American Backflow Prevention Association

1999 Survey

of

State

&

Public Water System

Cross Connection Control Programs

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I. Introduction

The American Backflow Prevention Association (ABPA) created and distributed a survey to collect data on cross connection control programs throughout the country. Two separate surveys were created. A survey of water system programs was mailed by US Postal service to approximately 400 systems in 44 states asking details of their cross connection control program. 135 Surveys were returned representing 30 states. Of the 135 returned surveys 25 were from small systems of less than 10,000 population. 103 represented systems with a population larger than 10,000. 7 systems did not report their population size making it unable do determine if they were small or large.

A Cross Connection Control Survey was sent to state officials of the 50 states and Puerto Rico to find data on their cross connection control program. 26 responses were received and compiled.

This is an on-going effort to provide documentation of the health risks and occurrence of cross connections and backflow incidents.

II. Background

In 1974, the United States Congress passed the Safe Drinking Water Act in order to assure the public that the water they drink is safe. Further requirements and safeguards were enacted in 1986 and again in 1996. The testing that is required ranges from treatment techniques to bacteriologic and chemical testing. The water quality monitoring ranges from naturally occurring chemicals to man-made contaminants such as solvents and pesticides. However, one area that has not been addressed and still poses a significant hazard to the quality, integrity and the safety of the water provided to the public is cross connections.

A cross connection is a link through which it is possible for contamination to enter a drinking water supply. The contamination can and will enter the drinking water system when the pressure of the consumer's plumbing system exceeds the pressure of the drinking water system or when the pressure of the drinking water system drops to a point where the demand of the drinking water system creates a vacuum which draws the contaminant into the public drinking water system.

These cross connections can provide a conduit for contaminants to enter the drinking water supply. Once in the distribution system the fate of the contaminate is uncertain due to many variables such as the chemical and physical properties of the contaminant, the point of entry into the distribution system, the pressure and flow within the distribution system, etc. The contaminant could stay as a slug and provide extremely high concentrations or could dilute providing less severe concentrations. There is no way to predict what will happen once the contaminate enters a dynamic distribution system.

A backflow incident could cause any substance that can come in contact with water to backflow into the distribution system contaminating the drinking water. The potential list of possible contaminates goes far beyond what is found in source water and could be contaminants or concentrations that no treatment process could remove or control.
Backflow incidents that have contaminated a drinking water supply have been recorded for

decades. The collection of these incidents has not been organized into any central repository. Most incidents that have been openly published come from technical publications or the press. Water systems may not want to readily release information on incidents due to the potential liability and lack of consumer confidence it may garner.

The negative effects from backflow on water quality have caused the need for cross connection control programs. Recognizing the potential health risk, public water systems have implemented programs to help negate the effects of backflow, even though not mandated. A few water systems instituted modest cross-connection control programs in the 1930's. The implementation of programs in the absence of guidance has led to many different program methods with varying levels of effectiveness and enforcement.

Although many cross-connection control programs have been initiated in recent decades, there are many utilities, which either do not have a program or do not have a sufficient program to provide for reasonable protection from cross-connections. Public water systems that do not have cross connection control programs mandated remain unprotected; Public systems with inadequate programs also remain at risk; and systems and states with adequate programs will be pressed to continue enforcement due to the other federally mandated requirements within the Reauthorized Safe Drinking Water Act. The level of some state administered cross connection control programs may be reduced in enforcement due to the federal mandates taking precedence over state initiatives and requirements.

Because no clear direction has been issued with regard to reporting backflow incidents, and the potential regulatory and liability repercussion, information on backflow incidents is not readily available and is another reason many public water systems have not initiated or maintained cross connection control programs.

III. Health Risk Assessments

The very definition of a cross connection makes it likely to occur or threaten drinking water quality. The EPA Office of Drinking Water defines cross connections as any actual or potential connection between a drinking (potable) water system and an unapproved water supply or other source of contamination. A backflow incident may present an instantaneous (short term exposure, acute health effect)or an intermittent (long term exposure, chronic health effect) threat to the water quality. Most regulated contaminants are not found in the source waters and contaminants that are not regulated would not be identified by routine water quality monitoring.

However, a backflow incident has the ability to provide a concentrated level of contamination which many times is higher than even the One-Day Health Advisory levels. This type of threat is of special concern to individuals of compromised health.

Backflow could occur contaminating just a portion of the distribution system, this localized degradation of water quality would certainly not be picked up by routine source monitoring (chemical). Routine bacteriological monitoring may not detect the contamination, especially in small water systems with a limited number of routine samples. **Additionally, the contaminant**

may not be bacteriological in nature which would make any disinfectant and disinfection residual ineffective. As a result of this backflow situation, individuals could ingest the contaminant and be subject to the health effects.

It is the unknown, unpredictable nature of cross connections and backflow that make them so dangerous. Health effects can range from irritation at the degradation of the aesthetic quality of water to major illness and death. Outlined in this section are the major contaminant groups for which water systems are required to monitor for and recent backflow events that have occurred introducing high levels of those same contaminants into the public water supply.

1. Bacteriological

EPA currently regulates monitoring for total coliforms and fecal or *Escherichia* coliform or fecal coliforms on a monthly or quarterly basis. There are also expensive continuous treatment techniques in place for viruses, *Giardia lamblia* and other bacteria. Bacteriological contamination is probably the most common result of a backflow incident as the following example illustrates.

Total Coliform and E-coli Bacteria[6]

Iron Mountain Pumping Plant exceeded the MCL for total coliform and E-coli bacteria in December 1997. This problem was the direct result of a cross connection between the potable water system and the fire water system.

Waterborne Disease Outbreaks[7]

In December 1989, Cabool, Missouri experienced an apparent cross connection between sewage overflow and two major distribution system line breaks caused by freezing temperatures, resulting in 200 cases of *E. coli* 0157H:7 infection in a town of 2000 people. Four people died, 86 had bloody stools, 32 were hospitalized. In November 1993, in Gideon, Missouri, about one half of its population of 1,000 contacted *Salmonella Typhimurium.* The *Salmonella* contributed to the death of three people.

Human Blood in the Water System[1]

The chief plumbing inspector had received a telephone call advising that blood was coming from drinking fountains within the building. Plumbing and county health department inspectors went to the scene and found evidence that the blood had been circulating in the water system within the building. They immediately ordered the building cut off from the water system at the meter. Investigation revealed that the funeral home had been using a hydraulic aspirator to drain fluids from the bodies of human "remains" as part of the embalming process. The aspirator directly connected to the water supply system at a faucet outlet located on a sink in the "preparation" (embalming) room. Water created suction that was utilized to draw body fluids through a hose and needle attached to the suction side of the aspirator. The contamination of the funeral home potable water supply was caused by a combination of low water pressure in conjunction with the simultaneous use of the aspirator. Instead of the body fluids flowing into the sanitary drain, they were drawn in the opposite direction -- into the potable water supply of the funeral home.

2. Pesticide / PCBs

EPA currently regulates 33 contaminants that belong to the pesticides/PCBs/SOCs group. This one requirement is the single most expensive sample that is required of public water system. This monitoring is required to occur as the source waters enter the distribution system. There have been many examples of this type of contaminant group entering the distribution system directly from a customer connection.

Uintah Highlands[2]

On 9/16/91 at 2:30 pm approximately 2.5 gallons of TriMec herbicide was backsiphoned into the Uintah Highlands water system. The water system had shut down a length of main line for repairs. The area of impact included a daycare facility, a nursing home facility as well as several single family homes and rental properties. Initial concentration of the active ingredients tested as high as 638 ppm of 2,4-D and 64.8 ppm of Dicamba. 2,4-D has a 1 day health advisory level of 1 ppm, 10 day health advisory level of 0.3 ppm and a MCL of .07 ppm. Dicamba is not regulated but both the 1 day and 10 day health advisory level is 0.3 ppm. The health impact of the chemical includes effects from ingestion and contact with the skin.

3. Untreated Surface Water

EPA currently required that all surface water be filtered and disinfected unless stringent controls are in place and additional standards are met. Even then, surface water is required to be disinfected. Continuous monitoring for different parameters are required of surface water sources to ensure that the water is safe to drink. When a cross connection allows untreated surface water into the distribution system all these safeguards are bypassed.

Irrigation water[3]

On February 23 and 24, 1991, positive total coliform and fecal coliform test results were received from water samples collected from a routine sample collection site near the point of supply to the neighboring system....The golf course irrigation system was supplied from a pond on the property. A valve separating the potable water system from the irrigation system was opened by fire department personnel during a fire system inspection. The cross connection was quickly detected because the regular sampling location for monitoring bacteriological quality was located at the club house kitchen. Bacteriological contamination of a water system through a cross connection is very difficult to trace.

Salty Drinks[1]

In January, 1981, a nationally known fast food restaurant located in southeastern United States, complained that all their soft drinks were being rejected by their customers as tasting “salty”. A second complaint came from a water front ship repair facility that was being served by the same water main lateral. The investigation centered on the ship repair facility and revealed a backflow preventer that had been installed on the service line to the shipyard had frozen and had been replaced with a pipe spool piece.

4. Inorganic Chemicals

EPA currently regulates 21 contaminants that belong to the Inorganic chemical group. Monitoring is required anywhere from annually to every nine years depending on different variables. This monitoring is required to occur as the source waters enter the distribution system. There have been many examples of this type of contaminant group entering the distribution system directly from a customer connection.

Hexavalent Chromium in Drinking Water[1]

In July, 1982, a well meaning maintenance mechanic, in attempting to correct a fogging lens in an overcooled laser machine, installed a tempering valve in the laser cooling line, and inadvertently set the stage for a backpressure backflow incident that resulted in hexavalent chromium contaminating the potable water of a large electronic manufacturing company in Massachusetts employing 9,000 people. Quantities of 50 parts per million hexavalent chromium were found in the drinking water which is sufficient to cause severe vomiting, diarrhea, and intestinal sickness.

5. Volatile Organic

EPA currently regulates 21 contaminants that belong to the VOC group. Monitoring is required anywhere from quarterly to every six years depending on different variables. This monitoring is required to occur as the source waters enter the distribution system. There have been many examples of this type of contaminant group entering the distribution system directly from a customer connection.

Propylene Glycol[2]

On December 28, 1991, a water system in Utah received complaints from a fast food store of foamy, smelly water. The system personnel flushed the system and appeared to alleviate the conditions. The backflow event recurred on December 30, 1991. Upon further investigation, the contaminant was identified as propylene glycol and was found to have originated from the complex's fire suppression system.

Propane Gas in the Water Mains[1]

Hundreds of people were evacuated from their homes and businesses on an August afternoon in a town in Connecticut in 1982 as a result of propane entering the city water supply system. Fires were reported in two homes and the town water supply was contaminated. One five-room residence was gutted by a blaze resulting from propane gas “bubbling and hissing” from a bathroom toilet and in another home a washing machine explosion blew a woman against a wall. Residents throughout the area reported hissing, bubbling noises, coming from washing machines, sinks and toilets. Faucets sputtered out small streams of water mixed with gas and residents in the area were asked to evacuate their homes.

6. Nitrate / Nitrite

EPA currently regulates Nitrate and Nitrite as Acute contaminants. With this designation much more stringent public notification requirements are enacted in the event that the maximum contaminant levels are exceeded. Monitoring is required on a quarterly or annual basis for Nitrate and on a quarterly to not at all basis for Nitrite. This monitoring is required to occur as the source waters enter the distribution system. As an acute contaminant, any time these contaminants enter the distribution system, extra caution should be taken.

Hot Water Heating System[3]

On February 15, 1977 a hospital in Seattle, Washington reported "red" water. Upon investigation, the problem was determined to be a cross connection between the closed hot water heating system and the cold water make-up supply line. No backflow prevention device was provided on the hot water heating boiler. A pressure relief valve apparently failed, forcing water treated with Borate-Nitrite back into the potable water system. The Borate-Nitrite solution in the hot water heating system is mixed 1:1000. The water in the lavatory above the cross connection had approximately 175 parts per million Borate-Nitrite. The water in the fresh water make up line had approximately 3450 ppm Borate-Nitrite. The color of the water was pink and fuschia respectively.

7. Radionuclides

EPA currently regulates Radionuclides, monitoring is currently required on a quarterly or four year basis. This monitoring is required to occur as the source waters enter the distribution system. Although there is limited activities where these contaminants would be present, even these have found there way into the public water supply.

Zircatec[5]

In mid June 1994 an unprotected cross connection allowed uranium contamination into the plant's drinking and showering water. A backflow prevention valve was not installed even though called for in the construction drawings. Ziratec estimates that the clean up costs will exceed $200,000.

IV. Occurrence Data

The "Waterborne Disease Outbreaks in the United States of America: Causes and Prevention", by Gunther Craun, states a significant portion of waterborne disease outbreaks that actually were reported by CDC are caused by distribution system deficiencies. According to Craun, during the period of 1981 through 1990, 24% of reported outbreaks were blamed on cross-connection problems in community water systems.

This data is present even with the apparent lack of documentation of actual backflow incidents. From the Office of Inspector General Survey Report number E1HWG4-01-0091-5400070, "Various experts indicated to the OIG's Engineering and Science Staff, that contamination of the potable water supply by cross connections is largely undetected, not investigated, not properly documented, or not reported." And of those that are reported, it is estimated that at best only

10% of backflow incidents are documentable.

1. 1999 ABPA Water System Survey (WS Survey) & State Program Survey (SP Survey) Results

1999 ABPA Water System Survey Results - For the WS Survey contained in Appendix A, approximately 400 surveys covering 44 states were sent to water systems inquiring on details of their cross connection control programs. 135 Surveys were returned representing 30 states. Of the 135 returned surveys 25 were from small systems of less than 10,000 population. 103 represented systems with a population larger than 10,000. Seven (7) systems did not report their population size making it unable to determine if they were small or large.

On page 2 of the WS Survey, question #10 asked, " what is the total number of cross connection surveys performed" The 135 respondents reported a total number of 213,158 cross connection surveys were performed by their cross connection control programs.

On page 2 of the WS Survey, question #12 asked, "What is the total number of cross connections (protected and unprotected) found during the surveys?". The 135 respondents reported a total of 90,171 cross connections were identified.

Dividing the number of surveys performed (213,158) by the number of cross connections found (90,171) this shows that 42% of all surveys conducted find a cross connection.

In addition to the information presented, copies of over 238 hazard assessment surveys conducted by water systems within 5 states are being sent from ABPA along with this report.

On page 2 of the WS Survey, question #13 asked, "What was the most common cross connections found during surveys". 11 common types of cross connections were listed. The 135 respondents reported yes to having the following cross connections found.

Table IV.1
Most Common Cross Connections

Type of Cross Connection	Number	Percent	Type of Cross Connection	Number	Percent
Irrigation	83	62	Boilers	50	38
Pools	33	25	Tanks	31	23

Spas	15	11	Food Equipment	28	21
Fire Systems	57	43	Garden/washdown hoses	57	43
Carbonation Systems	42	32	Sewers/waste facilities	22	17
Cooling Towers	33	25	Other	28	21

On page 3 of the WS Survey, question #14 asked, "Has your system ever experienced backflow incidents?". Of the 135 respondents 69 reported yes to the question. This means **51% of all respondents have experienced a backflow incident.**

On page 3 of the WS Survey, question #14 asked " If yes, how many______". The 135 respondents reported 233 actual backflow incidents. By dividing the number of respondents by the number of backflow incidents it shows our respondents experienced **1.7 incidents per system**.

State Program Survey Incident Data - The state agencies that responded to the survey report that 58% have records of documented backflow incidents.

2. Summary of Backflow Incident Occurrence

Included with this report, ABPA is providing documentation of over 430 backflow incidents that have occurred within 41 states.

There are two voluntary listings of backflow incidents that provide significant documentation of the backflow incidents that have occurred.

> The ***Summary of Backflow Incidents***, December 1995, Fourth Edition, Published by the Cross Connection Control Committee of the Pacific Northwest Section of the American Water Works Association, lists 274 incidents.
>
> The ***Manual of Cross Connection Control***, Ninth Edition, Published by the Foundation for Cross Connection Control and Hydraulic Research, University of Southern California, lists 398 incidents.

3. Potential Occurrence

In the survey conducted by USEPA titled *Drinking Water Infrastructure Needs Survey, First Report to Congress*[8], EPA 812-R-97-001, January 1997, it is estimated that there is a 20 year need for infrastructure improvements of $138.4 billion. Of that, the chart on page 9 indicates that $77.2 billion of that total or 56% of the total is needed for distribution system improvements. With the aging of the distribution systems nationwide, the repair and replacement of the distribution systems will produce conditions that cause backflow incidents to increase.

Many local water utilities rely on maintaining a positive water pressure throughout the distribution system. This is no guarantee that an unprotected cross connection could not cause contamination should an interruption in pressure occur. A recent report from the American Water Works

Association Research Foundation (AWWARF) on Distribution System Performance Evaluation recommends a water system provide adequate maintenance to reduce the number of water main breaks. The recommended goal for a "reasonable" number of main breaks for water systems in North America is 25 to 30 breaks per 100 miles of distribution piping per year. With this as a reasonable goal, it would be logical to assume that many more main breaks than this are occurring, particularly within a poorly managed system. Where main breaks occur, system pressure is interrupted, and the hydraulic conditions that cause backflow to occur would be present. This does not address the potential backpressure backflow condition, which could also allow the introduction of contaminants into the water system due to increased on-site pressure conditions.

V. Cost Data

1. 1999 ABPA Water System Survey (WS Survey) Results

From the 1999 ABPA Water System Survey contained in Appendix A, on page 1 question #2, cost data was requested in 9 categories.

1. Employee Cost
2. Equipment Cost
3. Training Cost
4. Supplies Costs
5. Mailing Costs
6. Data Entry Cost
7. Consultants Costs
8. Legal Costs
9. Miscellaneous & Other Costs

In each category two figures were requested. The first was the costs experienced in the first year of the cross connection control program. The second was the costs experienced in the present year. Programs began at different years with the oldest being from the 1940's until the present. No attempt was made to place present value to the cost figures quoted for the start up year. Three categories for cost data was created:

1. Small systems – Systems under 10,000 population (25 responded)
2. Large Systems – Systems over 10,000 population (103 responded)
3. All Systems – The total of all systems responding to the survey (135 responses)

Note - seven systems did not report population size so status could not be determined.

Many systems did not respond in the cost columns. The lack of data was a concern to determine if the system actually experienced no cost because of using existing resources or if they were not sure of the cost and a zero was entered on the survey. Because of the time constraints placed on the collection of this data we were unable to contact the systems to confirm their intent. To assure they did not affect a true representation of the costs, the costs were tabulated as follows. The first method (A) figures were compiled by adding up the averages of all nine columns which were divided by the number of systems who responded with a positive number for that column. The second method (B) the columns were added and divided by the number of all survey respondents even those lacking data in the cost column. For the third method (C) the two figures were added together and divided by two to come to an average of the higher and lower numbers.

Table V-1 Cross Connection Control Program Costs			
	(A) Divided by Respondents with costs	(B) Divided by all respondents	(C) average of A & B
Small System Start up costs (25)	$13,683.47	$4,524.60	$9,104.04
Small System Annual Costs (25)	$8,480.95	$3,632.60	$6,056.78
Large System Start up costs (103)	$98,135.76	$29,730.53	$63,933.15
Large System Annual Costs (103)	$105,763.53	$79,428.48	$92,596.01
Total Start up costs (135)	$80,291.13	$23,499.70	$51,895.42
Total Annual Costs (135)	$96,815.25	$64,814.92	$80,815.09

On page 1 of the WS Survey, question #1 asked, "What is the number of water service connections served by your water utility or company?" The 135 respondents reported they serve 7,633,778 connections between them. This equals an average of 56,547 connections per respondent. By dividing the Total Annual Costs average figure, in column C of Table V-1, of $80,815.09 to the average connections per system (56,547) produces an **average annual cost of $1.43 per water service connection.**

The small systems (25) reported a total of 44,542 connections. Dividing the small system connections by the number of small system respondents (44,542 / 25 =1,782) a system average of 1,782 connections could be assumed. Dividing the average small system annual costs, in column C of Table V-1 of $6,056.78 by the average number of small system connections ($6,056.78 / 1,782 = $3.40) leads to an **average annual cost of $3.40 per water service connection for a small system**.

The large systems (103) reported a total of 7,440,238 connections. Dividing the large system connections by the number of large system respondents (7,440,238 / 103 = 72,235) a system average of 72,235 connections per large system could be presumed. Dividing the average large system annual cost, in column C of Table V-1 of $92,596.01 by the average number of large system connections ($92,596.01 / 72,235 = $1.28) leads to an **average annual cost of $1.28 per water service connection for a large system**.

On page 2 of the WS Survey, question #4 asked, "Does your system have a way to recover some or all of the cost of your program?" Some programs have established fees to cover their costs of a cross connection control program. The results of the 135 respondents were that 52 said yes and 81 said no. This means 39% of all respondents have established a way to recover a portion of their cross connection control program costs.

On page 2 of the WS Survey, question #5 asked, "What percentage is recovered". 52 systems responded and the average of these 52 was 46.67% of their costs are recovered.

2. 1999 ABPA State Program Survey (SP Survey) Results

A SP Survey was sent to state officials of the 50 states and Puerto Rico to find data on their cross connection control program. 26 responses were received and compiled.

Cost Data

From the State Program Survey contained in Appendix B, on page 1 question #3 asked " Allocation of full time equivalents to cross connection control rule/regulation". We received a total of 13 responses but one response made an error in their interpretation of the question and we did not include their response in the data. (CA reported that 75 engineers were allocated to cross connection control. The person who filled out the survey confirmed that the state has 75 engineers throughout the state but not all of that time is allocated to cross connection control. The response to this question was deleted from the average). Twelve (12) states responded that they utilize a total of 10.0 full time equivalents to cross connection control rule/regulation. This shows an **average of 0.83 full time equivalent** is allocated to cross connection control rule/regulation.

3. Cost to Respond to a Backflow Incident

1999 ABPA Water System Survey Data:

On page 3 of the WS Survey, question #18 asked, "What were the approximate costs of responding to the incident". The question was asked to put down the number of man hours spent. The response could vary due to the emergency response plan the system utilizes. Some systems due to size and response policy would send more employees to investigate an incident. The severity of the incident would also have to be taken into consideration. A more severe incident would demand more response than minor incidents.

The intent of utilizing man hours instead of a dollar amount was that it would eliminate any disparity in differences in the salary of different employees. 92 incident cost responses were received. Of the 92 received, 11 had an inordinately high numerical response. The concern was that perhaps these respondents misinterpreted the question and applied actual dollar costs instead of hourly costs. Because of the constraints on time to respond, we were unable to contact the survey respondents to clarify.

In order to provide an accurate cost assessment the data was calculated as follows. (A) In the first method the 81 respondents that returned a more normal response (less than 1000 hours) were added and divided by 81. (B) In the second method the 11 responses that were inordinately high (over 1000 hours) were added and divided by the 11. (C) In the third method the 92 responses were totaled and divided by 92.

A) 4,925 hours / 81 responses = 60.8 hours average incident cost

B) 40,511 hours / 11 responses = 3,683 hours average incident cost

C) 45,436 hours / 92 responses = 494 hours average incident cost.

Documented Incident Costs:

In addition to the costs contained in the survey, Appendix C contains documented incident response and the dollars spent not necessarily by the water system but also by the state regulatory office. Where costs were reported in man-hours a dollar figure of $30.00 per hour was used.

1	Missouri (State cost of investigation and response)	$4,147
2	Utah #1	$3,840
3	Utah #2	$5,100
4	Utah #3	$5,100
5	Utah #4	$1,800
6	Utah #5	$14,840
7	Ziratec	$200,000
8	Charlotte-Mecklenburg Utilities	$117,000

Total expenses were $351,827. The per incident expense is $43,978.37. By removing the two high incident costs the remaining incident cost average is $5,804.50. Again the wide variation in response cost is due to the emergency response plan the system utilizes, the hazard presented by the contaminant and the severity of the incident.

VI. 1999 ABPA State Program Survey Results

1. Program Elements

On page 1 of the SP Survey, question #5 asked, "Which of the following cross connection control program elements are required by your state rule/regulation?". Seven elements were listed if their program contained this element. These 25 surveys responded as follows:

Table VI-1
State Cross Connection Control Program Elements

Item #	Program Element	Number	Percent
1	Authority to implement local rule/ordinance	15	60
2	Trained or certified staff to implement local rule/ordinance	7	28
3	Public Awareness of backflow potential	4	16

4	Record keeping, including but not limited to		
4a	Inventory of backflow assemblies in service	13	52
4b	Reports of routine testing of assemblies	15	60
4c	Hazard assessment surveys	8	32
4d	Enforcement activities	7	28
5	Backflow Assemblies (listing/approval)	14	56
6	Inspection components	7	28
7	Annual reporting to the state	6	24
8	Other	7	28

2. Programs Required

On page 2 of the SP Survey, question #9 asked "What percentage of systems required to have an active enforceable cross connection control program". Of the 25 respondents only 11 filled out question #9. **The 11 respondents averaged 55% of their systems required to have an enforceable program actually do.**

On page 2 of the SP Survey, question #10 asked " What percentage of systems recommended to have an active cross connection control program". Of the 26 respondents only 7 filled out question #10. **The 7 respondents averaged 37% of their systems recommended to have an enforceable program actually do.**

3. Federal Program Requirements

On page 3 of the SP Survey, question #17 asked, "Would your state object to a federal requirement for all public water systems to have a cross connection control program approved by their state, with minimum required elements". **Of the 26 respondents 5 reported yes (19%) and 21 reported no (81%).**

On page 3 of the SP Survey, question #18 asked "Would your state object to a federal requirement for all public water systems to have a cross connection control program that addresses these minimum elements and is approved by their state

Authority
Backflow Prevention Assemblies
Certified Personnel
Defensible Records
Education & Training

The elements can be decided through state/EPA work groups at a later date." **Of the 26**

respondents 5 reported yes (19%) and 21 reported no (81%).

VII. Conclusions

The intent of the Safe Drinking Water Act is to assure that everybody will be able to have safe drinking water. Even with the multitude of monitoring and treatment requirements the drinking water can still be unsafe to drink. A backflow incident has the potential to adversely affect water quality. This affect can be a minor taste and odor complaint or a lethal dose of some substance. The duration of the incident could compromise the drinking water for a short moment or could be an on going hydraulic problem. The need to identify and correct these potential hazards is important to maintaining safe drinking water in the distribution system.

Contamination of the potable water supply by cross connections is largely undetected, not investigated, not properly documented, or not reported. Even so, there are numerous incidents that illustrate the hazards and occurrence of backflow. Included in this document are examples of how every regulated contaminant group has found a pathway into our drinking water even with the drinking water standards in place and the required monitoring accomplished.

Many states have recognized the need to implement a cross connection control program. Without proper protection and operator training in place, a backflow incident may happen and a consumer complaint filed. In response the water system may simply flush the line without finding the source of the problem. A hidden danger with cross connections is that some contaminates can present a long-term health risk by exposure to contaminates that can be harmful; without correcting the situation with proper cross connection control the potential for contamination and risk is still present.

With the replacement of aging distribution systems the potential for more incidents of backflow could be expected due to main replacement and repair. The need to replace an aging infrastructure in the water industry has led to the forecast of billions of dollars being spent to comply with requirements of the Safe Drinking Water Act. A cross connection control program helps assure that the money spent on the distribution system allows it to operate without contamination.

The April 1998 Association of State Drinking Water Administrators' *Survey of Best Management Practices in Community Ground Water Systems*[9] has recognized the desirable effects of an effective cross connection control program and confirms that cross connection control is more than just a good engineering practice. The 1999 ABPA State Program Survey results indicate that 81% of the states would not object to a general requirement for cross connection control.

The data from the 1999 ABPA Water System Survey shows that the small water system annual cost on average is $6,057, the large system cost is $92,596. The average cost to respond to a backflow incident is 61 to 494 man-hours($1,830 to $14,820). In some cases the cost of response to a single backflow incident has exceeded $100,000 dollars, in a least two cases the entire distribution system was replaced at millions of dollars. It clearly seems that prevention is the only viably way to deal with potential backflow situations. The cost of a cross connection control program should be weighed against the cost of investigation, system clean up and the intangible cost in lost consumer confidence.

The consumer cost, such as, the installation, testing and maintenance of backflow prevention assemblies is not addressed in this summary, although included in the survey responses are water systems that install, test and maintain backflow prevention assemblies at the service connection. ABPA intends to collect additional data on consumer costs in a future survey.

The need to mandate the enforcement of programs allows existing programs to concentrate their efforts on enforcement and not spend their time defending why they are operating a program. Mandating cross connection control programs will cause programs with less than desirable enforcement practices to commit to protecting the drinking water from potentially harmful sources such as backflow.

Public water systems should seek out the best quality of water available and ensure it's original quality by testing to standards. Public water systems should also treat vulnerable surface water or ground water influenced by surface water with a higher degree of care and monitoring. Public water systems should construct the water facilities to the highest construction standards.

In addition, to protect the public health as well as the investment of time, money, and care in system infra-structure and monitoring; and due to the fact that hundreds and hundreds of documented backflow incidents have circumvented the existing level of protection: **Public water systems should be required to have and maintain an effective on-going cross connection control program.** In order to focus limited water system and state resources on the implementation of the program and not defend why the program is needed, this requirement must be made by the federal government in order to place it on equal footing with all the other federally mandated drinking water standards.

VIII. References

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4. ***Manual of Cross Connection Control***, Ninth Edition, Published by the Foundation for Cross Connection Control and Hydraulic Research, University of Southern California

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6. ***County of San Bernardino, Department of Public Health,*** letter dated March 30, 1998.

7. ***Office of Inspector General Survey Report*** number E1HWG4-01-0091-5400070.

8. ***Drinking Water Infrastructure Needs Survey, First Report to Congress***, EPA 812-R-97-001, January 1997

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