US EPA Lead Service Line Replacement Workshop

Airport Marriott, Atlanta, GA

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Facilitated by R. Scott Summers, University of Colorado-Boulder

The facilitator, Scott Summers, began the meeting by welcoming the panel participants and observers. Scott described the approach of the workshop as being designed to bring out as many technical issues as possible related to lead service line replacement. EPA is particularly interested in the experiences of the participants in implementing lead service line replacement programs, including success stories, pitfalls, and new approaches. Scott explained that over the course of the workshop the issues identified will be grouped into topic areas and then discussed by work groups. The participants are encouraged to propose solutions on how EPA can move forward on resolving the issues identified on lead service line replacement and to identify information gaps.

After introductions (see Attachment A for participant list), Eric Burneson of USEPA's Office of Ground Water and Drinking Water (OGWDW) elaborated on the context of the meeting. As part of the 6-year review cycle, EPA is in the initial stages of reviewing the Lead and Copper Rule (LCR), sparked in part by the elevated lead levels found in the District of Columbia drinking water and attendant health concerns. This workshop is part of a comprehensive review of the LCR. This workshop is focused on one aspect of the LCR – lead service line replacement programs and rule requirements. The participants for this workshop were chosen for their expertise and experience in this area. EPA is interested in hearing about the challenges and problems encountered by the participants in implementing lead service line replacement, as well as strategies and solutions for overcoming those difficulties. The emphasis should be on outcomes – definitive actions to improve the implementation of the LCR for greater protection of public health.

The broader review of the LCR consists of several components. EPA is conducting an assessment of compliance with the LCR using the results produced from the national 90th percentile monitoring data. Based on this assessment, approximately 3-4% of large and medium systems exceed the action level of 15 ppb at the 90th percentile. Further efforts are ongoing to evaluate compliance for smaller systems. EPA is also conducting an in-depth review of selected states on ways to meet LCR requirements, monitoring, and corrosion control optimization. EPA has also sponsored three previous expert workshops on LCR issues such as simultaneous compliance, monitoring protocols, and public education and risk communication. In addition to this workshop, a meeting on lead in schools is also planned.

The issue of lead in drinking water has also received a significant amount of attention in the form of Congressional hearings and media coverage, including one media report contending that sampling is not being conducted in full compliance with the LCR. The Agency is evaluating these and other concerns.

The comprehensive review of the LCR could result in two types of actions. First, EPA could modify the regulation itself either as part of the 6-year review process (due in 2008) or as an off-cycle rule modification. Separate from actual rule revisions, EPA could also clarify existing guidance or issue new guidance to assist in implementing the LCR.

The outputs of this workshop will assist EPA in both of these efforts. EPA would like to solicit from the participants information on lead service line replacement requirements – implementation problems, solutions developed, suggestions for additional guidance and training materials, and aspects of rule that are barriers to effectively replacing lead service lines. EPA would also like information on data gaps. Eric Burneson emphasized that the goal of the workshop is not to reach consensus on the issues raised, but rather to exchange information on, and to better understand national problems.

Eric next proceeded to summarize the requirements of the LCR related to lead service line replacement to provide a common understanding of existing regulatory requirements. Eric explained that the existing lead service line replacement rule requirements are not the originally promulgated requirements. Originally, the Agency required that utilities had to replace the entire lead service line, unless the utility could demonstrate that they did not have control over the line or portions of the line. The Agency was sued and the courts sided against the Agency, holding that the Agency had not sought comment on the definition of "control" over the lead service line. As part of corrections to the LCR issued in 2000, the Agency revised "control" to equate it with "ownership," i.e., utilities are only required to replace the part of lead service lines that they own. However, utilities are required to notify customers of upcoming lead service line replacement and replace the customer's portion of the lead service line if requested, but not at the utility's cost.

The LCR requires mandatory lead service line replacement. This is triggered by failure to comply with action level requirements. After corrosion control technology or source water treatment has been optimized for a system, if the 90^{th} percentile of the monitoring results exceeds the Action Level of 15 ppb, the utility is triggered into lead service line replacement and public education. The rationale is that once a system has optimized corrosion control treatment, and it is still unable to maintain the 90^{th} percentile below 15 ppb, then the next course of action is to remove sources of lead under the control of the utility. Eric explained that the 15 ppb Action Level is not a definitive public risk threshold, but a technology based limit. The public health goal is reflected in the maximum contaminant level goal (MCLG) of 0 ppb.

The LCR requires a materials evaluation to identify lead service lines. During the 1992/1993 timeframe, utilities had to evaluate the composition of service lines to select sampling sites. Once lead service line replacement is triggered, systems must again identify lead service lines, this time for potential replacement.

Utilities are required to replace 7% of their lead service lines annually, resulting in a 15-year schedule for replacement of all lead service lines. The State can shorten this schedule. The time frame begins when the Action Level is exceeded. The utility can cease lead service line

replacement if their compliance monitoring levels fall below the Action Level for 2 consecutive monitoring periods.

The Rule allows systems to "test out" a lead service line. If the sample (6 hour etc.) for a lead service line is below the Action Level, the utility does not have to replace that line and that line still counts towards meeting the 7% requirement. A utility must sample a service line within 72 hours after completion of the replacement and provide the results to the owner.

Under the LCR, systems do not bear the cost of replacing the customer-owned portion of a lead service line. However, the system does have to notify the customer and offer replacement of customer portion, at the customer's expense. The utility must also provide information to the customer about the lead service line and planned replacement. Monitoring results after the replacement must be communicated to the customer.

EPA distributed three issue papers prior to the workshop. The three papers contain some background and possible topics to be discussed by the participants:

Lead Service Line Replacement

- Techniques, technologies and practices to minimize lead levels and lead level spikes after full lead service line replacement
- Approaches to encourage full lead service line replacement
- Communication with customers before, during and after replacement

Inventory Management

- Strategies to locate and identify lead service lines
- Methods for updating and managing records as lead service lines are replaced
- Prioritization of replacement
- Communication with customers about the presence of lead service lines

Monitoring and Testing

- Procedures for taking samples
- Accuracy of samples taken by customers
- Test out provisions, including appropriateness of test-out procedure given potential future changes in water
- Sampling protocol after lead service line replacement, including whether the 72-hour monitoring provides the best indication of improvement in lead levels

Kevin Dixon, of Black and Veatch, next presented the preliminary findings of a utility survey documenting lead service line replacement practices. Kevin explained that Black & Veatch was nearing completion of the survey to provide a national overview on how utilities are handling lead service line replacement. The survey is being conducted under a contract with AWWA on LCR support. The objective of the survey is to find out which methods utilities are employing to replace lead service lines and to determine some idea of the cost of replacement to utilities and customers. Other objectives include identifying steps to reduce exposure during replacement and successful approaches to promote complete lead service line replacement.

As part of a "targeted" survey, 300 utilities were contacted, of which 65 have lead service lines or had lead service lines at one time. Of these 65, all are in compliance with the LCR Action Level. To date, 41 utilities have completed the survey and submitted responses, a 63% response rate. Of the systems that responded, 21 serve populations ranging from 6,000-100,000, and 20 serve greater than 100,000. The respondents are more prevalent in the Northeast and Midwest, where lead service lines are more common. Further, 8 of the respondents no longer have lead service lines.

The estimated inventory of lead service lines and replacement rates from the survey are as follows.

Table 1: Survey Information on Lead Service Line Replacement Rates Over the Last 10 Years

Service Line	Survey Response	1992	2003	Reduction
Utility Service Line	26 (63%)	558,135	513,160	8%
Breakdown for Utility vs Customer Portion				
Utility Service Line	17 (41%)	213,349	177,976	17%
Customer Service Line	17 (41%)	200,122	164,503	18%

Approximately two thirds (78%) of the respondents reported having a program for lead service line replacement. Of those, 72% conduct partial lead service line replacement and 28% conduct full replacement. With regards to the approach used to target which lines to replace, 50% replace lines encountered during routine maintenance, 22% target on an as-needed basis, and 28% have programmed replacement.

Table 2: Predominant Approach for Determining Lead Service Line Replacement

Approach	Systems
Routine Maintenance	52%
As needed	25%
Programmed Replacement	23%

Criteria used to prioritize replacement efforts reported in the survey include:

- Locations with at-risk populations
- 15 ppb exceeded at location
- Concurrent with other street/road construction projects
- Leaking lead service lines
- Lines serving schools and day care facilities
- Lines serving 20 or more people in an 8-hour day
- Neighborhood-by-neighborhood replacement

- As requested by customer

Methods used in replacing lead service lines include:

- Abandon old line in place and install new line
- Pull cable, extract old line, and pull new copper line behind
- Excavate entire line
- Trenchless

The average cost to replace the utility portion of the lead service line is $1,400, while the average cost to replace the customer portion of lead service lines is $1,800, although there was considerable range in reported costs, as indicated below.

Table 3: AWWA Survey- Average Costs for LSL Replacement (2003-2004)

	Average	Median	Range
Utility-Owned LSL	$1,400	$1,250	$300-$6,000
Customer-Owned LSL	$1,800	$1,500	$450-$10,000

Measures taken to reduce exposure to lead during replacement include:

- Written notification to customer
- Flushing recommendations
- Aggressive flushing of utility lines
- Brochures
- Bottled water
- Offer sampling and analysis, both before and after replacement

When utilities were asked if lead service lines contribute to the highest levels of lead in drinking water, approximately one third replied “yes” and two thirds replied “no.” In addition, 69% reported no observed linkage between lead service lines and levels of lead in drinking water.

Individual utility observations about the relationship between lead service lines and lead in drinking water include:

- Lead was detected in 22% of first draw samples at residences with lead service lines, whereas lead was detected in only 8% of first draw samples at residences with copper service lines
- Twice as likely to find lead in water if home has a lead service line, lead levels 4 times higher than copper lines
- Higher levels of lead with lead service lines
- Lead service lines actually had lower levels of lead in the water in comparison with copper lines due to the greater degree of passivation in lead lines than in copper lines

Practices associated with complete lead service line replacement include:

- Communications-wide range, early notification, brochures, direct mailing effort, plumbing inspector makes contact, articles in newspaper, positive media coverage
- Financial incentives-homeowner can deduct costs against property tax, reimburse homeowner up to $1,000, deferred loan payment, low interest loans
- Minimize Disruption-conduct replacement when business closed, provide temporary interim service, phone calls directly to schedule convenient time, replacement practices that are less intrusive such as cable pulling

A number of obstacles to complete replacement were identified, including high cost, disruptions/intrusions, public perception, lack of clarity of LCR (Lead and Copper Rule), lack of linkage with health effects, sensitive subpopulations spread throughout the utility's service area, inefficiencies, and uncertainty of materials composition in certain areas.

Information management tools used to manage lead service line replacement include databases, GIS, computerized work orders, and separate accounts of lead service line costs.

The workshop participants then posed questions and discussed the survey results.

- One participant asked if the inventory of replacement rates could be broken out by system size? Kevin agreed to provide this information to the group via email.
- Kevin was also asked to break out costs by system size.
- One participant voiced concern that the costs in the survey might not accurately reflect the true costs for rule-triggered lead service line replacement. Restoration costs could double the cost estimate.
- Some of the costs reported by respondents did include lines being replaced in response to an exceedance of the Action Level. For Philadelphia, utility and total costs are estimated at $2,200 and $4,200 respectively. These estimates include restoration costs.
- A participant asked if the utility and customer costs are additive, i.e., $3,300 for both? Could there be cost savings if done together? Kevin responded that there are a wide array of costs and variables. Much of the cost is homeowner driven. The unit costs from main to curb stop are rather well known, but there are far more variables in the customer line, such as length and landscaping. Overall, the range in customer costs is much broader.
- A participant asked if new taps are being installed during replacement? A representative from the Louisville utility explained that in his system service taps are driven into the main. If the line is older than 1910, it requires a new tap. If the tap is newer, then the utility will use the existing tap, if it is undamaged.
- A participant asked if the survey probed the basis of the 69% response by utilities that there are no observed linkages between lead service lines and lead levels in tap water. Kevin responded that only the stated question was asked.

- A participant asked if costs for trenchless methods were included? Kevin responded that trenchless costs are not part of this survey, but that other information sources regarding this may be available.
- Another participant questioned whether some trenchless methods raise environmental concerns since the lead pipe remains in place. Is this considered a hazard that might fall under other regulations? For example, a line left in place near an aquifer might release lead during groundwater percolation. The Agency should look at the impact of technologies that leave the existing lead service line in place. These technologies may have other long-term environmental problems.
- One participant noted that comparisons of lead contribution from the first draw with compliance monitoring may not be appropriate.

After this initial discussion, three case studies were presented to the panel.

Case Study #1: Greater Cincinnati Water Works Presented by Jack DeMarco Partial Lead Service Line Replacement

Jack DeMarco, of Greater Cincinnati Water Works (GCWW) presented information from his utility to discuss the pros and cons of partial lead service line replacement. Jack asserted that drinking water utility managers are concerned about the public health effects of lead in drinking water, however health departments indicate that other sources of lead, such as paint dust, contribute more to lead levels in blood.

GCWW serves a population of 800,000 in greater Cinncinati and includes some towns in northern Kentucky. The system distributes from both surface water (80%) and groundwater (20%). The running annual average for DBPs in the distribution is 28 ppb for TTHMs and 6 ppb for HAAs. At the river plant, the water is treated with sodium hex to achieve a pH of 8.6. At the groundwater plant, the water is treated with lime softening and sodium hex to achieve a pH of 9.0. GCWW estimates that there are 28,500 lead service branches that were installed from 1837-1927 (out of 230,000 total connections).

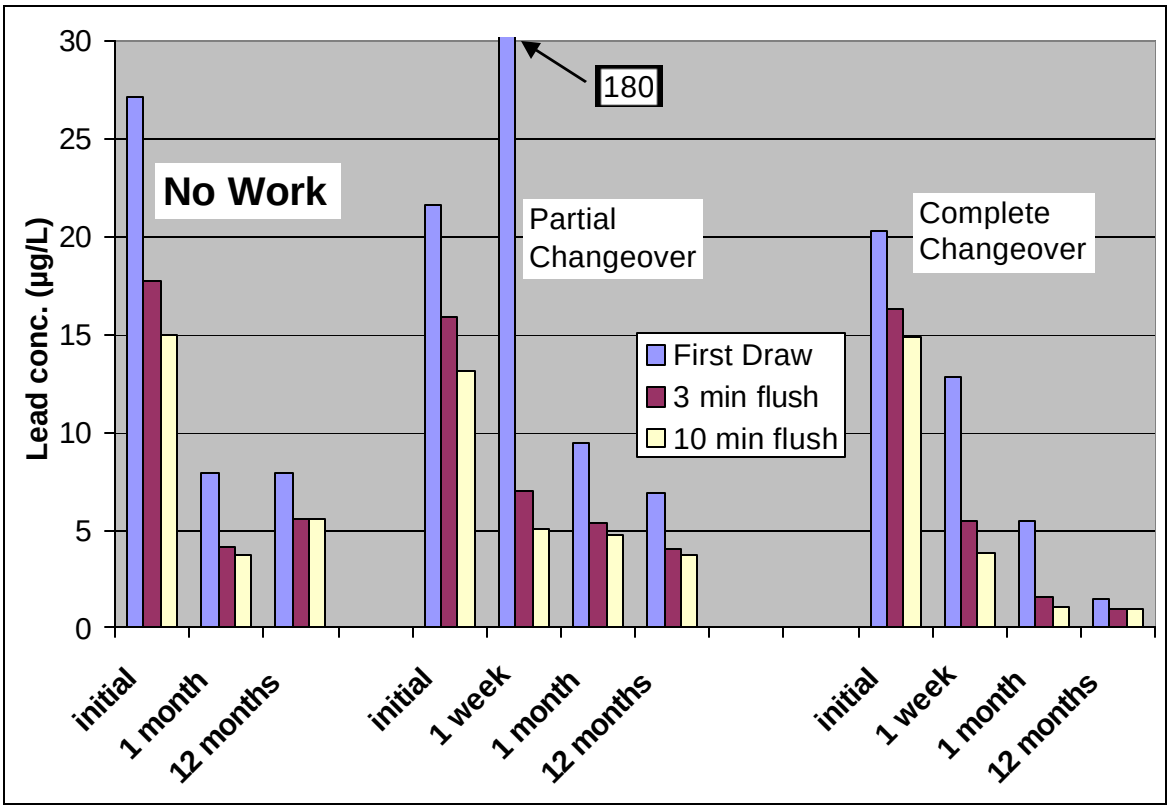
Since 1980, GCWW has conducted 17 different lead studies. The first service branch changeover study, conducted in 1991, sampled water before, immediately after, and 9 months after changeover. Findings include: immediately after changeover, some of the lead levels were high, around 300 ppb; 9 months after changeover, lead levels were down; and flushing will reduce lead levels most, but not all, of the time.

In the second branch changeover study (1999), GCWW sampled 5 sites with no changeover, 5 sites with partial service branch changeovers, 6 sites with partial changeover with Teflon sleeves, and 5 with complete changeover. GCWW sampled the first draw, 3-minute flush, and 10-minute flush, before changeover, 1 week after, and monthly after changeover for 1 year. Findings include:

- A big spike after partial changeover
- No clear benefit of partial changeover compared with no changeover

- Much lower lead levels after complete changeover with some lead remaining in the water
- Initial spike longer than 1 week and less than 1 month after partial changeover

Results are displayed in the following graph.



GCWW has conducted other lead studies including:

- In 1987, GCWW tested an old compound meter and found a sample with 1,130 ppb of lead from the meter.
- GCWW found 90th percentile samples greater than 15 ppb from drinking water fountains in GCWW facilities.
- GCWW conducted a meter leaching study and found large differences between old meters (1,240 ppb) and new meters made of Envirobrass (28 ppb).
- In a 1991 study of workplaces and schools, 86 of 656 samples were greater than 15 ppb.
- GCWW also compared the contribution of lead service lines and residential plumbing to lead in drinking water. The study found a higher correlation between lead levels and residential plumbing.
- GCWW worked with the Health Department to overlay maps of blood-lead levels with areas served by lead service lines. Areas with higher blood lead levels do seem to coincide with areas served by lead service lines, however these are also older,

urban areas that are likely to have higher alternative sources of lead, such as lead paint.

Jack also presented information derived from GCWW's compliance monitoring. Jack noted that analysis of this database, over time and across categories (such as material composition of service lines) can be a valuable resource for evaluating lead levels in drinking water.

Jack then posed the question of whether partial lead service line replacement is worth it? In 2002-2003, GCWW replaced 1,342 utility lead service branches. Of those 1,342 branches, only 84 customers chose to replace their portion of the lead service line. He said that financial help for customers is needed to get the job done right. The cost for replacing the utility service branch is $2,500 per branch and the cost for the customer branch is $3,600 per branch, resulting in an estimate of $173 million total cost for full replacement. Jack then summarized the provisions of the proposed Jeffords Bill and the cost implications, as well as the steps that GCWW takes when a high lead level is detected.

Jack concluded his presentation by suggesting that more information is needed on the lead reductions and health significance of partial vs. full lead service line replacement. The question remains whether the public is getting the biggest bang for the buck with partial lead service line replacement.

The participants then posed questions and discussed the presentation.

- One participant asked how sampling upstream and downstream of a project was taken. Jack responded that the sample was taken at the water main.
- Another participant asked how the second draw sample is determined. Jack responded that knowing volume displacement is the most accurate method. Using temperature change is more difficult.
- In response to a question, Jack explained that the cost estimate presented included the cost for restoration and trenching.

Case Study #2: Madison, Wisconsin Presented by David Denig-Chakroff
Full Lead Service Line Replacement

David Denig-Chakroff described the full lead service line replacement program being undertaken in Madison, WI. David explained that Madison arrived at a full lead service line replacement program through a "back door" in the Lead and Copper Rule. Essentially lead service line replacement was the optimal corrosion-control strategy to reduce lead levels in drinking water.

In 1992, Madison's 90th percentile monitoring data at 16 ppb exceeded the Action Level. This triggered corrosion control studies that were conducted in 1993-1998. Madison analyzed a range of corrosion control treatments include pH adjustment, use of polyphosphates, and use of orthophosphates. At the same time, Madison also determined that high lead levels in drinking

water were directly related to the lead service lines. The findings of the corrosion control studies were that standard treatments, except orthophosphate, were ineffective. Madison could not find a corrosion control treatment that worked in their system. The treatments tested resulted in higher lead levels or other serious side effects. Orthophosphate was found to lower lead levels, but would have severe impacts on wastewater treatment. It would also have a detrimental effect on environmental quality in the Great Lakes, due to the increased nutrient loading. The area wastewater treatment plant had just completed building a biological removal system for phosphate. The use of orthophosphate would mean building a new treatment system to remove the significant additional phosphate. The wastewater authority felt that these costs should be passed on to the customers of the water utility. Madison determined that the long-term costs of orthophosphate would be greater than lead service line replacement, and that replacing lead service lines would reduce lead levels more than orthophosphate could. When they made this determination, Madison had between 5,000-9,000 lead service lines remaining.

Based on the comparison of orthophosphate for corrosion control and lead service line replacement, an agreement was reached with the State that lead service line replacement was the better option. The challenge was getting that option through the LCR by emphasizing the wastewater problems of a chemical corrosion control approach, and demonstrating that lead service line replacement was in fact an activity equivalent to optimum corrosion control. Madison relied on the following two provisions of the LCR to support their choice of a lead service line replacement solution:

- "When approving optimal treatment, the department shall consider the effects that additional corrosion control treatment will have on water quality parameters and on other water quality treatment processes." (NR 809.543(4)(a)).

- "A system is deemed to have optimized corrosion control and is not required to complete the applicable corrosion control treatment steps if the system demonstrates to the satisfaction of the department that it has conducted activities equivalent to [chemical treatment]." (NR 809.542(2)(b)).

According to a compliance agreement, in order for lead service line replacement to be deemed "equivalent," the program had to:

- Provide public health protection to water consumers equivalent to chemical treatment
- Be mandatory for both city-owned and customer-owned portions of service line
- Address health risk reductions comparable to a 2 to 3 year implementation schedule for chemical treatment
- Ensure completion of lead service replacements in 10 years
- Be enforceable by the City through adoption of an ordinance

The City of Madison passed an ordinance including the following.

- Utility must replace all its lead service lines by 2011
- Replacements must be prioritized to expedite health risk reduction

- Customers in "lead service area" must conduct self-inspection and report service type to the utility
- Customers must replace their lead service lines at the same time as utility or on a schedule established by the utility

There was, however, disagreement on who should pay for the replacement of customer lead service lines. Customers with lead service lines held the opinion that since this was a mandate from the utility, the utility (i.e., all customers through future billing) should pay. In addition, if corrosion control treatment were alternatively implemented, all customers would pay. Customers without lead service lines felt that removing the lead service lines was an improvement to private property and therefore the customers with the lead service lines should pay.

Madison developed a financial program under which the City reimburses customers for half of the cost of replacing the customer's lead service line, up to $1,000. For low-income customers, the City provides a loan for half the cost with repayment deferred until the property is transferred, recorded on the deed as a liability. The ordinance and finance program was widely covered by the press and was approved by only 1 or 2 votes.

The utility set up a self-inspection and reporting program that offers guidance and a form for customers to complete and send back. Madison is not relying solely on self-inspection. Madison has a 10-year cycle for water meter replacement. During replacement, mechanics are trained to inspect lines and report on the composition.

The schedule for replacement is as follows. All projects are closely coordinated with area plumbers/contractors.

- Year 1: Schools and Day Care Centers.
- Year 2: Locations with tests over 15 ppb.
- Year 3: Locations serving >20 people.
- Neighborhoods with scheduled street resurfacing/reconstruction projects.
- Other neighborhoods.

Notices sent out to customers include:

- 6-month—1-year notice
- 60-90 day notice
- Overdue notices
- Annual lead information
- Annual water quality (CCR) report

Customers are reimbursed using a simple application form that is sent to the customer when the plumber applies for the permit to do the lead service line replacement. The application is returned along with a paid receipt from the plumber after the work has been performed. The application is processed and the customer receives a check for half of the cost, up to $1,000. Costs have run at about $2,000 for the utility portion of the line and $1,400 for the customer

portion of the line. There are penalties if the customer does not apply: they become ineligible for reimbursement and are subject to fines. Very few people have refused because they want to be eligible for reimbursement.

The procedure Madison is using involves digging a ditch at curb stop and second hole near the building. Then a boring tool is run between the ditch and the hole. Copper pipe is fed through behind the boring tool. The old lead pipes are left in place.

To date, 3,500 utility lead service lines have been replaced or abandoned and 3,100 customer lines have been replaced. Less than 3,000 utility lines and 2,100 customer lines remain in place. Madison is about half-way through replacement and is on schedule.

A preliminary post-replacement monitoring study sampled 16 sites where lead service lines were replaced between 16 days and 27 years ago. Both particulate and total lead levels were analyzed and compared to levels before lead service lines were replaced. The 90^{th} percentile for the sampling program was 22 ppb. The 90^{th} percentile of dissolved lead was 5 ppb, indicating that the high lead levels were due to particulate lead. Essentially removing lead service lines removes one source of lead, but sediments that were entrained in home plumbing may have broken loose due to replacement activities. Data suggests that lead particulate levels diminish over time after lead pipe is removed, although it could take 4-8 years to reduce particulate lead levels.

David concluded that there is no one solution to every situation, no "silver bullet," to reducing lead levels. Sound science is still relevant and important, but sound science does not necessarily mean conclusive science (to quote Ephraim King). The LCR should allow more flexibility in addressing specific situations. Keeping communication lines open and information flowing is important.

The participants then posed questions and discussed the presentation.

- One participant asked if Madison flushed lines after reconnection. Madison did not. Louisville utility found that high level of particulates can be reduced by flushing for 60 minutes after replacement.
- One participant asked if there have been any impacts of replacing lead with copper, such as pitting. David replied that they have had not such problems.
- In response to a question, David noted that they had not noticed an increase in turbidity when looking at particulates.
- A participant asked if there were issues with finding enough tier 1 homes for LCR compliance monitoring. David replied that according to Madison's agreement with DNR, they are not required to conduct compliance monitoring during the 10-year replacement program.
- One participant thought it was important to recommend to homeowners that they clean aerators and filters after replacement to reduce entrained particulates.
- Madison provides post-replacement flushing recommendations to customers - for 1 minute after water turns noticeably colder. This is relatively reliable because the cold groundwater used by Madison is easy to detect.

- Madison is hoping to continue sampling for 3-5 years after replacement is completed to get better information.
- David confirmed that the old lead line is left in place.

Case Study #3: Lead Pipe Rehabilitation and Replacement Technologies Presented by Glen Boyd

Glen Boyd of Tulane University presented information on work sponsored by AWWARF from 1997-2000 with collaborators from HDR/EES and the Water Research Center. The overall goal of the research was to look at trenchless technologies for small diameter pipes, field test and compare the techniques, develop some guidelines for selecting technologies, and develop cost estimates and planning tools. A number of utilities participated, as well as vendors and manufacturers.

The project involved a literature review and utility survey, followed by field-testing of techniques and preparation of guidelines and reports. Technologies evaluated include:

- Open trench
- Replacement along a new route using impact moling
- Replacement along a new route using guided boring
- Replacement along an existing route using pipe-pulling
- Replacement along an existing route using pipe-splitting
- Pipe coating
- Slip lining

Open trench methods required excavating along the entire length of pipe. The disruption to the site, particularly to streets and landscaping, and restoration cost can be very high but this technique can be used in any situation.

The advantage of the technologies that replace along a new route is not having to dig a trench. Two access pits are dug and then some kind of boring or moling tool is sent from one pit to another. The replacement pipe is attached to the tool and pulled through. These technologies are considerably less disruptive, but can interfere with other utilities and may not work for all situations (for example, soil heterogeneity can divert tool).

Technologies that replace pipe using an existing route are similar, in that a cable is fed through the existing lines, extracting the old pipe and pulling in new pipe. These technologies eliminate interference with other utilities, but existing pipe condition can cause problems.

The pipe coat rehabilitation technology involves cleaning out an existing pipe and then applying a liquid epoxy to coat the inside of the pipe. Pipe condition is an issue, as is long-term reliability and how long water service is turned off. It can also be difficult to get the pipe clean enough for epoxy to adhere.

Slip lining technology has been used on lead service lines in Europe, but not North America. There were 2 or 3 successful installations reported in Europe as part of the AWWARF study, but some liners tended to fail after a period of time.

For the utility survey, the project team contacted utilities with 90th percentile compliance values above the Action Level. They received responses from 13 US utilities and 10 utilities in other countries. For the US utilities, one third use open trench methods and the other two thirds use a trenchless replacement technology such as moling.

Cost estimates for the various technologies are as follows.

Table 4: Costs for Lead Service Line Replacement Technologies from AWWARF Research

		Replacement			
	Open Trench	Moling	Pull-Through	Slip Lining	Pipe Coating
Labor	$700 - $1,000	$600 - $800	$600 - $800	$600 - $800	$600 -$700
Equipment	$270 - $550	$300 - $350	$200 - $400	$200 - $600	$300- $400
Material	$80 - $120	$100 - $150	$100 - $200	$50 - $90	$100 - $150
Restoration	$800 - $1,000	$600 - $700	$600 - $1,200	$600 - $700	$400 - $600
Total	$1,850 - $2,670	$1,600 - $2,000	$1,500 - $2,600	$1,450 - $2,190	$1,400 - $1,850

Factors affecting selection include non-controllable factors – such as features of the site that are not easily altered or controlled (soil, landscaping, paving, pipe conditions) – and controllable factors – such as conditions that can be altered or controlled (operator activities, costs, customer impacts).

As part of the project, a step-wise method and checklist were prepared to assist in the selection of the appropriate technology. Glen offered to send copies of the publications if requested.

The participants then posed questions and discussed the presentation.

- One participant mentioned that there can be other customer-recognized benefits after replacement such as improved water pressure that might not be achieved with slip lining or coating.
- Some vendors are working on splitting techniques that worked better for other types of materials.
- One participant noted the length of pipe for the pull through technique is often limited by the condition of the pipe.
- Carrying capacity can be an issue for lining techniques.
- All costs for labor time are included in the cost estimates for Toronto and Louisville.

- One participant noted that epoxy lining can be done quickly, 1 hour instead of 4 hours.
- The participants felt that additional information was needed on epoxies, such as VOC emissions, reliability, service life, and performance under various water quality conditions.

The facilitator next opened the floor up to solicit comments from meeting observers (see list).

Tracey Case from AWWARF described ongoing research on LCR issues. A paper titled "Distribution System Corrosion and the Lead and Copper Rule: An Overview of AwwaRF Research" is available on the AWWARF website (www.awwarf.org). This paper summarizes the objectives, general research approach, and major findings of 15 AWWARF projects that examined various aspects of the lead and copper corrosion issue. In addition, two RFPs were recently awarded – a copper pitting assessment project to Marc Edwards and a project looking at the contributions of lead service lines and plumbing fixtures to a project team lead by HDR/EES. The survey results described by Kevin Dixon should be available in July 2005. Also, a handful of new projects have been recommended by the research advisory council and will be described on the website in February.

Steve Mori, of American Pipe Lining, Inc., provided additional information on epoxy lining. Steve explained that epoxy lining should not restrict flow in lead service lines because the pipes are cleaned first to take off residue and the coating itself is only 7-12 mils. In fact, the slick coating may increase flow. Steve noted that the actual costs of epoxy lining may be less than indicated in the AWWARF study described by Glen Boyd because more lines can be completed in a given day, reducing the cost per line. The only limiting factor is the number of small holes that need to be dug. Steve explained the new resins used do not emit VOCs and are quick-drying to cut down on the amount of customer disruption. Epoxy coating does not work well with cold ground temperatures, but pipes can be kept warm. The life span of epoxy coating is estimated at 50-70 years. The coatings have been in use on aircraft carriers for sewage lines for 15 years with no failures. Also, epoxy coating have been in use in the UK and Japan for about that amount of time. The coatings have been tested at pressures up to 10,000 PSI, so they are pretty rigorous. In retrospect, there have been concerns that the uniform coating of pipes is hard to verify.

Jodye Russell with DC WASA is managing the replacement of lead service lines in Washington, DC. DC is estimated to have 23,000 lead service lines, with an additional 27,000 lines of unknown materials. The WASA Board of Directors passed a resolution to replace lead service lines over 6 years at an estimated cost of $300 million. Jodye expressed concern over the effectiveness of partial lead service line replacement. WASA has a diverse customer base, consisting of the very affluent and the poor. It is not clear whether public health goals can be accomplished with only partial replacement. The Department of Housing has developed a grant program and low-income loans with Wachovia Bank. WASA is also proposing standard fees per foot of replacement so customers are not subject to contractor costs differences. The standard fee is $100/linear foot and $500 for digging the hole near the building, for an average cost of

$2,500 per customer lead service line. There has been increased interest in private side replacement, but the reality is that there is not too much money in hand.

Jodye is focusing intently on the possibility of epoxy or slip lining. Epoxy lining might be encouraging. WASA serves a very urbanized area with high traffic volume, so disruption is an issue. Also, the 6-year time frame for the program is a factor. Jodye would like to have commitment from EPA to develop a plan to look into epoxy lining and implementation schedules. She would hate to go forward without taking advantage of new technologies and is amenable to taking part in a pilot test. These experts can be reconvened to evaluate the results of the plan. It is unlikely that WASA can pass an ordinance similar to Madison. WASA could offer no interest loans, but there are some legal issues associated with using public funds for private welfare.

Would an initiative on epoxy be supported? There are industry concerns about reliability, longevity (after 10 years) and applicability for pipes this size. There is also very little data available on long-term efficacy of the epoxy lining approach. According to Steve Mori, the Army Corps of Engineers has done testing down to a half inch and the technology is now in use at the Cheyenne Air Force Base, where the lead levels dropped from 100 ppb to 5 ppb. Steve also noted that companies offer a 10-year guarantee (will recoat if epoxy fails in 10 years).

Issues

The facilitator next solicited specific comments from the panel. Attachment B contains the list of comments. The comments were then sorted by into four issue groups for further discussion.

- Monitoring
- Customer Communications
- Replacement technologies
- Managing Inventory

The panel was broken up into four workgroups, with each workgroup discussing one issue.

Reports from Issue Breakout Groups

After discussing and considering the issues, each panel group summarized their topic for the full panel.

Discussion of Lead Service Line Inventory Management Issues

The first group to present their discussion focused on inventory management issues related to lead service line replacement. The first step in inventory management is to determine the composition of service lines in the ground. Techniques include the following.

- Test pits, excavation
- "No dig magic box" – electric potential
- Analytical approach using records – date of construction, size, water test results
- Video short sections – the technology needs further development
- Lead test kits – swab method for confirmation

Record keeping should track techniques used. When in doubt about the composition of the line, replace it if the cost of evaluating the composition is comparable to the replacement cost.

The group offered these suggestions for guidance.

- Lead service line issues with larger buildings – nontransient, schools, multifamily residential and commercial buildings present more of a challenge because there isn't a good mechanism to alert residents about lead issues. Issues with larger buildings include identification by pipe size (i.e., larger pipe size could serve as a screen); notification procedures when the user may not be the customer; and guidance on flushing and post-replacement sampling. Commercial buildings may be lower priority than multifamily residential buildings.
- Identification of lead service lines during routine maintenance. An electronic checklist for crews to use during meter changeout/conversions or service calls would be useful, as would guidance on the use of lead field test kits.

Data gaps included a national clearinghouse for lead service line data, studies on exemplary inventory management systems, evaluation of pipes that have been coated, and the accuracy of databases on partial and complete lead service lines replacements.

The group questioned whether the national clearinghouse should be in the form of a database or a more traditional clearinghouse. If a database is developed, the design of the database should be useful with both partial and complete replacements. The contents of the database must go beyond information required by regulation. The UCMR database may be good starting template. There are issues as to who should own the database, perhaps AWWA or AWWARF. The database should use a standardized format that allows for easy retrieval, but should not be overly complex.

If a more traditional clearinghouse or repository is developed, it should accept all types of documents and existing information in various formats. It could be structured by categories and key words. The existence of the clearinghouse should be widely publicized, through EPA's website, AWWA, and other professional organizations. The clearinghouse would not necessarily contain an inventory of lead service lines, but would rather contain information on methods used,

lessons learned, and guidance. The motivation for contributing to the clearinghouse would be professional courtesy and the clearinghouse should be voluntary (not required by regulation).

The group thought that guidance on exemplary inventory management systems would be useful in sharing information on the number of utilities doing innovative inventory management systems. Studies that provide quick answers could be done by EPA or AWWA WITAF.

The group identified a need for the evaluation of pipes that have been rehabilitated. The evaluation could examine existing data from England, Japan, and Cheyenne Air Force Base. These efforts will likely be monitoring-intensive with profiling to evaluate effectiveness and uniformity, and both short term and long term impacts. This could perhaps be an AWWARF study.

Finally, guidance on ensuring the accuracy of inventory information, particularly for customer lead service lines and replacements is needed. EPA or AWWA could identify utilities that have databases and create a template from these existing databases to track information on the material composition of service lines.

Discussion of Lead Service Line Replacement Strategies Issues

The next group presented on issues related to lead service line replacement strategies. The group first discussed some problems and potential solutions of lead service line replacement. The fact that lead service lines are not fully-owned by systems is a big problem with limited solutions. The primary solution is State or local mandate for private property replacement, which can be difficult to implement because of equity and political concerns. There needs to be consideration of strategies for encouraging or enforcing full replacement. Funding for replacement and utility management/coordination is needed.

Another challenge is reducing lead levels after lead service line replacement. Guidance on flushing would be helpful. Galvanic corrosion can cause problems, as dissimilar metals are added or removed. This could be regulated through State or local plumbing codes.

The group discussed whether the 15-year schedule is too long for replacement. Should there be interim solutions, such as linings? How should utilities prioritize replacements and then communicate the prioritization to customers scheduled for replacement years in the future? Data sharing is another issue, with recordkeeping and GIS systems shared by all utility departments important considerations.

The group next offered suggestions for EPA guidance with respect to lead service line replacement strategies. The group felt that guidance on reducing spikes in lead levels and lead particulates after replacement is needed. The guidance should include information on the definition and factors effecting spikes and particulates and methods to reduce spikes. These methods include flushing single family and multi-family home plumbing with such factors as velocity, duration, and pigging described. Guidance on alternative conditioning treatments is needed.

Another topic includes guidance on strategies to encourage or enforce full lead service line replacement. Strategies to be described include financial incentives to customers, mortgage requirements, property sales disclosure, and better health effects information.

Guidance on alternative POU/POE treatments would be helpful, including temporary control (filters), appropriate use of these devices, and enforcement. Issues could include implementation of POE devices in schools or businesses that could be considered "treatment" and therefore trigger definition as a public water system (PWS).

Guidance that clearly defines replacement strategies under various ownership scenarios was suggested. These ownership scenarios include no ownership, main to curb stop, main to property line, and main to meter (complete ownership). Complete ownership by property owner may pose particular requirements.

Guidance should also focus on standardizing prioritization. The prioritization should balance flexibility and efficiency, should define "at risk" populations, and be based on sound science. Additional topics for guidance include alternatives to lead service line replacement and documenting replacements.

The 15-year replacement schedule is a challenge for private utilities to get rates approved by a public service commission. Even public utilities have to demonstrate and convince policy-makers that replacement is a public rather than private good.

The group next identified potential revisions to the LCR. The LCR should accommodate rehabilitation strategies in lieu of lead service line replacement, including alternative methods, further review of optimal corrosion control treatment in lieu of immediate replacement, and demonstration that treatment is equivalent to rehabilitation and replacement. These alternatives should have an equal playing field with respect to rule compliance. The rule should also remove barriers to unanticipated solutions. There should be provisions that provide flexibility if an emerging technology is proven good or better than existing technologies.

The rule should also allow stopping optimal corrosion control treatment after full replacement, if the utility can prove that the treatment is no longer necessary. Also, more Federal funding is needed for many things, including private property incentives, research on new technologies, and assisting utilities with replacement costs.

Data gaps identified include the following.

- Research on reducing lead spikes and particulates, causes and solutions, releases over time, methods for dislodging entrained particulates, and flushing/pigging.
- Evaluation of alternative methods to replacement including epoxy coating and slip lining, especially longevity.
- Galvanic corrosion (dissimilar materials).
- Should brass be replaced when encountered?

- Is abandoning lead lines in place a hazard? Additional data will hopefully show this is not a problem because removal could be quite an expense.
- Lead contribution from different sources although this may be different for each utility.
- Alternative materials could cause other problems.

The full panel discussed the presentation and issues related to replacement strategies.

- The abandoned in place is an interesting question. This could drive the feasibility of rehabilitation techniques. Are hazards in place already? Lead service lines have been in use for hundreds of years, with no lead in source water. Participants would like to have data that leaving the lines in place doesn't make a difference.
- Galvanized plumbing and piping could also be a source of lead. State and local plumbing codes may be the best solutions to galvanic corrosion. Hundreds of local codes need to be changed. Why not federal guidelines? If the issue is inside home or on private property it makes sense for the EPA rule to drive. Perhaps it is a combination of EPA rule and electric industry if grounded electric exacerbates problem.
- Stopping treatment after replacement, in relatively corrosive water, could result in increased lead levels if brass fittings in homes are a source. There is an ongoing need to ensure that water is not corrosive. There is no way to demonstrate that treatment is not necessary without risking increased lead levels. Some suggested loop studies to assess the issue and felt that ratepayers should not have to pay for treatment that is no longer necessary. The utility might be able to stop treatment, but if during routine compliance monitoring the Action Level is exceeded again, then the utility needs to re-evaluate. Also, using existing compliance data to compare impacts on lead and copper lines may be helpful in evaluating impacts after changes. Perhaps the utility must prove no adverse conditions. EPA responded that rule change might not be appropriate for a situation that is relatively rare. However, as more systems opt for full lead service line replacement, this may become a more prevalent issue. The use of inhibitors may provide benefit to the structure itself, but also may be a detriment in the form of sedimentation in a system.

Discussion of Lead Service Line Monitoring Issues

The next discussion group presented on issues related to monitoring before, during, and after lead service line replacement. The group began with issues related to the first draw sample. The first draw sample may or not test water that is from the lead service line. Thus, the regulatory tap sampling may or may not be testing the lead levels from the lead service lines. A focused lead service line monitoring protocol is needed.

With regards to diagnostic (test-out and follow-up) monitoring and testing, three methods are approved to ensure that the draw reaches the lead service line: flushing a specified volume, sampling directly from the service line, and water temperature variation. For the flushing specified volume method, improved guidance is needed, as exemplified by DC WASA's

approach of using sequential samples. Taking samples directly from the service line is more intrusive and difficult, but is the best method of ensuring that the lead service line is represented. Service line testing does still require cooperation from the customer. The water temperature change method is highly variable and the least desirable for test out. Should the temperature change method still be left in rule at all or in guidance?

Communications with customers of sampling protocol during test-out is particularly important because of the "pass/fail" nature of the testing. It is essential to provide customers with an easy-to-use sampling technique. Consideration should also be given to direct utility involvement (i.e., utility personnel taking the samples) because of the consequences of the testing (i.e., ability to opt out of replacement for each line).

Questions related to the post-replacement sampling are whether a single sample is appropriate and whether there is a lead concentration that triggers customer action. Post-replacement standard operating procedures are key to minimizing exposure to lead spikes. Guidance or regulatory action may be appropriate for immediate flushing procedures by crews. Also, guidance on ongoing flushing by customers, the use of POU filters, and cleaning aerators at the end of faucets would be useful.

For a voluntary lead service line replacement program (either partial or full), should utilities be required to sample post-replacement as per the regulation? Should customers be notified of results? It is good practice to sample and notify, but it is not clear in the Rule if this is required.

The group identified the following problems and solutions with regards to sampling monitoring and analysis.

Problem	Solution
Need reliable lead field test (current technologies don't capture lead)	Develop new field test methods for total lead
Need screening/diagnostic method to distinguish particulate from dissolved lead	Research to improve speed and accuracy of particulate/total lead
Need reliable filtration protocol	Research, standardize filtration protocol
Epoxy coverage complete?	Need to verify epoxy coverage
Epoxy works on lead service lines?	Need to verify that epoxy works for lead service lines
Standards for epoxy application, operators?	Need standards for epoxy application and operators
Long-term epoxy testing/verification	Need long-term verification
NSF standards for VOC contaminants adequate?	Need to review adequacy

Guidance from EPA is needed to ensure that sample collection is correct, perhaps as a standardized form. EPA should reiterate the limitations on invalidation of samples under the Rule.

With regards to potential rule revisions, EPA should review the requirement to digest the sample only if >1 NTU. Should all samples be digested to ensure that lead particulates are detected? Also, after partial lead service lines replacement all samples should be digested because the contaminants are most likely to be particulates.

On the issue of a standard form to have customers complete as part of the monitoring protocol, there is already a form that covers issues such as icemakers and requirements for sampling. Having a form that covers all topics to help determine validity of samples may be tough to get participants to fill out. Utilities may need to pay for samples or mandate cooperation. EPA reviewed one utility's form and it is now 2 pages. There was even a discussion on the correct sizing of words. There is some trouble because of an invalid sample, so you have assure that it is done right with one shot.

Data gaps for which research is needed include the following.

- Seasonal/WQ effect on test-out timing. One participant noted that DC did not see a difference in summer or winter. Lead levels were still high in winter. Phosphates don't react as fast in winter. This may be system specific and needs to be looked at more carefully.
- Is the 72-hour resample sufficient for stabilization? Is 1 sample sufficient or are more samples needed? What time frame (over 12 months?) is appropriate and what draw is the most indicative? What are the best practices with respect to customer flushing?
- Particulate lead analysis methods, including sample preparation and filtration methods (the same size filter can produce different results)
- Data on epoxy performance including byproducts, application verification, VOCs, taste, flow restriction, and long term monitoring.

The full panel discussed the presentation and issues related to monitoring.

- On the topic of test-out solutions, WASA has conducted extensive lead profiling in which a customer takes a sequence of samples, i.e., one liter samples for the first six liters. WASA then determines how many liters represent the sample to the main so they know exactly where each sample is testing.
- Other linings would fall into the same category as epoxy. These technologies are in development, but are further advanced in Europe. Some protocol is needed to test, perhaps from NSF.
- Sampling. One approach may be to include sampling points adjacent to valves or meters as part of permit programs.
- Epoxy. There is some positive experience in the US on large lines that take external stresses and loading. There is also VOC data out there. The data doesn't need to be specific to lead pipe. Some water tanks have epoxy linings, so that water has been in contact with epoxy for years with no ill effects. The NSF-tested protocol is pretty rigorous. Research should look at materials of epoxy to see what variables impact use. Are there AWWA standards?

- A participant noted a sample of epoxy on copper that was distributed at the meeting. The epoxy coating on copper was smooth, but the coating on lead may not be as smooth because of the condition of pipes.

Discussion of Public and Media Communication

The final group presented on issues related to public and media communication, specifically in the areas of customer and public motivation, public health-benefits and risks, and guidance for customers for full and partial lead service line replacement.

Issues related to customer and public motivation include the following.

- How do we sustain customer participation in sampling programs?
- How do we encourage full lead service line replacement given the financial and practical constraints?
- What are the community-wide benefits to generate support from the community for the program and rate increases?

Strategies to address these include the following.

- Public communications campaigns that include media strategies, strong fact-based approaches, information on health effects and other customer benefits such as improved flow
- Financial incentives such as incentive plans/discounts/low interest loans, credit on bill for sampling, or fines
- Local ordinances on mandatory participation or requirements for disclosure during property transfer

Recommendations related to customer and public motivation include the following.

- More information to demonstrate the value of lead service line replacement
- Fill data gaps on health effects, benefits to homeowners, and which customer communications strategies work/don't work
- Improved guidance on customer retention strategies, customer's role in identifying lead service lines, helping utilities understand the benefits of consistent sampling, suggested customer information before/during/after lead service line replacement, and special needs for small systems
- Rule revision related to the 72-hour sample after partial replacement (timing interval plus sampling for full replacement)

Communicating about public health issues, particularly risks and benefits, is important. For example, what can we say about the benefits of replacement and the health risks of being above or below the Action Level? These communications should be fact-based.

Recommendations related to public health – risks and benefits – include the following.

- Data gaps: information is needed on health risks of lead exposure, both above and below the Action Level; exposures of sensitive subpopulations, chronic vs acute exposures, relative source contributions of other water and non-water sources, and the appropriateness of the MCLG of 0.
- Rule revision-reevaluate the LCR to examine whether it is achieving appropriate public health risk goals.

Issues related to customer guidance for lead service line replacement include how much advance notice is appropriate, content of message before, during and after, if the message is different for full and partial replacement, and what is the significance of the 72-hour sample. Again, fact-based communications are the best strategy.

Recommendations on customer guidance include the following.

- Data gaps include communication strategies that work vs don't work, pre-replacement customer measures, post-replacement customer maintenance, the benefits of replacement, and timing for stabilization of lead levels after replacement.
- Improved guidance includes customer communication strategies, customer actions, suggested alternative sampling strategies, and special needs for small systems and non-owner occupied residences.
- Rule revisions include the 45-day minimum notice (too short, 6 months may be better), changes to the 72-hour post-replacement sample, 3-day reporting requirement (too short) and the mandatory language on flushing needs to be reexamined.

The full panel discussed the presentation and issues related to customer and media communications.

- One participant, Glen Boyd, mentioned an upcoming journal article on partial replacement. The article describes a simulated study of partial replacement using segments of lead pipe that monitored lead levels. The results are in the October issue of the Journal of Environmental Engineering (citation: Boyd et al, "Pb in Tap Water Following Simulated Partial Lead Pipe Replacements," *Journal of Environmental Engineering*, October 2004, pages 1188-1197).
- One participant urged caution on running studies because the time of year can make a difference. Use monthly data if available.
- Time frames are critical. There is a big gap between 72-hour, 3-day, when it takes months to run analysis.
- One participant thought that you could not extend the 45-day notification too much longer because you only have one year to replace 7% of lines. You could lose half of the construction in the first year. Initial outreach is important. A longer time for initial outreach could encourage full lead service line replacement.
- As soon as a customer has been identified for partial replacement, the utility should send notice to allow more time for participation.
- Perhaps this should be a two-step process, with an initial notice and then one 45 days before.

Summary and Conclusion

The panel discussed how schools and day-care centers should be prioritized and which replacement strategies are appropriate. EPA mentioned that an upcoming summit will deal exclusively with school issues, scheduled for December 7, 2004.

The facilitator next opened the floor up to solicit comments from meeting observers (see Attachment B).

Alan Carroll, of the Lansing Board of Water and Light, noted that they got from the State a list of licensed day care providers. This information can be hard to get because providers self-identify.

Jodye Russell of WASA offered to form an informal support group to talk about specific issues with regards to replacement, including practices that may help others. (See contact information in Attachment B.)

Some participants brought up broader questions to be discussed.

For example, one participant discussed the determination by EPA that defined "control" to mean only those lines that utilities owned (as a result of litigation). The organization represented by the participant, NRDC, does not agree with this determination. As shown in this workshop, partial lead service line replacement is not a complete solution and may not be a great investment. This definition ought to be revisited in the lead rule so that full replacements are possible under utility control. Other participants didn't necessarily disagree, but were unsure if there was enough information on health effects and the contribution of other sources to justify full replacement. We could spend billions and still have a problem. It will not be easy to come up with funding lead service line replacement if it is an incomplete solution. Other strategies, such as reducing lead in fixtures, should also be pursued. Also, there may be a growing awareness of other corrosion byproducts, such as cadmium, as found in samples taken from Seattle schools. We should learn from our experience gained and be open-minded in finding solutions to reduce exposure to lead and other corrosion byproducts.

Eric Burneson of EPA concluded the workshop by once again thanking the panel for their participation. A draft summary of the workshop will be circulated to the panel for comments. The summary will then be made available to the public. EPA will continue to gather information on lead and copper issues, such as an assessment of compliance and detailed evaluations of systems that have had success in reducing lead levels. A future summit is planned on schools. In the longer term, EPA will make a determination if there are national problems with compliance or the rule itself, depending on information collected, and consider rule revision for the 2008 6-year review or an off-cycle review. For quicker action, EPA will also consider to what extent national problems should be addressed through dissemination, modification, or development of guidance and training. The data gaps identified will be considered for future research, either through EPA's research program or other research mechanisms.

Scott again thanked participants and concluded the workshop.

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ATTACHMENT C: ISSUES

Inventory Management Issues

- How best to determine what material is in the ground
- Balance choice of material with plumbing, electrical code, and water quality
- Opportunities and obligations to identify lead service lines during routine maintenance
- Are there lead service line issues with non-transient systems
- Innovative techniques to identify materials of construction
- Data clearinghouse of lead service line data
- Look at pipes that have been rehabilitated and evaluate
- What is the accuracy of the database on partial and complete lead service line replacement

Customer, Media, and Public Communication Issues

- Methods of customer empowerment/actions
- Managing customer expectations before, during, and after lead service line replacement
- Motivation to customer to be interested in lead service line replacement
- Need to understand and articulate the benefits of lead service line replacement
- Specific language after partial lead service line replacement
- How to motivate absentee owners of multi-family dwellings
- Innovative techniques to encourage owners to continue monitoring
- Customer participation in epoxy coating of full lead service line
- How to maintain required sites or develop alternatives
- What can we tell customers about health risk of action level
- Is there guidance for customers if there is a post replacement spike
- Communicating benefits of replacement to entire community (rates) including wastewater community
- What is impact of chronic exposure (even under action level) on a child
- Re-evaluating LCR with regards to the MCLG of 0
- Appropriate notification for full lead service line replacement
- Is chronic vs acute exposure of concern well defined
- Changes to existing mandatory language/lead education

Monitoring Issues

- Modify/evaluate lead concentration monitoring to assess where problem exists
- Is there method to verify complete epoxy adherence
- Evaluate laboratory quality control activities
- Re-evaluate sample collection methods to determine if lead service line is being tested
- Appropriate monitoring techniques to measure lead in service line
- Post replacement monitoring (protocol and timing)

- Monitoring and analysis methods for epoxy and particulate lead
- Methods to get proper samples from customers
- Should we acidify all samples above 1 NTU
- What are monitoring actions following spike in 72-hour sample
- Water quality dependence on elevated lead duration
- Are there innovative/reliable lead field (in home) monitoring technologies
- What is the importance of lead level consistently just below Action Level
- Is there a relationship between lead lines and lead in drinking water
- Improve sampling to determine lead concentration in lead service lines
- Appropriateness of monitoring to balance exposure/protection/treatment
- Is 72-hour partial replacement monitoring necessary when the utility is voluntarily performing replacement
- Site test-out during June-September
- Reliability of customer-collected 72-hour post replacement monitoring
- First samples don't represent lead service line
- Should testing separate dissolved/particulate lead
- Is colloidal lead significant
- Need to tailor sample relative to property
- Does tier-1 sampling apply post partial lead service line replacement
- Consider sample location at meter
- Profile monitoring to show impact of partial/compete lead service line replacement
- Monitoring for voluntary lead service line replacement – is it mandated

Replacement Strategies Issues

- How do we best remove particulates during lead service line replacement
- Role of POU/POE treatment devices during replacement
- Develop draft criteria for accepting rehabilitation in lieu of replacement
- Flushing techniques after lead service line replacement
- Brass service lines issue?
- Minimize galvanic corrosion after replacement
- Ease of language on definition of ownership
- Rule barriers to allowing unanticipated solutions
- Should lead service lines be abandoned in place
- Need to evaluate epoxy coatings and lining materials under spectrum of water and loading conditions
- Relative contribution of lead service lines vs meters, plumbing, etc.
- Rule barriers to stopping treatment post replacement
- Accelerated lab testing of pipe rehabilitation materials to predict longevity
- Optimize field techniques to reduce lead spikes following replacement
- What is appropriate replacement approach when the PWS does not own the service line
- How do we encourage/ensure full lead service line replacement
- Are there other methods to reduce lead exposure

- Is 15 years too long
- Standardize priority of lead service line replacement
- Customer financial incentives for full replacement
- How can Rule address unique water quality conditions without going to full lead service line replacement
- Materials being used for lead service line replacement creating other problems
- Sharing information between monitoring group and replacement group