decisions by EPA in lieu of the State.* Pursuant to the procedures in § 142.19, the EPA Regional Administrator may review treatment determinations made by a State under paragraphs (b) (2), (4), or (6) of this section and issue Federal treatment determinations consistent with the requirements of those paragraphs where the Administrator finds that:

(i) A State has failed to issue a treatment determination by the applicable deadlines contained in Section 141.83(a),

(ii) A state has abused its discretion in a substantial number of cases or in cases affecting a substantial population, or

(iii) The technical aspects of a State's determination would be indefensible in an expected Federal enforcement action taken against a system.

§ 141.84 Lead service line replacement requirements.

(a) Systems that fail to meet the lead action level in tap samples taken pursuant to § 141.86(d)(2), after installing corrosion control and/or source water treatment (whichever sampling occurs later), shall replace lead service lines in accordance with the requirements of this section. If a system is in violation of § 141.81or § 141.83 for failure to install source water or corrosion control treatment, the State may require the system to commence lead service line replacement under this section after the date by which the system was required to conduct monitoring under § 141.86(d)(2) has passed.

(b) A system shall replace annually at least 7 percent of the initial number of lead service lines in its distribution system. The initial number of lead service lines is the number of lead lines in place at the time the replacement program begins. The system shall identify the initial number of lead service lines in its distribution system based upon a materials evaluation, including the evaluation required under § 141.86(a). The first year of lead service line replacement shall begin on the date the action level was exceeded in tap

sampling referenced in paragraph (a) of this section.

(c) A system is not required to replace an individual lead service line if the lead concentration in all service line samples from that line, taken pursuant to § 141.86(b)(3), is less than or equal to 0.015 mg/L.

(d) A water system shall replace the entire service line (up to the building inlet) unless it demonstrates to the satisfaction of the State under paragraph (e) of this section that it controls less than the entire service line. In such cases, the system shall replace the portion of the line which the State determines is under the system's control. The system shall notify the user served by the line that the system will replace the portion of the service line under its control and shall offer to replace the building owner's portion of the line, but is not required to bear the cost of replacing the building owner's portion of the line. For buildings where only a portion of the lead service line is replaced, the water system shall inform the resident(s) that the system will collect a first flush tap water sample after partial replacement of the service line is completed if the resident(s) so desire. In cases where the resident(s) accept the offer, the system shall collect the sample and report the results to the resident(s) within 14 days following partial lead service line replacement.

(e) A water system is presumed to control the entire lead service line (up to the building inlet) unless the system demonstrates to the satisfaction of the State, in a letter submitted under § 141.90(e)(4), that it does not have any of the following forms of control over the entire line (as defined by state statutes, municipal ordinances, public service contracts or other applicable legal authority): authority to set standards for construction, repair, or maintenance of the line, authority to replace, repair, or maintain the service line, or ownership of the service line. The State shall review the information supplied by the system and determine whether the system controls less than the entire service line and, in such cases, shall determine the extent of the system's control. The State's determination shall be in writing and explain the basis for its decision.

(f) The State shall require a system to replace lead service lines on a shorter schedule than that required by this section, taking into account the number of lead service lines in the system, where such a shorter replacement schedule is feasible. The State shall make this determination in writing and notify the system of its finding within 6 months after the system is triggered into lead service line replacement based on monitoring referenced in paragraph (a) of this section.

(g) Any system may cease replacing lead service lines whenever lead service line samples collected pursuant to § 141.86(d)(3) meet the lead action level during each of two consecutive monitoring periods and the system submits the results to the State. If the lead service line samples in any such water system thereafter exceeds the lead action level, the system shall recommence replacing lead service lines, pursuant to paragraph (b) in this section.

(h) To demonstrate compliance with paragraphs (a) through (d) of this section, a system shall report to the State the information specified in § 141.90(e).

§ 141.85 Public education and supplemental monitoring requirements.

A water system that exceeds the lead action level based on tap water samples collected in accordance with § 141.86 shall deliver the public education materials contained in paragraphs (a) and (b) of this section in accordance with the requirements in paragraph (c) of this section.

(a) Content of written materials. A water system shall include the following text in all of the printed materials it distributes through its lead public education program. Any additional information presented by a system shall be consistent with the information below and be in plain English that can be understood by laypersons.

(1) *Introduction.* The United States Environmental Protection Agency (EPA) and [insert name of water supplier] are concerned about lead in your drinking water. Although most homes have very low levels of lead in their drinking water, some homes in the community have lead levels above the EPA action level of 15 parts per billion (ppb), or 0.015 milligrams of lead per liter of water (mg/L). Under Federal law we are required to have a program in place to minimize lead in your drinking water by [insert date when corrosion control will be completed for your system]. This program includes corrosion control treatment, source water treatment, and public education. We are also required to replace each lead service line that we control if the line contributes lead concentrations of 15 ppb or more after we have completed the comprehensive treatment program. If you have any questions about how we are carrying out the requirements of the lead regulation please give us a call at [insert water system's phone number]. This brochure explains the simple steps you can take to protect you and your family by reducing your exposure to lead in drinking water.

(2) *Health effects of lead.* Lead is a common metal found throughout the environment in lead-based paint, air, soil, household dust, food, certain types of pottery porcelain and pewter, and water. Lead can pose a significant risk to your health if too much of it enters your body. Lead builds up in the body over many years and can cause damage to the brain, red blood cells and kidneys. The greatest risk is to young children and pregnant women. Amounts of lead that won't hurt adults can slow down normal mental and physical development of growing bodies. In addition, a child at play often comes into contact with sources of lead contamination—like dirt and dust—that rarely affect an adult. It is important to wash children's hands and toys often, and to try to make sure they only put food in their mouths.

(3) *Lead in Drinking Water.* (i) Lead in drinking water, although rarely the sole cause of lead poisoning, can significantly increase a person's total lead exposure, particularly the exposure of infants who drink baby formulas and concentrated juices that are mixed with water. The EPA estimates that drinking water can make up 20 percent or more of a person's total exposure to lead.

(ii) Lead is unusual among drinking water contaminants in that it seldom occurs naturally in water supplies like rivers and lakes. Lead enters drinking water primarily as a result of the corrosion, or wearing away, of materials containing lead in the water distribution system and household plumbing. These materials include lead-based solder used to join copper pipe, brass and chrome plated brass faucets, and in some cases, pipes made of lead that connect your house to the water main (service lines). In 1986, Congress banned the use of lead solder containing greater than 0.2% lead, and restricted the lead content of faucets, pipes and other plumbing materials to 8.0%.

(iii) When water stands in lead pipes or plumbing systems containing lead for several hours or more, the lead may dissolve into your drinking water. This means the first water drawn from the tap in the morning, or later in the afternoon after returning from work or school, can contain fairly high levels of lead.

(4) *Steps You Can Take in the Home To Reduce Exposure To Lead in Drinking Water.* (i) Despite our best efforts mentioned earlier to control water corrosivity and remove lead from the water supply, lead

levels in some homes or buildings can be high. To find out whether you need to take action in your own home, have your drinking water tested to determine if it contains excessive concentrations of lead. Testing the water is essential because you cannot see, taste, or smell lead in drinking water. Some local laboratories that can provide this service are listed at the end of this booklet. For more information on having your water tested, please call [insert phone number of water system].

(ii) If a water test indicates that the drinking water drawn from a tap in your home contains lead above 15 ppb, then you should take the following precautions:

(A) Let the water run from the tap before using it for drinking or cooking any time the water in a faucet has gone unused for more than six hours. The longer water resides in your home's plumbing the more lead it may contain. Flushing the tap means running the cold water faucet until the water gets noticeably colder, usually about 15–30 seconds. If your house has a lead service line to the water main, you may have to flush the water for a longer time, perhaps one minute, before drinking. Although toilet flushing or showering flushes water through a portion of your home's plumbing system, you still need to flush the water in each faucet before using it for drinking or cooking. Flushing tap water is a simple and inexpensive measure you can take to protect your family's health. It usually uses less than one or two gallons of water and costs less than [insert a cost estimate based on flushing two times a day for 30 days] per month. To conserve water, fill a couple of bottles for drinking water after flushing the tap, and whenever possible use the first flush water to wash the dishes or water the plants. If you live in a high-rise building, letting the water flow before using it may not work to lessen your risk from lead. The plumbing systems have more, and sometimes larger pipes than smaller buildings. Ask your landlord for help in locating the source of the lead and for advice on reducing the lead level.

(B) Try not to cook with, or drink water from the hot water tap. Hot water can dissolve more lead more quickly than cold water. If you need hot water, draw water from the cold tap and heat it on the stove.

(C) Remove loose lead solder and debris from the plumbing materials installed in newly constructed homes, or homes in which the plumbing has recently been replaced, by removing the faucet strainers from all taps and running the water from 3 to 5 minutes. Thereafter, periodically remove the strainers and flush out any debris that has accumulated over time.

(D) If your copper pipes are joined with lead solder that has been installed illegally since it was banned in 1986, notify the plumber who did the work and request that he or she replace the lead solder with lead-free solder. Lead solder looks dull gray, and when scratched with a key looks shiny. In addition, notify your State [insert name of department responsible for enforcing the Safe Drinking Water Act in your State] about the violation.

(E) Determine whether or not the service line that connects your home or apartment to the water main is made of lead. The best way to determine if your service line is made of lead is by either hiring a licensed plumber to inspect the line or by contacting the plumbing contractor who installed the line. You can identify the plumbing contractor by checking the city's record of building permits which should be maintained in the files of the [insert name of department that issues building permits]. A licensed plumber can at the same time check to see if your homes's plumbing contains lead solder, lead pipes, or pipe fittings that contain lead. The public water system that delivers water to your home should also maintain records of the materials located in the distribution system. If the service line that connects your dwelling to the water main contributes more than 15 ppb to drinking water, after our comprehensive treatment program is in place, we are required to replace the line. If the line is only partially controlled by the [insert name of the city, county, or water system that controls the line], we are required to provide you with information on how to replace your portion of the service line, and offer to replace that portion of the line at your expense and take a follow-up tap water sample within 14 days of the replacement. Acceptable replacement alternatives include copper, steel, iron, and plastic pipes.

(F) Have an electrician check your wiring. If grounding wires from the electrical system are attached to your pipes, corrosion may be greater. Check with a licensed electrician or your local electrical code to determine if your wiring can be grounded elsewhere. DO NOT attempt to change the wiring yourself because improper grounding can cause electrical shock and fire hazards.

(iii) The steps described above will reduce the lead concentrations in your drinking water. However, if a water test indicates that the drinking water coming from your tap contains lead concentrations in excess of 15 ppb after flushing, or after we have completed our actions to minimize lead levels, then you may want to take the following additional measures:

(A) Purchase or lease a home treatment device. Home treatment devices are limited in that each unit treats only the water that flows from the faucet to which it is connected, and all of the devices require periodic maintenance and replacement. Devices such as reverse osmosis systems or distillers can effectively remove lead from your drinking water. Some activated carbon filters *may* reduce lead levels at the tap, however all lead reduction claims should be investigated. Be sure to check the actual performance of a specific home treatment device before and after installing the unit.

(B) Purchase bottled water for drinking and cooking.

(iv) You can consult a variety of sources for additional information. Your family doctor or pediatrician can perform a blood test for lead and provide you with information about the health effects of lead. State and local government agencies that can be contacted include:

(A) [insert the name of city or county department of public utilities] at [insert phone number] can provide you with information about your community's water supply, and a list of local laboratories that have been certified by EPA for testing water quality;

(B) [insert the name of city of county department that issues building permits] at [insert phone number] can provide you with information about building permit records that should contain the names of plumbing contractors that plumbed your home; and

(C) [insert the name of the State Department of Public Health] at [insert phone number] or the [insert the name of the city or county health department] at [insert phone number] can provide you with information about the health effects of lead and how you can have your child's blood tested.

(v) The following is a list of some State approved laboratories in your area that you can call to have your water tested for lead. [Insert names and phone numbers of at least two laboratories].

(b) *Content of broadcast materials.* A water system shall include the following information in all public service announcements submitted under its lead public education program to television and radio stations for broadcasting:

(1) Why should everyone want to know the facts about lead and drinking water? Because unhealthy amounts of lead can enter drinking water through the plumbing in your home. That's why I

urge you to do what I did. I had my water tested for [insert free or $ per sample]. You can contact the [insert the name of the city or water system] for information on testing and on simple ways to reduce your exposure to lead in drinking water.

(2) To have your water tested for lead, or to get more information about this public health concern, please call [insert the phone number of the city or water system].

(c) *Delivery of a public education program.* (1) In communities where a significant proportion of the population speaks a language other than English, public education materials shall be communicated in the appropriate language(s).

(2) A community water system that fails to meet the lead action level on the basis of tap water samples collected in accordance with § 141.86 shall, within 60 days:

(i) insert notices in each customer's water utility bill containing the information in paragraph (a) of this section, along with the following alert on the water bill itself in large print: "SOME HOMES IN THIS COMMUNITY HAVE ELEVATED LEAD LEVELS IN THEIR DRINKING WATER. LEAD CAN POSE A SIGNIFICANT RISK TO YOUR HEALTH. PLEASE READ THE ENCLOSED NOTICE FOR FURTHER INFORMATION."

(ii) submit the information in paragraph (a) of this section to the editorial departments of the major daily and weekly newspapers circulated throughout the community.

(iii) deliver pamphlets and/or brochures that contain the public education materials in paragraphs (a) (2) and (4) of this section to facilities and organizations, including the following:

(A) public schools and/or local school boards;

(B) city or county health department;

(C) Women, Infants, and Children and/or Head Start Program(s) whenever available;

(D) public and private hospitals and/or clinics;

(E) pediatricians;

(F) family planning clinics; and

(G) local welfare agencies.

(iv) submit the public service announcement in paragraph (b) of this section to at least five of the radio and television stations with the largest audiences that broadcast to the community served by the water system.

(3) A community water system shall repeat the tasks contained in paragraphs (c)(2) (i), (ii) and (iii) of this section every 12 months, and the tasks contained in paragraphs (c)(2)(iv) of this section every 6 months for as long as the system exceeds the lead action level.

(4) Within 60 days after it exceeds the lead action level, a non-transient non-community water system shall deliver the public education materials contained in paragraphs (a) (1), (2), and (4) of this section as follows:

(i) post informational posters on lead in drinking water in a public place or common area in each of the buildings served by the system; and

(ii) distribute informational pamphlets and/or brochures on lead in drinking water to each person served by the non-transient non-community water system.

(5) A non-transient non-community water system shall repeat the tasks contained in paragraph (c)(4) of this section at least once during each calendar year in which the system exceeds the lead action level.

(6) A water system may discontinue delivery of public education materials if the system has met the lead action level during the most recent six-month monitoring period conducted pursuant to § 141.86. Such a system shall recommence public education in accordance with this section if it subsequently exceeds the lead action level during any monitoring period.

(d) Supplemental monitoring and notification of results.

A water system that fails to meet the lead action level on the basis of tap samples collected in accordance with § 141.86 shall offer to sample the tap water of any customer who requests it. The system is not required to pay for collecting or analyzing the sample, nor is the system required to collect and analyze the sample itself.

§ 141.86 Monitoring requirements for lead and copper in tap water.

(a) *Sample site location.* (1) By the applicable date for commencement of monitoring under paragraph (d)(1) of this section, each water system shall complete a materials evaluation of its distribution system in order to identify a pool of targeted sampling sites that meets the requirements of this section, and which is sufficiently large to ensure that the water system can collect the number of lead and copper tap samples required in paragraph (c) of this section. All sites from which first draw samples are collected shall be selected from this pool of targeted sampling sites. Sampling sites may not include faucets that have point-of-use or point-of-entry treatment devices designed to remove inorganic contaminants.

(2) A water system shall use the information on lead, copper, and galvanized steel that it is required to collect under § 141.42(d) of this part [special monitoring for corrosivity characteristics] when conducting a materials evaluation. When an evaluation of the information collected pursuant to § 141.42(d) is insufficient to locate the requisite number of lead and copper sampling sites that meet the targeting criteria in paragraph (a) of this section, the water system shall review the sources of information listed below in order to identify a sufficient number of sampling sites. In addition, the system shall seek to collect such information where possible in the course of its normal operations (e.g., checking service line materials when reading water meters or performing maintenance activities):

(i) all plumbing codes, permits, and records in the files of the building department(s) which indicate the plumbing materials that are installed within publicly and privately owned structures connected to the distribution system;

(ii) all inspections and records of the distribution system that indicate the material composition of the service connections that connect a structure to the distribution system; and

(iii) all existing water quality information, which includes the results of all prior analyses of the system or individual structures connected to the system, indicating locations that may be particularly susceptible to high lead or copper concentrations.

(3) The sampling sites selected for a community water system's sampling pool ("tier 1 sampling sites") shall consist of single family structures that:

(i) contain copper pipes with lead solder installed after 1982 or contain lead pipes; and/or

(ii) are served by a lead service line. When multiple-family residences comprise at least 20 percent of the structures served by a water system, the system may include these types of structures in its sampling pool.

(4) Any community water system with insufficient tier 1 sampling sites shall complete its sampling pool with "tier 2 sampling sites", consisting of buildings, including multiple-family residences that:

(i) contain copper pipes with lead solder installed after 1982 or contain lead pipes; and/or

(ii) are served by a lead service line.

(5) Any community water system with insufficient tier 1 and tier 2 sampling sites shall complete its sampling pool with "tier 3 sampling sites", consisting of single family structures that contain copper pipes with lead solder installed before 1983.

(6) The sampling sites selected for a non-transient noncommunity water system ("tier 1 sampling sites") shall consist of buildings that:

(i) contain copper pipes with lead solder installed after 1982 or contain lead pipes; and/or

(ii) are served by a lead service line.

(7) A non-transient non-community water system with insufficient tier 1 sites that meet the targeting criteria in paragraph (a)(6) of this section shall complete its sampling pool with sampling sites that contain copper pipes with lead solder installed before 1983.

(8) Any water system whose sampling pool does not consist exclusively of tier 1 sites shall demonstrate in a letter submitted to the State under § 141.90(a)(2) why a review of the information listed in paragraph (a)(2) of this section was inadequate to locate a sufficient number of tier 1 sites. Any community water system which includes tier 3 sampling sites in its sampling pool shall demonstrate in such a letter why it was unable to locate a sufficient number of tier 1 and tier 2 sampling sites.

(9) Any water system whose distribution system contains lead service lines shall draw 50 percent of the samples it collects during each monitoring period from sites that contain lead pipes, or copper pipes with lead solder, and 50 percent of those samples from sites served by a lead service line. A water system that cannot identify a sufficient number of sampling sites served by a lead service line shall demonstrate in a letter submitted to the State under § 141.90(a)(4) why the system was unable to locate a sufficient number of such sites. Such a water system shall collect lead service line samples from all of the sites identified as being served by such lines.

(b) *Sample collection methods.* (1) All tap samples for lead and copper collected in accordance with this subpart, with the exception of lead service line samples collected under § 141.84(c), shall be first draw samples.

(2) Each first-draw tap sample for lead and copper shall be one liter in volume and have stood motionless in the plumbing system of each sampling site for at least six hours. First draw samples from residential housing shall be collected from the cold-water kitchen tap or bathroom sink tap. First-draw samples from a non-residential building shall be collected at an interior tap from which water is typically drawn for consumption. First draw samples may be collected by the system or the system may allow residents to collect first draw samples after instructing the residents of the sampling procedures specified in this paragraph. If a system allows residents to perform sampling, the system may not challenge, based on alleged errors in sample collection, the accuracy of sampling results.

(3) Each service line sample shall be one liter in volume and have stood motionless in the lead service line for at least six hours. Lead service line samples shall be collected in one of the following three ways:

(i) at the tap after flushing the volume of water between the tap and the lead service line. The volume of water shall be calculated based on the interior diameter and length of the pipe between the tap and the lead service line;

(ii) tapping directly into the lead service line; or

(iii) if the sampling site is a building constructed as a single-family residence, allowing the water to run until there is a significant change in temperature which would be indicative of water that has been standing in the lead service line.

(4) A water system shall collect each first draw tap sample from the same sampling site from which it collected a previous sample. If, for any reason, the water system cannot gain entry to a sampling site in order to collect a follow-up tap sample, the system may collect the follow-up tap sample from another sampling site in its sampling pool as long as the new site meets the same targeting criteria, and is within reasonable proximity of the original site.

(c) *Number of samples.* Water systems shall collect at least one sample during each monitoring period specified in paragraph (d) of this section from the number of sites listed in the first column below ("standard monitoring"). A system conducting reduced monitoring under paragraph (d)(4) of this section may collect one sample from the number of sites specified in the second column below during each monitoring period specified in paragraph (d)(4) of this section.

System size (No. people served)	No. of sites (standard monitoring)	No. of sites (reduced monitoring)
>100,000	100	50
10,001-100,000	60	30
3,301 to 10,000	40	20
501 to 3,300	20	10
101 to 500	10	5
<100	5	5

(d) *Timing of monitoring*—(1) *Initial tap sampling.*

The first six-month monitoring period for small, medium-size and large systems shall begin on the following dates:

System size (No. people served)	First six-month monitoring period begins on
>50,000	January 1, 1992.
3,301 to 50,000	July 1, 1992.
<3,300	July 1, 1993.

(i) All large systems shall monitor during two consecutive six-month periods.

(ii) All small and medium-size systems shall monitor during each six-month monitoring period until:

(A) the system exceeds the lead or copper action level and is therefore required to implement the corrosion control treatment requirements under § 141.81, in which case the system shall continue monitoring in accordance with paragraph (d)(2) of this section, or

(B) the system meets the lead or copper action levels during two consecutive six-month monitoring periods, in which case the system may reduce monitoring in accordance with paragraph (d)(4) of this section.

(2) *Monitoring after installation of corrosion control and source water treatment.* (i) Any large system which installs optimal corrosion control treatment pursuant to § 141.81(d)(4) shall monitor during two consecutive six-month monitoring periods by the date specified in § 141.81(d)(5).

(ii) Any small or medium-size system which installs optimal corrosion control treatment pursuant to § 141.81(e)(5) shall monitor during two consecutive six-month monitoring periods by the date specified in § 141.81(e)(6).

(iii) Any system which installs source water treatment pursuant to § 141.83(a)(3) shall monitor during two consecutive six-month monitoring periods by the date specified in § 141.83(a)(4).

(3) *Monitoring after State specifies water quality parameter values for optimal corrosion control.* After the State specifies the values for water quality control parameters under § 141.82(f), the system shall monitor during each subsequent six-month monitoring period, with the first monitoring period to begin on the date the State specifies the optimal values under § 141.82(f).

(4) *Reduced monitoring.* (i) A small or medium-size water system that meets the lead and copper action levels during each of two consecutive six-month monitoring periods may reduce the number of samples in accordance with paragraph (c) of this section, and reduce the frequency of sampling to once per year.

(ii) Any water system that maintains the range of values for the water quality control parameters reflecting optimal corrosion control treatment specified by the State under § 141.82(f) during each of two consecutive six-month monitoring periods may request that the State allow the system to reduce the frequency of monitoring to once per year and to reduce the number of lead and copper samples in accordance with paragraph (c) of this section. The State shall review the information submitted by the water system and shall make its decision in writing, setting forth the basis for its determination. The State shall review, and where appropriate, revise its determination when the system submits new monitoring or treatment data, or when other data relevant to the number and frequency of tap sampling becomes available.

(iii) A small or medium-size water system that meets the lead and copper action levels during three consecutive years of monitoring may reduce the frequency of monitoring for lead and copper from annually to once every three years. Any water system that maintains the range of values for the water quality control parameters reflecting optimal corrosion control treatment specified by the State under § 141.82(f) during three consecutive years of monitoring may request that the State allow the system to reduce the frequency of monitoring from annually to once every three years. The State shall review the information submitted by the water system and shall make its decision in writing, setting forth the basis for its determination. The State shall review, and where appropriate, revise its determination when the system submits new monitoring or treatment data, or when other data relevant to the number and frequency of tap sampling becomes available.

(iv) A water system that reduces the number and frequency of sampling shall collect these samples from sites included in the pool of targeted sampling sites identified in paragraph (a) of this section. Systems sampling annually or less frequently shall conduct the lead and copper tap sampling during the months of June, July, August or September.

(v) A small or medium-size water system subject to reduced monitoring that exceeds the lead or copper action level shall resume sampling in accordance with paragraph (d)(3) of this section and collect the number of samples specified for standard monitoring under paragraph (c) of this section. Any water system subject to reduced monitoring frequency that fails to operate within the range of values for the water quality control parameters specified by the State under § 141.82(f) shall resume tap water sampling in accordance with paragraph (d)(3) of this section and collect the number of samples specified for standard monitoring under paragraph (c) of this section.

(e) *Additional monitoring by systems.* The results of any monitoring conducted in addition to the minimum requirements of this section shall be considered by the system and the State in making any determinations (i.e., calculating the 90th percentile lead or copper level) under this subpart.

§ 141.87 Monitoring requirements for water quality parameters.

All large water systems and all small and medium-size systems that exceed the lead or copper action level shall monitor water quality parameters in addition to lead and copper in accordance with this section. The requirements of this section are summarized in the table at the end of this section.

(a) *General Requirements*—(1) *Sample collection methods.* (i) Tap samples shall be representative of water quality throughout the distribution system taking into account the number of persons served, the different sources of water, the different treatment methods employed by the system, and seasonal variability. Tap sampling under this section is not required to be conducted at taps targeted for lead and copper sampling under § 141.86(a). [Note: Systems may find it convenient to conduct tap sampling for water quality parameters at sites used for coliform sampling under 40 CFR § 141.21.]

(ii) Samples collected at the entry point(s) to the distribution system shall be from locations representative of each source after treatment. If a system draws water from more than one source and the sources are combined before distribution, the system must sample at an entry point to the distribution system during periods of normal operating conditions (i.e., when water is representative of all sources being used).

(2) *Number of samples.* (i) Systems shall collect two tap samples for applicable water quality parameters during each monitoring period specified under paragraphs (b) through (e) of this section from the following number of sites.

System size (No. people served)	No. of sites for water quality parameters
>100,000	25
10,0001-100,000	10
3,301 to 10,000	3
501 to 3,300	2
101 to 500	1
<100	1

(ii) Systems shall collect two samples for each applicable water quality parameter at each entry point to the distribution system during each monitoring period specified in paragraph (b) of this section. During each monitoring period specified in paragraphs (c)–(e) of this section, systems shall collect one sample for each applicable water quality parameter at each entry point to the distribution system.

(b) *Initial Sampling.* All large water systems shall measure the applicable water quality parameters as specified below at taps and at each entry point to the distribution system during each six-month monitoring period specified in § 141.86(d)(1). All small and medium-size systems shall measure the applicable water quality parameters at the locations specified below during each six-month monitoring period specified in § 141.86(d)(1) during which the system exceeds the lead or copper action level.

(1) At taps:

(i) pH;

(ii) Alkalinity;

(iii) Orthophosphate, when an inhibitor containing a phosphate compound is used;

(iv) Silica, when an inhibitor containing a silicate compound is used;

(v) calcium;

(vi) conductivity; and

(vii) water temperature.

(2) At each entry point to the distribution system: all of the applicable parameters listed in paragraph (b)(1) of this section.

(c) *Monitoring after installation of corrosion control.* Any large system which installs optimal corrosion control treatment pursuant to § 141.81(d)(4) shall measure the water quality parameters at the locations and frequencies specified below during each six-month monitoring period specified in § 141.86(d)(2)(i). Any small or medium-size system which installs optimal corrosion control treatment shall conduct such monitoring during each six-month monitoring period specified in § 141.86(d)(2)(ii) in which the system exceeds the lead or copper action level.

(1) At taps, two samples for:

(i) pH;

(ii) Alkalinity;

(iii) Orthophosphate, when an inhibitor containing a phosphate compound is used;

(iv) Silica, when an inhibitor containing a silicate compound is used;

(v) Calcium, when calcium carbonate stabilization is used as part of corrosion control.

(2) At each entry point to the distribution system, one sample every two weeks (bi-weekly) for:

(i) pH;

(ii) When alkalinity is adjusted as part of optimal corrosion control, a reading of the dosage rate of the chemical used to adjust alkalinity, and the alkalinity concentration; and

(iii) When a corrosion inhibitor is used as part of optimal corrosion control, a reading of the dosage rate of the inhibitor used, and the concentration of orthophosphate or silica (whichever is applicable).

(d) *Monitoring after State specifies water quality parameter values for optimal corrosion control.* After the State specifies the values for applicable water quality control parameters reflecting optimal corrosion control treatment under § 141.82(f), all large systems shall measure the applicable water quality parameters in accordance with paragraph (c) of this section during each monitoring period specified in § 141.86(d)(3). Any small or medium-size system shall conduct such monitoring during each monitoring period specified in § 141.86(d)(3) in which the system exceeds the lead or copper action level. The system may take a confirmation sample for any water quality parameter value no later than 3 days after the first sample. If a confirmation sample is taken, the result must be averaged with the first sampling result and the average must be used for any compliance determinations under § 141.82(g). States have discretion to delete results of obvious sampling errors from this calculation.

(e) *Reduced monitoring.* (1) Any water system that maintains the range of values for the water quality parameters reflecting optimal corrosion control treatment during each of two consecutive six-month monitoring periods under paragraph (d) of this section shall continue monitoring at the entry point(s) to the distribution system as specified in paragraph (c)(2) of this section. Such system may collect two tap samples for applicable water quality parameters from the following reduced number of sites during each six-month monitoring period.

System size (No. of people served)	Reduced No. of sites for water quality parameters
>100,000	10
10,001 to 100,000	7
3,301 to 10,000	3
501 to 3,300	2
101 to 500	1
≤100	1

(2) Any water system that maintains the range of values for the water quality parameters reflecting optimal corrosion control treatment specified by the State under § 141.82(f) during three consecutive years of monitoring may reduce the frequency with which it collects the number of tap samples for applicable water quality parameters specified in this paragraph (e)(1) of this section from every six months to annually.

(3) A water system that conducts sampling annually shall collect these samples evenly throughout the year so as to reflect seasonal variability.

(4) Any water system subject to reduced monitoring frequency that fails to operate within the range of values for the water quality parameters specified by the State under § 141.82(f) shall resume tap water sampling in accordance with the number and frequency requirements in paragraph (c) of this section.

(f) *Additional monitoring by systems.* The results of any monitoring conducted in addition to the minimum requirements of this section shall be considered by the system and the State in making any determinations (i.e., determining concentrations of water quality parameters) under this section or § 141.82.

SUMMARY OF MONITORING REQUIREMENTS FOR WATER QUALITY PARAMETERS [1]

Monitoring Period	Parameters [2]	Location	Frequency
Initial Monitoring	pH, alkalinity, orthophosphate or silica [3], calcium, conductivity, temperature.	Taps and at entry point(s) to distribution system.	Every 6 months
After Installation of Corrosion Control	pH, alkalinity, orthophosphate or silica [3], calcium [4]	Taps	Every 6 months
	pH, alkalinity dosage rate and concentration (if alkalinity adjusted as part of corrosion control), inhibitor dosage rate and inhibitor residual [5].	Entry point(s) to distribution system.	Biweekly
After State Specifies Parameter Values For Optimal Corrosion Control.	pH, alkalinity, orthophosphate or silica [3], calcium [4]	Taps	Every 6 months
	pH, alkalinity dosage rate and concentration (if alkalinity adjusted as part of corrosion control), inhibitor dosage rate and inhibitor residual [5].	Entry point(s) to distribution system.	Biweekly
Reduced Monitoring	pH, alkalinity, orthophosphate or silica [3], calcium [4]	Taps	Every 6 months at a reduced number of sites

SUMMARY OF MONITORING REQUIREMENTS FOR WATER QUALITY PARAMETERS [1]—Continued

Monitoring Period	Parameters [2]	Location	Frequency
	pH, alkalinity dosage rate and concentration (if alkalinity adjusted as part of corrosion control), inhibitor dosage rate and inhibitor residual [5].	Entry point(s) to distribution system.	Biweekly

[1] Table is for illustrative purposes; consult the text of this section for precise regulatory requirements.
[2] Small and medium-size systems have to monitor for water quality parameters only during monitoring periods in which the system exceeds the lead or copper action level.
[3] Orthophosphate must be measured only when an inhibitor containing a phosphate compound is used. Silica must be measured only when an inhibitor containing silicate compound is used.
[4] Calcium must be measured only when calcium carbonate stabilization is used as part of corrosion control.
[5] Inhibitor dosage rates and inhibitor residual concentrations (orthophosphate or silica) must be measured only when an inhibitor is used.

§ 141.88 Monitoring requirements for lead and copper in source water.

(a) *Sample location, collection methods, and number of samples.* (1) A water system that fails to meet the lead or copper action level on the basis of tap samples collected in accordance with § 141.86 shall collect lead and copper source water samples in accordance with the requirements regarding sample location, number of samples, and collection methods specified in § 141.23(a)(1)–(4) (inorganic chemical sampling). (Note: The timing of sampling for lead and copper shall be in accordance with paragraphs (b) and (c) of this section, and not dates specified in § 141.23(a)(1) and (2)).

(2) Where the results of sampling indicate an exceedance of maximum permissible source water levels established under § 141.83(b)(4), the State may require that one additional sample be collected as soon as possible after the initial sample was taken (but not to exceed two weeks) at the same sampling point. If a State-required confirmation sample is taken for lead or copper, then the results of the initial and confirmation sample shall be averaged in determining compliance with the State-specified maximum permissible levels. Any sample value below the detection limit shall be considered to be zero. Any value above the detection limit but below the PQL shall either be considered as the measured value or be considered one-half the PQL.

(b) *Monitoring frequency after system exceeds tap water action level.* Any system which exceeds the lead or copper action level at the tap shall collect one source water sample from each entry point to the distribution system within six months after the exceedance.

(c) *Monitoring frequency after installation of source water treatment.* Any system which installs source water treatment pursuant to § 141.83(a)(2) shall collect an additional source water sample from each entry point to the distribution system during two consecutive six-month monitoring periods by the deadline specified in § 141.83(a)(4).

(d) *Monitoring frequency after State specifies maximum permissible source water levels or determines that source water treatment is not needed.* (1) A system shall monitor at the frequency specified below in cases where the State specifies maximum permissible source water levels under § 141.83(b)(4) or determines that the system is not required to install source water treatment under § 141.83(b)(2).

(i) A water system using only groundwater shall collect samples once during the three-year compliance period (as that term is defined in § 141.2) in effect when the applicable State determination under paragraph (d)(1) of this section is made. Such systems shall collect samples once during each subsequent compliance period.

(ii) A water system using surface water (or a combination of surface and groundwater) shall collect samples once during each year, the first annual monitoring period to begin on the date on which the applicable State determination is made under paragraph (d)(1) of this section.

(2) A system is not required to conduct source water sampling for lead and/or copper if the system meets the action level for the specific contaminant in tap water samples during the entire source water sampling period applicable to the system under paragraph (d)(1) (i) or (ii) of this section.

(e) *Reduced monitoring frequency.* (1) A water system using only groundwater which demonstrates that finished drinking water entering the distribution system has been maintained below the maximum permissible lead and/or copper concentrations specified by the State in § 141.83(b)(4) during at least three consecutive compliance periods under paragraph (d)(1) of this section may reduce the monitoring frequency for lead and/or copper to once during each nine-year compliance cycle (as that term is defined in § 141.2).

(2) A water system using surface water (or a combination of surface and ground waters) which demonstrates that finished drinking water entering the distribution system has been maintained below the maximum permissible lead and copper concentrations specified by the State in § 141.83(b)(4) for at least three consecutive years may reduce the monitoring frequency in paragraph (d)(1) of this section to once during each nine-year compliance cycle (as that term is defined in § 141.23).

(3) A water system that uses a new source of water is not eligible for reduced monitoring for lead and/or copper until concentrations in samples collected from the new source during three consecutive monitoring periods are below the maximum permissible lead and copper concentrations specified by the State in § 141.83(a)(5).

§ 141.89 Analytical methods.

(a) Analyses for lead, copper, pH, conductivity, calcium, alkalinity, orthophosphate, silica, and temperature shall be conducted using the following methods:

ANALYTICAL METHODS

Contaminant	Methodology [9]	Reference (Method Number)		SM[3]	USGS[4]
		EPA[1]	ASTM[2]		
Lead	Atomic absorption; furnace technique	239.2	D3559-85D	3113	
	Inductively-coupled plasma; mass spectrometry	200.8[6]			
	Atomic absorption; platform furnace technique	200.9[7]			
Copper	Atomic absorption; furnace technique	220.2	D1688-90c	3113	
	Atomic absorption; direct aspiration	220.1	D1688-90A	3111-B	
	Inductively-coupled plasma	200.7[5]		3120	
	Inductively-coupled plasma; mass spectrometry	200.8[6]			
	Atomic absorption; platform furnace	200.9[7]			
pH	Electrometric	150.1	D1293-84B	4500-H^+	
		150.2			
Conductivity	Conductance	120.1	D1125-82B	2510	
Calcium	EDTA titrimetric	215.2	D511-88A	3500-Ca-D	
	Atomic absorption; direct aspiration	215.1	D511-88B	3111-B	
	Inductively-coupled plasma	200.7[5]		3120	
Alkalinity	Titrimetric	310.1	D1067-88B	2320	
	Electrometric titration				I-1030-85
Orthophosphate, unifiltered, no digestion or hydrolysis.	365.1		4500-P-F		
Colorimetric, automated, ascorbic acid.					
	Colorimetric, ascorbic acid, two reagent	365.3		4500-P-F	
	Colorimetric, ascorbic acid, two reagent	365.2	D515-88A		
	Colorimetric, phosphomolybdate;				I-1601-85
	automated-segmented flow;				I-2601-85
	automated discrete				I-2598-85
	I on chromatography	300.0[8]	D4327-88	4110	
Silica	Colorimetric, molybdate blue;				I-1700-85
	automated-segmented flow				I-2700-85
	Colorimetric	370.1	D859-88		
	Molybdosilicate			4500-Si-D	
	Heteropoly blue			4500-Si-E	
	Automated method for molybdate-reactive silica			4500-Si-F	
	Inductively-coupled plasma	200.7[5]		3120	
Temperature	Thermometric			2550	

[1] The procedures 239.2, 220.2, 220.1, 150.1, 150.2, 120.1, 215.2, 215.1, 310.1, 365.1, 365.3, 365.2, and 370.1 are incorporated by reference and shall be done in accordance with "Methods for Chemical Analysis of Water and Wastes," EPA Environmental Monitoring and Support Laboratory, Cincinnati, OH (EPA-600/4-79-020), Revised March 1983, pp. 239.2-1 through 239.2-2 and metals-1 through metals-19, 220.2-1 through 220.2-2 and metals-1 through metals-19, 220.1-1 through 220.1-2 and metals-1 through metals-19, 150.1-1 through 150.1-3, 150.2-1 through 150.2-3, 120.1-1 through 120.1-3, 215.2-1 through 215.2-3, 215.1-1 through 215.1-2, 310.1-1 through 310.1-3, 365.1-1 through 365.1-9, 365.3-1 through 365.3-4, 365.2-1 through 365.2-6, and 370.1-1 through 370.1-5, respectively. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. Copies may be obtained from ORD Publications, CERI, EPA, Cincinnati, OH 45268. Copies may be inspected at the United States Environmental Protection Agency, 401 M Street, SW., Room EB-15, Washington, D.C. 20460 or at the Office of the Federal Register, 1100 L Street, NW., Room 8401, Washington, D.C.

[2] The procedures D3559-85D, D1688-90C, D1688-90A, D1293-84B, D1125-82B, D511-88, D1067-88B, D515-88A, D4327-88, and D859-88 are incorporated by reference and shall be done in accordance with Annual Book of ASTM Standards, Vol. 11.01, American Society for Testing and Materials, 1990. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. Copies may be obtained from America Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103. Copies may be inspected at the United States Environmental Protection Agency, 401 M Street, SW., Room EB-15, Washington, D.C. 20460 or at the Office of the Federal Register, 1100 L Street, NW., Room 8401, Washington, D.C.

[3] The procedures 3113, 3111-B, 3120, 4500-H^+, 2510, 3500-Ca-D, 3120, 2320, 4500-P-F, 4500-P-E, 4110, 4500-Si-D, 4500-Si-E, 4500-Si-F, and 2550 are incorporated by reference and shall be done in accordance with "Standard Methods for the Examination of Water and Wastewater," 17th Edition, American Public Health Association, American Water Works Association, Water Pollution Control Federation, 1989, pp. 3-32 through 3-43, 3-20 through 3-23, 3-53 through 3-63, 4-94 through 4-102, 2-57 through 2-61, 3-85 through 3-87, 2-35 through 2-39, 4-178 through 4-181, 4-117 through 4-178, 4-2 through 4-6, 4-184 through 4-187, 4-188 through 4-189, 4-189 through 4-191, and 2-80 through 2-81, respectively. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. Copies may be obtained from the American Water Works Association, Customer Service, 6666 West Quincy Avenue, Denver, CO 80235, Phone (303) 794-7711. Copies may be inspected at the United States Environmental Protection Agency, 401 M Street, SW., Room EB-15, Washington, D.C. 20460 or at the Office of the Federal Register, 1100 L Street, NW., Room 8401, Washington, D.C.

[4] The procedures I-2601-85, 1-1030-85, 1-1601-85, I-2598-85, I-1700-85, and I-2700-85 are incorporated by reference and shall be done in accordance with "Methods for Determination of Inorganic Substances in Water and Fluvial Sediments," 3rd edition, U.S. Department of Interior, U.S. Geological Survey, 1989, pp. 55-56, 381-382, 383-385, 387-388, 415-416, and 417-419, respectively. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR Part 51. Copies may be purchased from the Books and Open-File Reports Section, U.S. Geological Survey, Federal Center, Box 25425, Denver, CO 80225. Copies may be inspected at the United States Environmental Protection Agency, 401 M Street, SW., Room EB-15, Washington, D.C. 20460 or at the Office of the Federal Register, 1100 L Street, NW., Room 8401, Washington, D.C.

[5] "Determination of Metals and Trace Elements in Water and Wastes by Inductively-Coupled Plasma Atomic Emission Spectrometry," Revision 3.2, August 1990, U.S. EPA, EMSL. This document is available from U.S. EPA, EMSL, Cincinnati, OH 45268.

[6] "Determination of Trace Elements in Water and Wastes by Inductively-Coupled Plasma-Mass Spectrometry," Method 200.8, August 1990, Revision 4.3, U.S. EPA EMSL. This document is available from U.S. EPA, EMSL, Cincinnati, OH 45268.

[7] "Determination of Trace Elements by Stabilized Temperature Graphite Furnace Atomic Absorption, Spectrometry," Method 200.9, August 1990, U.S. EPA EMSL. This document is available from U.S. EPA, EMSL, Cincinnati, OH 45268.

[8] "Determination of Inorganic Ions in Water by Ion Chromatography," Method 300.0, December 1989, U.S. EPA EMSL. This document is available from U.S. EPA, EMSL, Cincinnati, OH 45268.

[9] For analyzing Lead and copper, the technique applicable to total metals must be used and samples cannot be filtered.

(1) Analyses under this section shall only be conducted by laboratories that have been certified by EPA or the State. To obtain certification to conduct analyses for lead and copper, laboratories must:

(i) Analyze performance evaluation samples which include lead and copper provided by EPA Environmental Monitoring and Support Laboratory or equivalent samples provided by the State; and

(ii) Achieve quantitative acceptance limits as follows:

(A) Lead: ±30 percent of the actual amount in the Performance Evaluation sample when the actual amount is greater than or equal to 0.005 mg/L, and

(B) Copper: ±10 percent of the actual amount in the Performance Evaluation sample when the actual amount is greater than or equal to 0.050 mg/L;

(iii) Achieve method detection limits according to the procedures in appendix B of part 136 of this title as follows:

(A) Lead: 0.001 mg/L (only if source water compositing is done under § 141.23(a)(4)); and

(B) Copper: 0.001 mg/L or 0.020 mg/L when atomic absorption direct aspiration is used (only if source water compositing is done under § 141.23(a)(4)).

(iv) Be currently certified by EPA or the State to perform analyses to the specifications described in paragraph (a)(2) of this section.

(2) States have the authority to allow the use of previously collected monitoring data for purposes of monitoring, if the data were collected and analyzed in accordance with the requirements of this subpart.

(3) All lead levels measured between the PQL and the MDL must be either reported as measured or they can be reported as one-half the PQL (0.0025 mg/L). All levels below the lead MDL must be reported as zero.

(4) All copper levels measured between the PQL and the MDL must be either reported as measured or they can be reported as one-half the PQL (0.015 mg/L). All levels below the copper MDL must be reported as zero.

§ 141.90 Reporting requirements.

All water systems shall report all of the following information to the State in accordance with this section.

(a) *Reporting requirements for tap water monitoring for lead and copper and for water quality parameter monitoring.* (1) A water system shall report the information specified below for all tap water samples within the first 10 days following the end of each applicable monitoring period specified in § 141.86 and § 141.87 and § 141.88 (i.e., every six-months, annually, or every 3 years).

(i) the results of all tap samples for lead and copper including the location of each site and the criteria under § 141.86(a) (3), (4), (5), (6), and/or (7) under which the site was selected for the system's sampling pool;

(ii) a certification that each first draw sample collected by the water system is one-liter in volume and, to the best of their knowledge, has stood motionless in the service line, or in the interior plumbing of a sampling site, for at least six hours;

(iii) where residents collected samples, a certification that each tap sample collected by the residents was taken after the water system informed them of proper sampling procedures specified in § 141.86(b)(2);

(iv) the 90th percentile lead and copper concentrations measured from among all lead and copper tap water samples collected during each monitoring period (calculated in accordance with § 141.80(c)(3));

(v) with the exception of initial tap sampling conducted pursuant to § 141.86(d)(1), the system shall designate any site which was not sampled during previous monitoring periods, and include an explanation of why sampling sites have changed;

(vi) the results of all tap samples for pH, and where applicable, alkalinity, calcium, conductivity, temperature, and orthophosphate or silica collected under § 141.87(b)–(e);

(vii) the results of all samples collected at the entry point(s) to the distribution system for applicable water quality parameters under § 141.87(b)–(e).

(2) By the applicable date in § 141.86(d)(1) for commencement of monitoring, each community water system which does not complete its targeted sampling pool with tier 1 sampling sites meeting the criteria in § 141.86(a)(3) shall send a letter to the State justifying its selection of tier 2 and/or tier 3 sampling sites under § 141.86 (a)(4) and/or (a)(5).

(3) By the applicable date in § 141.86(d)(1) for commencement of monitoring, each non-transient, non-community water system which does not complete its sampling pool with tier 1 sampling sites meeting the criteria in § 141.86(a)(6) shall send a letter to the State justifying its selection of sampling sites under § 141.86(a)(7).

(4) By the applicable date in § 141.86(d)(1) for commencement of monitoring, each water system with lead service lines that is not able to locate the number of sites served by such lines required under § 141.86(a)(9) shall send a letter to the State demonstrating why it was unable to locate a sufficient number of such sites based upon the information listed in § 141.86(a)(2).

(5) Each water system that requests that the State reduce the number and frequency of sampling shall provide the information required under § 141.86(d)(4).

(b) *Source water monitoring reporting requirements.* (1) A water system shall report the sampling results for all source water samples collected in accordance with § 141.88 within the first 10 days following the end of each source water monitoring period (i.e., annually, per compliance period, per compliance cycle) specified in § 141.88.

(2) With the exception of the first round of source water sampling conducted pursuant to § 141.88(b), the system shall specify any site which was not sampled during previous monitoring periods, and include an explanation of why the sampling point has changed.

(c) *Corrosion control treatment reporting requirements.* By the applicable dates under § 141.81, systems shall report the following information:

(1) For systems demonstrating that they have already optimized corrosion control, information required in § 141.82(b) (2) or (3).

(2) for systems required to optimize corrosion control, their recommendation regarding optimal corrosion control treatment under § 141.82(a).

(3) for systems required to evaluate the effectiveness of corrosion control treatments under §141.82(c), the information required by that paragraph.

(4) for systems required to install optimal corrosion control designated by the State under § 141.82(d), a letter certifying that the system has completed installing that treatment.

(d) *Source water treatment reporting requirements.* By the applicable dates in § 141.83, systems shall provide the following information to the State:

(1) if required under § 141.83(b)(1), their recommendation regarding source water treatment;

(2) for systems required to install source water treatment under § 141.83(b)(2), a letter certifying that the system has completed installing the treatment designated by the State within 24 months after the State designated the treatment.

(e) *Lead service line replacement reporting requirements.* Systems shall report the following information to the State to demonstrate compliance with the requirements of § 141.84:

(1) Within 12 months after a system exceeds the lead action level in sampling referred to in § 141.84(a), the system shall demonstrate in writing to the State that it has conducted a material evaluation, including the evaluation in § 141.86(a), to identify the initial number of lead service lines in its distribution system, and shall provide the State with the system's schedule for replacing annually at least 7 percent of the initial number of lead service lines in its distribution system.

(2) Within 12 months after a system exceeds the lead action level in sampling referred to in § 141.84(a), and every 12 months thereafter, the system shall demonstrate to the State in writing that the system has either:

(i) replaced in the previous 12 months at least 7 percent of the initial lead

service lines (or a greater number of lines specified by the State under § 141.84(f)) in its distribution system, or

(ii) conducted sampling which demonstrates that the lead concentration in all service lines samples from an individual line(s), taken pursuant to § 141.86(b)(3), is less than or equal to 0.015 mg/L. In such cases, the total number of lines replaced and/or which meet the criteria in § 141.84(b) shall equal at least 7 percent of the initial number of lead lines identified under paragraph (a) of this section (or the percentage specified by the State under § 141.84(f)).

(3) The annual letter submitted to the State under paragraph (e)(2) of this section shall contain the following information:

(i) The number of lead service lines scheduled to be replaced during the previous year of the system's replacement schedule;

(ii) the number and location of each lead service line replaced during the previous year of the system's replacement schedule;

(iii) if measured, the water lead concentration and location of each lead service line sampled, the sampling method, and the date of sampling.

(4) As soon as practicable, but in no case later than three months after a system exceeds the lead action level in sampling referred to in § 141.84(a), any system seeking to rebut the presumption that it has control over the entire lead service line pursuant to § 141.84(d) shall submit a letter to the State describing the legal authority (e.g., state statutes, municipal ordinances, public service contracts or other applicable legal authority) which limits the system's control over the service lines and the extent of the system's control.

(f) *Public education program reporting requirements.* By December 31st of each year, any water system that is subject to the public education requirements in § 141.85 shall submit a letter to the State demonstrating that the system has delivered the public education materials that meet the content requirements in § 141.85(a) and (b) and the delivery requirements in § 141.85(c). This information shall include a list of all the newspapers, radio stations, television stations, facilities and organizations to which the system delivered public education materials during the previous year. The water system shall submit the letter required by this paragraph annually for as long as it exceeds the lead action level.

(g) *Reporting of additional monitoring data.* Any system which collects sampling data in addition to that required by this subpart shall report the results to the State by the end of the applicable monitoring period under §§ 141.86, 141.87 and § 141.88 during which the samples are collected.

§ 141.91 Recordkeeping requirements.

Any system subject to the requirements of this subpart shall retain on its premises original records of all sampling data and analyses, reports, surveys, letters, evaluations, schedules, State determinations, and any other information required by § 141.81 through § 141.88. Each water system shall retain the records required by this section for no fewer than 12 years.

PART 142—NATIONAL PRIMARY DRINKING WATER REGULATIONS IMPLEMENTATION

1. The authority for part 142 continues to read as follows: 42 U.S.C. 300g, 300g–1, 300g–2, 300g–3, 300g–4, 300g–5, 300g–6, 300j–4, and 300j–9.

2. Section 142.14 is amended by adding paragraphs (d)(8) through (11) to read as follows:

§ 142.14 Records kept by States.

* * * * *

(d) * * *

(8) Records of the currently applicable or most recent State determinations, including all supporting information and an explanation of the technical basis for each decision, made under the following provisions of 40 CFR, part 141, subpart I for the control of lead and copper:

(i) Section 141.82(b)—decisions to require a water system to conduct corrosion control treatment studies;

(ii) Section 141.82(d)—designations of optimal corrosion control treatment;

(iii) Section 141.82(f)—designations of optimal water quality parameters;

(iv) Section 141.82(h)—decisions to modify a public water system's optimal corrosion control treatment or water quality parameters;

(v) Section 141.83(b)(2)—determinations of source water treatment; and

(vi) Section 141.83(b)(4)—designations of maximum permissible lead and copper concentrations in source water.

(vii) Section 141.84(e)—determinations that a system does not control entire lead service lines.

(viii) Section 141.84(f)—determinations establishing a shorter lead service line replacement schedule than required by § 141.84.

(9) Records of reports and any other information submitted by PWSs under § 141.90;

(10) Records of state activities, and the results thereof, to verify compliance with State determinations issued under §§ 141.82(f), 141.82(h), 141.83(b)(2), and 141.83(b)(4) and compliance with lead service line replacement schedules under § 141.84.

(11) Records of each system's currently applicable or most recently designated monitoring requirements. If, for the records identified in §§ 142.14(d)(8)(i) through 142.14(d)(8)(viii) above, no change is made to State decision during a 12 year retention period, the State shall maintain the record until a new decision, determination or designation has been issued.

* * * * *

3. Section 142.15 is amended by adding new paragraph (c)(4) to read as follows:

§ 142.15 Reports by States.

* * * * *

(c) * * *

(4) States shall report to EPA by May 15, August 15, November 15 and February 15 of each year the following information related to each system's compliance with the treatment techniques for lead and copper under 40 CFR Part 141, Subpart I during the preceding calendar quarter. Specifically, States shall report the name and PWS identification number of:

(i) each public water system which exceeded the lead and copper action levels and the date upon which the exceedance occurred;

(ii) each public water system required to complete the corrosion control evaluation specified in § 141.82(c) and the date the State received the results of the evaluations from each system;

(iii) each public water system for which the State has designated optimal corrosion control treatment under § 141.82(d), the date of the determination, and each system that completed installation of treatment as certified under § 141.90(c)(3);

(iv) each public water system for which the State has designated optimal water quality parameters under § 141.82(f) and the date of the determination;

(v) each public water system which the State has required to install source water treatment under § 141.83(b)(2), the date of the determination, and each system that completed installation of treatment as certified under § 141.90(d)(2);

(vi) each public water system for which the State has specified maximum permissible source water levels under § 141.83(b)(4); and

(vii) each public water system required to begin replacing lead service lines as specified in § 141.84, each public water system for which the State has

established a replacement schedule under § 141.84(f), and each system reporting compliance with its replacement schedule under § 141.90(e)(2).

* * * * *

4. Section 142.16 is amended by adding paragraph (d) to read as follows:

§ 142.16 Special primacy requirements.

* * * * *

(d) Requirements for States to adopt 40 CFR Part 141, Subpart I Lead and Copper. An application for approval of a State program revision which adopts the requirements specified in 40 CFR Part 141 Subpart I must contain (in addition to the general primacy requirements enumerated elsewhere in this part, including the requirement that state regulations be at least as stringent as the federal requirements) a description of how the State will accomplish the following program requirements:

(1) §§ 141.82(d), 141.82(f) and 141.82(h)—Designating optimal corrosion control treatment methods, optimal water quality parameters and modifications thereto.

(2) §§ 141.83(b)(2) and 141.83(b)(4)—Designating source water treatment methods, maximum permissible source water levels for lead and copper and modifications thereto.

(3) Section 141.90(e)—Verifying compliance with lead service line replacement schedules and of PWS demonstrations of limited control over lead service lines.

* * * * *

5. § 142.19 is added to read as follows:

§ 142.19 EPA review of State implementation of national primary drinking water regulations for lead and copper.

(a) Pursuant to the procedures in this section, the Regional Administrator may review state determinations establishing corrosion control or source water treatment requirements for lead or copper and may issue an order establishing federal treatment requirements for a public water system pursuant to § 141.82 (d) and (f) and § 141.83(b) (2) and (4) where the Regional Administrator finds that:

(1) a State has failed to issue a treatment determination by the applicable deadline;

(2) a State has abused its discretion in making corrosion control or source water treatment determinations in a substantial number of cases or in cases affecting a substantial population, or

(3) the technical aspects of State's determination would be indefensible in an expected federal enforcement action taken against a system.

(b) If the Regional Administrator determines that review of state determination(s) under this section may be appropriate, he shall request the State to forward to EPA the state determination and all information that was considered by the State in making its determination, including public comments, if any, within 60 days of the Regional Adminstrator's request.

(c) Proposed review of state determinations:

(1) Where the Regional Administrator finds that review of a state determination under paragraph (a) of this section is appropriate, he shall issue a proposed review order which shall:

(i) Identify the public water system(s) affected, the State determination being reviewed and the provisions of state and/or federal law at issue;

(ii) Identify the determination that the State failed to carry out by the applicable deadline, or identify the particular provisions of the State determination which, in the Regional Administrator's judgment, fail to carry out properly applicable treatment requirements, and explain the basis for the Regional Administrator's conclusion;

(iii) Identify the treatment requirements which the Regional Administrator proposes to apply to the affected system(s), and explain the basis for the proposed requirements;

(iv) Request public comment on the proposed order and the supporting record.

(2) The Regional Administrator shall provide notice of the proposed review order by:

(i) Mailing the proposed order to the affected public water system(s), the state agency whose order is being reviewed, and any other parties of interest known to the Regional Administrator; and

(ii) Publishing a copy of the proposed order in a newspaper of general circulation in the affected communities.

(3) The Regional Administrator shall make available for public inspection during the comment period the record supporting the proposed order, which shall include all of the information submitted by the State to EPA under paragraph (b) of this section, all other studies, monitoring data and other information considered by the Agency in developing the proposed order.

(d) Final review order

(1) Based upon review of all information obtained regarding the proposed review order, including public comments, the Regional Administrator shall issue a final review order within 120 days after issuance of the proposed order which affirms, modifies, or withdraws the proposed order. The Regional Administrator may extend the time period for issuing the final order for good cause. If the final order modifies or withdraws the proposed order, the final order shall explain the reasons supporting the change.

(2) The record of the final order shall consist of the record supporting the proposed order, all public comments, all other information considered by the Regional Administrator in issuing the final order and a document responding to all significant public comments submitted on the proposed order. If new points are raised or new material supplied during the public comment period, the Regional Administrator may support the responses on those matters by adding new materials to the record. The record shall be complete when the final order is issued.

(3) Notice of the final order shall be provided by mailing the final order to the affected system(s), the State, and all parties who commented on the proposed order.

(4) Upon issuance of the final order, its terms constitute requirements of the national primary drinking water regulation for lead and/or copper until such time as the Regional Administrator issues a new order (which may include recision of the previous order) pursuant to the procedures in this section. Such requirements shall supersede any inconsistent treatment requirements established by the State pursuant to the national primary drinking water regulations for lead and copper.

(5) The Regional Administrator may not issue a final order to impose conditions less stringent than those imposed by the State.

(e) The Regional Administrator may not delegate authority to sign the final order under this section.

(f) Final action of the Regional Administrator under paragraph (d) of this section shall constitute action of the Administrator for purposes of 42 U.S.C. § 300j-7(a)(2).

6. In section 142.62, the title of the section and paragraphs (f) and (g) are revised to read as follows, and paragraph (h)(7) is added to read as follows:

§ 142.62 Variances and exemptions from the maximum contaminant levels for organic and inorganic chemicals and exemptions from the treatment technique for lead and copper.

* * * * *

(f) The State may require a public water system to use bottled water, point-of-use devices, point-of-entry devices or other means as a condition of granting a variance or an exemption

from the requirements of § 141.61 (a) and (c) and § 141.62, to avoid an unreasonable risk to health. The State may require a public water system to use bottled water and point-of-use devices or other means, *but not point-of-entry devices*, as a condition for granting an exemption from corrosion control treatment requirements for lead and copper in §§ 141.81 and 141.82 to avoid an unreasonable risk to health. The State may require a public water system to use point-of-entry devices as a condition for granting an exemption from the source water and lead service line replacement requirements for lead and copper under §§ 141.83 or 141.84 to avoid an unreasonable risk to health.

(g) Public water systems that use bottled water as a condition for receiving a variance or an exemption from the requirements of § 141.61 (a) and (c) and § 141.62, or an exemption from the requirements of §§ 141.81–141.84 must meet the requirements specified in either paragraph (g)(1) or (g)(2) and paragraph (g)(3) of this section:

(1) The Administrator or primacy State must require and approve a monitoring program for bottled water. The public water system must develop and put in place a monitoring program that provides reasonable assurances that the bottled water meets all MCLs. The public water system must monitor a representative sample of the bottled water for all contaminants regulated under § 141.61 (a) and (c) and § 141.62 during the first three-month period that it supplies the bottled water to the public, and annually thereafter. Results of the monitoring program shall be provided to the State annually.

(2) The public water system must receive a certification from the bottled water company that the bottled water supplied has been taken from an "approved source" as defined in 21 CFR 129.3(a); the bottled water company has conducted monitoring in accordance with 21 CFR 129.80(g) (1) through (3); and the bottled water does not exceed any MCLs or quality limits as set out in 21 CFR 102.35, 110, and 129. The public water system shall provide the certification to the State the first quarter after it supplies bottled water and annually thereafter. At the State's option a public water system may satisfy the requirements of this subsection if an approved monitoring program is already in place in another State.

(3) The public water system is fully responsible for the provision of sufficient quantities of bottled water to every person supplied by the public water system via door-to-door bottled water delivery.

(h) * * *

(7) In requiring the use of a point-of-entry device as a condition for granting an exemption from the treatment requirements for lead and copper under § 141.83 or § 141.84, the State must be assured that use of the device will not cause increased corrosion of lead and copper bearing materials located between the device and the tap that could increase contaminant levels at the tap.

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