Lead and Copper Rule State File Review: National Report

Lead and Copper Rule State File Review: National Report

CONTENTS

Figures

Tables

Acronyms

AL	Action Level
ALE	Action Level Exceedance
CCT	Corrosion Control Treatment
CWS	Community Water System
EPA	Environmental Protection Agency
LCR	Lead and Copper Rule
LCRMR	Lead and Copper Rule Minor Revisions
LSL	Lead Service Line
LSLR	Lead Service Line Replacement
MCLG	Maximum Contaminant Level Goal
mg/L	Milligrams per Liter
NPDWR	National Primary Drinking Water Regulation
NTNCWS	Non-Transient Non-Community Water System
OGWDW	Office of Ground Water and Drinking Water
OWQP	Optimal Water Quality Parameter
PE	Public Education
Pb	Lead, chemical symbol
ppb	Parts per Billion
PQL	Practical Quantitation Level
PSA	Public Service Announcement
PWS	Public Water System
SDWA	Safe Drinking Water Act
SDWIS	Safe Drinking Water Information System
WQP	Water Quality Parameter

This page left intentionally blank.

EXECUTIVE SUMMARY

The Environmental Protection Agency (EPA) conducted a review and analysis of state file data from 483 drinking water systems in ten states to gain a national picture of Lead and Copper Rule (LCR) implementation. EPA contractors looked at LCR compliance data from 1992, the effective date of the LCR, through 2004. Most of the analysis of this report focuses on the time period 2000-2004 in recognition that implementation improvements have been made since the rule was finalized.

Of the 483 water systems selected for review; 406 were randomly selected and 77 were targeted for selection based on certain characteristics (e.g., past compliance with the LCR, water system size or water system type). While this sample set provides a degree of confidence in national implementation, it does not provide enough data points to draw conclusions for subsets of data. For each water system, EPA evaluated implementation of requirements of the LCR such as accuracy of the 90th percentile data[1] reported to EPA's Safe Drinking Water Information System (SDWIS), sampling site selection and sample management, water systems' response to lead action level exceedances (ALEs), and implementation by regulated schools.

The state file review did not identify a widespread problem with elevated lead levels in America's public water supplies. For the 406 randomly selected water systems, 7% of sampling rounds reviewed had a 90th percentile value greater than the action level. Fewer than 1% of the randomly selected systems had more than 1 ALE 2000-2004. Data evaluated from 17,542 individual tap water lead samples collected between 2000 and 2004 show that only 5% of all lead samples were greater than the lead action level of 15 parts per billion (ppb).

Information collected during the file review demonstrated that SDWIS data of 90th percentile lead values is accurate. While a small number of 90th percentile calculations were done incorrectly, in only 1% of the cases did this error affect whether a water system was required to take action. The reviews of state files did not show evidence that 90th percentile values reported to SDWIS were artificially lowered due to inappropriate re-sampling, manipulation of data, or improper invalidation.

The review did identify a need for improved documentation in both SDWIS and in state files. Individual home sample results were not available for 21% of the water system sampling rounds reviewed. Therefore, 90th percentile calculations could not be verified. In addition, many state files did not contain the water system's materials evaluation, sampling site plans, and other information to determine if water system sampling reflected the requirements of

[1] The LCR established an action level of 0.015 mg/L (15 ppb) for lead based on the 90th percentile level of tap water samples. If more than 10 percent of tap water samples are above the action level, the water system must take steps to reduce the corrosivity of the water, replace lead service lines, and inform customers about risks associated with exposure to elevated levels of lead.

the LCR. Information regarding required follow-up activities after an action level exceedance, such as public education and corrosion control treatment steps was also lacking. Follow-up activity (milestone) information is often missing in SDWIS as well.

The file review revealed a lack of system response to action level exceedances. This was especially true for requirements to inform the public, where water systems provided the required information to their consumers less than 1/3 of the time. In addition, out of 134 occasions in which water quality parameter (WQP) and source water monitoring was required during 2000-2004, documentation in the state files indicated initial WQP and source water monitoring was conducted only 42 percent of the time.

The file review identified problems at schools. More than half the schools that had a lead action level exceedance did not begin the appropriate follow-up requirements. For schools that did begin ALE follow-up activities, none completed every step on schedule.

EPA believes that the data from the file review, coupled with information gathered from other Agency evaluation efforts, does not show a wide-spread problem with lead in drinking water. However, both the state file review and the Agency's year long LCR review demonstrated a need for implementation improvements, especially related to exceedances of the action level. Both EPA and states have undertaken steps to improve this activity.

EPA has already increased its oversight of the LCR, and has emphasized SDWIS reporting. To address the public education issue, EPA asked the National Drinking Water Advisory Council (NDWAC) to develop recommendations to improve message and delivery. EPA expects that these recommendations will both improve compliance and provide clearer information to those most vulnerable to lead concerns. EPA has also significantly increased its efforts to reduce lead levels in schools.

EPA identified opportunities to improve implementation of the current rule, through revised guidance and revisions to the LCR in the areas of monitoring, treatment processes, customer awareness, and lead service line replacement. In addition, EPA will conduct further research to address other issues identified.

Many states, including all of the states in the review, have informed EPA of new efforts they have undertaken to improve LCR oversight. Actions include new rounds of training for water systems, improved data flow management, internal reviews of responses to action level exceedances and enforcement, increased focus on education materials for schools and child care facilities, and changes or increases in staffing. EPA is encouraged by this response. While EPA recognizes the resource constraints of many states, the state role is key to ensuring reduction of lead levels.

It is important to note that the work of states and water utilities to implement the LCR has resulted in lower lead levels across the United States. While this report is focused on the most recent years of implementation, the reviewers looked at data through the 1990s as well. Reviewers noted that implementation has consistently improved over time. States and water systems have resolved many of the problems in the rule, and should be given credit for their actions. The examples of the District of Columbia and other communities throughout the country show that water systems, states, and EPA must continue their actions to keep lead levels down.

This page left intentionally blank.

1. LEAD AND COPPER RULE STATE FILE REVIEW

1.1 Introduction

In 2004, the EPA began a national review of implementation of the Lead and Copper Rule (LCR) as part of its oversight responsibilities under the Safe Drinking Water Act (SDWA). The review was prompted by concerns from Congress and consumers that high lead levels observed in the District of Columbia's drinking water were representative of a nation-wide problem. The national review consisted of 3 components: an evaluation of the LCR data reported to EPA's Safe Drinking Water Information System (SDWIS); LCR expert workshops on the topics of monitoring, public education, simultaneous compliance, lead service line replacement, and plumbing fixtures; and an analysis of how states are implementing the rule through a review of water system files in selected states. This report summarizes the findings of the state file review which focused on four main areas: accuracy of SDWIS 90th percentile data, appropriateness of sampling site selection and sample management, water systems' response to lead action level exceedances (ALEs), and implementation of the LCR requirements by schools.

EPA used an contractor to conduct the state file reviews and to evaluate implementation concerns raised in various venues. To gain a national picture of LCR implementation, the file reviews looked at data for 483 water systems across the country. While this sample set gives a degree of confidence in implementation as a whole, it does not provide enough data points to give an accurate picture for subsets of data (i.e., large vs. medium-sized systems).

1.2 Background

The LCR, promulgated June 7, 1991, established a maximum contaminant level goal (MCLG) for lead of zero and an MCLG for copper of 1.3 mg/L. The rule also established a National Primary Drinking Water Regulation (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. The rule set an action level (AL) of 0.015 mg/L or 15 parts per billion (ppb) for lead and 1.3 mg/L or 1300 ppb for copper. The action level is a concentration of lead or copper in the 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. The action level is exceeded if the concentration in more than 10 percent of tap water samples collected during any monitoring period is greater than the action level (i.e., if the 90th percentile level is greater than the action level). If the 90th percentile value for tap water samples is above the action levels, it does not signal a violation but can trigger other requirements that include water quality parameter (WQP) monitoring, corrosion control treatment (CCT), source water monitoring/treatment, public education, and lead service line replacement.

Sampling is conducted at high-risk sites because, unlike the majority of other contaminants, most of the lead in drinking water comes from components of the water system's distribution system (e.g., service lines, meters) and from the consumer's home plumbing. This means that lead levels will vary throughout the distribution system, and may be highest at the consumer's tap. To address this variability, EPA established a sampling schema that requires water systems to collect a specified number of samples at homes with the highest potential risk for lead leaching. Sites with the highest risk for lead are called Tier 1 sites and include single family homes that contain copper pipes with lead solder installed after 1982 or lead pipes and/or with a lead service line. The LCR outlines criteria for Tier 2 and Tier 3 sites as well. Water systems must use Tier 1 sites for tap water sampling. If a system does not have enough Tier 1 sites for a sufficiently large pool of sites, the water system will then add Tier 2 sites to complete the sampling pool. Tier 3 sites are only used when the water system does not have sufficient Tier 1 and Tier 2 sites to complete its sampling pool. This sampling schema is designed to identify the need for system-wide CCT or to determine if CCT has been optimized.

Water systems which exceed the action level must conduct water quality parameter (WQP) monitoring. WQP samples are collected at taps and at each entry point to the distribution system. WQPs include: pH, alkalinity, calcium, and in the initial sample, conductivity and temperature as well. If treatment is currently installed, other parameters may also be included depending on the treatment type. After follow-up monitoring, the primacy agency will set a range of optimal WQPs.

Systems must also check the source water for lead or copper following an action level exceedance. Systems must collect samples at each entry point to the distribution system, and make a recommendation for source water treatment as needed.

Corrosion control activities triggered by an action level exceedance (ALE) include: recommendation for optimal corrosion control treatment, completion of a corrosion control study (if required by the state), installation of corrosion control treatment after the state has determined appropriate treatment, and monitoring of WQP at entry points for 2 consecutive 6-month periods.

Water systems which exceed the lead action level are required to implement a public education program which includes distribution of print materials and other activities to provide information to customers about the health effects of lead, sources of lead in drinking water, and actions consumers can take to reduce their risk.

A water system must begin replacing lead service lines (LSLs) if it continues to exceed the lead action level after installing corrosion control treatment and/or source water treatment. A water system that has triggered lead service line replacement (LSLR) must annually replace seven percent of their LSL inventory.

1.3 Methodology

Representatives from EPA and The Cadmus Group, Inc., a contractor to EPA, conducted on-site reviews of water systems data in the drinking water supervision programs in ten states. The purpose of the review was to examine in great detail the states' implementation of the LCR. The review consisted of detailed file examinations and interviews.

Water system files from ten states were evaluated, one state from each US EPA Region. Selection of states was based on geographic diversity and previously scheduled on-site review activities. Five states were selected because they were already scheduled for a file review between August and December 2004 as part of the routine oversight practiced by EPA. The protocol used for conducting the routine state review was augmented to include additional LCR specific information for examination. For the remaining five regions, states were selected that had not undergone a recent routine state review. Reviews were conducted in Massachusetts, New Jersey, Virginia, Georgia, Illinois, Texas, Iowa, Utah, California, and Oregon. While the states selected may not be statistically representative of the nation, they serve to represent an overall national impression of implementation at the state and system level. Appendix A provides information about state program structures.

Once the states were chosen, a subset of systems from each state was selected for review. The systems reviewed (see Table 1) were selected through a two-step process. First, a sample was selected using the random selection utility in SDWIS to provide a 90 percent confidence interval and 5 percent error tolerance. This produced a list of 22 to 36 active community water systems (CWSs)[2] and 17 to 19 non-transient non-community water systems (NTNCWSs)[3] per state, yielding 406 water systems total. In this report, these systems are referred to as "random systems". Second, the selections were reviewed to ensure that systems with the following specific characteristics were included in the pool for review:

- At least two large systems serving > 50,000 people; with at least one system with a lead action level exceedance (ALE)
- At least five medium systems serving 3,300 - 50,000 people; with at least two systems with ALEs
- Small systems serving less than 3,300 people; with at least two systems with ALEs
- Schools; with at least three to five schools with an ALE

[2] A community water system is a public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

[3] A non-transient non-community water system is a public water system that is not a community water system and that regularly serves at least 25 persons over 6 months per year.

EPA selected 77 additional systems – 46 CWSs and 31 NTNCWSs (including 21 schools) because of high lead 90th percentile values or other issues of interest noted in SDWIS. These systems are discussed separately in sections of this report and are referred to as "targeted systems." The total number of systems reviewed in the ten states was 483. Table 1 provides inventory details of the systems that were reviewed.

Table 1. Systems Reviewed

State	Total	Community Water Systems			Non-transient Non-community Water Systems		
		>50,000	3,301-50,000	≤3,300	3,301-50,000	≤3,300	Schools
California	42	2	9	15	0	11	5
Georgia	50	2	7	19	0	14	8
Iowa	44	2	4	18	0	13	7
Illinois	52	3	10	16	0	12	11
Massachusetts	46	3	6	14	0	10	13
New Jersey	50	4	10	15	0	16	5
Oregon	56	4	8	20	0	11	13
Texas	48	2	11	20	0	9	6
Utah	49	4	4	22	2	14	3
Virginia	46	1	8	17	0	10	10
Total	483	27	77	176	2	120	81

The file review protocol utilized hard copy and microfiched documents and electronic data for the sample of public water systems (PWSs). Reviewers examined file records from the beginning of initial implementation of the LCR in 1992 to the most current information. Data for LCR compliance for 2000-2004 was examined in greater detail in order to compare file review information with data reported to SDWIS. The reviewers looked at four main areas: accuracy of SDWIS 90th percentile data, appropriateness of sampling site selection and sample management, water systems' response to lead action level exceedances (ALEs), and implementation of the LCR requirements by schools.

If individual results for sampling rounds were available, the 90th percentile calculations were verified. Verification of the 90th percentile calculations allowed reviewers to determine if data reported to SDWIS is accurate and if ALEs were correctly identified and addressed.

When available, reviewers compared the original site sampling plans and initial monitoring results to the sampling sites used for the most current sampling rounds. This would identify if sampling sites were changed inappropriately over time.

When file documentation indicated an ALE, records were reviewed to determine if the water system completed all required activities such as public education (PE) and CCT steps. In addition, records for water systems which began CCT steps in response to a lead ALE were evaluated to determine if the system met the criteria for discontinuing corrosion control treatment steps (e.g., by having two consecutive six-month sampling rounds below the lead and copper action levels).

This page left intentionally blank.

2. NATIONAL FINDINGS

2.1 90th Percentile

The LCR established an action level of 0.015 mg/L (15 ppb) for lead and 1.3 mg/L (1300 ppb) for copper based on the 90th percentile level of tap water samples. This means no more than 10 percent of samples can be above either action level. If lead or copper levels are found above the action levels, it does not signal a violation but can trigger other requirements that include water quality parameter monitoring, corrosion control treatment, source water monitoring/treatment, public education, and lead service line replacement.

For each monitoring period, a system (or the state) must calculate and report the lead 90th percentile value for sites monitored during the sampling round. To calculate the 90th percentile, all results are ranked from the lowest to the highest value, numbering each from 1 up to the number of samples taken. The number of samples taken is multiplied by 0.9. The resulting number is the value that is the 90th percentile. For example, if a system collects tap water samples from 100 sites, it sorts its results from the lowest to the highest concentration and reports the concentration it observed in the 90th sample (100 x 0.9). If this 90th percentile result exceeds the action level for lead (15 ppb) the water system is required to undertake public education and corrosion control activities. It is important that the 90th percentile is calculated and reported correctly. If the 90th percentile level is incorrectly calculated, it can falsely trigger a system into treatment steps or, conversely, delay the implementation of needed treatment or public education.

In 2000 the LCR underwent minor revisions. These minor revisions (also known as the Lead and Copper Rule Minor Revisions or LCRMR) streamlined requirements, promoted consistent national implementation, and in many cases, reduced burden for water systems. One of the provisions of th LCRMR require States to report the 90th percentile to EPA's SDWIS database for all water systems serving 3,300 or more persons. States must report the 90th percentile value for water systems serving less than 3,300 persons only if the water system exceeds the action level. The effective new reporting requirements became effective in 2002.

2.1.1 Accuracy of 90th Percentile Calculations

File reviewers evaluated the accuracy of the 90th percentile calculations for all water systems. A total of 1,135 sampling rounds were reviewed for the 483 systems for the period between 2000 to 2004. Evaluation of the accuracy of 90th percentile values revealed that for those values that could be verified, 93% of sampling rounds had been calculated correctly. The state is required to maintain within their files individual sample results that are used to calculate the 90th percentile for a sampling round. Reviewers found sufficient information in state files to

perform verification of the 90th percentile value for over 78% of sampling rounds reviewed. However, this data was not available for 250 rounds of lead sampling.

For the 885 sample rounds that did have individual sample results, reviewers confirmed that the 90th percentile level was calculated correctly for 824 sampling rounds. For the 61 rounds where the 90th percentile was calculated incorrectly, 22 sampling rounds were above the action level when recalculated. For those 22 rounds, 11 of the corrected values would have resulted in a previously unidentified action level exceedance. The remaining 11 rounds although calculated incorrectly as above the action level, when corrected were still above the action level. The remaining 39 calculations, while incorrect, were still below the action level when recalculated correctly.

Two hundred fifty sampling rounds could not be verified because the file did not include all individual sample results. A review of the state files for these 250 sampling rounds showed that 17 sampling rounds had no 90th percentile lead value recorded, 29 sampling rounds had 90th percentile lead levels greater than the AL, and 204 sampling rounds had 90th percentile lead levels less than the lead AL.

Figure 1 shows the results of verification of the 90th percentile values for the 1,135 sampling rounds evaluated. Table 2 provides a summary of the accuracy of 90th percentile calculations for 1,135 sampling rounds collected during 2000-2004.

Figure 2. Results of Verification of 90th Percentile Values for 1,135 Sampling Rounds

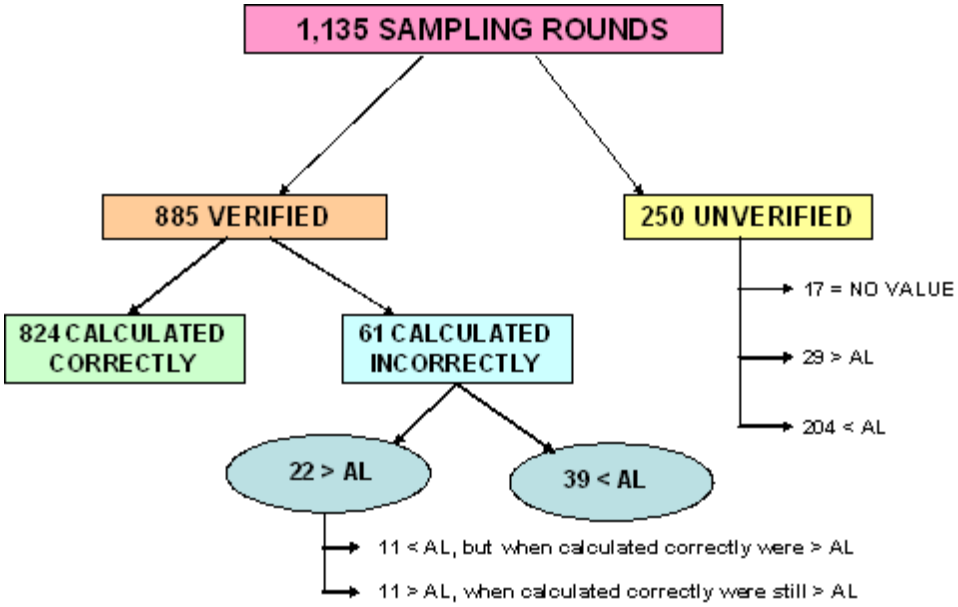

Table 2. Accuracy of 90th Percentile Calculation
(Based on data for 1,135 sampling rounds between 2000-2004)

Calculation of 90th Percentile Values	Total Sample Rounds	Community Water Systems			Non-transient Non-community Water Systems		
		>50,000	3,301-50,000	≤3,300	3,301-50,000	≤3,300	Schools
Calculated correctly	824	64	121	265	3	214	157
Calculated incorrectly - correct values less than the AL	39	3	10	6	0	14	6
Calculated incorrectly - correct values greater than the AL[1]	22	0	5	3	1	8	5
Subtotal	885	67	136	274	4	236	168
Unknown[2]	250	13	42	81	0	56	58
Total	1,135	80	178	355	4	292	226

[1] For 22 sampling rounds (18 systems) the 90th percentile was incorrectly calculated. Eleven systems original 90th percentile was less than the AL and when recalculated correctly was above the AL, and 11 systems original 90th percentile was greater than the AL and when recalculated correctly was still above the AL.

[2] Note: For 250 values the 90th percentile could not be confirmed because only the 90th percentile or no 90th percentile value was available for review (individual tap sample results were not in the file). Twenty nine sampling rounds were greater than the ALE, 204 were less than the AL, and 17 had no values in the state files.

2.1.2 90th Percentile Values

For the 483 systems reviewed, 1,135 lead 90th percentile values from 2000- 2004 were identified (Table 3). For the randomly selected systems, 91 percent of the sampling rounds fell below the action level and 7 percent of sampling rounds reviewed had a 90th percentile value greater than the action level. For the targeted systems, 70 percent of the sampling rounds were below the action level. The lower percentage of sampling rounds at or below the action level for the targeted systems was expected, since many of the targeted systems were selected due to ALE data reported to SDWIS. Table 3 identifies the size of the public water systems (PWSs) and the range of 90th percentiles values.

Table 3. Lead 90th Percentile Values Identified for PWSs
(Based on data from 1,135 sampling rounds during 2000-2004)

90th Percentile Value Ranges	Number of 90th percentile Values	Community Water Systems			Non-transient Non-community Water Systems		
		>50,000	3,301-50,000	≤3,300	3,301-50,000	≤3,300	Schools
Randomly Selected Systems							
Not Detected	185	2	14	74		59	36
≤15 ppb	599	38	94	198	2	183	84
>15-50 ppb	49	3	8	10	-	13	15
>50-100 ppb	7	1	1	2	-	1	2
>100 ppb	6	-	-	-	-	3	3
Unknown (1)	14	1	4	5	-	3	1
Total	860	45	121	289	2	262	141
Targeted Systems							
Not Detected	21		4	6		1	10
≤15 ppb	171	25	37	37	1	18	53
>15-50 ppb	57	10	12	8	1	10	16
>50-100 ppb	12	-	3	7	-	-	2
>100 ppb	11	-	1	8	-	1	1
Unknown (1)	3	-	-	-	-	-	3
Total	275	35	57	66	2	30	85

Table 3. Lead 90th Percentile Values Identified for PWSs
(Based on data from 1,135 sampling rounds during 2000-2004)

90th Percentile Value Ranges	Number of 90th percentile Values	Community Water Systems			Non-transient Non-community Water Systems		
		>50,000	3,301-50,000	≤3,300	3,301-50,000	≤3,300	Schools
All Systems in Sample							
Not Detected	206	2	18	80	-	60	46
≤15 ppb	770	63	131	235	3	205	137
>15-50 ppb	106	13	20	18	1	25	31
>50-100 ppb	19	1	4	9	-	1	4
>100 ppb	17	-	1	8	-	4	4
Unknown (1)	17	1	4	5	-	3	4
Total	1135	80	178	355	4	292	226

(1) The 90th percentile was not present in the file.

2.2 Site Selection and Sample Management

The rule requires that systems create a pool of sample sites that are expected to have the highest levels of lead. Federal regulations require each water system to complete a materials evaluation of its distribution system in order to identify this pool of targeted sampling sites that may be particularly susceptible to high lead concentrations. Determination of sites as high risk is based on a tiering system. Tier 1 sites are those that are most likely to show the highest lead concentrations at the customer's tap within the water systems service area. Water systems are required to monitor a select number of sites from the identified pool.

2.2.1 Sample Site Plans and Sample Collection Forms

States are not required to review and approve the materials evaluation plans. However, the reviewers did check files for materials evaluation plans and sampling site plans. Frequently state files did not contain the original sampling site plans or materials evaluation. States noted that, because the plans were created more than 10 years ago, they have either archived, microfiched, or required the systems to retain the records. When the system retains the records, state employees verify that the system has a sampling site plan during sanitary surveys but do not verify the sampling site locations or tiering for the sites within the pool.

The rule requires that systems report the results of all the samples including the criteria under which the site was selected for the sampling pool (i.e., Tier 1, Tier 2, Tier 3). In order to ensure correct site locations are used, the regulations require systems to identify any new site which was not sampled during previous monitoring periods and include an explanation of why the sampling sites have changed.

To help ensure that proper sites are used, nearly every state reviewed had designed a standardized sample collection form that the systems are required to submit with their samples. The forms clearly identify each site and tier to which the site belongs, the address of the site, and a contact name. Most forms ask whether any sites changed and request an explanation if they do. However, the forms often were either unavailable or incomplete in the files. For nearly half of the systems reviewed, it was not possible to determine if the sample sites met the highest possible tiering classification.

For 106 of the 483 water systems, sampling site locations have not changed from the system's initial LCR monitoring. One hundred and sixty-five systems changed sites without explanation, and 34 systems selectively dropped sites that had tested above the action level. During the state review, reviewers could not determine whether systems sampled consistent sites for 82 systems because the state files did not contain information clearly identifying sampling site locations. Ninety-four water systems did change sampling sites, but provided an explanation for the change. Commonly identified reasons for site changes were homeowners refusing to continue to participate, a homeowner who had moved and the new owner was unwilling to participate, plumbing changes, or not wanting to use a vacant home. Only two states review the sampling round site information to determine whether systems changed sites. Table 4 provides an overview of sampling site change status.

Table 4. Status of Systems' Sampling Site Changes
(Based on data from 483 systems)

Reason	Total Systems	Number of Systems					
		Community Water Systems			Non-transient Non-community Water Systems		
		>50,000	3,301-50,000	≤3,300	3,301-50,000	≤,3,300	Schools
No Change	106	2	6	49	-	27	22
Varied Between Rounds, but from Approved Pool	2	-	1	1	-	-	-

Table 4. Status of Systems' Sampling Site Changes
(Based on data from 483 systems)

Reason	Total Systems	Number of Systems					
		Community Water Systems			Non-transient Non-community Water Systems		
		>50,000	3,301-50,000	≤3,300	3,301-50,000	≤,3,300	Schools
Sites No Longer Available[1]	94	10	24	32	-	21	7
Sites Appeared to Be Selectively Dropped	34	1	7	15	-	4	7
Sites Changed but Reason Unexplained	165	12	28	52	1	42	30
Unable to Verify if Sites Changed[2]	82	2	11	27	1	26	15
Total Number of Systems Reviewed	483	27	77	176	2	120	81

[1] Homeowners refused to continue to participate, homeowner moved and the new owner was unwilling to participate, plumbing changes, or home vacant.
[2] Sampling sites locations were not clearly identified in the state files.

2.2.2 Sampling Protocol

The tap water sample collection protocol for the LCR is designed to identify the contributions of different sources of lead in drinking water: source water, lead service lines, lead and copper interior piping, lead solder, and fixtures and faucets. Because lead in drinking water is primarily due to the corrosion of distribution components and household plumbing materials, tap water samples are collected at kitchen or bathroom taps of residences and other buildings. In addition, EPA considers that the best measure to adequately assess the degree to which a system

has minimized corrosivity of the water for lead and copper is through measurement of first draw[4] lead and copper levels at the tap.

Under the LCR, samples may be collected by the system or the system may allow residents to collect samples after instructing the residents on proper sampling procedures. However, water systems are responsible for ensuring that reported results accurately reflect the samples collected. Because concerns have been raised about samples being taking incorrectly by homeowners, the reviewers closely considered this issue.

2.2.3 Who Collects the Sample?

Although the information is not required to be in the state files, reviewers looked to see if they could determine who collected the sample. For 248 systems, the files did not contain information indicating who collected the sample. Ninety-six of the systems collect the tap water samples (usually NTNCWSs who have access to all of their taps) and 124 of the systems rely on occupants to collect samples. The remaining 15 systems arrange for a laboratory to collect samples or vary collection between the occupant and the water system.

Training for collecting samples included a comprehensive letter accompanying the sample bottles with clear instructions for homeowners about how and when to collect a sample, training seminars and a video describing proper sample collection procedures for the water systems. All of the states seemed to have good sample collection training programs and the availability of training materials was judged to be adequate to excellent.

2.2.4 Where are the samples taken?

About 124 of the systems reviewed routinely indicated the location where the sample was collected (e.g., at the sink, a tap at the well, or the outside hose bib). This type of information can be helpful to the state to ensure that the sample was taken at the correct location. Roughly half of the system files, 241 out of 483 systems, did not provide that information. Thirty-six systems did not consistently provide the information and a few systems did not have information about where the sample was collected because they were not required to monitor (either a new or inactive system, or a system that had been issued a waiver).

---

[4] A first draw sample is 1 liter in volume and is collected from a cold water kitchen tap or bathroom sink tap. The sample is collected immediately after turning the water on without allowing any water to run into the drain. Water must have stood motionless in the plumbing system for each sampling site for at least six hours.

2.2.5 How much time passes between the collection of the first and last sample used to calculate the 90th percentile?

Reviewers considered when samples are collected to see if water systems were manipulating results by extending the monitoring period[5]. An evaluation of the amount of time that passes between the first and last compliance samples taken in a sampling round shows that the majority of sampling rounds are completed within the same day. For 1,635 sampling rounds of the 2,069 evaluated from 1992 to 2004, 79% were collected within one day, while samples for 262 of the 2,069 sampling rounds (12.7%) were collected within one month. Samples for 97 sampling rounds (4.7%) were taken within 4 months or more, and the time frame over which sampling was conducted could not be determined for 75 sampling rounds (3.6%). The file review did not reveal evidence that monitoring period extension resulted in manipulation of results.

2.2.6 Sample Invalidation and Replacement Samples

The LCR contains provisions which allow for invalidation of individual tap water samples. States may invalidate a lead or copper tap water sample if at least one of the following conditions is met: the laboratory establishes that improper sample analysis caused erroneous results, the state determines that the sample was taken from a site that did not meet the site selection criteria, the sample container was damaged in transit, or there is substantial reason to believe that the sample was subject to tampering. While the file review found that states infrequently invalidated samples, it also found that most of the invalidations did not meet the criteria of the LCR.

Individual samples were invalidated in at least one sampling round for 26 systems (5%) of the 483 systems reviewed. Samples for only two systems were invalidated according to one of the four acceptable criteria outlined under the LCR. For the remaining 24 systems, the reason for sample invalidation did not meet one of the allowable invalidation criteria. This "improper" sample invalidation was noted in seven states. The systems where improper invalidation occurred used replacement samples for one or two rounds of the systems' monitoring history. One of the systems had invalidated samples during four different sampling rounds.

The reason for invalidation was not always documented in the files. However, invalidation occurred most often when a sample site yielded a high lead concentration. This was noted in four states for a total of 12 systems (2% of all systems reviewed). Under the invalidation

[5] The monitoring period may be 6 months, for water systems on standard monitoring, or annual, triennial, or once every 9 years if the water systems meets criteria for reduced monitoring or a waiver. Water systems sampling annually or less frequently shall conduct tap water sampling during the months of June, July, August or September unless the state has approved a different sampling period.

provisions of the LCR, states may not invalidate a sample solely on the grounds that a follow-up sample result is higher or lower than that of the original sample. States also incorrectly invalidated samples because of recent plumbing changes, use of an improper tap (e.g., outdoor hose bib, shower), or because the sample was collected after an excessively long standing time (e.g., site was abandoned, closed for the summer, taken from a vacation home). One sample was invalidated for being collected after too short of a standing time.

An invalidated sample does not count toward determining lead or copper 90th percentile levels or toward meeting the minimum number of samples required. The water system must collect a replacement sample if, after the invalidation, the system has too few samples to meet the minimum requirements. The replacement samples must be taken at the same locations as the invalidated samples or, if that is not possible, at locations other than those already used for sampling during the monitoring period.

Systems varied in how the replacement samples were used in the 90th percentile calculation. For the 26 occasions of invalidated samples, 22 systems correctly used only the replacement sample results, three systems used both the replacement sample value and the original sample values, and one system did not use the result from the replacement sample in the 90th percentile calculation.

In most cases, sample invalidation affected whether the system continued to have an ALE. For 19 of the 24 systems (79%) in which samples were invalidated improperly, the system no longer exceeded the lead AL. For four of the 24 systems, sample invalidation did not affect whether the system exceeded the lead AL and the effect on the 90th percentile level was not documented for the remaining system.

2.2.7 Individual Lead Sample Results and Homeowner Notification

A total of 17,541 individual sample values were included in the sampling rounds from 2000-2004 that were evaluated by the reviewers. Five percent (912 of 17,541) of the individual samples from random and targeted systems exceeded the action level. The randomly selected systems had 357 of 10,932 (3 percent) of individual sample values above the action level and targeted systems had 555 of 6,609 (8 percent) above the action level. Figure 2 shows the distribution of lead concentrations in individual tap water samples. Table 5 shows the range of lead concentrations found in individual tap water samples.

Figure 3. Distribution of Individual Sample Results For All Water Systems (2000-2004)

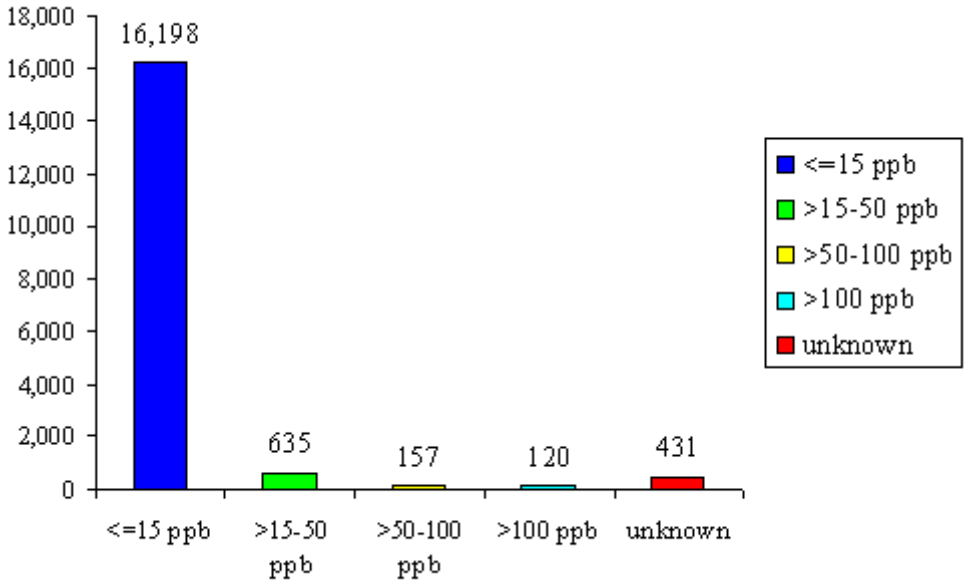

Table 5. Ranges of Individual Lead Sample Results
From Data between 2000-2004

Pb Sample Value	Number of Samples	Number of Samples					
		Community Water Systems			Non-transient Non-community Water Systems		
		>50,000	3,301-50,000	≤3,300	3,301-50,000	≤3,300	Schools
Randomly Selected Systems (10,932 samples)							
≤15 ppb	10,304	2,016	3,263	2,511	38	1,532	944
>15-50 ppb	250	45	83	39	0	39	44
>50-100 ppb	57	9	20	11	0	13	4
>100 ppb	50	4	18	6	2	15	5
unknown	271	76	53	73	2	28	39
Subtotal	10,932	2,150	3,437	2,640	42	1,627	1,036
Targeted Systems (6,609 samples)							
≤15 ppb	5,841	2,708	1,701	520	33	171	761
>15-50 ppb	385	164	112	29	6	24	50
>50-100 ppb	100	42	38	13	1	0	6
>100 ppb	70	4	24	33	0	4	5
unknown	160	105	20	6	0	1	28
Subtotal	6,609	3,023	1,895	601	40	200	850
All Systems in Sample (17,541 samples)							
≤15 ppb	16,198	4,724	4,964	3,031	71	1,703	1,705
>15-50 ppb	635	209	195	68	6	63	94
>50-100 ppb	157	51	58	24	1	13	10
>100 ppb	120	8	42	39	2	19	10
unknown	431	181	73	79	2	29	67
Total	17,541	5,173	5,332	3,241	82	1,827	1,886

Table 5. Ranges of Individual Lead Sample Results
From Data between 2000-2004

Pb Sample Value	Number of Samples	Number of Samples					
		Community Water Systems			Non-transient Non-community Water Systems		
		>50,000	3,301-50,000	≤3,300	3,301-50,000	≤3,300	Schools

Note:
The total does not include data for 17 systems for which no 90th percentile values were available or where the highest lead sample result was not noted for the sampling round. Lead sample values that are "unknown" are due to the lack of individual sample results in files. To approximate the number of samples that were less than the lead action level, the number of samples where the highest value was less than the action level was counted. The number of samples that are less than the action level is likely to be much higher.

There are no federal requirements under the LCR for water systems to notify homeowners of the results of sampling carried out in their residence. Therefore, it was not possible to determine how many systems are informing homeowners of elevated lead samples. In their standard letter to systems informing them of their sample results, five states tell systems that they should inform their customers if any individual sample result exceeds the action level. One state routinely provides two copies of the analytical results produced by the state lab and requests that one copy be forwarded to the occupants. Another state commented that many homeowners volunteered to participate in the sampling program in order to receive this type of information.

2.3 Response to Action Level Exceedances

Exceeding the action level at the 90th percentile is representative of a potential system-wide problem related to lack of corrosion control. As such, an exceedance triggers several actions by the water system that are important to take to ensure that risks to the public are minimized. Water systems which exceed the action level are required by regulation to begin corrosion control steps, monitor water quality parameters and source water, and deliver public education to alert the public of the problem. If the system has already installed corrosion control and source water treatment, the water system must optimize these treatment processes and begin lead service line replacement (LSLR).

Large systems, serving a population greater than 50,000, are required to implement corrosion control, regardless of whether they exceed the action level during tap sampling. Medium and small systems are only triggered into implementing corrosion control if they exceed the action level. The system may elect to continue sampling at six-month intervals at the standard number of sites while initiating corrosion control. If the system is below the action level for two consecutive rounds of samples, the system may discontinue corrosion control activities. However, if they later exceed the action level again, the system must resume their corrosion control program at the point at which it had previously been discontinued.

Of the 483 systems reviewed, 82 systems had lead action level exceedances (ALEs) from 2000 to 2004. Each of the 10 states reviewed had from four to thirteen systems with lead ALEs during the four year period. The 82 systems had anywhere from one to eight lead ALEs during this time period. Fewer than 1% of the randomly selected systems had more than 1 ALE from 2000-2004. Most of the 82 systems (about 63%) had only one exceedance during this time period (Table 6a). Table 6b shows the distribution by system size of the 82 systems with ALEs.

Table 6a. Number of ALE Events for the 82 Systems With Lead ALEs:
52 systems had one ALE
17 systems had 2 ALEs
8 systems had 3 ALEs
4 systems had 4 ALEs
1 system had 8 ALEs

An evaluation of the time period from 2000 to 2004, shows these 82 systems had at least 134 occasions when the systems should have initiated follow-up actions such as public education, water quality parameter monitoring (WQP), source water monitoring, and corrosion control treatment (CCT) steps as a result of a lead ALE. As with the site sampling plans, files for individual systems were frequently incomplete.

Table 6b. Systems with Lead Action Level Exceedances during 2000 - 2004							
		Community Water Systems			Non-transient Non-community Water Systems		
		>50,000	3,301-50,000	≤3,300	3,301-50,000	≤3,300	Schools*
Randomly Selected Systems (39 of 406 "randomly selected" systems reviewed had at least one lead ALE during 2000-2004)							
Numbers of Systems with ALEs	39	2	5	7	0	12	13
Targeted Systems (43 of 77 "targeted" systems reviewed had at least one lead ALE 2000-2004)							
Numbers of Systems with ALEs	43	5	9	13	1	6	9
All Systems in Sample (82 systems had at least one lead ALE during 2000-2004)							
Numbers of Systems with ALEs	82	7	14	20	1	18	22
* One of the targeted schools in the sample is a community water system.							

2.3.1 System Responses to Lead ALEs

Although it is not required by regulation, notifying a PWS of its exceedance and required follow-up actions is key in ensuring that small and medium systems stay on schedule to address requirements. Unlike large systems, for which state and system CCT deadlines are specified in the LCR, the schedule for a small and medium system is triggered by a state's determination of whether a CCT study is needed, the type of treatment to be installed, and the designation of optimal water quality parameters (OWQPs)[6].

[6] Ranges or minimums set by the primacy agency that indicate a system's CCT is operating at a level to most effectively minimize lead and copper concentrations at user's taps. Water Quality Parameters (WQPs) may include pH, alkalinity, orthophosphate, silica, and/or calcium.

For the 82 systems that had ALEs during 2000-2004, Table 7 presents a history of the known responses the systems took based on the information available in the state files. The table separately describes all follow-up actions for large systems (Table 7a), and initial follow-up actions (those that must be completed within 6 months of the ALE) for small and medium systems (Table 8).

Table 7: Follow-up Actions by Seven Large Systems that Exceeded the Lead Action Level during 2000 - 2004
(Expressed as Number of Systems)

Action	Unknown	Not Required	No	Yes	
				Some	All
Public Education (PE) conducted?[1]	0	**All systems must conduct PE.**	0	2	5
Water Quality Parameter (WQP) monitoring conducted?[2]	1	1	1	1	3
Source monitoring conducted?[3]	1	1	1	0	4
Corrosion Control Treatment (CCT) study completed?[4]	1	0	0	6	

Action	Unknown	Not Required	No	Yes	
				≤ AL	> AL
CCT installed?[5]	1	1	0	1	4
CCT adjusted [applies to PWSs w/ ALE after CCT installation][6]	1	4	0	2	0

Table 7: Follow-up Actions by Seven Large Systems that Exceeded the Lead Action Level during 2000 - 2004
(Expressed as Number of Systems)

Action	Unknown	Not Required	Began	Will Begin after 2004
Lead Service Line Replacement (LSLR) initiated?[7]	0	4	3	0

[1] For an initial ALE PWSs must begin PE requirements within 60 days. Public service announcements are due every 6 months for CWSs. Other public education requirements must be repeated annually for as long as system has a lead ALE. Systems document completion of these activities in an annual letter to the state.

[2] Large systems must conduct WQPs during each initial lead and copper tap monitoring period, and after CCT installation, irrespective of whether they exceed an AL.

[3] Systems must collect source water samples within 6 months of the initial ALE, and for those systems that install source water treatment, collect source water samples after the installation of this treatment. Source water samples are also collected by systems that are applying for (b)(3) status. A (b)(3) system is one that can demonstrate that it has minimally corrosive water based on source water monitoring and lead/copper tap monitoring results. As long as a system qualifies as a (b)(3) system, it does not have to conduct corrosion control treatment (CCT) steps. One PWS was granted (b)(3) status in 1995 after it completed a study. It exceeded the action level in 2000 but its (b)(3) status was not rescinded. Another PWS purchases all its water from another water system and was not required to conduct source water monitoring, or CCT steps.

[4] Large systems, except (b)(3) systems (see footnote 3 above), were required to submit a CCT study by July 1, 1995.

[5] Large systems, except (b)(3) systems (see footnote 3 above), were required to install CCT by January 1, 1997. For one system, CCT was installed by seller. One large system reviewed met the (b)(3) criteria and therefore was not required to install CCT.

[6] Only systems that continue to exceed the AL after installing CCT may be required to make changes to treatment and the state may establish new OWQPs. For the 4 systems that were not required to adjust CCT, 3 no longer exceeded the AL and 1 was not required by the state to adjust CCT. One system received state approval to adjust treatment but it is unknown if it was completed.

[7] A minimum of 7% of lead service lines must be replaced annually in systems that continue to exceed the lead AL after installing treatment. Lead service line replacement (LSLR) may stop after the water system no longer exceeds the lead AL for 2 consecutive monitoring periods. One water system listed as starting LSLR is developing a LSLR plan. Another stopped LSLR after two years because the system had two sampling rounds below the action level.

Table 8: Initial Follow-up Actions by 75 Medium or Small Systems that Exceeded the Lead Action Level during 2000 - 2004[1]
(Expressed as Number of Systems)

Section A. Did not Conduct Any Required Initial Actions Because (39 systems):

ALE not recognized by State/PWS[2]	ALE too recent[3]	Reason Unknown/Other[4]
8	4	27

Section B. Follow-up Actions Conducted by 36 Systems ***(Does not include systems in Section A.)***

Action	Unknown[8]	None	Some	All
Public Education (PE) Conducted?[5]	0	18	0	18
Initial Water Quality Parameters (WQPs) Conducted?[6]	0	7	0	29
Initial Source Water Monitoring Conducted?[7]	2	8	0	26

Table 8: Initial Follow-up Actions by 75 Medium or Small Systems that Exceeded the Lead Action Level during 2000 - 2004[1]
(Expressed as Number of Systems)

Notes

[1] Initial follow-up actions include those that must be completed within 6 months or less of the ALE.

[2] Includes situations where a PWS was incorrectly determined to be at or below the lead AL due to: a) incorrect calculation of the 90th percentile level; or b) improper invalidation of samples (i.e., reasons for invalidation were not documented or did not meet one of the four criteria allowed under the regulation.)

[3] For these systems, the first exceedance occurred during 2004 and it was too soon to determine if the required follow-up actions had been completed during the review.

[4] No evidence that systems responded to initial ALE. One system already had treatment in place due to copper problems but no evidence that system responded to state letters to conduct PE, WQPs, source water monitoring, or CCT plan in response to the lead ALE.

[5] Initial public education delivery is due within 60 days of lead ALE.

[6] Initial WQP monitoring must be conducted during each initial lead and copper tap monitoring period in which an ALE occurs.

[7] Initial source water monitoring is due within six months of the first ALE. One system purchases its water entirely from another system and was not required to conduct source water monitoring.

[8] State files did not contain enough information to determine if actions were taken or not.

2.3.2 Public Education

Water systems are required to carry out Public Education (PE) efforts when they exceed the lead action level. The LCR specifies mandatory PE language that must be included in a system's PE materials. Systems must deliver PE materials within 60 days of learning about an ALE. Public service announcements (PSA) must be repeated every 6 months for as long as the ALE continues and print material delivery must continue annually for as long as the ALE continues. Only large systems are required to deliver PSAs.

Little documentation was found in the state files that identified whether a system delivered PE in any year after the lead ALE. Copies of PE materials for early lead ALEs may not have been present in state files because many records from the early 1990's had been archived. Documentation found in the files indicated that only one state routinely tracked whether systems continued to deliver PE as required, and systems in two states never completed required follow-up

PE activities. Generally, PE was never conducted in more than half of the systems reviewed for both CWSs and NTNCWSs.

From 2000-2004, 82 of the 483 water systems reviewed had at least one ALE. Of those 82 systems, 24 water systems (29%) did initial PE after the ALE. The low level of PE compliance was consistent across all the states reviewed. Only one state's water systems delivered initial PE 50% of the time. Table 9 displays systems which completed initial PE requirements following the systems first lead ALE

Table 9: Initial Public Education for Lead Action Level Exceedance Identified for PWSs *(Based on data from 2000-2004)*

Public Education	Number of Systems that did PE	Community Water Systems			Non-transient Non-community Water Systems		
		>50,000	3,301-50,000	≤3,300	3,301-50,000	≤3,300	Schools
Randomly Selected Systems (39 of 407 "randomly selected" systems reviewed had at least one lead ALE during 2000-2004)							
PE First Year of ALE	9	1	4	3	0	1	0
Targeted Systems (43 of 76 "targeted" systems reviewed had at least one lead ALE 2000-2004)							
PE First Year of ALE	15	5	5	2	0	2	1
All Systems in Sample (82 of 483 systems had at least one lead ALE during 2000-2004)							
PE First Year of ALE	24	6	9	5	0	3	1

Note: This table includes systems that conducted public education in response to their first lead action level exceedance during 2000 - 2004. Systems that failed to conduct public education in response to this lead action level but conducted it for an earlier or subsequent lead action level exceedance are not included in this table.

2.3.3 Water Quality Parameters and Source Water Monitoring

Systems that exceed either the lead or copper action level must conduct WQP monitoring within the same monitoring period in which the ALE occurred. Source water monitoring must

also be conducted within six months after the ALE to help identify the source of lead or copper. Many of the systems that were reviewed did not complete all required monitoring after an ALE.

Out of 134 occasions in which WQP and source water monitoring was required during 2000-2004, documentation in the state files indicated initial WQP and source water monitoring was conducted only 42 percent of the time. Thirty-three of 82 systems (40%) with an ALE conducted initial WQP monitoring and 30 systems (37%) conducted initial source water monitoring. None of the systems reviewed in two states conducted initial WQP or source water monitoring after an ALE.

2.3.4 Corrosion Control

Corrosion control treatment (CCT) steps must be conducted by large systems (serving more than 50,000 people) unless they can meet specific criteria that demonstrate they have very low levels of lead and copper in their distribution system (see the next paragraph for more detail). Small and medium water systems must carry out CCT steps if they exceed the action level. Based on a recommendation from the system regarding the type of corrosion control to be installed, the state decides if small or medium systems must conduct a corrosion control study to help evaluate the most effective type of corrosion control treatment for the system (studies are required for large systems). Systems have 24 months to install the type of corrosion control treatment specified by the state and must complete follow-up lead and copper tap monitoring and meet state-set WQP ranges or minimums (called optimal water quality parameters or OWQPs) that indicate that they are operating corrosion control treatment at a level that most effectively minimizes lead and copper concentrations at consumers' taps. Small and medium systems can discontinue these steps if they are at or below both action levels for two consecutive six month monitoring periods.

A system can be deemed to have optimized CCT if it submits results of tap water monitoring and source water monitoring demonstrating that, for two consecutive six month monitoring periods, the difference between the 90th percentile tap water lead level and the highest source water lead concentration is less than 5 ppb (the Practical Quantitation Level for lead). Based on this criteria, one state exempted all 11 large water systems that were reviewed from corrosion control activities, unless the action level was exceeded in the future. The reviewers found that one of the water systems (serving 110,000 people) technically did not meet the criteria because the difference between its source water level and 90th percentile level for one of the sampling rounds was 6 ppb.

Reviewers found that, as with other required ALE follow-up actions, most water systems are not completing corrosion control on schedule and some are not completing this requirement at all. Twenty-seven of the 82 water systems with ALEs installed corrosion control, 5 of the 7 large systems and 22 of the 75 medium and small systems. Water systems that exceeded the action level after the installation of corrosion control generally resumed where they had left off in the

corrosion control process. However, some continued for eight to ten years before resolving (or sometimes not resolving) the problem.

Seven of ten states reviewed allowed plumbing changes, flushing, and other non-corrosion control steps to replace undertaking a CCT study and selecting and installing treatment. This practice occurred on an occasional basis.

2.3.5 Monitoring Changes for New Sources or Corrosion Control Treatment Adjustments

The regulations require that no later than 60 days after the addition of a new source or any change in water treatment (unless the state requires earlier notification), a water system must send written documentation to the state describing the change. The federal regulation does not require prior state approval of these changes; although, it may be required by other drinking water regulations or by the state. While EPA did not expect this information to be in all of the files since approval is not required, reviewers looked for this information to see how states are addressing this issue.

Fourteen water systems returned to standard six-month monitoring periods as a result of adding a new source or a change in treatment. Qualitative observations indicate that about half of these water systems increased monitoring due to a new source. Two states were observed to require increased monitoring in response to the addition of a new source and/or treatment. One state required water systems to revert to initial monitoring at an increased number of sites in response to the addition of a new source.

All states require water systems to undergo review of plans and specifications before adding treatment, but whether the state assesses the impact of proposed changes on the corrosion control program was less clear. Corrosion control treatment adjustment information was rarely found in the files because few of the water systems reviewed had installed corrosion control. Of those that did, correspondence regarding treatment changes was not commonly found. In one state, special samples were required to confirm that nothing affected their compliance with the LCR.

2.3.6 Lead Service Line Replacement (LSLR)

A water system must begin replacing lead service lines (LSLs) if it continues to exceed the lead action level after installing corrosion control treatment and/or source water treatment. The state can also require LSLR if the water system is in violation for failure to install treatment after the deadline has passed (i.e., the water system is more than one year late installing CCT). Water systems also replace LSLs for reasons other than the federal requirements, including voluntarily replacement as part of routine maintenance and construction projects.

A water system that has triggered LSLR under the LCR must annually replace seven percent of their LSL inventory. None of the 10 states selected require that water systems replace more than seven percent of LSLs annually. Fourteen of the 82 water systems with lead ALEs during 2000-2004 indicated that they had no LSLs. Although some did have lead components in the distribution system (e.g., goosenecks and/or pigtails), these are not considered to be LSLs.

Three water systems that had more than two monitoring periods with a lead ALE were told to initiate a LSLR program. Two water systems began LSLR after installation of corrosion control failed to mitigate lead levels. One water systems began a LSLR program in 1999. It correctly followed the requirements and completed LSLR in 2004. The other water system met the seven percent LSLR requirement for two years but replaced less than seven percent in subsequent years. In 2004, the third water system was instructed to initiate a LSLR program, but it was too soon in the process to determine the status of the LSLR program during the state file review. All water systems' files had limited information on the LSLR process, although the file for at least one water system indicated that it did notify homeowners of the option to replace their lines.

2.4 Schools

EPA included 81 schools that are also public water systems in the review. Sixty of the schools were randomly selected and 21 were targeted for review. From 2000 to 2004, 13 out of the 60 randomly selected schools had at least one lead ALE and 9 out of 21 targeted schools had at least one lead ALE. Reflecting the trend for all water systems reviewed (CWS and other NTNCWSs), more than half of the schools (15) did not begin the appropriate initial follow-up requirements in response to a lead ALE. Reasons for not beginning initial follow-up actions include: the ALE was not identified by the state or the PWS, ALE was too recent, or the files did not coontain enough information to determine why initial follow-up actions were not taken.

Fifteen of the 22 schools eventually completed one or more follow-up actions. Fifty percent of the schools conducted some or all required PE and six of the 22 schools installed corrosion control following an ALE during 2000-2004. However, none of the schools completed every step on schedule.

Table 10 provides information on all follow-up actions taken by the 22 schools with a lead ALE during 2000-2004.

Table 10: Follow-up Actions by 22 Schools that Exceeded the Lead Action Level during 2000 - 2004 [1]
(Expressed as Number of Schools)

A. General Response of 22 Schools				
Did not conduct any required follow-up actions because:			Had 2 consecutive 6-month rounds ≤ Pb AL so were not required to continue follow-up actions	Completed one or more follow-up actions *(See section B. of this table for more detail)*
ALE not recognized[2]	ALE too recent[3]	Reason(s) Unknown/Other[4]		
1	1	5	0	15

B. Follow-up Actions Conducted by 15 Schools			
Public Education (PE) Conducted?[5]			
None		Some	All
4		9	2

8 Water Systems Did Not Complete All Corrosion Control Treatment (CCT) Steps Because:			
Non-regulatory response[6]		Completed 2 consecutive 6-month monitoring rounds ≤ AL w/o installing CCT	Increased monitoring frequency but took no other action
≤ AL	> AL		
4	1	2	1

CCT Study Completed?[7]				
Unknown	Not required	Not completed	Completed study	Study due after 2004
2	7	2	4	0

CCT Installed?[8]					
Unknown	Not required	Not completed	Installed CCT		CCT Due after 2004
			≤ AL	> AL	
2	7	0	2	4	0

Table 10: Follow-up Actions by 22 Schools that Exceeded the Lead Action Level during 2000 - 2004 [1]
(Expressed as Number of Schools)

On-going Water Quality Parameter (WQP) Monitoring Conducted?[9]				
Unknown	Not required	Not conducted	Some	All
0	0	7	8	0

CCT Adjusted?[10] [applies to the 4 water systems that exceeded the AL after CCT installation]					
Unknown	Not required	Not completed	Adjusted CCT		Adjustment Due after 2004
			≤ AL	> AL	
2	0	0	2	0	0

Lead Service Line Replacement (LSLR) Initiated?[11]				
Unknown	Not Required	Not Initiated	Began LSLR	Will Begin after 2004
1	14	0	0	0

Table 10: Follow-up Actions by 22 Schools that Exceeded the Lead Action Level during 2000 - 2004 [1]

(Expressed as Number of Schools)

[1] Follow-up actions include all initial actions and those that must be completed after 6 months of the ALE.

[2]PWS was incorrectly determined to be at or below the Pb AL due to improper invalidation of samples (i.e., reasons for invalidation were not documented or did not meet one of the four criteria allowed under the regulation.)

[3] For these water systems, exceedance occurred too recently to determine if required follow-up actions have been completed (i.e., action is not due or has not been determined, or too early to have received documents from water system).

[4] Unknown why the water system stayed on reduced monitoring and conducted no follow-up . Sometimes the reason is known ("other"), for example the water system was given a waiver inappropriately.

[5]PSAs are due every 6 months for CWSs/other public education is due annually for as long as water system has lead ALE. Water systems document completion of these activities in an annual letter.

[6] These water systems took steps that are not outlined in the rule after an ALE, such as replacing plumbing fixtures, which reduced their values to below the action level, although no other follow-up steps were completed.

[7]If required by the state, study must be completed within 18 mos for medium PWSs/24 mos for small PWSs of state requirement.

[8]CCT installation is due within 24 months of state's determination of the type of CCT to be installed.

[9]After CCT is installed, WQPs are required during each monitoring period in which an ALE occurs.

[10]Water systems that continue to exceed after installing CCT may be required to make changes to their treatment and the state may establish new OWQPs.

[11]Minimum of 7% of lead service lines must be replaced annually in water systems that continue to exceed the lead AL after installing treatment. LSLR may stop after the water system no longer exceeds the lead AL for 2 consecutive monitoring periods. If no LSLs are present, water systems are not required to implement LSLR.

2.5 Waivers and Bottled Water

The LCR allows states to grant small water systems (serving less than 3,300 persons) a 9-year monitoring waiver if the water system meets certain materials and monitoring criteria. To qualify, the water system's distribution system, service lines and all drinking water supply plumbing, including plumbing conveying drinking water within all residences and buildings

connected to the water system must be free of lead and/or copper containing materials. Additionally, the 90th percentile levels in all rounds of monitoring conducted since the water system became free of all lead and/or copper containing materials must not exceed 5 ppb for a lead waiver or 650 ppb for a copper waiver. Of the 379 small water systems reviewed, 16 water systems were granted this waiver. All 16 water systems were in one state which offered all of its small water systems the 9-year monitoring waiver if they indicated they met the criteria in the regulations. However, reviewers found that at least five of the 16 water systems were inappropriately granted a waiver when they did not meet the criteria, either by having lead or copper pipes in the distribution systems or having existing or prior ALEs.

During the state file review, it was noted that a few NTNCWS with ALEs used bottled water in lieu of installing CCT. The use of bottled water is not an approved alternative to installing CCT. At least one NTNCWS in each of four states used bottled water for years before beginning a CCT program. In two cases the NTNCWS used bottle water for six to nine years before beginning CCT installation.

This page left intentionally blank.

3. CONCLUSION

Information collected during the file review did not reveal evidence that SDWIS data of 90th percentile lead values is inaccurate. While a small number of 90th percentile calculations were done incorrectly, in only 1% of the cases did this error affect whether a water system was required to take action. During EPA's review of the LCR, concerns were raised that the water systems' 90th percentiles reported into SDWIS were erroneous. The reviews of state files did not show significant evidence that 90th percentile values reported to SDWIS were artificially lowered due to inappropriate re-sampling, manipulation of data, or improper invalidation.

The state file review did not reveal that elevated lead levels are a widespread problem in America's public water supplies. Data evaluated from 17,542 individual tap water lead samples collected between 2000 and 2004 shows that only 5% of all lead samples were greater than the lead action level of 15 parts per billion (ppb).

The review identified a need for improved documentation in both SDWIS and in state files. Individual sample results were not available for 21% of the water system sampling rounds reviewed. Therefore, 90th percentile calculations could not be verified. In addition, many files did not contain the water system's materials evaluations, sampling site plans and other documentation to determine if water system sampling reflected the requirements of the LCR. The LCR requires relatively few sampling locations because it focuses on locations with the highest risk of lead leaching. It is important that regulators and water systems work together to ensure that sampling is conducted at the highest risk sites.

The reviewers found that, generally, states are doing limited oversight of the sample pools, sampling site plans, changes in sampling site locations, and tiering appropriateness. States indicated that this is largely because they lack the resources needed to review these plans. Most states generally provide information to their systems to help them review sampling results but are unable to devote resources to more detailed oversight.

Follow-up activities that systems are required to conduct after a lead ALE were not always completed. For example, water systems provided the required PE information to their consumers less than 1/3 of the time. EPA is very concerned that consumers be given useful and timely information to make important decisions that affect their health. Children and pregnant women are at greatest risk. Therefore, it is very important that the consumer be given information so that they can determine their risk and take any needed action.

Information regarding required follow-up activities after an action level exceedance, such as WQP and source water monitoring, and CCT steps, was also lacking in files. Reviewers noted many reasons for this. Some states had lost key LCR personnel, and had not been able to fill

those positions due to resource constraints. In some cases, the state was moving its files to a new database, or putting old information on microfiche. In other cases this represented a lack of robust state oversight for implementation of the LCR.

While too few schools were reviewed to draw national conclusions, enough problems were identified to raise concern, especially as children 6 years old and under are the most vulnerable to high lead levels. More than half of the schools reviewed did not begin the appropriate follow-up requirements in response to a lead ALE**.** Although some required follow-up activities were conducted, no schools completed all required actions. Improving implementation at schools is critical to protect this most vulnerable population.

One of the states that was reviewed targeted schools that are not public water systems by asking water systems to identify if any schools are within its distribution system. If there are, the state requires the water system to collect samples at the school. These samples are separate from the LCR program because EPA recommends a different sample collection protocol for non-regulated schools.

4. NEXT STEPS

EPA has already placed an increased emphasis on LCR implementation through a focus on SDWIS data and oversight. To address the issue of data completeness, EPA will continue to monitor 90th percentile results reporting in SDWIS. EPA also encourages states to use the state version of SDWIS to help track water system activities.

The LCR is a complex rule. States and water systems experience significant turnover of personnel, which causes challenges for compliance and oversight. To help, EPA will conduct rule training for states, and updatr guidance documents to help both states and water systems improve implementation. EPA will continue to conduct oversight of LCR implementation and will seek to identify ways to improve the rule.

EPA believes that a well-informed consumer is central to public health protection, and public education is a key component of the LCR. EPA asked the National Drinking Water Advisory Council (NDWAC) to develop recommendations to improve both the message and the delivery of public education on lead in drinking water. The NDWAC considered approaches that will ensure that systems continue to communicate with their customers until the problem is resolved. In addition, the NDWAC placed special emphasis on requirements that would give the customer clear steps to limit their exposure to lead in drinking water, but they will also be easier for the system to implement. This will result in the necessary information getting to the most vulnerable populations as quickly as possible. EPA considered several of the recommendations in developing proposed revisions to the LCR.

Finally, EPA has significantly increased its efforts to reduce lead levels in school drinking water. EPA has developed a plain English Quick Reference Guide of the LCR to help schools who are regulated under SDWA and posted it on a new website with a focus on schools (www.epa.gov/safewater/schools). Further, EPA will reach out to state and county personnel overseeing schools and child care facilities, who in some cases are not located in the drinking water program. For schools that receive their water from a public water system, EPA is encouraging them to voluntarily test their water to determine lead levels. EPA has developed new guidance and materials to help schools conduct this testing and determine an appropriate response if elevated lead levels are found.

Many states, including all of the states in the review, have informed EPA of new efforts they have undertaken to improve LCR oversight. Actions include new rounds of training for water systems, improved data flow management, internal reviews of responses to action level exceedances and enforcement, increased focus on education materials for schools and child care facilities, and changes or increases in staffing. EPA is encouraged by this response. While EPA

recognizes the resource constraints of many states, the state role is key to ensuring reduction of lead levels.

It is important to note that the work of states and water utilities to implement the LCR has resulted in lower lead levels across the United States. While this report is focused on the most recent years of implementation, the reviewers looked at data through the 1990s as well. Reviewers noted that implementation has consistently improved over time. States and water systems have resolved many of the problems in the rule, and should be given credit for their actions. The examples of the District of Columbia and other communities throughout the country show that water systems, states, and EPA must continue their actions to keep lead levels down.

APPENDIX A

Program Structures of Reviewed States

States approach program implementation in different ways. Organizational structures vary between decentralized and centralized program management. Some states provide financial or technical assistance to water systems with high lead or copper values. Some state staff or state lab staff collect tap samples. Other states pay for lab analysis for some or all of their water system and some place all financial and monitoring responsibility on the water systems.

Six of the ten states reviewed — Georgia, Iowa, New Jersey, Oregon, Texas and Utah — centralize their drinking water programs and house all functions in one location, while the other four states — California, Illinois, Massachusetts and Virginia, divide program management among different offices. In New Jersey, a state which centralizes their functions, the Bureau of Safe Drinking Water within the state Department of Environmental Protection (NJ DEP) has primacy for the LCR and oversees the program at their central location in Trenton, NJ. The state includes three regional Water Compliance and Enforcement field offices within NJ DEP who are responsible for conducting compliance inspections and issuing enforcement actions.

There are three models for decentralization. Massachusetts and Virginia have both central and regional offices; the regional offices perform all compliance determinations and are responsible for water systems in their region, while the central offices provide statewide oversight and serves as a link for drinking water data. California has central and regional state offices with CWSs and large NTNCWSs overseen by the regional offices and responsibility for smaller NTNCWSs and TNCWSs delegated to local health departments; again, the central office serves as a nexus for drinking water data. Illinois employs a third model that divides responsibility between two state drinking water programs by water system type, where community water water systems are overseen by the IL Environmental Protection Agency and non-transient non-community water water systems are overseen by the IL Department of Health.

One state, Illinois, makes a special provision to assist water systems in collecting samples for the LCR. Water systems can participate in the CWS Testing Fund and pay a fee for sample analysis. They must agree to a three-year commitment to participate in the program and the responsibility for conducting all sampling still falls on the water systems. Water systems in the other nine states do their own sampling and analysis.

California, Georgia, Iowa, Texas and Virginia require laboratories to provide the sample results directly to the state as well as the water system, to ensure that all results are reviewed by state staff. In Massachusetts, New Jersey, Oregon, Utah, and Illinois, delivery of sample results falls to the water systems, although many labs send copies to the state.