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Notice of Filing Rebuttal Testimony

W-01445A-11-0310

PART 2 OF 2
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BAR CODE #0000135789

ARIZONA WATER COMPANY

Docket No. W-01445A-11-0310

2011 RATE HEARING

For Test Year Ending 12/31/10

PREPARED

REBUTTAL TESTIMONY & EXHIBITS

OF

FREDRICK K. SCHNEIDER

TABLE OF CONTENTS

		Page
I.	INTRODUCTION AND PURPOSE OF TESTIMONY	3
II.	PUMPING AND TRANSMISSION AND DISTRIBUTION SYSTEM MAINTENANCE	4
III.	WATER LOSS AND THE COMPANY'S PROPOSED DISTRIBUTION SYSTEM IMPROVEMENT CHARGE ("DSIC")	9
IV.	UTILITY PLANT PRO FORMA ADJUSTMENTS	11
V.	OFF-SITE FACILITIES FEE	12

EXHIBITS

SUPERSTITION 10-YEAR INFRASTRUCTURE REPLACEMENT COST ESTIMATE	FKS-RB1
BISBEE 10-YEAR INFRASTRUCTURE REPLACEMENT COST ESTIMATE	FKS-RB2
ORACLE 10-YEAR INFRASTRUCTURE REPLACEMENT COST ESTIMATE	FKS-RB3
BURIED NO LONGER: CONFRONTING AMERICA'S WATER INFRASTRUCTURE CHALLENGE, AMERICAN WATER WORKS ASSOCIATION, 2012	FKS-RB4
2009 INFRASTRUCTURE FACT SHEET, AMERICAN SOCIETY OF CIVIL ENGINEERS, 2009	FKS-RB5
DRINKING WATER INFRASTRUCTURE NEEDS SURVEY AND ASSESSMENT – FOURTH REPORT TO CONGRESS, ENVIRONMENTAL PROTECTION AGENCY, 2009	FKS-RB6
DAWN OF THE REPLACEMENT ERA – REINVESTING IN DRINKING WATER INFRASTRUCTURE, AMERICAN WATER WORKS ASSOCIATION, 2001	FKS-RB7
A REPORT ON ARIZONA WATER COMPANY'S PLAN TO REDUCE WATER LOSSES	FKS-RB8
REQUEST FOR BIDS TO PERFORM REQUIRED REPAIRS – WELL NO. 17 IN MIAMI	FKS-RB9
CONSTRUCTION PLACED IN SERVICE NOTICE – WELL NO. 17 IN MIAMI	FKS-RB10

ARIZONA WATER COMPANY

Rebuttal Testimony of

Fredrick K. Schneider

I. Introduction and Purpose of Testimony

Q. PLEASE STATE YOUR NAME, EMPLOYER, AND OCCUPATION.

A. My name is Fredrick K. Schneider. I am employed by Arizona Water Company (the "Company") as Vice President of Engineering. My business address is 3805 N. Black Canyon Highway, Phoenix, Arizona 85015.

Q. ARE YOU THE SAME FREDRICK K. SCHNEIDER THAT PREVIOUSLY PROVIDED DIRECT TESTIMONY IN THIS MATTER?

A. Yes.

Q. HAVE YOU REVIEWED THE DIRECT TESTIMONY FILED BY THE OTHER PARTIES TO THIS PROCEEDING?

A. Yes, I have reviewed the testimony of each of the witnesses of the Arizona Corporation Commission's ("Commission") Utilities Division Staff ("Staff") and the Residential Utility Consumer Office ("RUCO").

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. The purpose of my rebuttal testimony is to respond to the direct testimony of Staff witness Jeffrey M. Michlik and RUCO witness William A. Rigsby.

Q. HOW IS YOUR REBUTTAL TESTIMONY ORGANIZED?

A. My rebuttal testimony is presented in five sections including this introductory Section I. In Section II, I present the Company's response to Staff witness Mr. Michlik, specifically related to the Company's need to maintain adequate Pumping and Transmission and Distribution Maintenance ("Pumping and T&D Maintenance") expenses to provide the required and necessary system maintenance. In Section III, I respond to Staff witness Mr. Michlik, and RUCO

witness Mr. Rigsby, specifically related to the extraordinary utility plant investments necessary to replace old and failing water mains and service lines required to reduce water losses below 10 percent pursuant to the Commission order in Decision No. 71845. In Section IV, I respond to Staff witness Mr. Michlik, related to his recommendation that the Company retire certain utility plant in the Superstition system. In Section V, I respond to Staff witness Mr. Michlik, related to his recommended reduction in the Company's proposed off-site facilities fee.

Q. ARE YOU SPONSORING ANY EXHIBITS WITH YOUR REBUTTAL TESTIMONY?

A. Yes. I am sponsoring the following exhibits:

FKS-RB1 – Superstition 10-Year Infrastructure Replacement Cost Estimate.
FKS-RB2 – Bisbee 10-Year Infrastructure Replacement Cost Estimate
FKS-RB3 – Oracle 10-Year Infrastructure Replacement Cost Estimate
FKS-RB4 – Buried No Longer: Confronting America's Water Infrastructure Challenge, American Water Works Association, 2012
FKS-RB5 – 2009 Infrastructure Fact Sheet, American Society of Civil Engineers, 2009.
FKS-RB6 – Drinking Water Infrastructure Needs Survey and Assessment – Fourth Report to Congress, Environmental Protection Agency, 2009.
FKS-RB7 – Dawn of the Replacement Era – Reinvesting in Drinking Water Infrastructure, American Water Works Association, 2001.
FKS-RB8 – A Report on Arizona Water Company's Plan to Reduce Water Losses, dated December 30, 2011.
FKS-RB9 – Request for Bids to Perform Required Repairs – Well No. 17 in Miami.
FKS-RB10 – Construction Placed in Service Notice – Well No. 17 in Miami

II. <u>Pumping and Transmission and Distribution Maintenance Expense</u>

Q. DO YOU AGREE WITH STAFF WITNESS MICHLIK'S RECOMMENDATION AT PP. 20-23 OF HIS DIRECT TESTIMONY THAT THE COMPANY'S PRO

FORMA ADJUSTMENT TO PUMPING AND T&D MAINTENANCE EXPENSES BE REMOVED?

A. No. The adjustment is required to normalize routine and ordinary pumping and T&D maintenance expenses. As explained by Mr. Reiker in Section IV of his rebuttal testimony, as a result of cost-cutting measures implemented by the Company in 2008, the Test Year levels of Pumping and T&D maintenance expenses were abnormally low and are not representative of the level of costs that would be prudently incurred going forward. As a result, these expenses require normalization in this proceeding.

Q. CAN THE COMPANY POSTPONE MAINTENANCE INDEFINITELY?

A. No. The temporary cost-cutting measures mentioned above were in response to the economic downturn and cannot be continued without the undesirable consequences Mr. Michlik cautions about in his direct testimony on page 21, line 25 through page 22, line 1, where he states:

> "Inadequate maintenance can have undesirable consequences, including: decreasing the useful life of plant equipment, causing increases in other short-term or long-term expenses, decreasing system function efficiency and increasing water loss."

Continuing these cost-cutting measures indefinitely will lead to long-term maintenance problems including premature pump and motor repairs, loss of water system efficiency and increases in lost and unaccounted for water. For these reasons, the Company proposed the pro forma adjustment to this expense item.

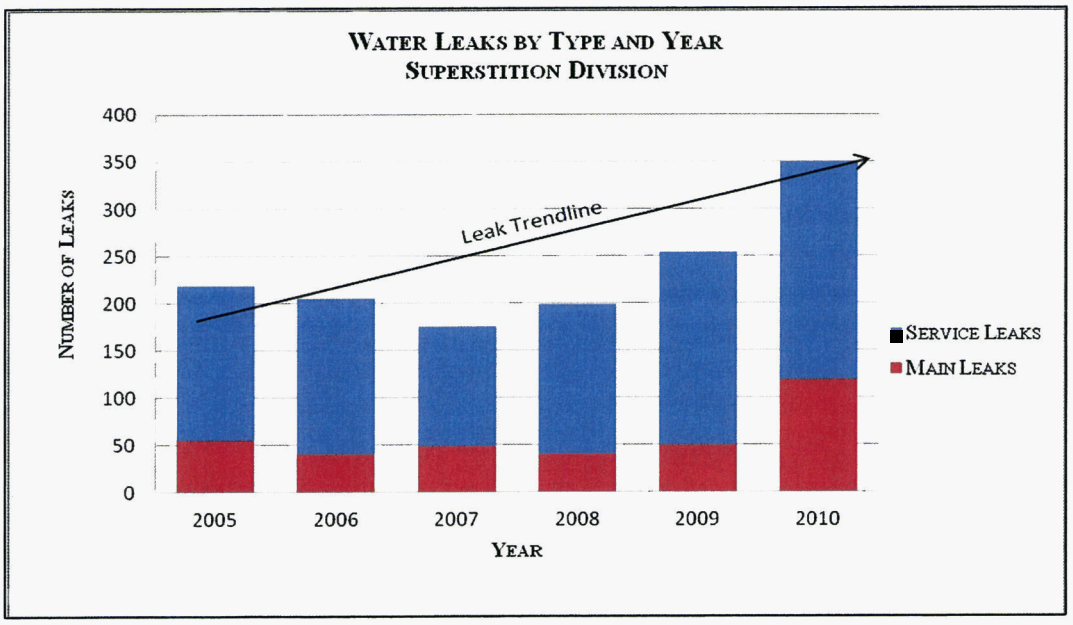
Mr. Michlik agrees with the Company that inadequate maintenance causes undesirable consequences. Clearly, Mr. Michlik also agrees with the Company's assessment that Pumping and T&D Maintenance is critical and important. But Mr. Michlik's recommendation to remove the Company's pro forma adjustment to Pumping and T&D Maintenance expenses is inconsistent

with his statement about the dangers associated with performing inadequate maintenance.

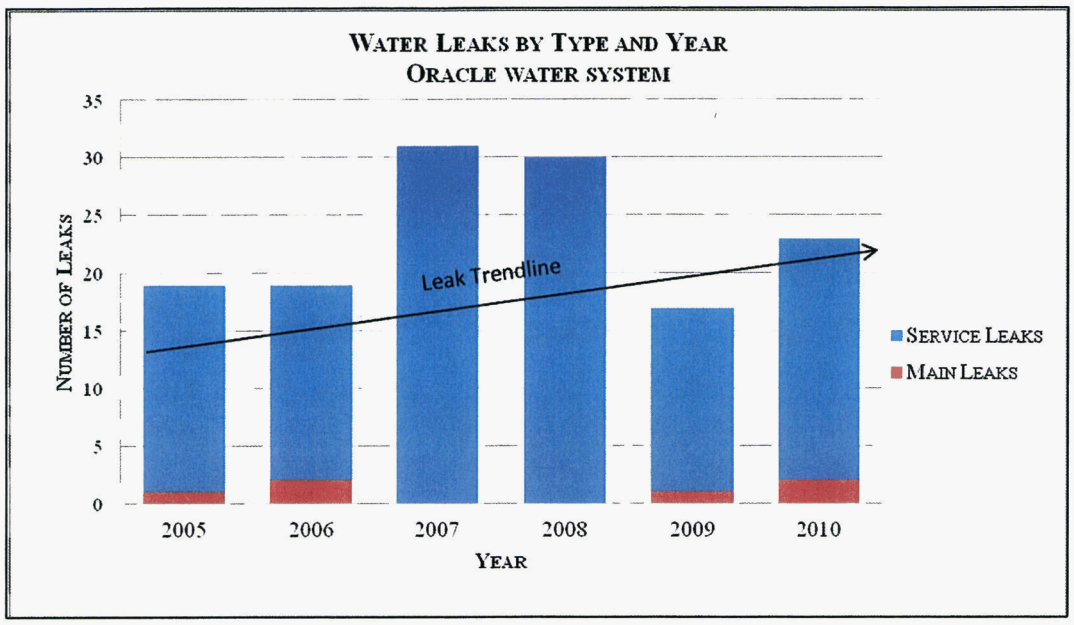
Q. IF THE COMPANY PERFORMS ROUTINE WATER MAIN AND SERVICE LINE MAINTENANCE, WILL THAT POSTPONE INDEFINITELY THE NEED TO REPLACE AGING AND FAILING INFRASTRUCTURE, AS RUCO ARGUES?

A. No. As the Company's analysis of water losses shows on pages 42, 68 and 83 and Graphs 5-7, 6-7 and 7-6 of Exhibit FKS-13 ("Water Loss Reduction Program For Water Systems In The Eastern Group") included below, despite the fact that leaking water mains and service lines have been, and are being, repaired, the frequency and number of leaks and breaks is increasing:

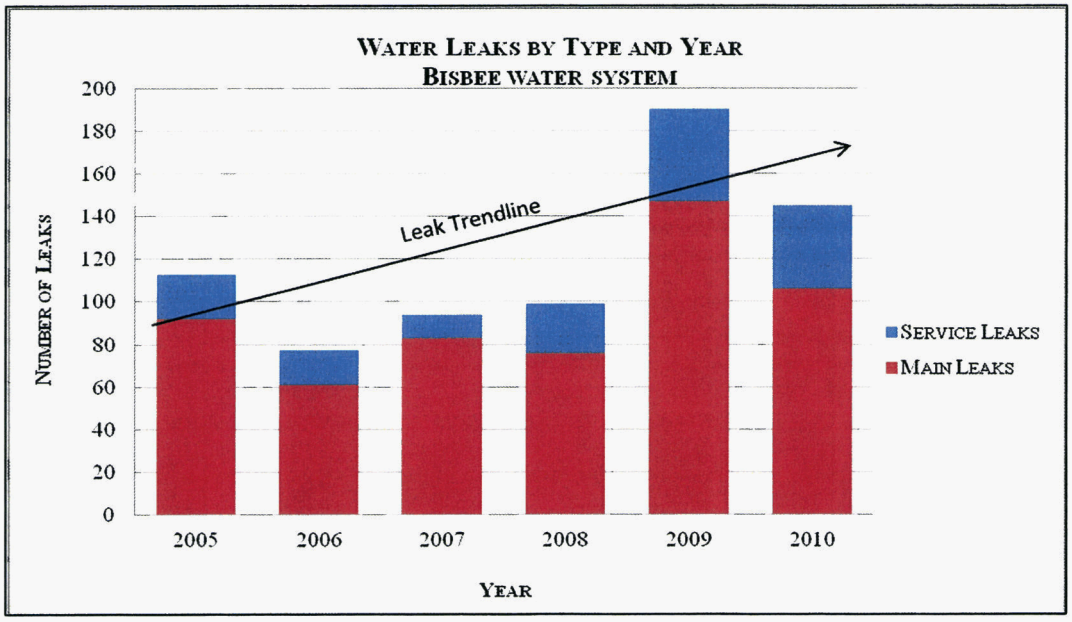
Graph 5-7 Water Leaks by Type and Year - Superstition Division



Graph 6-7 Water Leaks by Type and Year – Oracle Water System



Graph 7-6 Water Leaks by Type and Year – Bisbee Water System



The required maintenance the Company performs on these underground facilities is primarily related to locating and repairing leaks and breaks as they occur. The point that RUCO misses is that there comes a point when making repairs cannot keep up with increasing numbers of leaks and breaks, and replacement of the water main is necessary. According to the Company's

detailed analysis submitted as Exhibit FKS-13 and the replacement cost analyses submitted as Exhibits FKS-14, 15 and 16 (attached hereto as Exhibit FKS-RB1, RB2 and RB3), there are over 370,000 feet of water mains and 8,700 failing plastic and galvanized service lines that can no longer be reliably repaired and must be replaced.

Q. DO STAFF, RUCO AND THE COMPANY AGREE ON THE IMPORTANCE OF PERFORMING THIS MAINTENANCE?

A. Yes. However, Staff's recommendation to remove the Company's proposed pro forma adjustment to normalize Pumping and T&D Maintenance expenses fails to recognize the fact that the Company cannot continue reduced levels of maintenance without experiencing continued leaks, main breaks, water losses and the types of negative consequences Mr. Michlik concedes on page 21, line 25 through page 22, line 1 of his direct testimony.

Q. DOES RUCO AGREE WITH THE COMPANY THAT THE TEST YEAR LEVEL OF PUMPING AND T&D MAINTENANCE EXPENSE WAS ABNORMALLY LOW?

A. Yes.

Q. DOES STAFF SUGGEST THIS ROUTINE REQUIRED MAINTENANCE BE ELIMINATED BY THE COMPANY?

A. No. Mr. Michlik agrees with the Company on the need to perform this required maintenance work. Mr. Michlik even acknowledges and concedes the problems that will occur if required maintenance is not completed.

Q. HAS THE COMPANY PERFORMED CRITICAL PUMPING AND T&D MAINTENANCE SINCE IMPLEMENTATION OF ITS COST-CUTTING MEASURES IN 2008?

A. Yes. This type of maintenance has been prioritized and all critical maintenance has been completed in order to maintain safe, reliable and adequate water service. This responsibility is always a priority of the Company. The Company

prioritized the most critical maintenance and temporarily postponed less-critical maintenance wherever possible to cut costs. However, even less-critical maintenance becomes critical when postponed too long. Temporarily postponing less-critical maintenance to cut costs, where possible, was prudent during the severe economic crisis that started in 2008. However, postponing less-critical maintenance was intended to be only temporary. Again, short-term reductions in Pumping and T&D Maintenance cannot be continued. Pumping and T&D Maintenance expenses need to be normalized for the Company to be able to perform all required maintenance, not just emergency maintenance, on a normal schedule. The Company's pro forma adjustment for these required maintenance expenses is prudent and necessary.

III. Water Loss and the Company's Proposed Distribution System Improvement Charge ("DSIC")

Q. DOES THE COMPANY AGREE WITH STAFF'S AND RUCO'S RECOMMENDED DENIAL OF THE DSIC?

A. No. The Company's 91-page detailed report, "Water Loss Reduction Program for Water Systems in the Eastern Group" provided extensive evidence of the Company's efforts to manage and reduce water loss. More importantly, this report provided very specific and detailed short and long-term plans to replace the Superstition, Bisbee and Oracle water systems aging and failing water mains and service lines. Neither Staff nor RUCO dispute the need to replace this aging infrastructure. The Eastern Group water systems have water mains which were installed as early as 1906 and have been in service for more than 100 years. There have been numerous studies completed by various agencies, associations and universities which have quantified the looming aging infrastructure phenomenon the United States Water Industry is facing. Four of these studies are attached hereto as Exhibits FKS-RB4, FKS-RB5, FKS-RB6 and FKS-RB7.

It was precisely the extraordinary nature of the capital costs and the need for timely recovery of the increased cost of service related to the capital outlay that led the Pennsylvania PUC and others to adopt a DSIC. In addition, Company witnesses Mr. Harris and Ms. Ahern further discuss the need for the Commission to approve a DSIC in this case.

Q. WHAT DOES THE COMPANY'S "WATER LOSS REDUCTION PROGRAM FOR WATER SYSTEMS IN THE EASTERN GROUP" REPORT SHOW?

A. The report completed and submitted as Exhibit FKS-13 shows that nearly $67 million of water mains and service lines in the Eastern Group have reached or are nearing the end of their useful lives and must be replaced. This is detailed in Exhibit FKS-14, FKS-15 and FKS-16, which are attached hereto as Exhibits FKS-RB1, FKS-RB2 and FKS-RB3, respectively. Mr. Harris discusses the magnitude of these required utility plant replacements compared to other Commission-approved cost recovery mechanisms the Company has successfully implemented. Ms. Ahern discusses the need for a DSIC to support these required utility plant replacements in further detail in her rebuttal testimony.

Q. HAS STAFF OR RUCO DISPUTED THE CONCLUSIONS OF THE COMPANY'S ANALYSIS?

A. No. In fact, Staff witness Ms. Stukov agrees that many of these aging and failing water mains and service lines need to be replaced. Specifically, she recommends the Company implement its 3-year replacement plan in the Superstition-Miami, Cochise-Bisbee and Oracle water systems.

Q. WHAT ELSE HAS THE COMPANY DONE TO QUANTIFY ITS EFFORTS TO REDUCE WATER LOSS?

A. On December 30, 2011, the Company completed and docketed "A Report on Arizona Water Company's Plan to Reduce Water Losses" with the Commission as required in Decision No. 71845 whereby the Commission directed the Company to do the following:

> "That Arizona Water Company shall reduce the non-account water for each of its systems to less than 10 percent by July 1, 2011. For those systems that have not achieved a water loss rate of less than 10 percent by July 1, 2011, AWC should evaluate the systems and prepare a report demonstrating how the Company plans to reduce water losses to less than 10 percent. If the Company contends that reducing water losses to less than 10 percent is not cost effective, it should submit a detailed cost analysis and explanation demonstrating why the water loss reduction to less than 10 percent is not cost effective. Absent extraordinary circumstances, and with compelling supporting documentation, no system should be permitted to maintain non-account water above 15 percent. The water loss report should be filed with Docket Control, as a compliance item in this docket, by no later than December 31, 2011."

A copy of that report is attached hereto as Exhibit FKS-RB8.

Q. WHAT DOES THE WATER LOSS REPORT CONCLUDE?

A. That report concludes that the Company's current efforts alone are not sufficient to reduce water losses below 10 percent (or, in some systems, 15 percent) as ordered by the Commission without extensive investments in replacement infrastructure.

Q. HAS STAFF PROPOSED AN ALTERNATIVE TO THE COMPANY'S PROPOSED DSIC?

A. Yes. Mr. Miclik proposed what Staff calls the Sustainable Water Loss Improvement Program or "SWIP" for short. Mr. Harris addresses the SWIP in his rebuttal testimony.

IV. <u>Utility Plant Pro Forma Adjustments</u>

Q. DO YOU AGREE WITH STAFF WITNESS MICHLIK'S RECOMMENDED ADJUSTMENT TO RETIRE MIAMI WELL NO. 17 IN THE SUPERSTITION SYSTEM?

A. No. The Company informed Staff witness Ms. Stukov that the Company plans to make the needed repairs to the Company's Miami Well No. 17. In fact, Well No. 17 is one of the Miami water system wells which the Company routinely uses to

provide Miami customers with safe, reliable and adequate water service, but the well needed to be repaired. A copy of the Company's request for bids to perform the required repairs to Well No. 17 is attached hereto as Exhibit FKS-RB9. Based on this information, Miami Well No. 17 cannot and should not be retired from service.

Q. WHAT IS THE STATUS OF MIAMI WELL NO. 17?

A. The well is in service and the Company is using this well to provide water service to its Miami customers. A copy of the Company's Construction Placed in Service Notice for Well No. 17 is attached hereto as Exhibit FKS-RB10 documenting that the required repairs have been completed.

Q. IS STAFF QUESTIONING THE NEED FOR THIS CRITICAL UTILITY PLANT?

A. No.

V. <u>Off-Site Facilities Fee</u>

Q. DO YOU AGREE WITH STAFF WITNESS MICHLIK'S RECOMMENDED OFF-SITE FACILITIES FEE OF $1500 FOR A 5/8 x 3/4-INCH METER?

A. No. The Company proposed a $3,500 Off-Site Facilities Fee, but the $1,500 fee proposed by Staff will prevent the Company from attaining the funds needed to construct the Superstition CAP Regional Surface Water Treatment Plant ("Superstition CAP Treatment Plant") when it is needed. The Superstition CAP Treatment Plant is critical to meeting the future water supply demands of the Company's customers with a long-term, cost effective, sustainable and renewable water supply. Without the necessary funds, the Company is unable to construct the facilities required to use its CAP water supplies in a timely manner, thereby causing the Company to rely more heavily upon groundwater, which is not sustainable. A lower fee will delay the construction of the facilities needed to utilize CAP water, thereby leading to construction cost increases and additional delays.

Staff has offered no evidence that the Company's proposed fee is not reasonable, and has not explained where water supplies will be added until the Superstition CAP Treatment Plant can be completed.

Q. DID THE COMPANY ESTIMATE THE COST OF CONSTRUCTING THE SUPERSTITION CAP TREATMENT PLANT?

A. Yes. As shown in Exhibit FKS-7, the Company estimated the Superstition CAP Treatment Plant Construction would cost $8.8 million if constructed today. By 2028, the year in which the Superstition CAP Treatment Plant construction is anticipated to be completed, the facility is projected to cost nearly $13.4 million. Therefore, the cost of construction used in determining the fee should be $13,384,000 as noted in Exhibit JDH-7 included in Mr. Harris' direct testimony.

Q. DOES THAT CONCLUDE YOUR REBUTTAL TESTIMONY?

A. Yes.

FKS-RB1

ARIZONA WATER COMPANY

PRELIMINARY COST ESTIMATE

DATE PREPARED:	PREPARED BY:	APPROVED BY:	SYSTEM:	DIVISION:
7/1/2011	MRL	FKS	SUPERSTITION	SUPERSTITION

PROJECT LOCATION:	PROJECT NUMBER:	REFERENCE MAP:

PROJECT DESCRIPTION:

SUPERSTITION DIVISION 10-YEAR INFRASTRUCTURE REPLACEMENT PLAN

MATERIALS AND LABOR

QUANTITY	UNIT	$/UNIT	DESCRIPTION	ESTIMATED ITEM COST
1,011	LF	$ 68	REPLACE 1910-1919 MAINS w/ 6" DIP	$ 68,748
860	LF	68	REPLACE 1920-1929 MAINS w/ 6" DIP	58,480
40,984	LF	68	REPLACE 1930-1939 MAINS w/ 6" DIP	2,786,912
5,903	LF	98	REPLACE 1930-1939 MAINS w/ 8" DIP	578,494
856	LF	128	REPLACE 1930-1939 MAINS w/ 12" DIP	109,568
51,333	LF	68	REPLACE 1940-1949 MAINS w/ 6" DIP	3,490,644
70,509	LF	68	REPLACE PROBLEMATIC MAINS 1950&NEWER W/ 6" DIP	4,794,612
2,350	EA	3,000	REPLACE SERVICES ON MAINS 1910-1949	7,050,000
4,250	EA	3,000	REPLACE PLASTIC SERVICES	12,750,000
				-
				-
				-
				-

(1) **SUBTOTAL - MATERIALS AND LABOR**	31,687,458
(2) PERFORMANCE BOND @ 1.5% OF LINE (1)	475,312
(3) SURVEY, R.O.W. PERMITTING, TESTING AND FIELD INSPECTION	2,218,122
(4) SUBTOTAL - LINES (1), (2) AND (3)	**$ 34,380,892**
(5) OVERHEAD - 15% OF LINE (4)	5,157,134
(6) PREPARATION OF DETAILED PLANS, SPECIFICATIONS & BIDDING DOCUMENTS	2,062,854
SUBTOTAL - LINES (4), (5) AND (6)	**$ 41,600,880**
ESTIMATED COST OF CONSTRUCTION	**$ 41,600,880**

AFH

FKS-RB2

ARIZONA WATER COMPANY

PRELIMINARY COST ESTIMATE

DATE PREPARED:
7/1/2011

PREPARED BY:	APPROVED BY:	SYSTEM:	DIVISION:
MRL	FKS	BISBEE	COCHISE

PROJECT LOCATION:	PROJECT NUMBER:	REFERENCE MAP:

PROJECT DESCRIPTION:

BISBEE WATER SYSTEM 10-YEAR INFRASTRUCTURE REPLACEMENT PLAN

MATERIALS AND LABOR

QUANTITY	UNIT	$/UNIT	DESCRIPTION	ESTIMATED ITEM COST
40,379	LF	$ 70	REPLACE 1900-1909 MAINS w/ 6" DIP	$ 2,826,530
3,153	LF	100	REPLACE 1900-1909 MAINS w/ 8" DIP	315,300
20,139	LF	130	REPLACE 1900-1909 MAINS w/ 12" DIP	2,618,070
21,701	LF	70	REPLACE 1910-1919 MAINS w/ 6" DIP	1,519,070
14,077	LF	70	REPLACE 1920-1929 MAINS w/ 6" DIP	985,390
6,731	LF	70	REPLACE 1930-1939 MAINS w/ 6" DIP	471,170
23,684	LF	70	REPLACE 1940-1949 MAINS w/ 6" DIP	1,657,880
58,551	LF	70	REPLACE PROBLEMATIC MAINS 1950&NEWER W/ 6" DIP	4,098,570
1,500	EA	2,000	REPLACE SERVICES ON MAINS 1900-1949	3,000,000
215	EA	2,000	REPLACE PLASTIC SERVICES	430,000
				-
				-
				-

(1) **SUBTOTAL - MATERIALS AND LABOR**	17,921,980
(2) PERFORMANCE BOND @ 1.5% OF LINE (1)	268,830
(3) SURVEY, R.O.W. PERMITTING, TESTING AND FIELD INSPECTION	1,254,539
(4) SUBTOTAL - LINES (1), (2) AND (3)	**$ 19,445,349**
(5) OVERHEAD - 15% OF LINE (4)	2,916,802
(6) PREPARATION OF DETAILED PLANS, SPECIFICATIONS & BIDDING DOCUMENTS	1,166,721
SUBTOTAL - LINES (4), (5) AND (6)	**$ 23,528,872**
ESTIMATED COST OF CONSTRUCTION	**$ 23,528,872**

AFH

FKS-RB3

ARIZONA WATER COMPANY

PRELIMINARY COST ESTIMATE

DATE PREPARED:
7/1/2011

PREPARED BY:	APPROVED BY:	SYSTEM:	DIVISION:
MRL	FKS	ORACLE	SAN MANUEL

PROJECT LOCATION:	PROJECT NUMBER:	REFERENCE MAP:

PROJECT DESCRIPTION:

ORACLE WATER SYSTEM 10-YEAR INFRASTRUCTURE REPLACEMENT PLAN

MATERIALS AND LABOR

QUANTITY	UNIT	$/UNIT	DESCRIPTION	ESTIMATED ITEM COST
10,689	LF	$ 55	REPLACE PROBLEMATIC MAINS 1950&NEWER W/ 6" DIP	$ 587,895
450	EA	1,750	REPLACE PLASTIC SERVICES	787,500
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-

(1) **SUBTOTAL - MATERIALS AND LABOR**	1,375,395
(2) PERFORMANCE BOND @ 1.5% OF LINE (1)	20,631
(3) SURVEY, R.O.W. PERMITTING, TESTING AND FIELD INSPECTION	96,278
(4) SUBTOTAL - LINES (1), (2) AND (3)	**$ 1,492,304**
(5) OVERHEAD - 15% OF LINE (4)	223,846
(6) PREPARATION OF DETAILED PLANS, SPECIFICATIONS & BIDDING DOCUMENTS	89,538
SUBTOTAL - LINES (4), (5) AND (6)	**$ 1,805,688**
ESTIMATED COST OF CONSTRUCTION	**$ 1,805,688**

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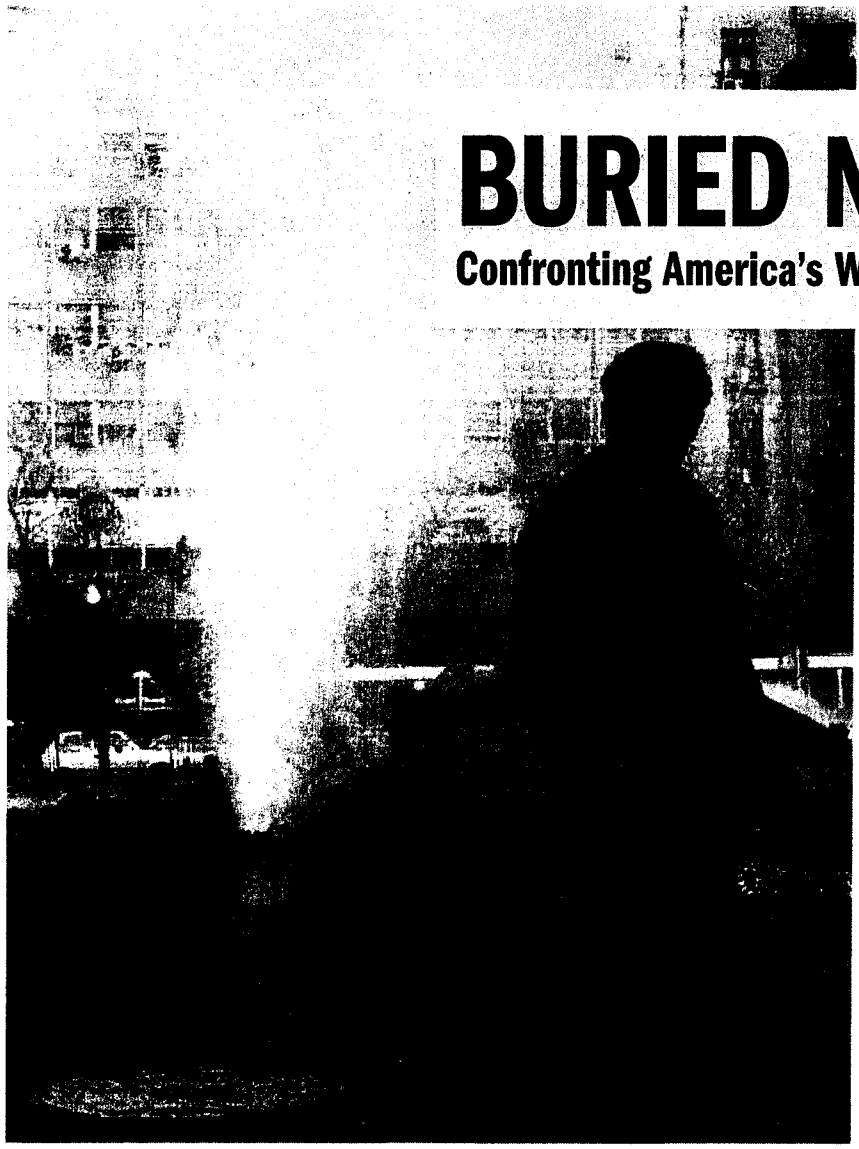
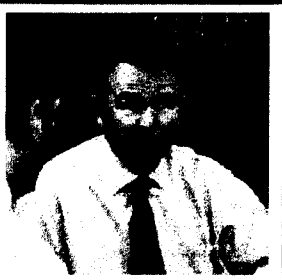
FKS-RB4

BURIED NO LONGER:

Confronting America's Water Infrastructure Challenge





American Water Works Association

The Authoritative Resource on Safe Water®

Acknowledgments

This report was developed by the American Water Works Association under the direction of its Water Utility Council, through Stratus Consulting in Boulder, Colorado. Significant portions of the analyses described in this report were initiated or developed by John Cromwell, who unfortunately passed away before this project was completed. John was a true visionary, a wonderful friend and colleague, and an ardent believer in promoting sound management of water system infrastructure. We hope this report does proper service to John's intent, integrity and passion. Special recognition is also due to Bob Raucher, who completed the work with great attention to detail, patience and outstanding professionalism.

Haydn Reynolds is the developer of the Nessie Model and managed all the empirical investigations in this report. His continued engagement in the development of this report has been exemplary, as has been his willingness to address the many questions involved in the transition of the final report preparation from John Cromwell to Bob Raucher and others at Stratus Consulting. Finally, but not least, a number of AWWA utility members did significant work on this project, including Dave Rager (who chairs the Water Utility Council), Mike Hooker (who was WUC chair when the report was initiated), Aurel Arndt (who chairs the advisory work group on this project), and Joe Bella, John Sullivan, Richard Talley, Robert Walters, and Dave Weihrauch, all of whom made significant contributions as members of the advisory work group.

Project Funding

Funding for this project was provided by the Water Industry Technical Action fund (WITAF). WITAF is funded through AWWA organizational member dues. It supports activities, information, and analysis to advance sound and effective drinking water legislation, regulation and policy.

Introduction. A new kind of challenge is emerging in the United States, one that for many years was largely buried in our national consciousness. Now it can be buried no longer. Much of our drinking water infrastructure, the more than one million miles of pipes beneath our streets, is nearing the end of its useful life and approaching the age at which it needs to be replaced. Moreover, our shifting population brings significant growth to some areas of the country, requiring larger pipe networks to provide water service.

As documented in this report, restoring existing water systems as they reach the end of their useful lives and expanding them to serve a growing population will cost at least $1 trillion over the next 25 years, if we are to maintain current levels of water service. Delaying the investment can result in degrading water service, increasing water service disruptions, and increasing expenditures for emergency repairs. Ultimately we will have to face the need to "catch up" with past deferred investments, and the more we delay the harder the job will be when the day of reckoning comes.

In the years ahead, all of us who pay for water service will absorb the cost of this investment, primarily through higher water bills. The amounts will vary depending on community size and geographic region, but in some communities these infrastructure costs alone could triple the size of a typical family's water bills. Other communities will need to collect significant "impact" or development fees to meet the needs of a growing population. Numerous communities will need to invest for replacement **and** raise funds to accommodate growth at the same time. Investments that may be required to meet new standards for drinking water quality will add even more to the bill.

Although the challenge to our water infrastructure has been less visible than other infrastructure concerns, it's no less important. Our water treatment and delivery systems provide public health protection, fire protection, economic prosperity and the high quality of life we enjoy. Yet most Americans pay less than $3.75 for every 1,000 gallons of safe water delivered to their taps.

This report demonstrates that as a nation, we need to bring the conversation about water infrastructure above ground. Deferring needed investments today will only result in greater expenses tomorrow and pass on a greater burden to our children and grandchildren. It's time to confront America's water infrastructure challenge.

The Era of Infrastructure Replacement. More than a decade ago the American Water Works Association (AWWA) announced that a new era was dawning: the replacement era, in which our nation would need to begin rebuilding the water and wastewater systems bequeathed to us by earlier generations. Our seminal report—*Dawn of the Replacement Era*—demonstrated that significant investments will be required in coming decades if we are to maintain the water and wastewater systems that are so essential to our way of life.

The *Dawn* report examined 20 water systems, using a relatively new technique to build what came to be called a "Nessie Curve" for each system. The Nessie Curve, so called because the graph follows an outline that someone likened to a silhouette of the Loch Ness Monster, revealed that each of the 20 water systems faced unprecedented needs to rebuild its underground water infrastructure—its pipe network. For each system, the future investment was an "echo" of the demographic history of the community, reflecting succeeding generations of pipe that were laid down as the community grew over many years. Most of those generations of pipe were shown to be coming to an end of their useful service lives in a relatively compressed period. Like the pipes themselves, the need for this massive investment was mostly buried and out of sight. But it threatens our future if we don't elevate it and begin to take action now.

The present report was undertaken to extend the *Dawn* report beyond those 20 original cities and encompass the entire United States. The results are startling. They confirm what every water utility professional knows: we face the need for massive reinvestment in our water infrastructure over the coming decades. The pipe networks that were largely built and paid for by earlier generations—and passed down to us as an inheritance—last a long time, but they are not immortal. The nation's drinking water infrastructure—especially the underground pipes that deliver safe water to America's homes and businesses—is aging and in need of significant reinvestment. Like many of the roads, bridges, and other public assets on which the country relies, most of our buried drinking water infrastructure was built 50 or more years ago, in the post-World War II era of rapid demographic change and economic growth. In some older urban areas, many water mains have been in the ground for a century or longer.

Given its age, it comes as no surprise that a large proportion of US water infrastructure is approaching, or has already reached, the end of its useful life. The need to rebuild these pipe networks must come on top of other water investment needs, such as the need to replace water treatment plants and storage tanks, and investments needed to comply with standards for drinking water quality. They also come on top of wastewater and stormwater investment needs which—judging from the US Environmental Protection Agency's (USEPA) most recent "gap analysis"—are likely to be as large as drinking water needs over the coming decades. Moreover, both water and wastewater infrastructure needs come on top of the other vital community infrastructures, such as streets, schools, etc.

Prudent planning for infrastructure renewal requires credible, analysis-based estimates of where, when, and how much pipe replacement or expansion for growth is required. This report summarizes a comprehensive and robust national-level analysis of the cost, timing, and location of the investments necessary to renew water mains over the coming decades. It also examines the additional pipe investments we can anticipate to meet projected population growth, regional population shifts, and service area growth through 2050.

This analysis is based on the insight that there will be "demographic echoes" in which waves of reinvestment are driven by a combination of the original patterns of pipe investment, the pipe materials used, and local operating environments. The report examines the reinvestment demands implied by these factors, along with population trends, in order to estimate needs for pipe replacement and concurrent investment demands to accommodate population growth.

Although this report does not substitute for a careful and detailed analysis at the utility level as a means of informing local decisions, it constitutes the most thorough and comprehensive analysis ever undertaken of the nation's drinking water infrastructure renewal needs. The keys to our analysis include the following:

1. Understanding the original timing of water system development in the United States.
2. Understanding the various materials from which pipes were made, and where and when the pipes of each material were likely to have been installed in various sizes.
3. Understanding the life expectancy of the various types and sizes of pipe ("pipe cohorts") in actual operating environments.
4. Understanding the replacement costs for each type and size of pipe.
5. Developing a probability distribution for the "wear-out" of each pipe cohort.

Methodology

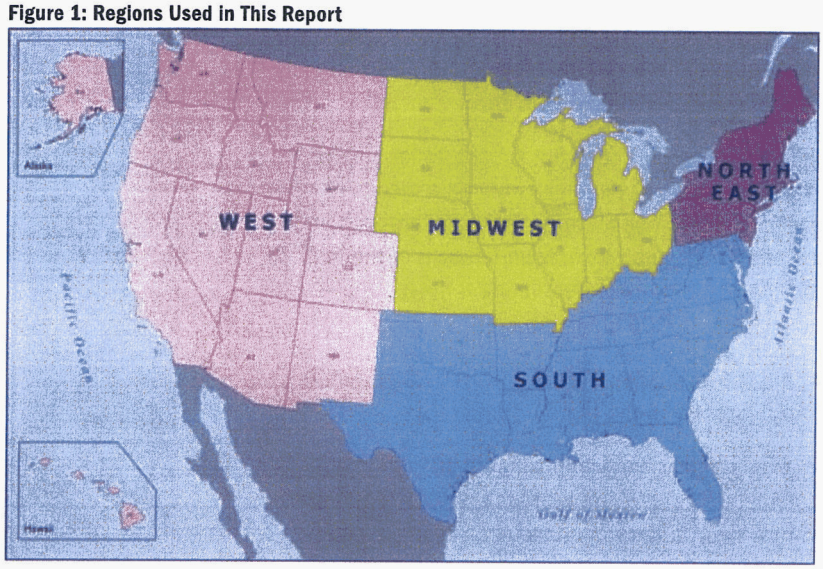
For this report, we differentiated across four water system size categories*:

- Very small systems (serving fewer than 3,300 people, representing 84.5% of community water systems).
- Small systems (3,300 to 9,999 served, representing 8.5% of community water systems).
- Medium-size systems (10,000 to 49,999 served, representing over 5.5% of systems). And,
- Large systems (serving more than 50,000 people, representing 1.5% of community water systems).

** Note that the water system size categories used in this analysis are not identical to the size categories USEPA uses for regulatory purposes. Note also that although data were analyzed based on these four size categories, some of the graphs that accompany this report combine medium-size and small systems. This is done for simplicity in the visual presentation, when the particular dynamics being represented are closely similar for medium-size and small systems.*

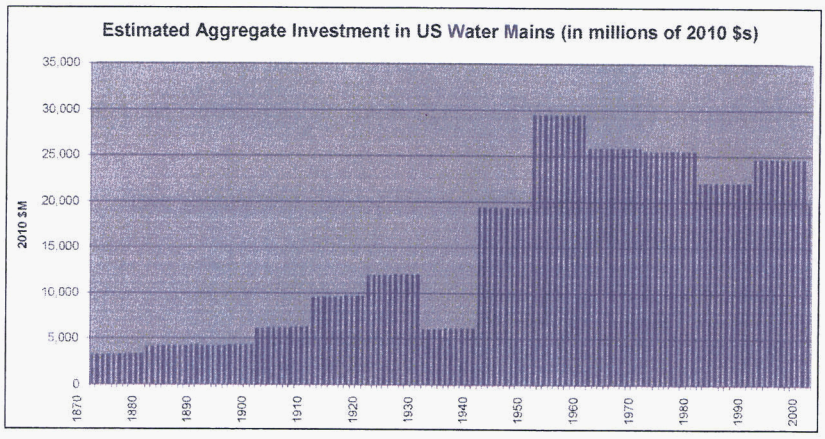
Next, we divided the country into four regions (Northeast, Midwest, South, and West), as shown in Figure 1. These regions are not equal in population, but they roughly share certain similarities, including their population dynamics and the

Figure 1: Regions Used in This Report



historical patterns of pipe installation driven by those dynamics. Data published by USEPA, the water industry, and the US Census Bureau were tapped to obtain a solid basis for regional pipe installation profiles by system size and pipe diameter. The US Census Bureau has produced a number of retrospective studies of the changes in urban and rural circumstances between 1900 and 2000 that proved especially useful in this analysis. The report also used the AWWA Water/Stats database, the USEPA Community Water Supply Survey, and data from the 2002 Public Works Infrastructure Survey (PWIS) as essential inputs in the analysis.

Figure 2: Historic Investment Profile for All US Water Systems, 1850-2000



In addition, we conducted a limited survey of professionals in the field concerning pipe replacement issues and other relevant "professional knowledge." The national aggregate for the original investment in all types and sizes of pipes is shown in Figure 2, while Figure 3 shows the aggregate current replacement value of water pipes by pipe material and utility size, totaling over $2.1 trillion.

Figure 3: Aggregate Replacement Value of Water Pipes by Pipe Material and Utility Size (millions 2010 $s)

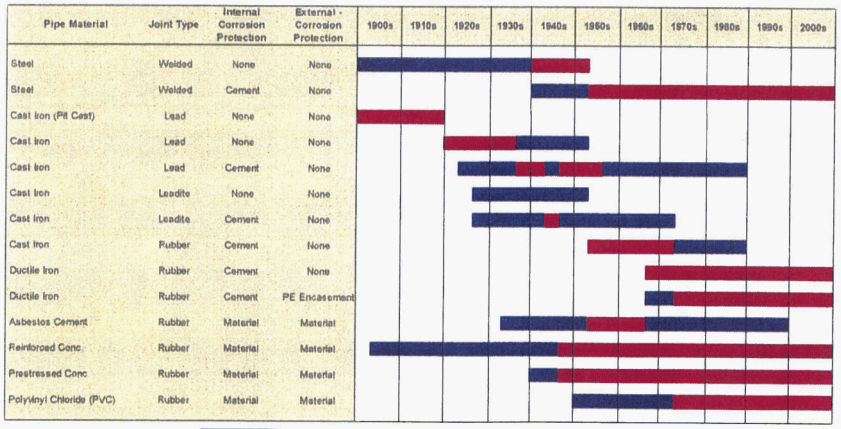
Region	CI	CICL	DI	AC	PV	Steel	PCCP	TOTAL
Northeast Large	48,958	8,995	5,050	2,308	1,875	335	0	67,522
Northeast Medium & Small	66,357	61,755	28,777	26,007	16,084	5,533	6,899	211,411
Northeast Very Small	14,491	15,992	10,661	7,281	7,937	329	462	57,152
Midwest Large	37,413	9,151	3,077	2,504	1,098	784	512	54,539
Midwest Medium & Small	74,654	92,106	51,577	37,248	30,506	8,682	11,152	305,925
Midwest Very Small	37,597	28,943	25,464	12,428	19,720	601	828	125,581
Southeast Large	30,425	28,980	29,569	21,229	14,936	9,337	7,227	141,703
South Medium & Small	54,772	98,608	140,079	103,659	102,804	21,394	17,160	538,475
South Very Small	43,183	24,998	49,791	34,529	47,823	1,461	1,244	203,028
West Large	15,448	16,055	28,949	14,774	14,723	7,443	6,215	103,607
West Medium & Small	15,775	50,145	70,355	50,541	48,885	12,276	9,806	257,782
West Very Small	16,344	11,199	17,910	13,166	17,245	545	453	76,862
Total	455,416	446,927	461,258	325,674	323,637	68,719	61,957	2,143,589

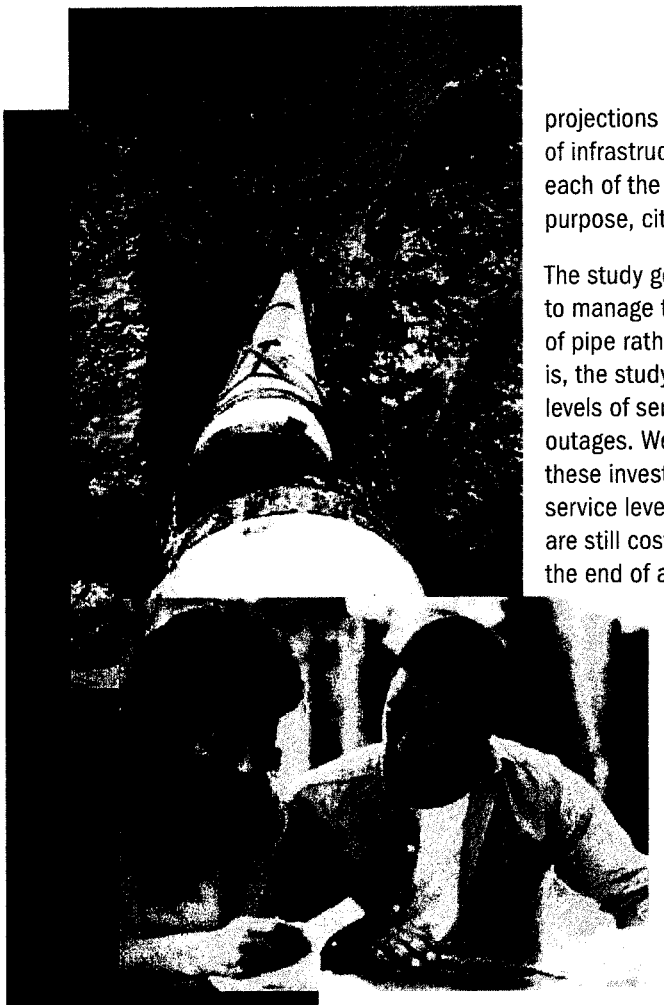
CI: cast iron; CICL: cast iron cement lined; DI: ductile iron; AC: asbestos cement; PV: polyvinyl chloride; PCCP: prestressed concrete cylinder pipe

Finally, we used historical data on the production and use of seven major types of pipe with 14 total variations (Figure 4) to estimate what kinds of pipe were installed in water systems in particular years. This was validated by field checking with a sample of water utilities as well as checking against the original Nessie analysis. Together these steps resulted in the development of 16 separate inventories (four regions with four utility sizes in each region), with seven types of pipe in each inventory, *thus providing the most comprehensive picture of the nation's water pipe inventory ever assembled.* Note that in some of the report's graphs, "long-" and "short-lived" versions of certain pipe materials are combined, for purposes of visual simplicity in the presentation.

In order to consider growth, it was also necessary to examine population trends across rural, suburban, and urban settings over the past century. US Census Bureau

Figure 4: Historic Production and Use of Water Pipe by Material





projections of demographic trends allowed the development of infrastructure need profiles for growth through 2050 in each of the regions and utility size categories (for the latter purpose, city size was used as a proxy for utility size).

The study generally assumes that utilities continue efforts to manage the number of main breaks that occur per mile of pipe rather than absorb increases in pipe failures. That is, the study assumes utilities will strive to maintain current levels of service rather than allow increasing water service outages. We assume that each utility's objective is to make these investments at the optimal time for maintaining current service levels and to avoid replacing pipes while the repairs are still cost-effective. Ideally, pipe replacement occurs at the end of a pipe's "useful life"; that is, the point in time when replacement or rehabilitation becomes less expensive in going forward than the costs of numerous unscheduled breaks and associated emergency repairs.

With this data in hand and using the assumptions above, we projected the "typical" useful service life of the pipes in our inventory using the "Nessie Model"™. The model embodies pipe failure probability distributions based on many utilities' current operating experiences, coupled with insights from extensive research and professional experiences with typical pipe conditions at different ages and sizes, according to pipe material. The analysis used seven different types of pipe in three diameters and addressed pipe inventories dating back to 1870. Estimated typical service lives of pipes are

Figure 5: Average Estimated Service Lives by Pipe Materials (average years of service)

Derived Current Service Lives (Years)	CI	CICL (LSL)	CICL (SSL)	DI (LSL)	DI (SSL)	AC (LSL)	AC (SSL)	PVC	Steel	Conc & PCCP
Northeast Large	**130**	**120**	**100**	**110**	**50**	**80**	**80**	**100**	**100**	**100**
Midwest Large	125	120	85	110	50	100	85	55	80	105
South Large	**110**	**100**	**100**	**105**	**55**	**100**	**80**	**55**	**70**	**105**
West Large	115	100	75	110	60	105	75	70	95	75
Northeast Medium & Small	**115**	**120**	**100**	**110**	**55**	**100**	**85**	**100**	**100**	**100**
Midwest Medium & Small	125	120	85	110	50	70	70	55	80	105
South Medium & Small	**105**	**100**	**100**	**105**	**55**	**100**	**80**	**55**	**70**	**105**
West Medium & Small	105	100	75	110	60	105	75	70	95	75
Northeast Very Small	**115**	**120**	**100**	**120**	**60**	**100**	**85**	**100**	**100**	**100**
Midwest Very Small	135	120	85	110	60	80	75	55	80	105
South Very Small	**130**	**110**	**100**	**105**	**55**	**100**	**80**	**55**	**70**	**105**
West Very Small	130	100	75	110	60	105	65	70	95	75

LSL indicates a relatively long service life for the material resulting from some combination of benign ground conditions and evolved laying practices etc.
SSL indicates a relatively short service life for the material resulting from some combination of harsh ground conditions and early laying practices, etc.

Figure 6: Aggregate Needs for Investment in Water Mains Through 2035 and 2050, by Region

2011-2035 Totals			
(2010 $M)	Replacement	Growth	Total
Northeast	$92,218	$16,525	$108,744
Midwest	$146,997	$25,222	$172,219
South	$204,357	$302,782	$507,139
West	$82,866	$153,756	$236,622
Total	**$526,438**	**$498,285**	**$1,024,724**

2011-2050 Totals			
(2010 $M)	Replacement	Growth	Total
Northeast	$155,101	$23,200	$178,301
Midwest	$242,487	$36,755	$279,242
South	$394,219	$492,493	$886,712
West	$159,476	$249,794	$409,270
Total	**$951,283**	**$802,242**	**$1,753,525**

reflected in Figure 5. Note that the *actual* lives of pipes may be quite different in a given utility. Because pipe life depends on many important local variables as well as upon utility practices, predicting the actual life expectancy of any given pipe is outside the scope of this study. Many utilities will have pipes that last much longer than these values suggest while others will have pipes that begin to fail sooner. However, these values have been validated as national "averages" by comparing them to actual field experience in a number of utilities throughout the country. The model also includes estimates of the indicative costs to replace each size category of pipe, as well as the cost to repair the projected number of pipe breaks over time according to pipe size.

The analysis of pipe replacement needs is compiled in the Nessie Model by combining the demographically based pipe inventories with the projected effective service lifetimes for each pipe type. This yields an estimate of how much pipe of each size in each region must be replaced in each of the coming 40 years. Factoring in the typical cost to replace these pipes, we derive an estimate of the total investment cost for each future year. The model then derives a series of graphs (the Nessie curves) that depict the amount of spending required in each future year to replace each of the different pipe types by utility size and region. Aggregating this information, we derived the dollar value of total drinking water infrastructure replacement needs over the coming 25 and 40 years for each utility size category per region, and for the United States.

Key Findings

1. The Needs Are Large. *Investment needs for buried drinking water infrastructure total more than $1 trillion nationwide over the next 25 years,* assuming pipes are replaced at the end of their service lives and systems are expanded to serve growing populations. Delaying this investment could mean either increasing rates of pipe breakage and deteriorating water service, or suboptimal use of utility funds, such as paying more to repair broken pipes than the long-term cost of replacing them. Nationally, the need is close to evenly divided between replacement due to wear-out and needs generated by demographic changes (growth and migration).

Over the coming 40-year period, *through 2050, these needs exceed $1.7 trillion.* Replacement needs account for about 54% of the national total, with about 46% attributable to population growth and migration over that period.

Figure 6 (previous page) shows aggregate needs for investment in water mains through 2050, due to wear-out and population growth.

2. Household Water Bills Will Go Up. Important caveats are necessary here, because there are many ways that the increased investment in water infrastructure can be allocated among customers. Variables include rate structures, how the investment is financed, and other important local factors. But the level of investment required to replace worn-out pipes and maintain current levels of water service *in the most affected communities could in some cases triple household water bills.* This projection assumes the costs are spread evenly across the population in a "pay-as-you-go" approach (See "The Costs Keep Coming" below). Figures 7 and 8 illustrate the increasing cost of water that can be expected by households for replacement, and for replacement plus growth, respectively. The utility categories shown in these figures are presented to depict a range of household cost impacts, from the least-to-the-most affected utilities.

Figure 7: Costs per Household for Water Main Replacement by Utility Size and Region

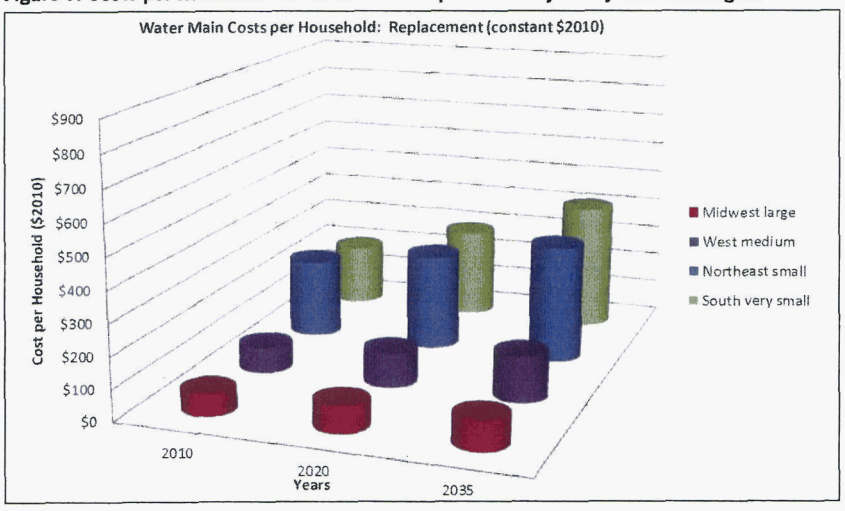
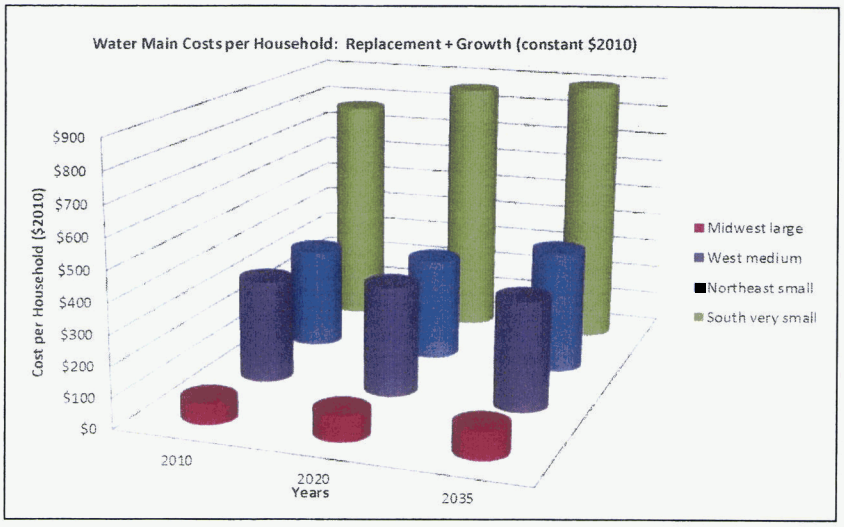


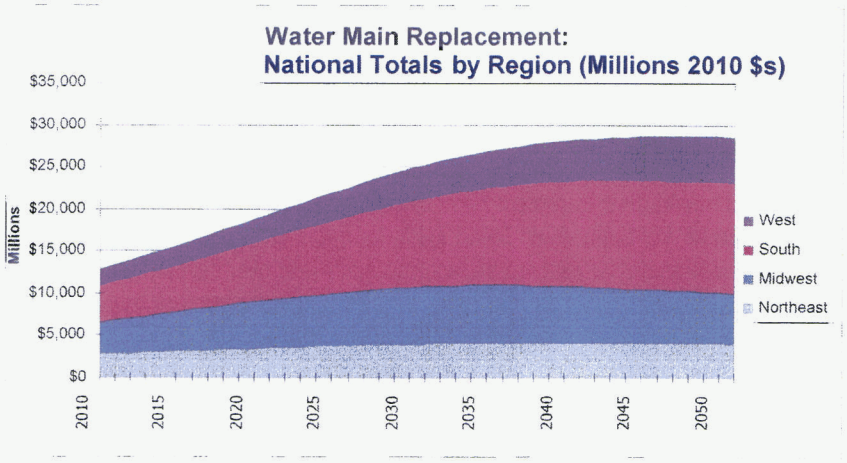
Figure 8: Costs per Household for Water Main Replacement Plus Growth



With respect to the cost of growth, other caveats are important. Many communities expect growth to pay or help pay for itself through developer fees, impact fees, or similar charges. In such communities, established residents will not be required to shoulder the cost of population growth to the extent that these fees recover those costs. *But regardless of how the costs of replacement and growth are allocated among builders, newcomers, or established residents, the total cost that must be borne by the community will still rise.*

3. There Are Important Regional Differences. The growing national need affects different regions in different ways. In general, the South and the West will face the steepest investment challenges, with total needs accounting for considerably more than half the national total (see Figures 6 and 9). This is largely attributable to the fact that the population of these regions is growing rapidly. In contrast, in the Northeast and Midwest, growth is a relatively small component of the projected need. However, the population shifts away from these regions complicate the infrastructure challenge, as there are fewer remaining local customers across whom to spread the cost of renewing their infrastructure.

Figure 9: Water Main Replacement Costs per Region



This regional perspective reveals the inherent difficulty of managing infrastructure supply and demand. Although water pipes are fixed in place and long-lasting, the population that drives the demand for these assets is very mobile and dynamic. People move out of one community, leaving behind a pipe network of fixed size but with fewer customers to support it. They move into a new community, requiring that the water system there be expanded to serve the new customers.

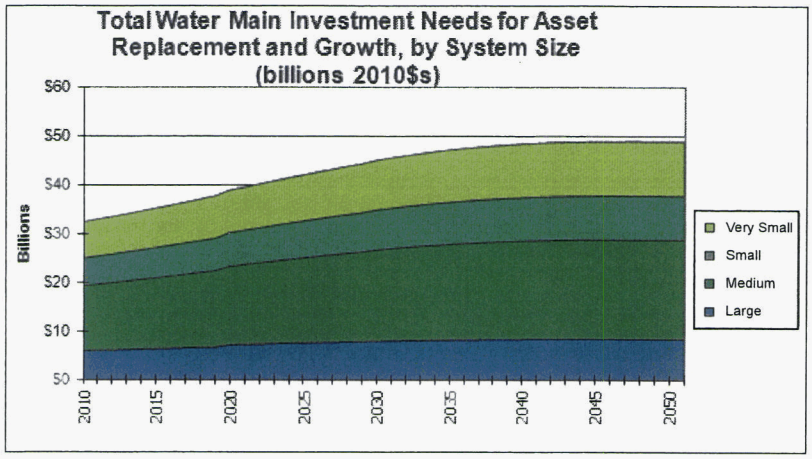
4. There Are Important Differences Based on System Size.

As with many other costs, *small communities may find a steeper challenge ahead on water infrastructure.* Small communities have fewer people, and those people are often more spread out, requiring more pipe "miles per customer" than larger systems. In the most affected small communities, the study suggests that a typical three-person household could see its drinking water bill increase by as much as $550 per year above current levels, simply to address infrastructure needs, depending as always on the caveats identified above.

In the largest water systems, costs can be spread over a large population base. Needed investments would be consistent with annual per household cost increases ranging from roughly $75 to more than $100 per year by the mid-2030s, assuming the expenses were spread across the population in the year they were incurred. Figure 10 illustrates the differing total costs of required investment by system size.

5. The Costs Keep Coming. The national-level investment we face will roughly double from about $13 billion a year in 2010 to almost $30 billion annually by the 2040s for replacement alone. If growth is included, needed investment must increase from a little over $30 billion today to nearly $50 billion over the same period. This level of investment must then be sustained for many years, if current levels of water service are to be maintained. *Many utilities will have to face these investment needs year after year, for at least several decades.* That is, by the time the last cohort of pipes analyzed in this study (predominantly the pipes laid between the late 1800s and 1960) has been replaced in, for example, 2050, it may soon thereafter be time to begin replacing the pipes laid after 1960, and so on. In that respect, these capital outlays are unlike those required to build a new treatment plant or storage tank, where the capital costs are incurred up front and aren't faced again for many years. Rather, infrastructure renewal investments are likely to be incurred each year over several decades. For that reason, *many utilities may choose to finance infrastructure replacement on a "pay-as-you-go" basis rather than through debt financing.*

Figure 10: Total Water Main Replacement and Growth Needs by System Size



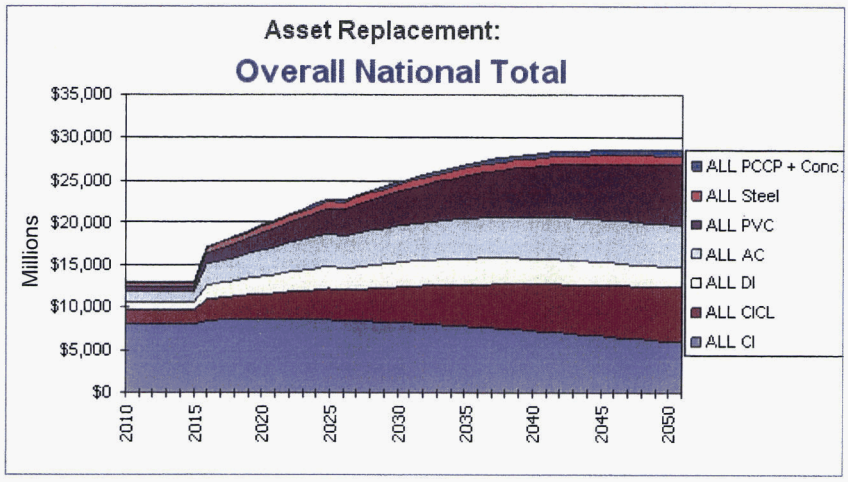
6. Postponing Investment Only Makes the Problem Worse.

Overlooking or postponing infrastructure renewal investments in the near term will only add to the scale of the challenge we face in the years to come. Postponing the investment steepens the slope of the investment curve that must ultimately be met, as shown in Figure 11 (next page). It also increases the odds of facing the high costs associated with water main breaks and other infrastructure failures. The good news is that *not all of the $1 trillion investment through 2035 must be made right now.* There is time to make suitable plans and implement policies that will help address the longer-term challenge. The bad news is that the required investment level is growing, as more pipes continue to age and reach the end of their effective service lives.

As daunting as the figures in this report are, the prospect of not making the necessary investment is even more chilling. Aging water mains are subject to more frequent breaks and other failures that can threaten public health and safety (such as compromising tap water quality and fire-fighting flows). Buried infrastructure failures also may impose significant damages (for example, through flooding and sinkholes), are costly to repair, disrupt businesses and residential communities, and waste precious water resources. These maladies weaken our economy and undermine our quality of life. As large as the cost of reinvestment may be, **not** undertaking it will be worse in the long run by almost any standard.

This suggests that a crucial responsibility for utility managers now and in the future is to develop the processes necessary to continually improve their understanding of the "replacement dynamics" of their own water systems. Those dynamics should be reflected in an Asset Management Plan (AMP) and, of course, in a long-term capital investment plan. The 2006 AWWA Report *Water Infrastructure at a Turning Point* includes a full discussion of this issue.

Figure 11: Effect of Deferring Investment Five Years with a Ten-Year Make-Up Period



Conclusion

Because pipe assets last a long time, water systems that were built in the latter part of the 19th century and throughout much of the 20th century have, for the most part, never experienced the need for pipe replacement on a large scale. The dawn of the era in which these assets will need to be replaced puts a growing financial stress on communities that will continually increase for decades to come. It adds large and hitherto unknown expenses to the more apparent above-ground spending required to meet regulatory standards and address other pressing needs.

It is important to reemphasize that there are significant differences in the timing and magnitude of the challenges facing different regions of the country and different sizes of water systems. But the investments we describe in this report are real, they are large, and they are coming.

The United States is reaching a crossroads and faces a difficult choice. We can incur the haphazard and growing costs of living with aging and failing drinking water infrastructure. Or, we can carefully prioritize and undertake drinking water infrastructure renewal investments to ensure that our water utilities can continue to reliably and cost-effectively support the public health, safety, and economic vitality of our communities. AWWA undertook this report to provide the best, most accurate information available about the scale and timing of these needed investments.

It is clear the era AWWA predicted a decade ago—the replacement era—has arrived. The issue of aging water infrastructure, which was buried for years, can be buried no longer. Ultimately, the cost of the renewal we face must come from local utility customers, through higher water rates. However, the magnitude of the cost and the associated affordability and other adverse impacts on

communities—as well as the varying degrees of impact to be felt across regions and across urban and rural areas—suggest that there is a key role for states and the federal government as well. In particular, states and the federal government can help with a careful and cost-effective program that lowers the cost of necessary investments to our communities, such as the creation of a credit support program—for example, AWWA's proposed Water Infrastructure Finance and Innovation Authority (WIFIA).

Finally, in many cases, difficult choices may need to be made between competing needs if water bills are to be kept affordable. Water utilities are willing to ask their customers to invest more, but it's important this investment be in things that bring the greatest actual benefit to the community. Only in that spirit can we achieve the goal to which we all aspire, the reliable provision of safe and affordable water to all Americans.

Additional Information and Resources.

A full and robust infrastructure analysis is an indispensable tool for decision making by water and wastewater utilities. This report does not substitute for such detailed local analysis for purposes of designing an infrastructure asset management program for individual utilities.

Additional information is available from AWWA concerning asset management. Particular attention should be given to the WITAF reports *Dawn of the Replacement Era, Avoiding Rate Shock, Thinking Outside the Bill* and *Water Infrastructure at a Turning Point.* In addition, Manual M1, *Principles of Water Rates, Fees, and Charges,* and the AWWA Utility Management Standards may be helpful. For more information, visit the AWWA Bookstore at **www.awwa.org/store.**

A number of graphs and figures from this report are also available through the AWWA website at **www.awwa.org/infrastructure.** They include:

Estimated Distribution of Mains by Material
Northeast and Midwest
South and West

Proportion of 2010 Systems Built by Year
Northeast
Midwest
South
West

Investment for Replacement Plus Growth, by Region and Size of Utility

Northeast
Large
Medium
Small
Very Small

Midwest
Large
Medium
Small
Very Small

South
Large
Medium
Small
Very Small

West
Large
Medium
Small
Very Small

Household Cost of Needed Investment by Region and Size of Utility

Northeast
Large
Medium
Small
Very Small

Midwest
Large
Medium
Small
Very Small

South
Large
Medium
Small
Very Small

West
Large
Medium
Small
Very Small

www.awwa.org/infrastructure

Estimated Distribution of Mains by Material Over Time
Northeast & Midwest Regions

	CI	CICL (LSL)	CICL (SSL)	DI (LSL)	DI (SSL)	AC (LSL)	AC (SSL)	PVC	CI	CICL (LSL)	CICL (SSL)	DI (LSL)	DI (SSL)	AC (SSL)	AC (LSL)	PVC	CI	CICL (LSL)	CICL (SSL)	DI (LSL)	AC (LSL)	Steel	Conc & PCCP
	<6 inch diameter								6-10 inch diameter								>10 inch diameter						
1870	100%								100%								100%						
1880	100%								100%								100%						
1890	100%								100%								100%						
1900	100%								100%								100%						
1910	100%								100%								100%						
1920	100%								100%								100%						
1930	50%	30%	20%						50%	30%	20%						50%	30%	20%				
1940	20%	60%	20%						20%	60%	20%						20%	40%	20%			20%	
1950		60%				20%	20%			60%				20%	20%			40%			10%	20%	30%
1960		50%			10%	20%	20%			50%			10%	20%	20%			35%		5%	10%	20%	30%
1970		20%			40%			40%		20%			40%			40%				50%		20%	30%
1980				25%	30%			45%				25%	35%			40%				60%		15%	25%
1990				50%	5%			45%				50%	5%			45%				60%		15%	25%
2000				55%				45%				55%				45%				60%		15%	25%
2010				55%				45%				55%				45%				60%		15%	25%
2020				55%				45%				55%				45%				60%		15%	25%
2030				55%				45%				55%				45%				60%		15%	25%

Steel and PCCP pipe not in widespread use in sizes under 10 inches.

CI: cast iron; CICL: cast iron cement lined; DI: ductile iron; AC: asbestos cement; PV: polyvinyl chloride; PCCP: prestressed concrete cylinder pipe

The regions are combined because they share similar dynmaics for this distribution.

Note:
"LSL" indicates a relatively long service life for the material resulting from some combination of benign ground conditions and evolved laying practices etc.

"SSL" indicates a relatively short service life for the material resulting from some combination of harsh ground conditions and early laying practices etc.

Estimated Distribution of Mains by Material Over Time
South & West Regions

	CI	CICL (LSL)	CICL (SSL)	DI (LSL)	DI (SSL)	AC (LSL)	AC (SSL)	PVC	CI	CICL (LSL)	CICL (SSL)	DI (LSL)	DI (SSL)	AC (LSL)	AC (SSL)	PVC	CI	CICL (LSL)	CICL (SSL)	DI (LSL)	AC (LSL)	Steel	Conc & PCCP
	<6 inch diameter								6-10 inch diameter								>10 inch diameter						
1870	100%								100%								100%						
1880	100%								100%								100%						
1890	100%								100%								100%						
1900	100%								100%								100%						
1910	100%								100%								100%						
1920	100%								100%								100%						
1930	50%	30%	20%						50%	30%	20%						50%	30%	20%				
1940		70%	30%							70%	30%							50%	30%			20%	
1950		25%				40%	35%			25%				40%	35%			40%			15%	25%	20%
1960		25%		2%	3%	40%	30%			25%		2%	3%	40%	30%			40%		5%	10%	25%	20%
1970		10%		10%	10%	40%		30%		10%		10%	10%	40%		30%				45%	10%	25%	20%
1980				25%	25%			50%				30%	30%			40%				60%		20%	20%
1990				45%	5%			50%				50%	5%			45%				60%		20%	20%
2000				50%				50%				50%				50%				60%		20%	20%
2010				50%				50%				50%				50%				60%		20%	20%
2020				50%				50%				50%				50%				60%		20%	20%
2030				50%				50%				50%				50%				60%		20%	20%

Steel and PCCP pipe not in widespread use in sizes under 10 inches.

CI: cast iron; CICL: cast iron cement lined; DI: ductile iron; AC: asbestos cement; PV: polyvinyl chloride; PCCP: prestressed concrete cylinder pipe

The regions are combined because they share similar dynmaics for this distribution.

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"LSL" indicates a relatively long service life for the material resulting from some combination of benign ground conditions and evolved laying practices etc.

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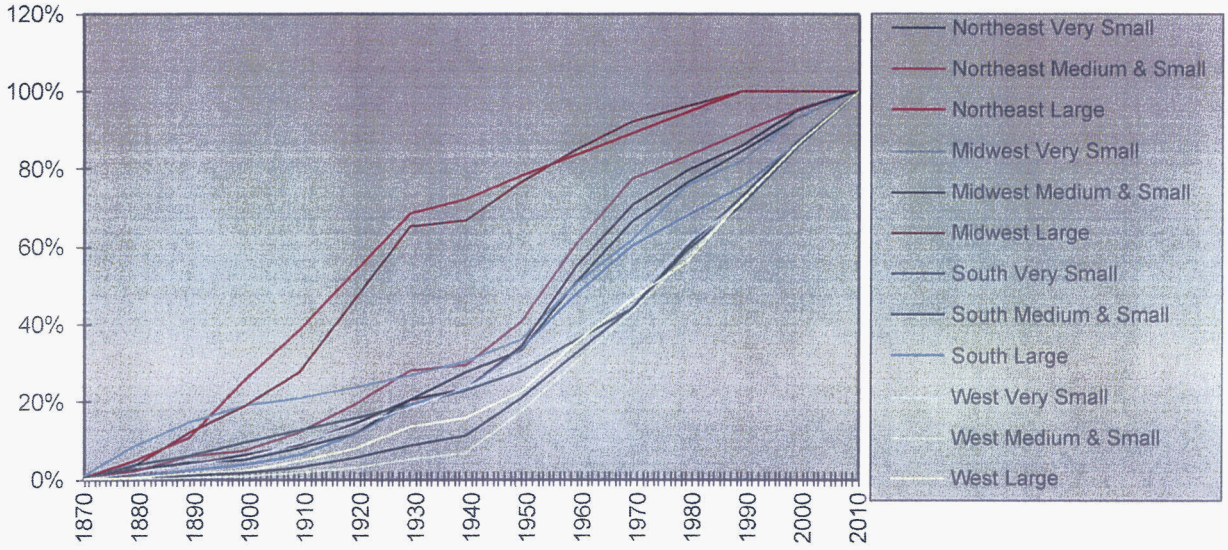
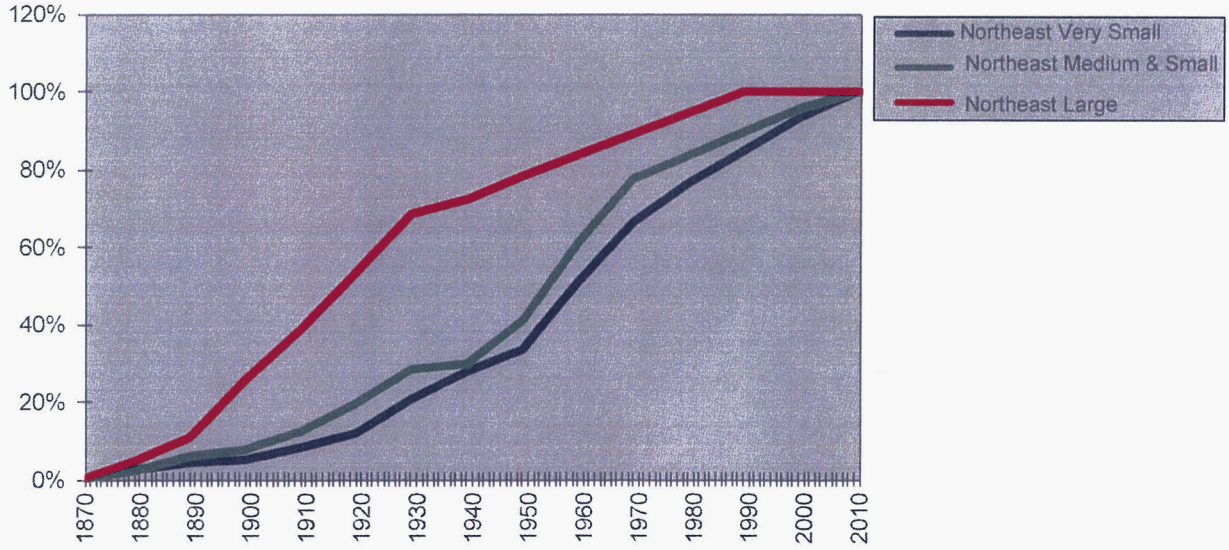
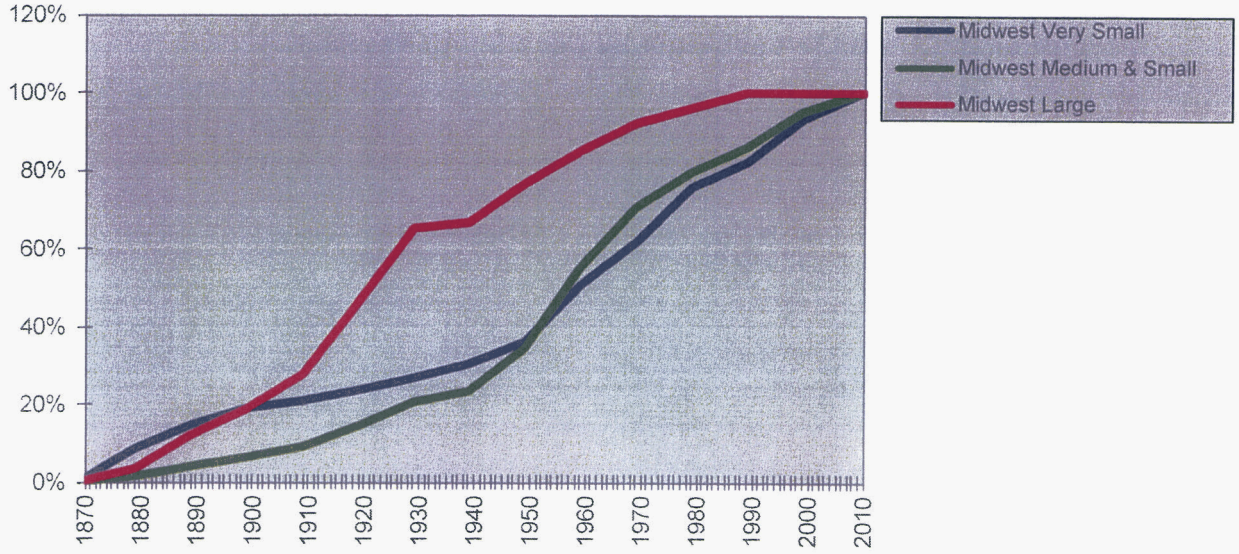
Proportion of Current System Built by Decade: All Regions



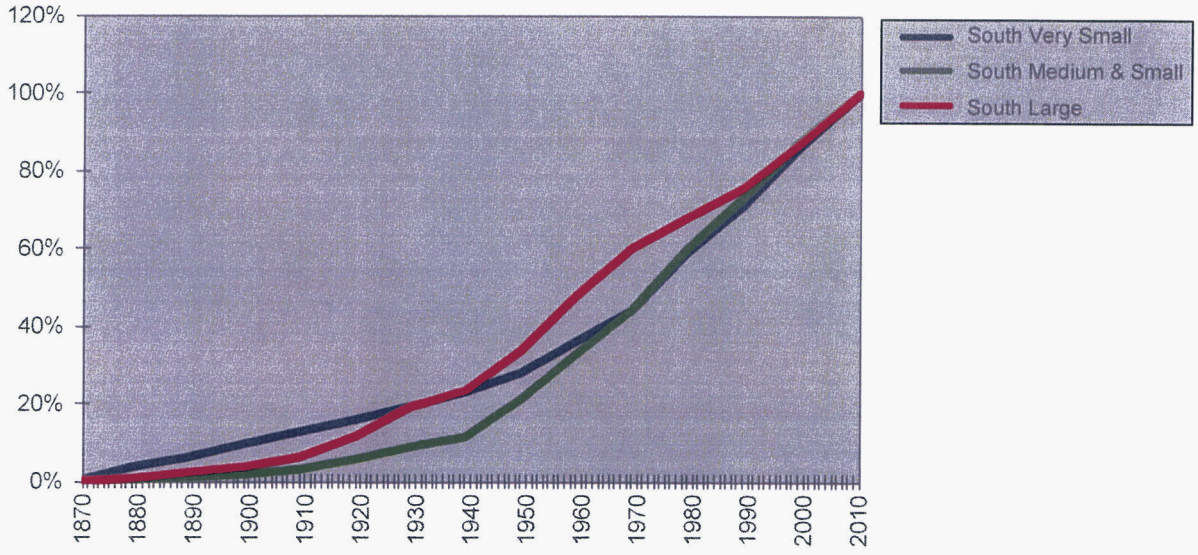
Proportion of Current System Built by Decade: Northeast



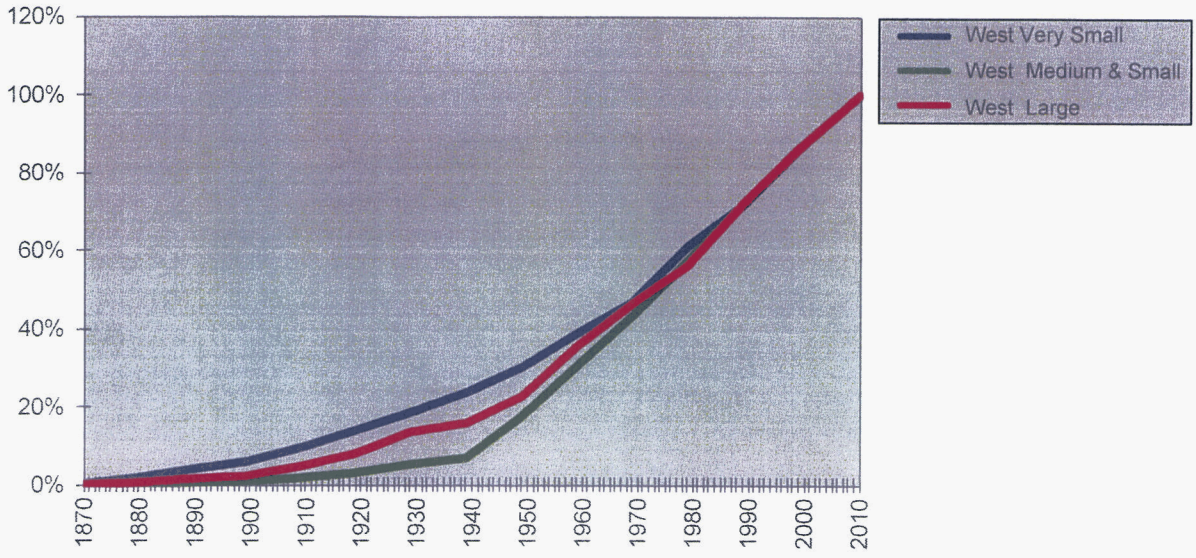
Proportion of Current System Built by Decade: Midwest

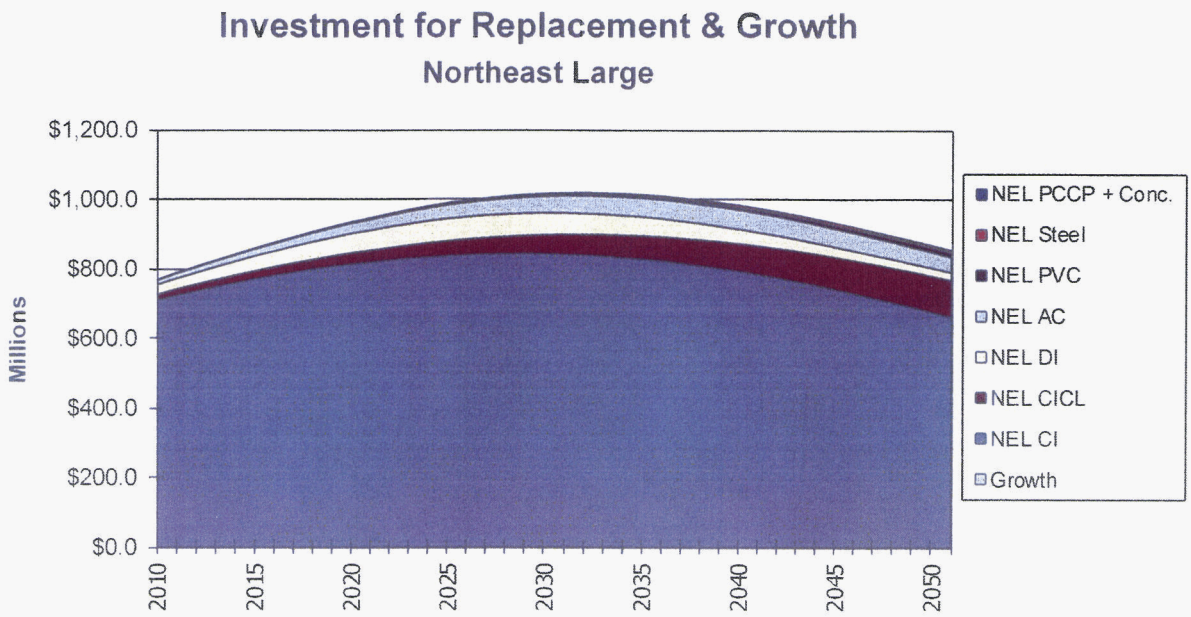


Proportion of Current System Built by Decade: South



Proportion of Current System Built by Decade: South





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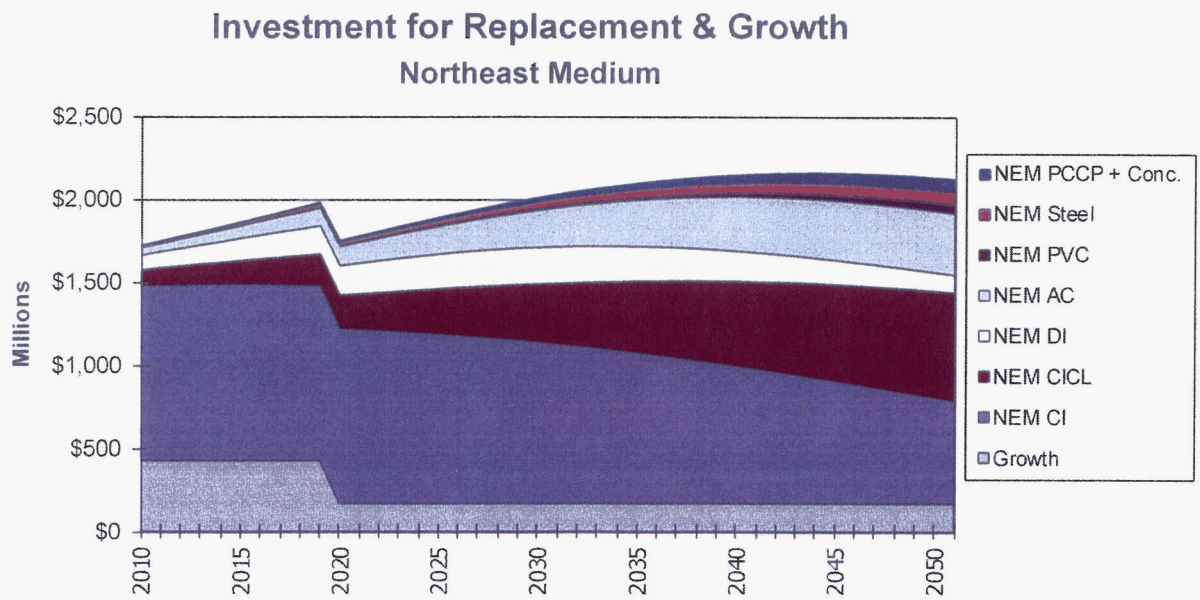

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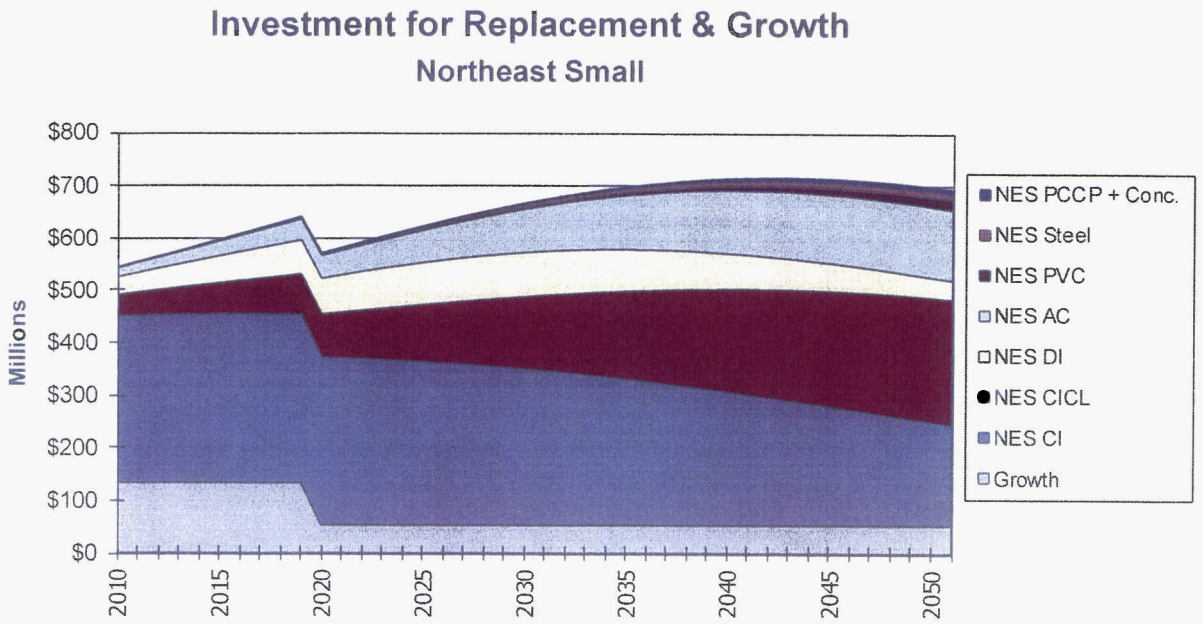
The charts show needs for replacement of particular types of pipe and for growth (see the keys below and to the right of the chart). An artifact of the model and US Census data result in an apparent upward or downward "spike" in growth-related needs between certain decades. In reality, the apparent sudden shift in growth-related needs will be spread more evenly over the years bridging each decade to the next.



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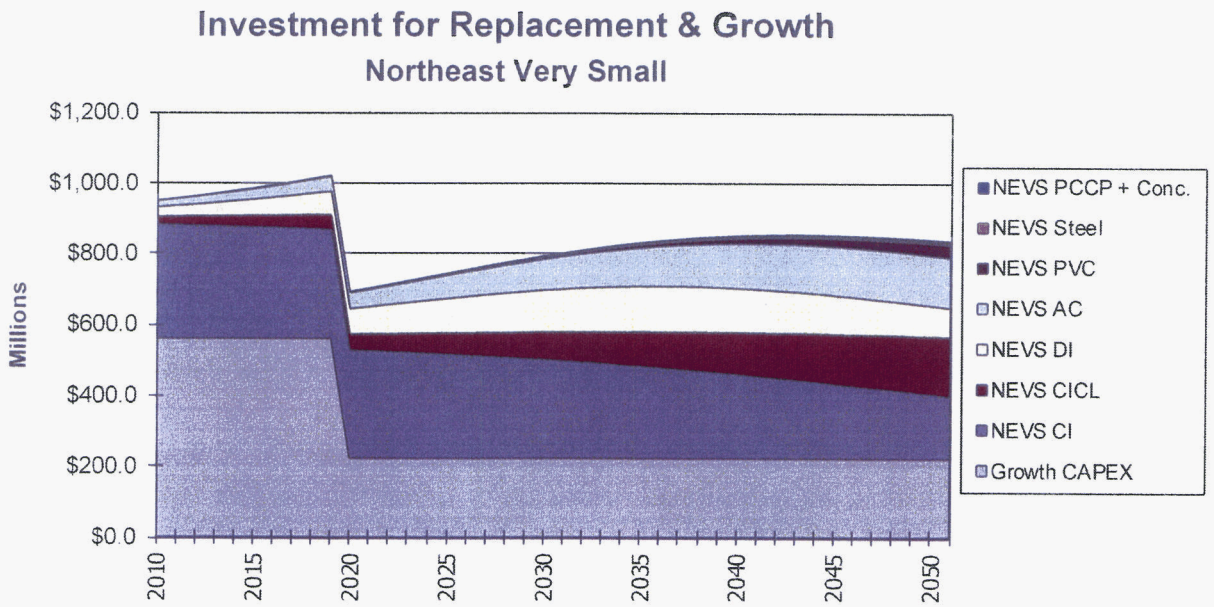

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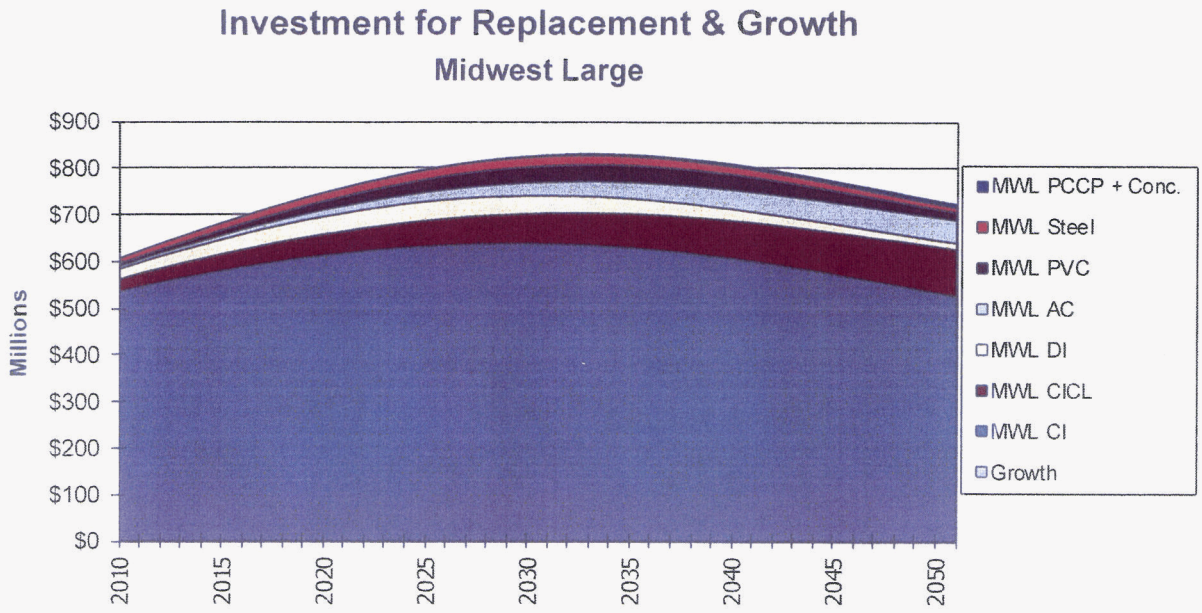

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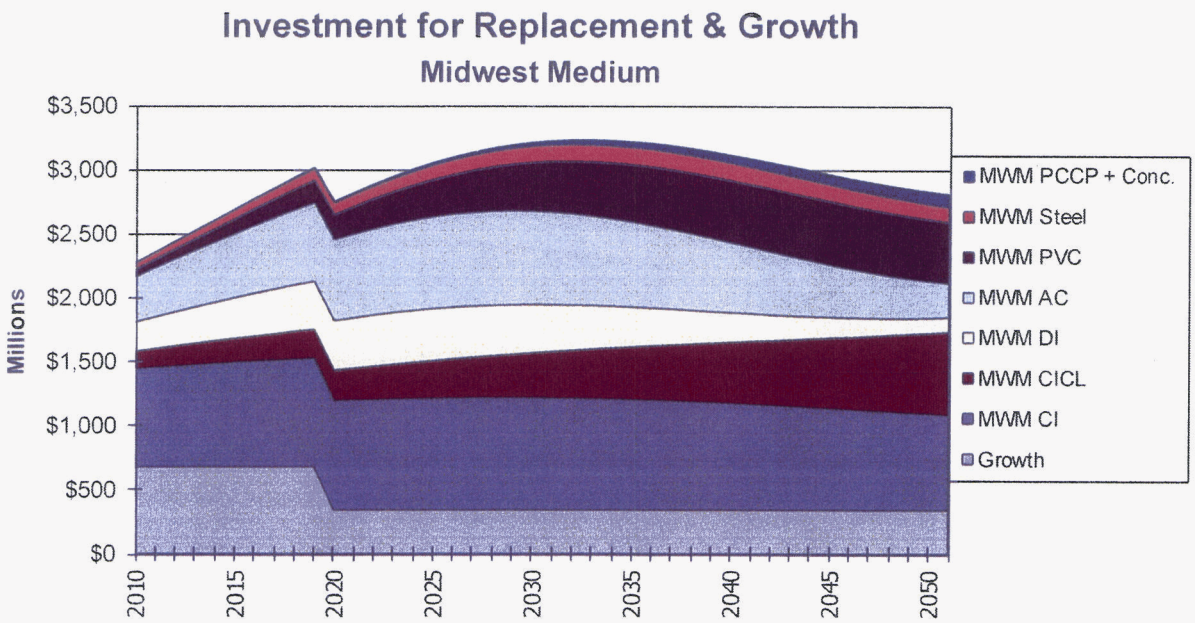

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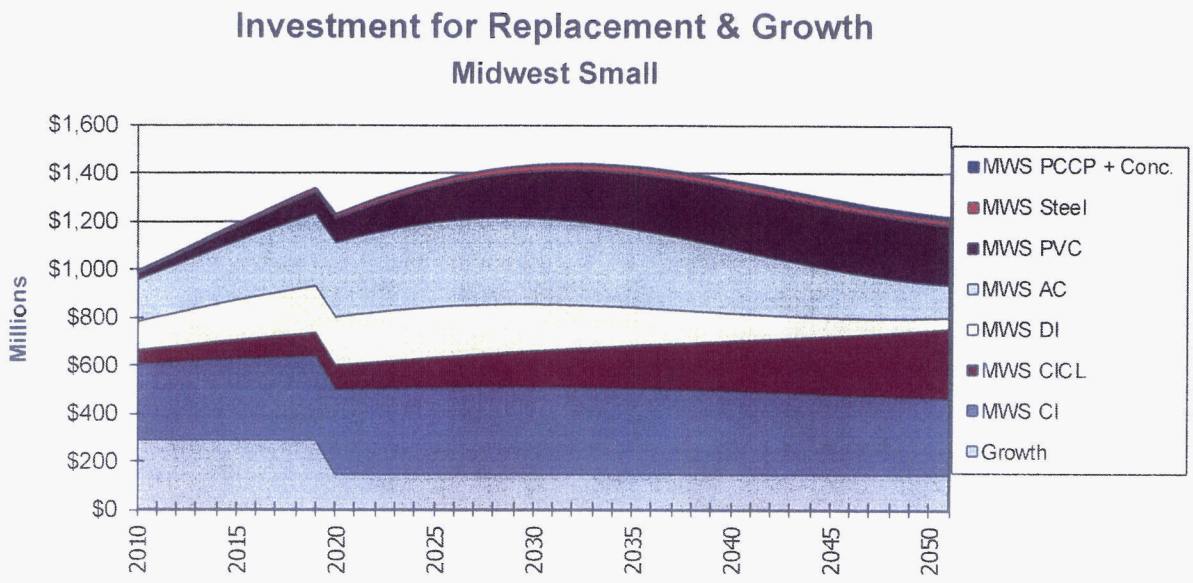

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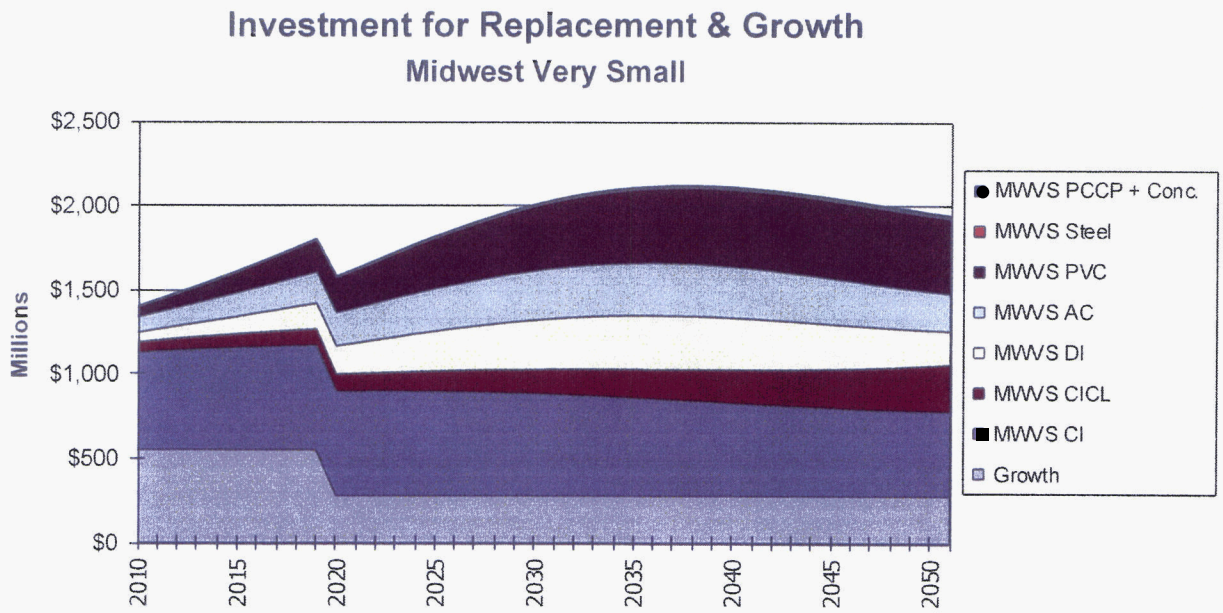

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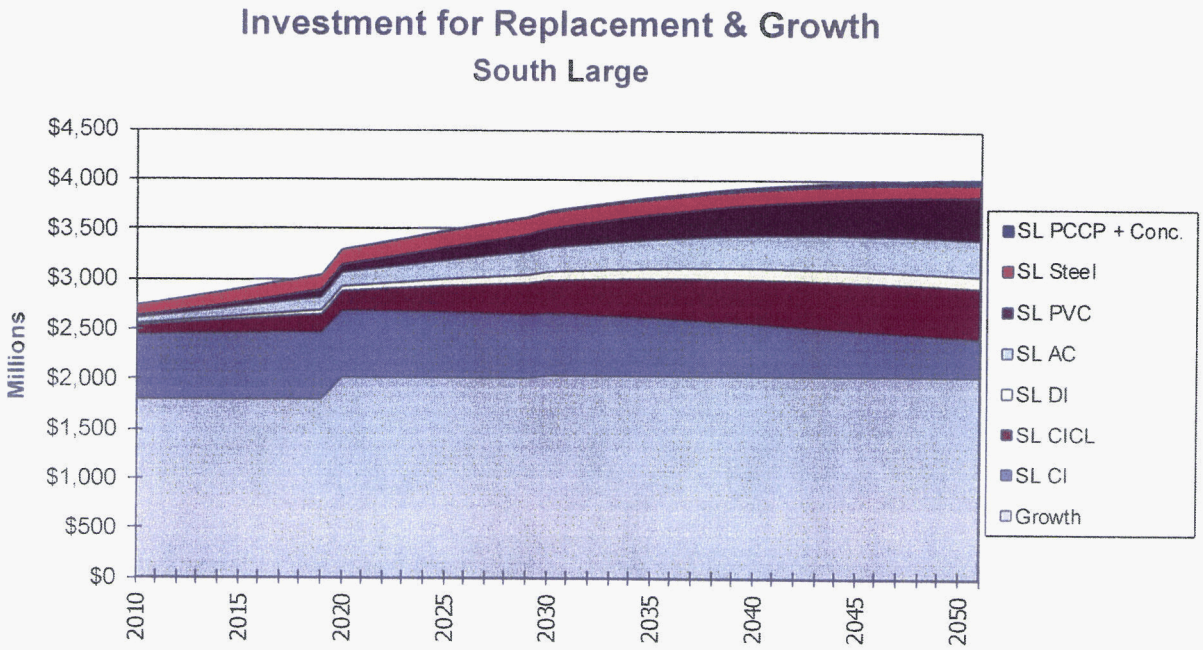

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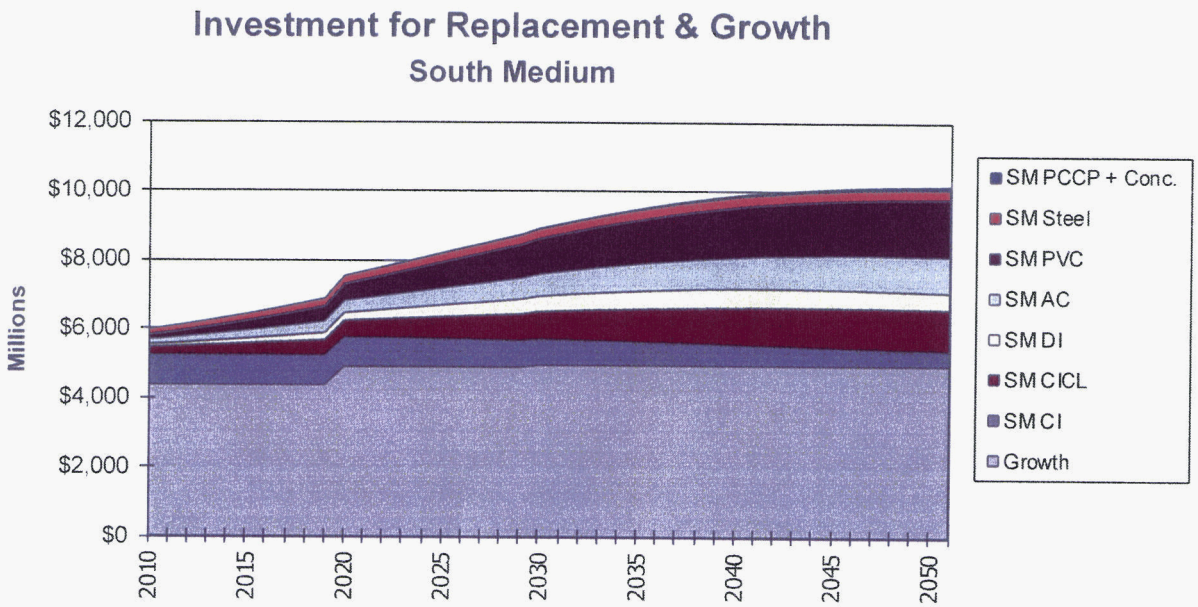

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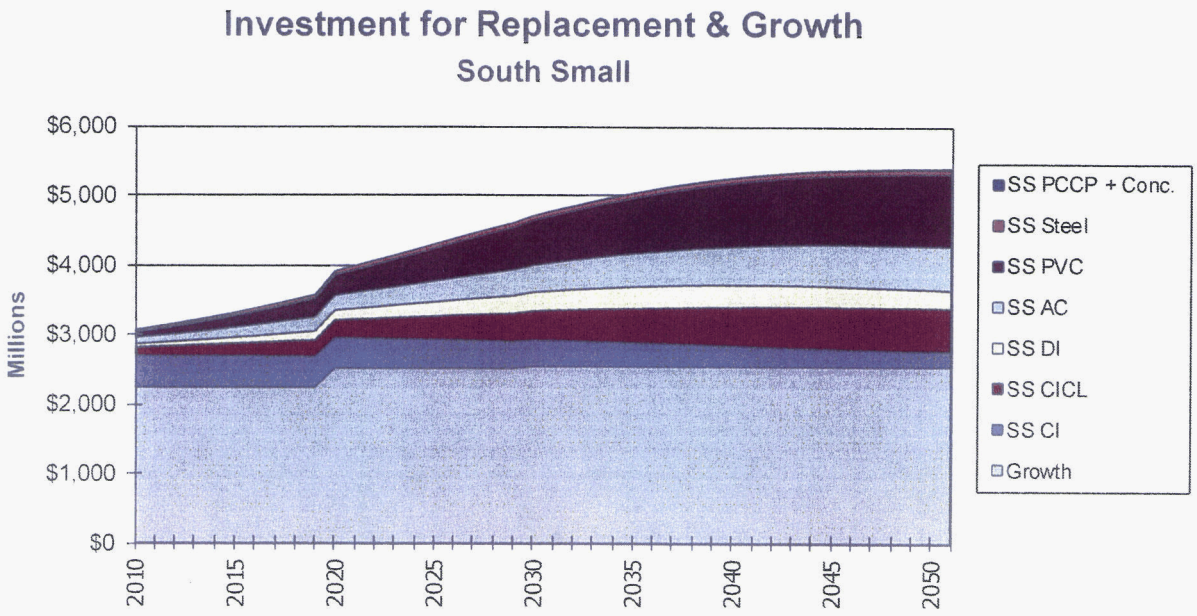

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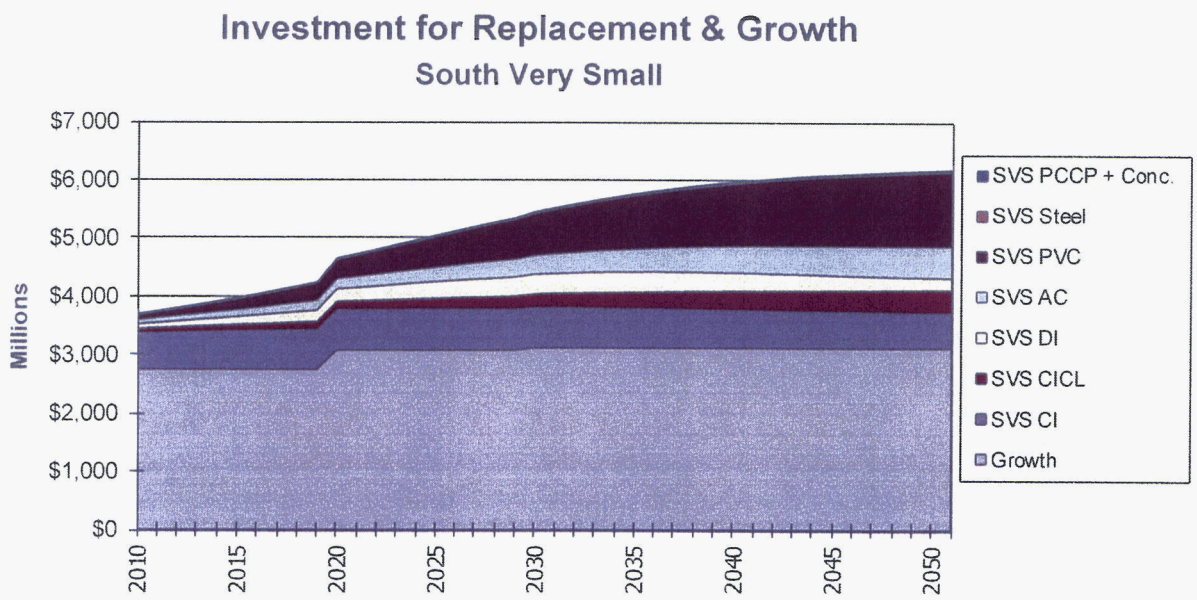

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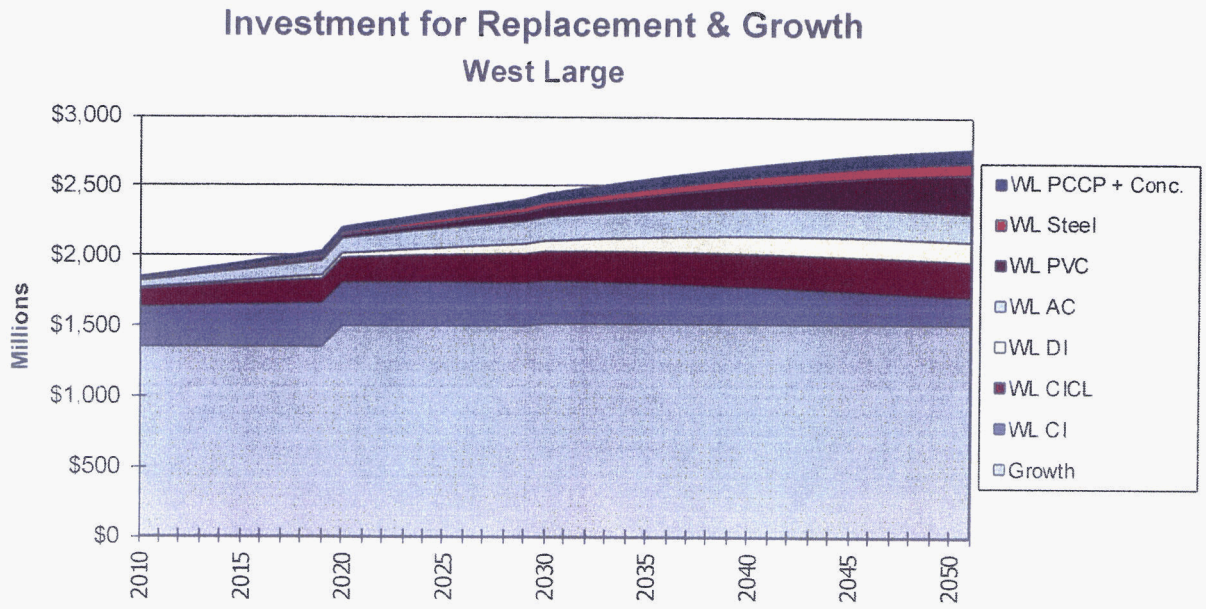

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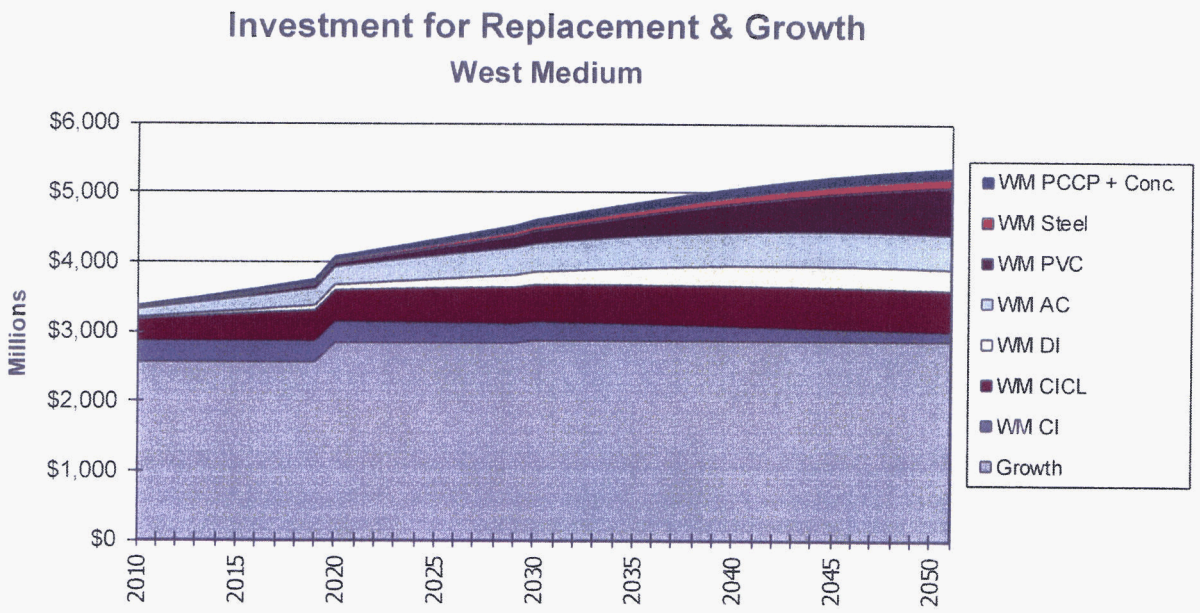

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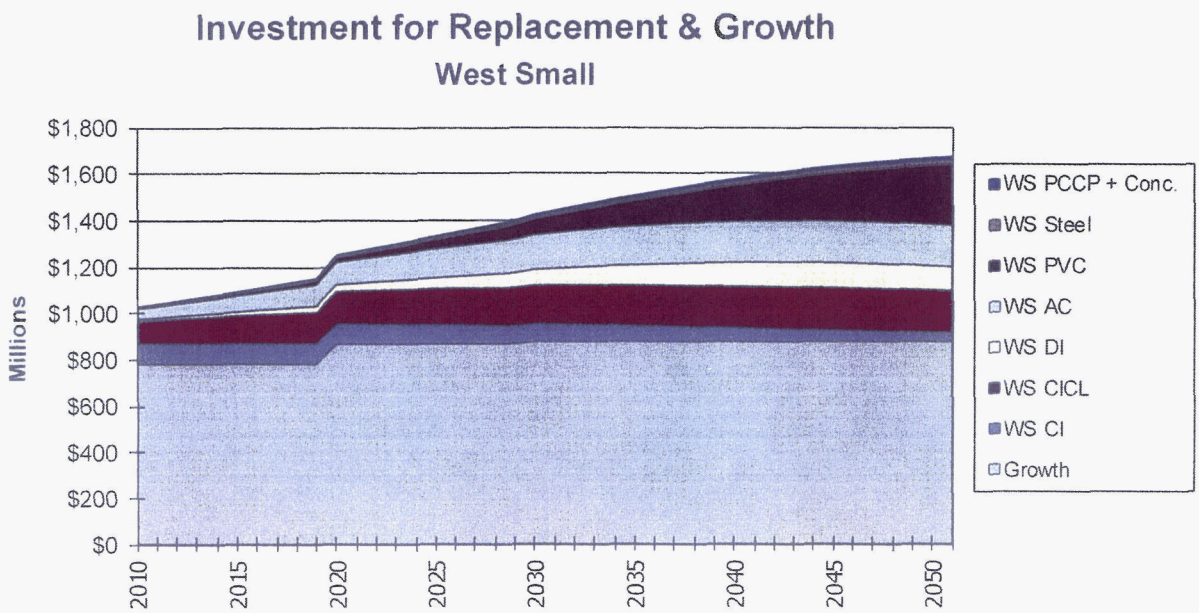

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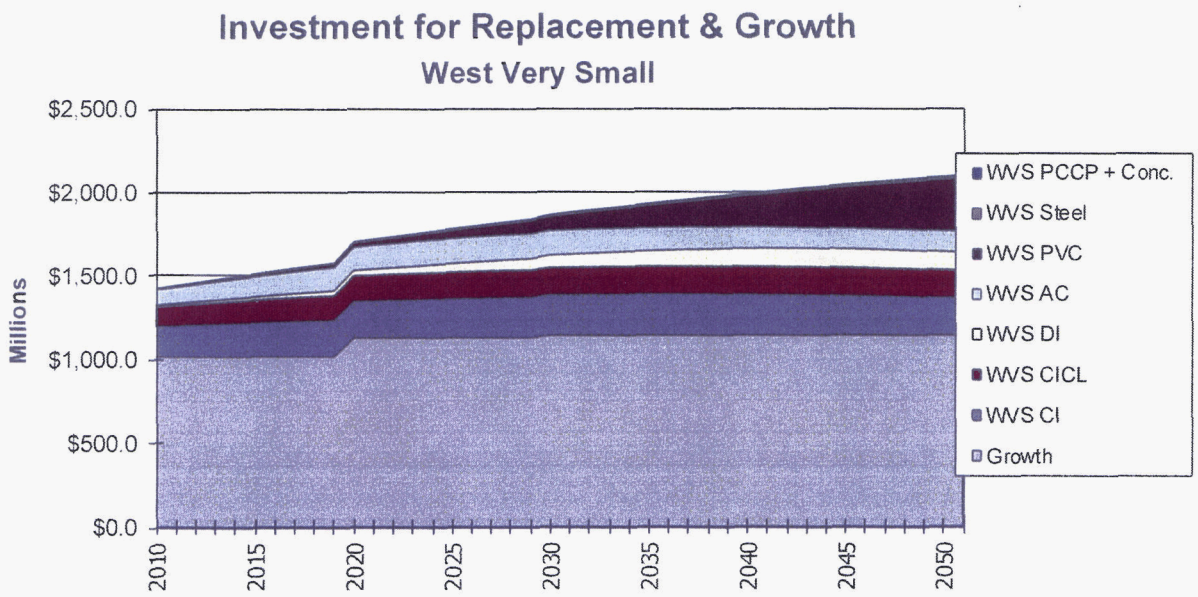

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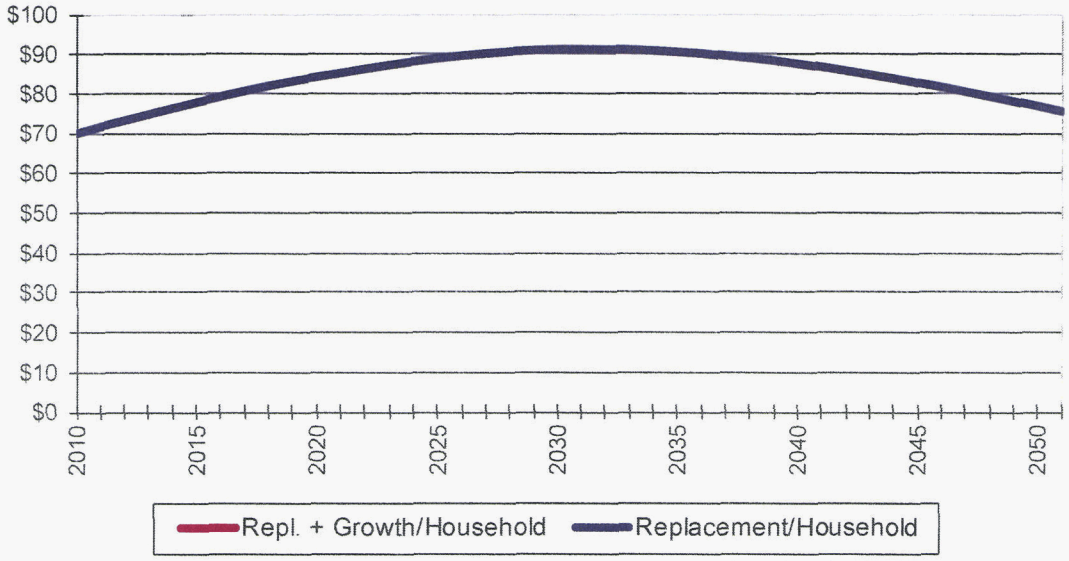
Household Cost of Needed Investment for Replacement Plus Growth*

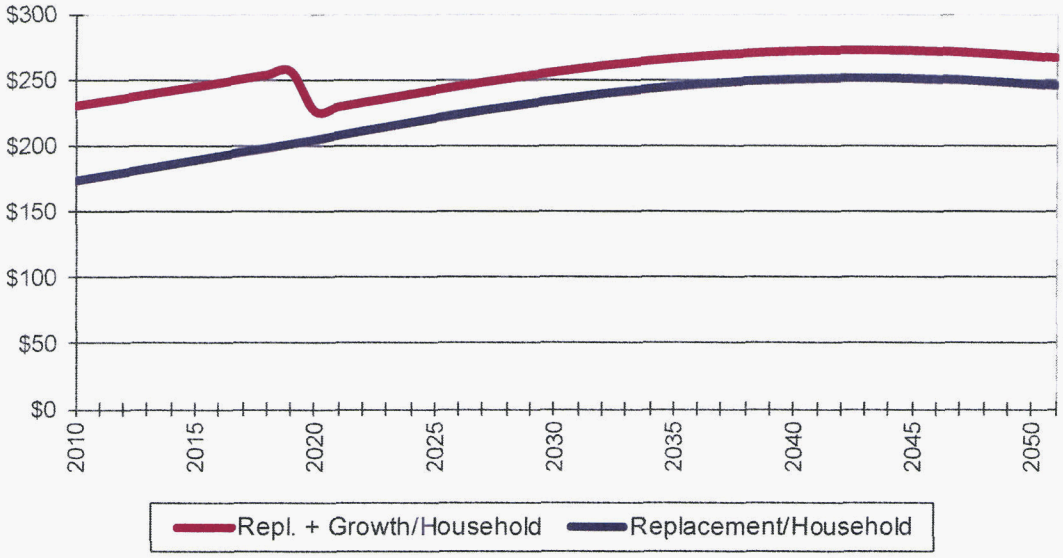
Northeast Large



This assumes costs are spread evenly across households of 2.6 persons each, based on data from the US Census.

Household Cost of Needed Investment for Replacement Plus Growth*

Northeast Medium



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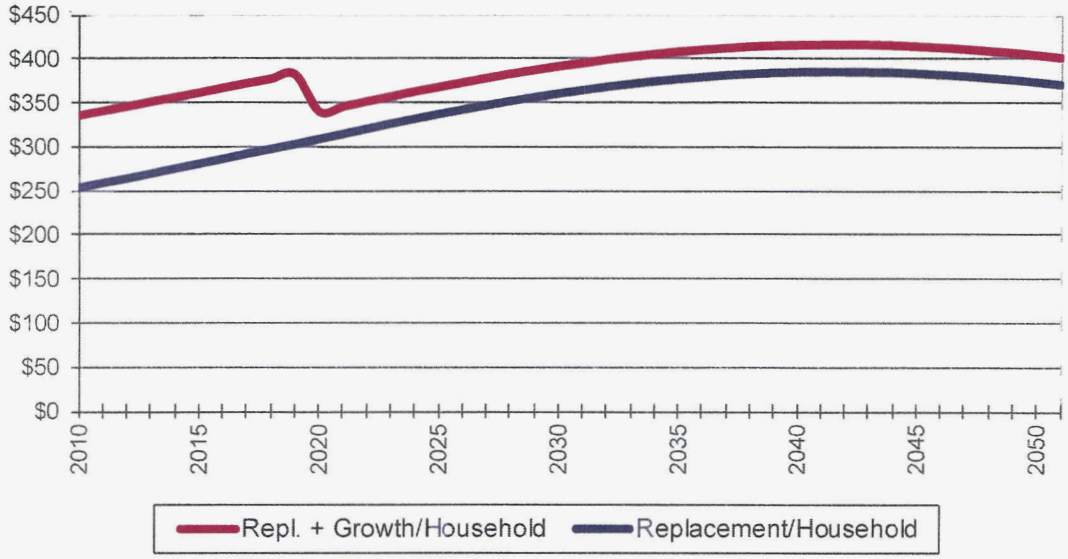
Household Cost of Needed Investment for Replacement Plus Growth*

Northeast Small



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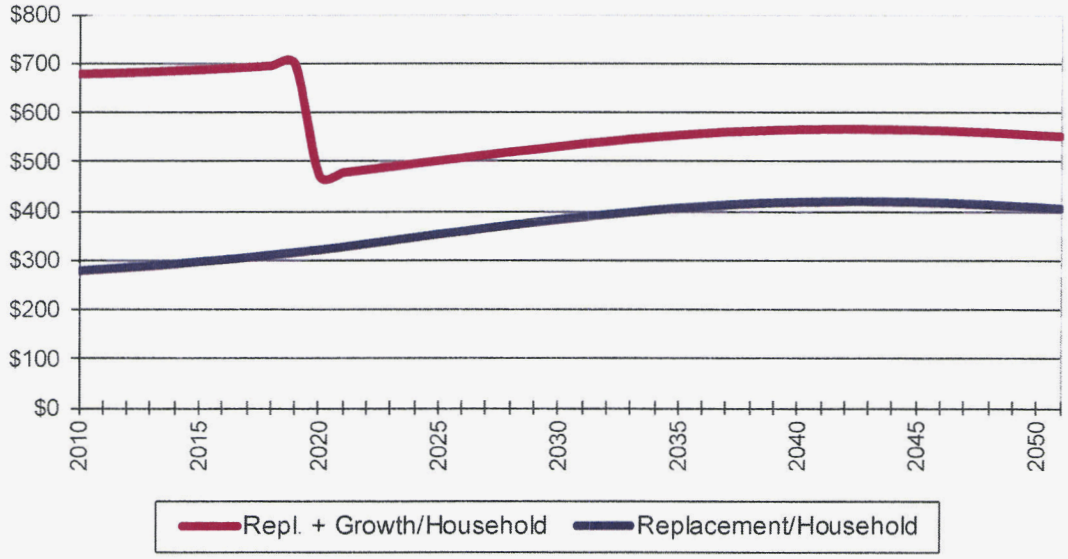
Household Cost of Needed Investment for Replacement Plus Growth*

Northeast Very Small



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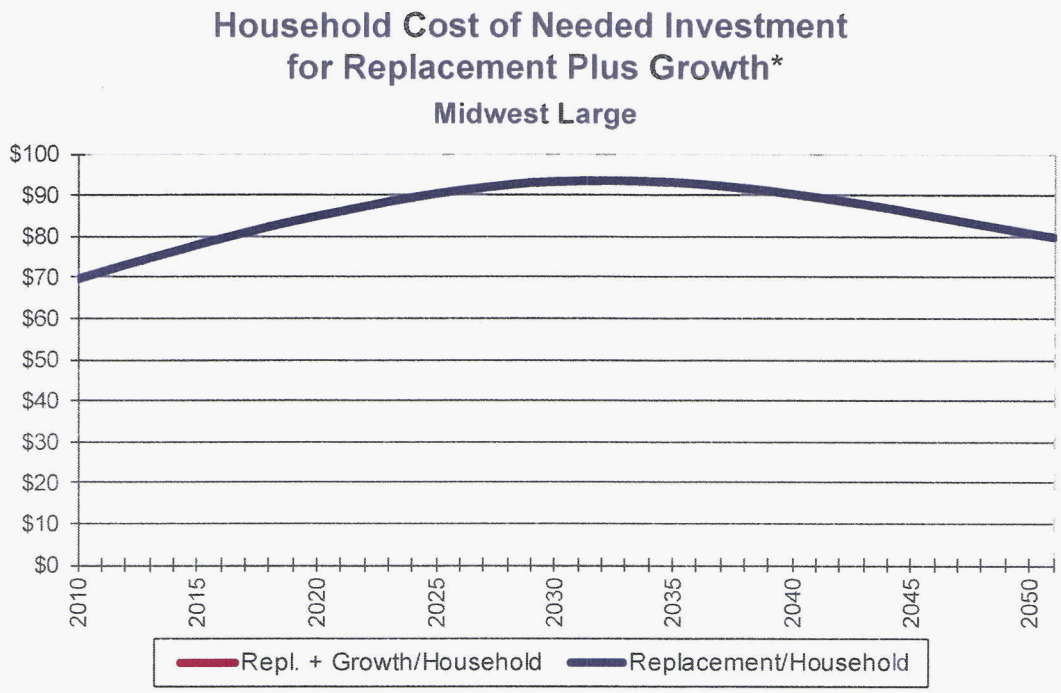

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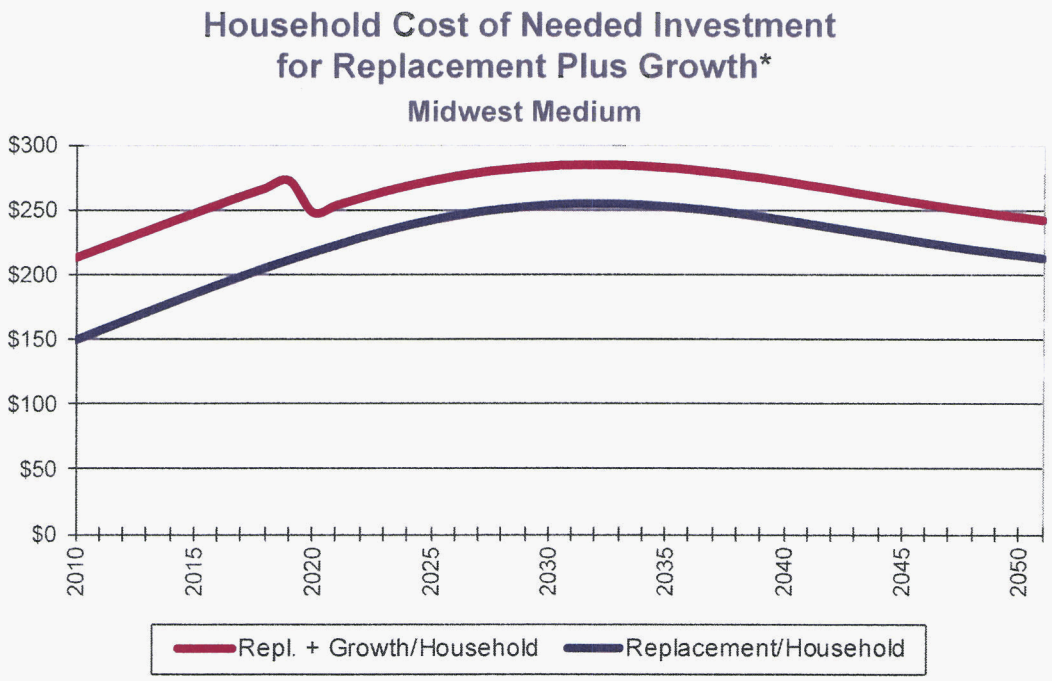

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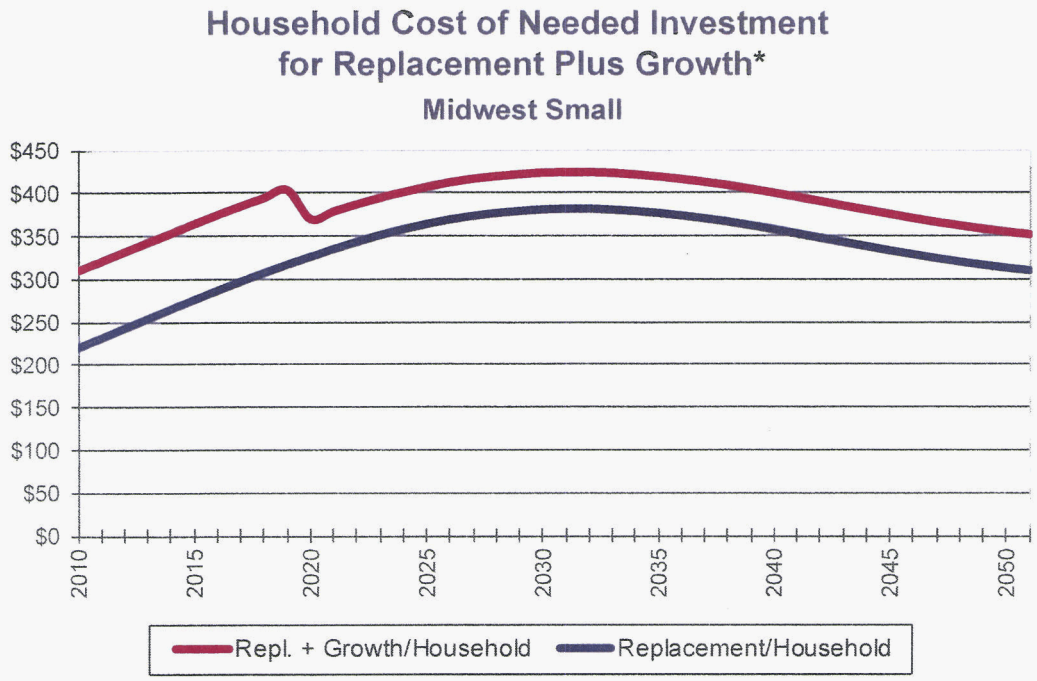

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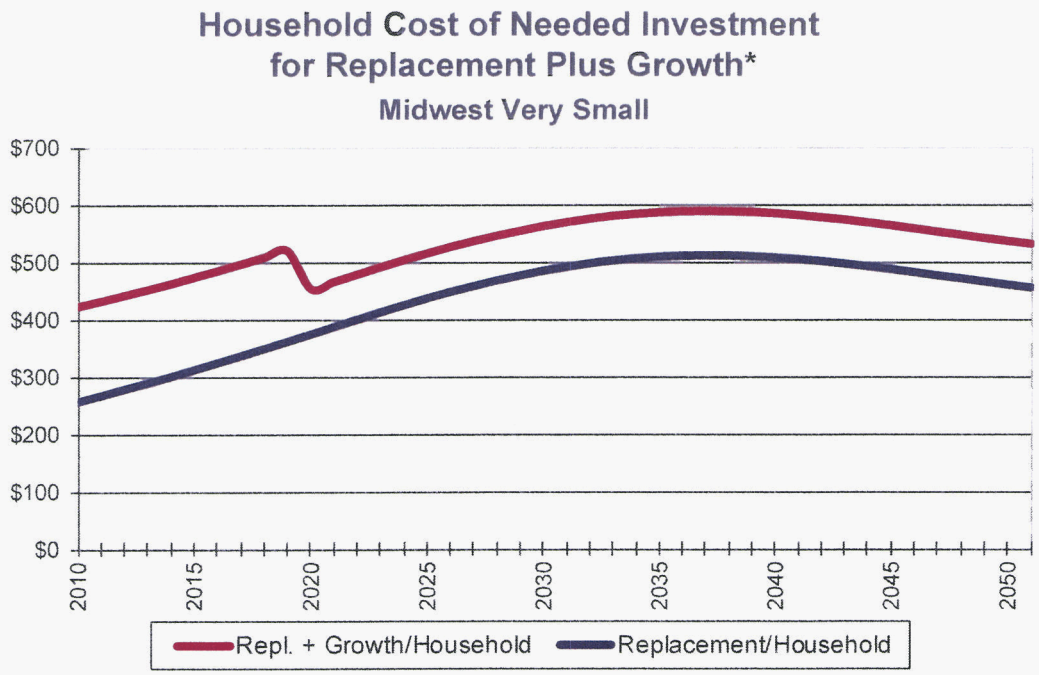

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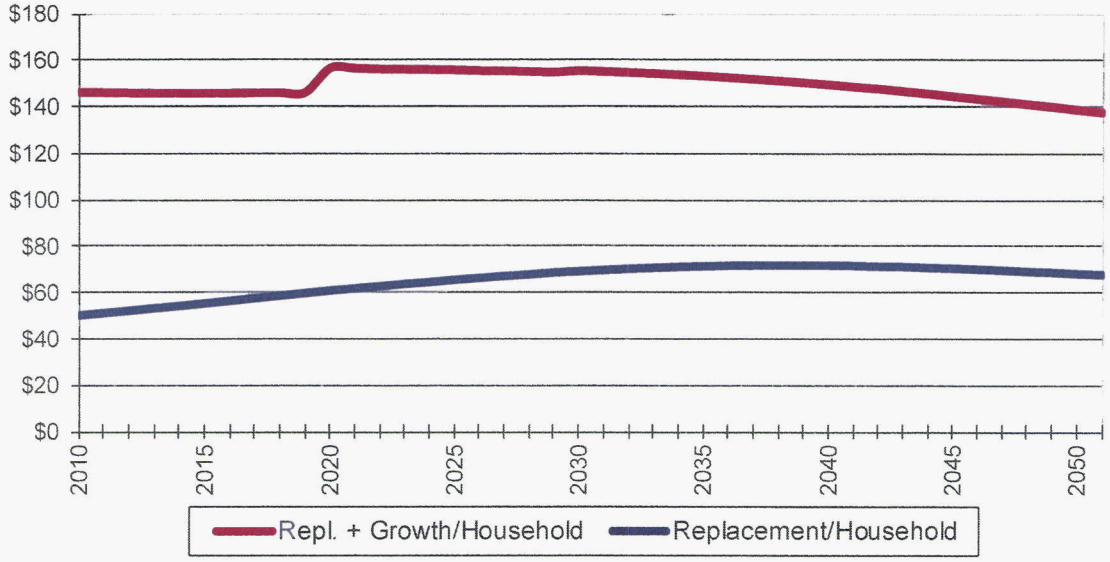
Household Cost of Needed Investment for Replacement Plus Growth*

South Large



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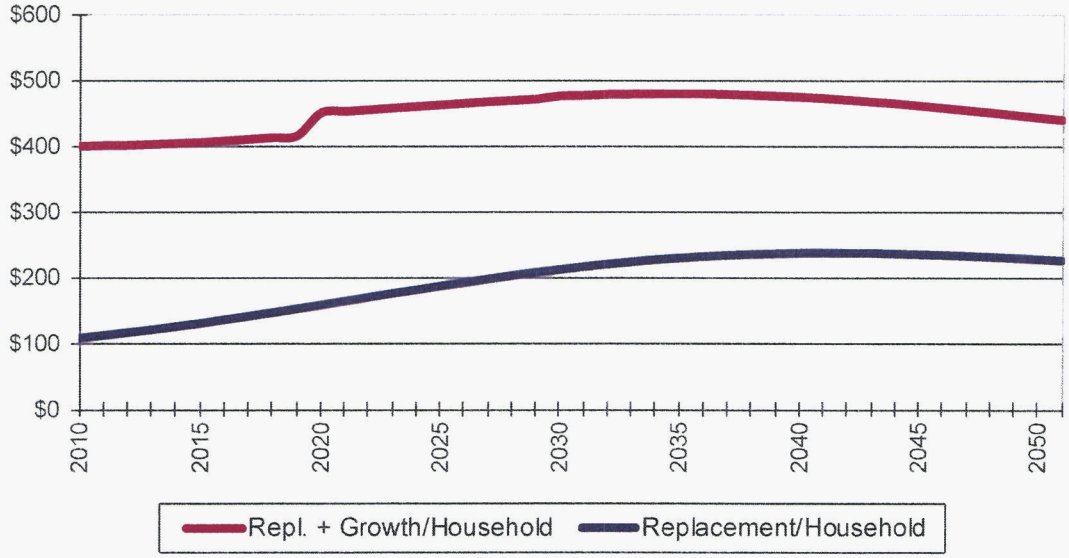
Household Cost of Needed Investment for Replacement Plus Growth*

South Medium



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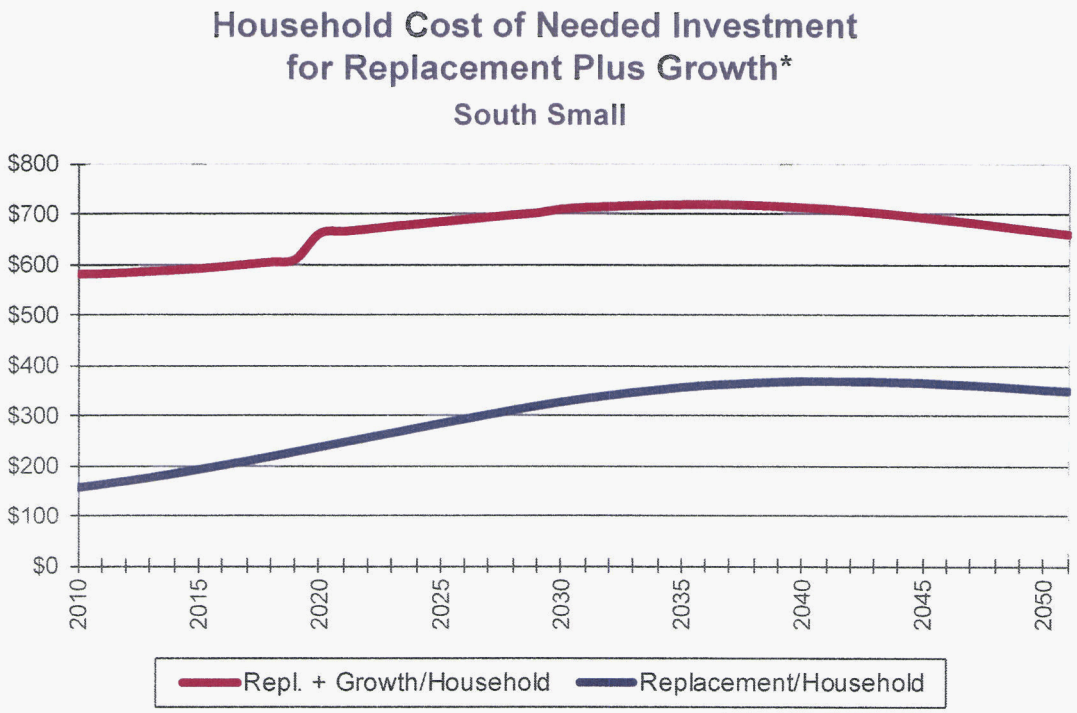

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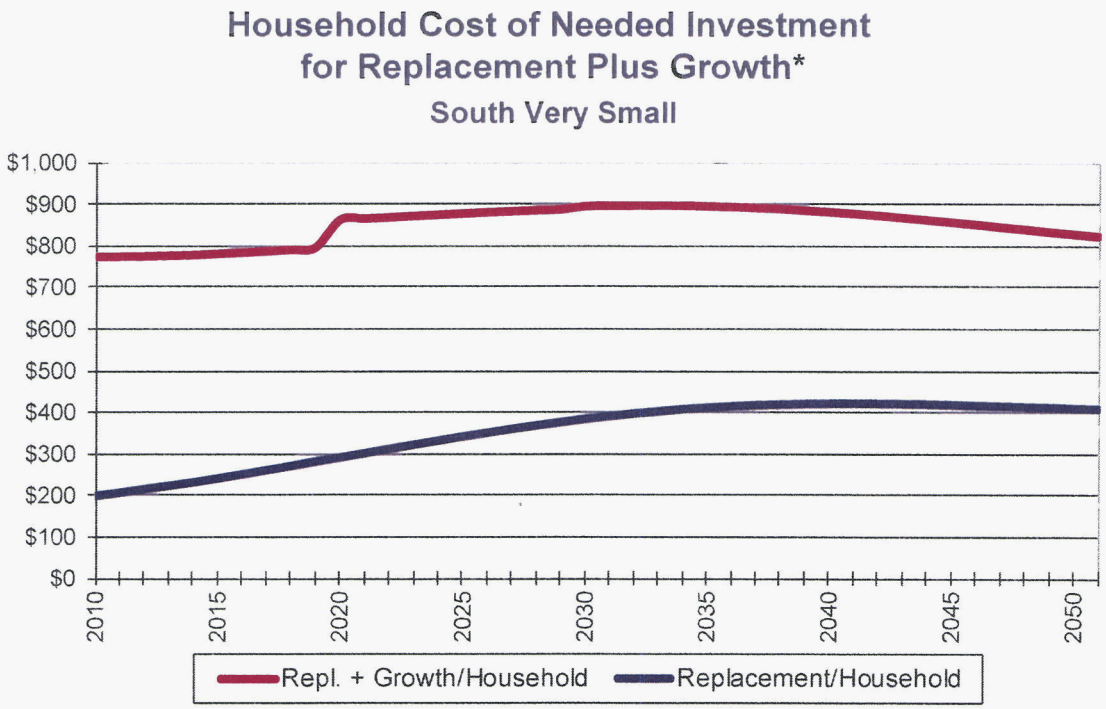

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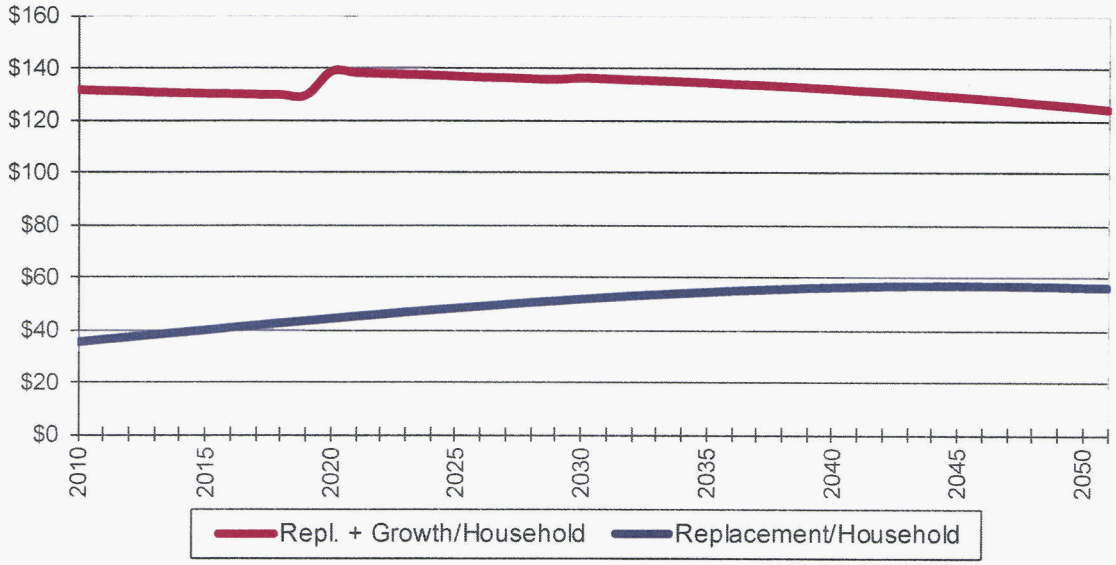
West Large



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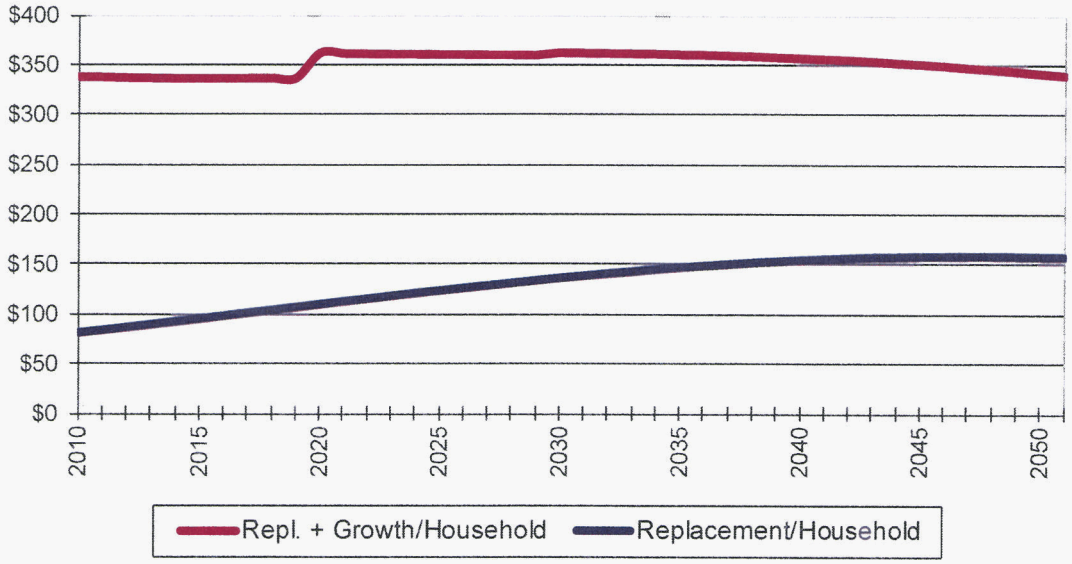
Household Cost of Needed Investment for Replacement Plus Growth*

West Medium



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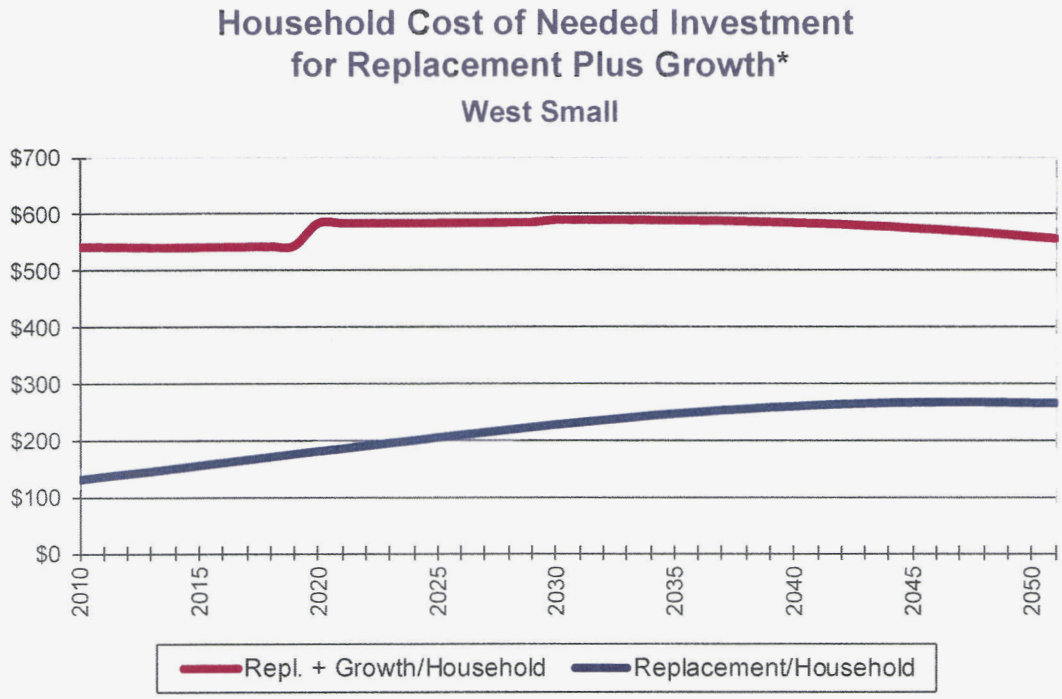

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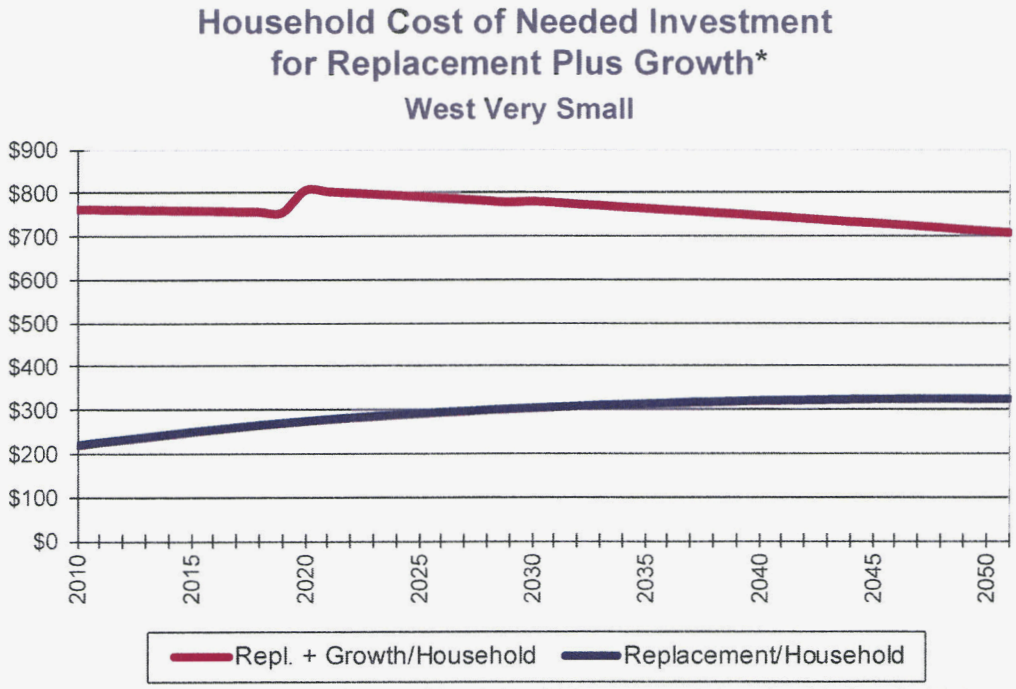


This assumes costs are spread evenly across households of 2.6 persons each, based on data from the US Census.

The charts show per household costs for replacement, and for replacement plus growth. The model assumes costs are spread evenly over households averaging 2.6 persons per household in accordance with US Census data. An artifact of the model and US Census data result in an apparent upward or downward "spike" in growth-related needs between certain decades. In reality, the apparent sudden shift in growth-related needs will be spread more evenly over the years bridging each decade to the next."

FKS-RB5

2009 INFRASTRUCTURE FACT SHEET

ASCE American Society of Civil Engineers

America's drinking water systems face an annual shortfall of at least $11 billion to replace aging facilities that are near the end of their useful lives and to comply with existing and future federal water regulations. This does not account for growth in the demand for drinking water over the next 20 years. Leaking pipes lose an estimated 7 billion gallons of clean drinking water a day.

WATER AND ENVIRONMENT

FACTS ABOUT

DRINKING WATER

WATER AND ENVIRONMENT

DRINKING WATER

2009 GRADE **D-**

RAISING THE GRADES

SOLUTIONS

THAT WILL WORK **NOW**

A = Exceptional
B = Good
C = Mediocre
D = Poor
F = Failing

AMERICA'S INFRASTRUCTURE G.P.A. **D**

ESTIMATED 5-YEAR FUNDING REQUIREMENTS FOR **DRINKING WATER AND WASTEWATER**

Total investment needs
$255 BILLION

Estimated spending
$146.4 BILLION

Projected shortfall
$108.6 BILLION

★ **INCREASE** funding for water infrastructure system improvements and associated operations through a comprehensive federal program;

★ **CREATE** a Water Infrastructure Trust Fund to finance the national shortfall in funding of infrastructure systems under the Clean Water Act and the Safe Drinking Water Act, including storm-water management and other projects designed to improve the nation's water quality;

★ **EMPLOY** a range of financing mechanisms, such as appropriations from general treasury funds, issuance of revenue bonds and tax exempt financing at state and local levels, public-private partnerships, state infrastructure banks, and user fees on certain consumer products as well as innovative financing mechanisms, including broad-based environmental restoration taxes to address problems associated with water pollution, wastewater management and treatment, and storm-water management.

CONDITIONS

The nation's drinking-water systems face staggering public investment needs over the next 20 years. Although America spends billions on infrastructure each year, drinking water systems face an annual shortfall of at least $11 billion in funding needed to replace aging facilities that are near the end of their useful life and to comply with existing and future federal water regulations. The shortfall does not account for any growth in the demand for drinking water over the next 20 years.[2]

Of the nearly 53,000 community water systems, approximately 83% serve 3,300 or fewer people. These systems provide water to just 9% of the total U.S. population served by all community systems. In contrast, 8% of community water systems serve more than 10,000 people and provide water to 81% of the population served. Eighty-five percent (16,348) of nontransient, noncommunity water systems and 97% (83,351) of transient noncommunity water systems serve 500 or fewer people. These smaller systems face huge financial, technological, and managerial challenges in meeting a growing number of federal drinking-water regulations.

In 2002, the U.S. Environmental Protection Agency (EPA) issued The Clean Water and Drinking Water Infrastructure Gap Analysis, which identified potential funding gaps between projected needs and spending from 2000 through 2019. This analysis estimated a potential 20-year funding gap for drinking water capital expenditures as well as operations and maintenance, ranging from $45 billion to $263 billion, depending on spending levels. Capital needs alone were pegged at $161 billion.[2]

The Congressional Budget Office (CBO) concluded in 2003 that "current funding from all levels of government and current revenues generated from ratepayers will not be sufficient to meet the nation's future demand for water infrastructure." The CBO estimated the nation's needs for drinking water investments at between $10 billion and $20 billion over the next 20 years.[3]

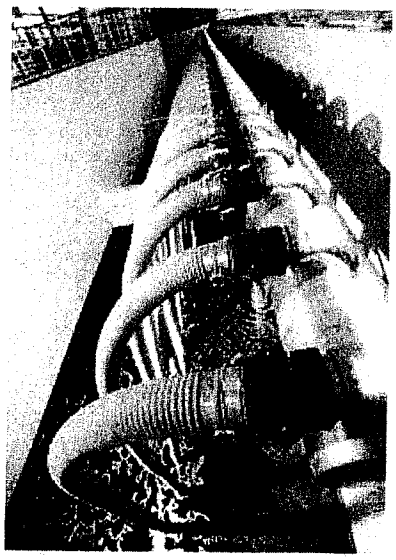
In 1996, Congress enacted the drinking-water state revolving loan fund (SRF) program. The program authorizes the EPA to award annual capitalization grants to states. States then use their grants (plus a 20% state match) to provide loans and other assistance to public water systems. Communities repay loans into the fund, thus replenishing the fund and making resources available for projects in other communities. Eligible projects include installation and replacement of treatment facilities, distribution systems, and some storage facilities. Projects to replace aging infrastructure are eligible if they are needed to maintain compliance or to further public health protection goals.

Federal assistance has not kept pace with demand, however. Between FY 1997 and FY 2008, Congress appropriated approximately $9.5 billion for the SRF. This 11-year total is only slightly more than the annual capital investment gap for each of those years as calculated by the EPA in 2002.

RAISING THE GRADES
CASE STUDIES

ORANGE COUNTY, CA ★ Groundwater Replenishment System

The California Department of Water Resources predicts that by 2020, the entire state will experience water shortages equal to the needs of 4 to 12 million families of four for one year. To meet growing demand and reduce reliance on water imported from northern California and the Colorado River, the Orange County Water District developed the Groundwater Replenishment (GWR) System that takes highly treated sewer water and purifies it to levels that meet state and federal drinking water standards. GWR System water will be between 35% to 75% cheaper than water produced by seawater desalination and the purification process will consume about half the energy. *Photos courtesy of Orange County Water District.*



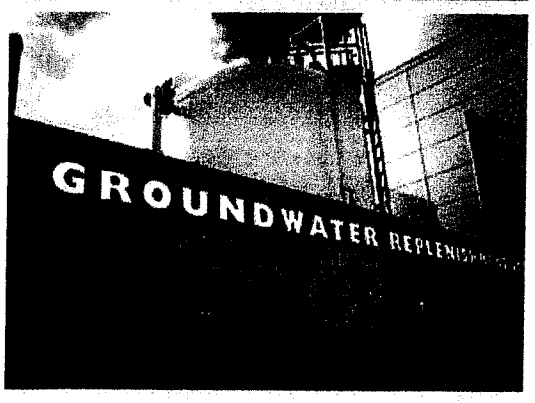


TABLE 2.1 ★ Design Life of Drinking Water Systems

COMPONENTS	YEARS OF DESIGN LIFE
Reservoirs and Dams	50–80
Treatment Plants—Concrete Structures	60–70
Treatment Plants—Mechanical and Electrical	15–25
Trunk Mains	65–95
Pumping Stations—Concrete Structures	60–70
Pumping Stations—Mechanical and Electrical	25
Distribution	60–95

SOURCE US EPA Clean Water and Drinking Water Infrastructure Gap Analysis Report, September 2002

TABLE 2.2 ★ Water Usage: 1950 and 2000

	1950	2000	PERCENT CHANGE
Population (Millions)	93.4	242	159%
Usage (Billions of Gallons per Day)	14	43	207%
Per Capita Usage (Gallons per Person per Day)	149	179	20%

SOURCE US EPA Clean Water and Drinking Water Infrastructure Gap Analysis Report, September 2002

RESILIENCE

Drinking water systems provide a critical public health function and are essential to life, economic development, and growth. Disruptions in service can hinder disaster response and recovery efforts, expose the public to water-borne contaminants, and cause damage to roadways, structures, and other infrastructure, endangering lives and resulting in billions of dollars in losses.

The nation's drinking-water systems are not highly resilient; present capabilities to prevent failure and properly maintain or reconstitute services are inadequate. Additionally, the lack of investment and the interdependence on the energy sector contribute to the lack of overall system resilience. These shortcomings are currently being addressed through the construction of dedicated emergency power generation at key drinking water utility facilities, increased connections with adjacent utilities for emergency supply, and the development of security and criticality criteria. Investment prioritization must take into consideration system vulnerabilities, interdependencies, improved efficiencies in water usage via market incentives, system robustness, redundancy, failure consequences, and ease and cost of recovery.

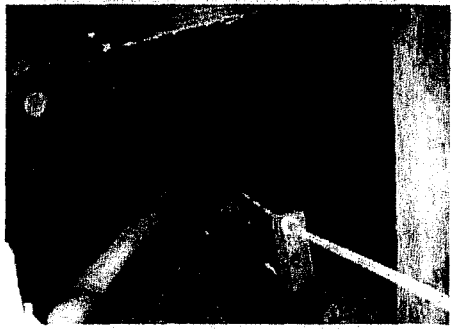
The question is not whether the federal government should take more responsibility for drinking water improvements but how it should take more responsibility.

LOUISVILLE, KY ★ American Recovery and Reinvestment Act Funding

The Louisville Water Company has proposed $11 million in projects that could be funded as part of the 2009 American Recovery and Reinvestment Act (P.L. 111-005). The projects would rehabilitate 75 miles of water main to extend the useful life of the system and reduce water main breaks. In addition, 9.5 miles of water main would be replaced to improve water quality, fire hydrant flow and reduce maintenance. Together, the projects would support 101 jobs.

PORT ANGELES, WA ★ Downtown Water Main Project

In 2008, the City of Port Angeles completed a project to replace the water mains and sidewalks in the downtown area. The replacement water mains bring the city's downtown area to a service level that meets current fire flow standards, reduces seismic risks and helps prevent water main failures due to age. The original water mains were installed in 1914. In conjunction with the water main replacement, many sidewalks were replaced with pavers that enhance the downtown appearance. Also, new conduit and wiring was installed for street and pedestrian lighting. *Photos courtesy of the City of Port Angeles.*



CONCLUSION

New solutions are needed for what amounts to nearly $1 trillion in critical drinking water and wastewater investments over the next two decades. Not meeting the investment needs of the next 20 years risks reversing public health, environmental, and economic gains of the past three decades.

Without a significantly enhanced federal role in providing assistance to drinking water infrastructure, critical investments will not occur. Possible solutions include grants, trust funds, loans and incentives for private investment. The question is not whether the federal government should take more responsibility for drinking water improvements but how it should take more responsibility.

The case for federal investment is compelling. Needs are large and unprecedented; in many locations, local sources cannot be expected to meet this challenge alone, and because waters are shared across local and state boundaries, the benefits of federal help will accrue to the entire nation. Clean and safe water is no less a national priority than are national defense, an adequate system of interstate highways, and a safe and efficient aviation system. These latter infrastructure programs enjoy sustainable, long-term federal grant programs; under current policy, water and wastewater infrastructure do not. ★

SOURCES

1 Congressional Research Service, *Safe Drinking Water Act: Selected Regulatory and Legislative Issues*, April 2008.

2 U.S. Environmental Protection Agency, *The Clean Water and Drinking Water Infrastructure Gap Analysis*, September 2002.

3 U.S. Congressional Budget Office, *Future Investment in Drinking Water and Wastewater Infrastructure*, May 2002.

4 G. Tracy Mehan, Testimony before the Subcommittee on Water Resources and Environment, U.S. House Transportation and Infrastructure Committee, February 2009. http://transportation.house.gov/hearings/hearing.aspx.

FKS-RB6

United States
Environmental Protection
Agency

Drinking Water Infrastructure Needs Survey and Assessment

Fourth Report to Congress

Cover photos (clockwise from top right): Girl in pool, www.iStockphoto.com; Water tower, www.iStockphoto.com; Desolation Wilderness, California, Amy Draut; Flocculators in a Butte, Montana treatment facility, Montana Department of Environmental Quality; Upper Rogue River, Oregon, Amy Draut; Man with daughter at drinking fountain, www.iStockphoto.com; Inside the new pipe gallery at the Neuse Regional Water and Sewer Authority in North Carolina, Jim McRight, North Carolina Department of Environment and Natural Resources; Water utility worker, www.iStockphoto.com; Distribution main at the construction site of a new treatment plant in Helena, Montana, City of Helena; Girl drinking water, Sandie Koenig; Construction at a water treatment facility in Corsicana, Texas, Texas Water Development Board; Quabbin Reservoir, Massachusetts, Charles Hernick

Office of Water (4606M)
EPA 816-R-09-001
February 2009
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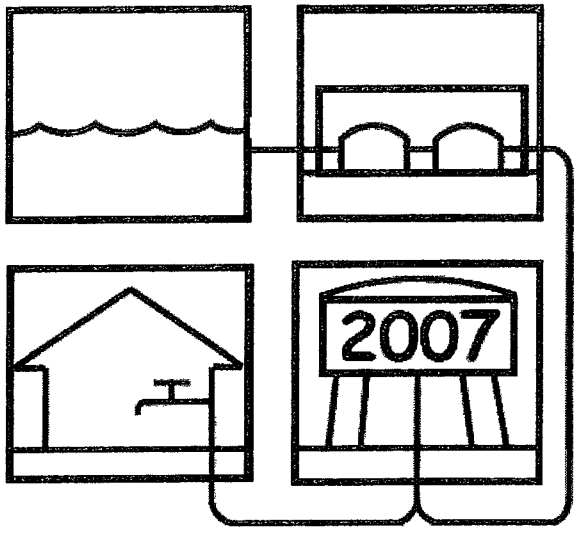
Drinking Water Infrastructure Needs Survey and Assessment

Fourth Report to Congress



U.S. Environmental Protection Agency
Office of Water
Office of Ground Water and Drinking Water
Drinking Water Protection Division
Washington, D.C. 20460

Contents

EXECUTIVE SUMMARY i

CHAPTER 1: FINDINGS - NATIONAL NEED 1

- 2007 Total National Need 1
- 2007 Total National Need Compared to EPA's Previous Assessments 3
- Total National Need by Project Type 5
  - Transmission and Distribution Needs 6
  - Treatment Needs 7
  - Source Needs 7
  - Storage Needs 8
  - Other Needs 8
- Need by System Size 9
- Needs Associated with SDWA Regulations 10
  - Existing Regulations 10
  - Proposed or Recently Promulgated Regulatory Needs 11
- Security Needs 13
- American Indian and Alaskan Native Village Water System Needs 14

CHAPTER 2: FINDINGS - STATE NEED 17

- State-Specific Needs 17
- Changes in State-Specific Need through Assessment Cycles 22
- Continuing Evolution of the DWINSA 24
- Key Observations on Each Assessment's Approach 25
- Unique Needs of Water Systems in U.S. Territories 26

APPENDIX A - SURVEY METHODS 29

APPENDIX B - DATA COLLECTION 39

APPENDIX C - POLICIES 45

APPENDIX D - ACCURACY, PRECISION, AND UNCERTAINTY 53

APPENDIX E - SUMMARY OF FINDINGS FOR SYSTEMS SERVING 10,000 AND FEWER PERSONS 57

GLOSSARY 61

Exhibits

Exhibit ES.1: DWINSA Comparison of 20-Year National Need i
Exhibit 1.1: Total National 20-Year Need 1
Exhibit 1.2: Total National 20-Year Need Comparison to Previous DWINSA Findings 3
Exhibit 1.3: Total 20-Year Need Comparison to Other Assessments 4
Exhibit 1.4: Total 20-Year Need by Project Type 5
Exhibit 1.5: Total 20-Year Need by System Size and Type and Project Type 5
Exhibit 1.6: Community Water System 20-Year Need by Size and Population 9
Exhibit 1.7: Total Regulatory vs. Non-Regulatory 20-Year Need 10
Exhibit 1.8: Total 20-Year National Regulatory Need 10
Exhibit 1.9: Total National 20-Year Need for Proposed and Recently Promulgated Regulations 12
Exhibit 1.10: Total National 20-Year Security Needs 13
Exhibit 1.11: Total 20-Year American Indian and Alaskan Native Village Water System Need by Project Type 14
Exhibit 1.12: 20-Year American Indian and Alaskan Native Village Water System Need by EPA Region 15
Exhibit 2.1: State 20-Year Need Reported by Project Type 18
Exhibit 2.2: State 20-Year Need Reported by System Size 19
Exhibit 2.3: Overview of 20-Year Need by State 20
Exhibit 2.4: State 20-Year Need Reported for Partially Surveyed States 21
Exhibit 2.5: Historic State Need Reported for Each DWINSA 23
Exhibit 2.6: 20-Year Need Reported by U.S. Territories 26
Exhibit A.1: Community Water System Stratification for the 2007 Assessment 31
Exhibit A.2: Medium and Large Community Water System Sample Size 32
Exhibit A.3: Small Community Water System Sample Size 34
Exhibit B.1: DWINSA Allowable and Unallowable Projects 40
Exhibit E.1: 2007 State Need Reported by Project Type for CWSs Serving a Population of 10,000 and Fewer 58

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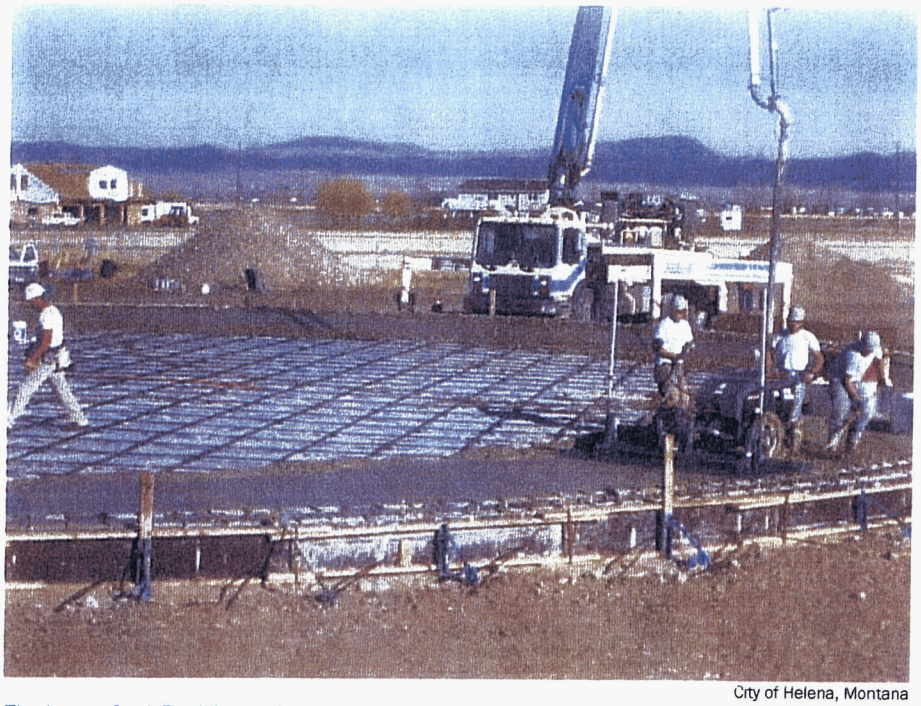


City of Helena, Montana

The base of a 1.5 million gallon storage tank under construction in Helena, Montana.

Executive Summary

Total National Need

The U.S. Environmental Protection Agency's (EPA's) fourth national assessment of public water system infrastructure needs shows a total twenty-year capital improvement need of $334.8 billion. This estimate represents infrastructure projects necessary from January 1, 2007, through December 31, 2026, for water systems to continue to provide safe drinking water to the public. The national total comprises the infrastructure investment needs of the nation's approximately 52,000 community water systems and 21,400 not-for-profit noncommunity water systems, including the needs of American Indian and Alaskan Native Village water systems, and the costs associated with proposed and recently promulgated regulations. The findings are based on the 2007 Drinking Water Needs Survey and Assessment (DWINSA or Assessment) which relied primarily on a statistical survey of public water systems (approximately 3,250 responses).

$334.8 Billion is Needed

The nation's drinking water utilities need $334.8 billion in infrastructure investments over the next 20 years for thousands of miles of pipe as well as thousands of treatment plants, storage tanks, and other key assets to ensure the public health and economic well-being of our cities, towns, and communities.

Authority, Purpose, and History

The 1996 Safe Drinking Water Act Amendments mandated that EPA conduct an assessment of the nation's public water systems' infrastructure needs every 4 years, and use the findings to allocate Drinking Water State Revolving Fund (DWSRF) capitalization grants to states. The DWSRF was established to help public water systems obtain financing for improvements necessary to protect public health and comply with drinking water regulations. From 1997 to 2007, states loaned $12.6 billion to water systems for 5,550 projects.

The estimate covers infrastructure needs that are eligible for, but not necessarily financed by, Drinking Water State Revolving Fund (DWSRF) monies (note-DWSRF is designed to supplement, not replace, investment funding by states and localities as well as rate payers). Projects eligible for DWSRF funding include the installation of new infrastructure and the rehabilitation, expansion, or replacement of existing infrastructure. Projects may be needed because existing infrastructure is deteriorated or undersized, or to ensure compliance with regulations. Cost estimates assume comprehensive construction costs including engineering and design, purchase of raw materials and equipment, construction and installation labor, and final inspection.

EPA recognizes that there are legitimate and significant water system needs that are not eligible for DWSRF funding, such as raw water dams and reservoirs, projects related primarily to population growth, and water system operation and maintenance costs. However, because the Assessment is directly associated with the allocation of DWSRF capitalization grants, needs ineligible for DWSRF funding are not included in the estimate.

National Need Compared to Previous Needs Assessments

EPA conducted three previous Assessments, in 1995, 1999, and 2003. Exhibit ES.1, which adjusts the findings to 2007 dollars, shows the 2007 Assessment's total national need

Exhibit ES.1: DWINSA Comparison of 20-Year National Need

Year	1995	1999	2003	2007
National Need	$200.4	$198.2	$331.4	$334.8

The national 20-year need estimate is reported in billions of January 2007 dollars.

to be comparable to the 2003 estimate, continuing the success of better capturing longer term needs that were underreported in the two earlier surveys. While the 2003 and 2007 efforts share a similar statistical approach and total national need findings, the 2007 Assessment employed specific efforts to greatly improve the consistency of methods for estimating needs across the states and water systems.

Individual State Need

The 2007 Assessment shows significant changes in some states' needs from previous Assessments. These changes will result in modifications to individual states' DWSRF allotments. While shifts in states' needs can be attributed to expected changes in the status of projects from one survey to the next, some of the shifts in the 2007 findings are due to this Assessment's emphasis on improving method consistency across states and water systems.

Regulatory Need

The findings of the 2007 Assessment indicate that the need associated directly with Safe Drinking Water Act (SDWA) regulations remains a small percentage, 16 percent, of the total national need. Most water system needs are not directly related to violations of, or compliance with, SDWA regulations. Most needs are ongoing investments that systems must make to continue delivering safe drinking water to their customers.

Small System Need

For the 2007 Assessment, EPA sent water system professionals to 600 randomly selected small systems to collect information about their needs. Small systems were defined as serving 3,300 persons or fewer. Similar field surveys of small water systems were conducted for the 1995 and 1999 Assessments, but the 2003 Assessment relied on the results of the 1999 survey adjusted to 2003 dollars. The new field survey of small systems allowed for the application of the cost models used to estimate needs of medium and large systems, providing a more consistent approach across all system sizes. The 2007 results show a small systems need of $59.4 billion, or 18 percent of the total national need, a result similar to that of the previous filed survey of these systems.

Needs of American Indian and Alaskan Native Village Water Systems

The needs of water systems serving American Indians and Alaskan Native Villages are a small percentage of the nation's total need; however, they represent a high need per household. Many water systems for American Indian tribes and Alaskan Native Villages are located in remote rural areas or in areas with permafrost. These conditions present special challenges for providing drinking water service. The findings presented in this report are based on an in-depth survey of these systems conducted in 1999 adjusted to 2007 dollars.

Water Industry Capital Investment Planning and Documentation of Needs

Systems submitted a variety of planning documents and excerpts of documents in support of projects reported for the 2007 Assessment. These documents made clear that as our nation's infrastructure continues to age and deteriorate, many water systems are using asset management strategies to better understand and address their infrastructure rehabilitation and replacement challenges. However, for many other systems, the information and documentation provided indicates that a significant gap still exists between information about their inventory of infrastructure and their knowledge of that infrastructure's condition or remaining useful life.

Denver Water

A 40-by-60-foot sinkhole on Interstate 25 outside of Denver, Colorado formed after a water main ruptured. The rupture was caused by an emergency pump shutoff that increased pressure from 180 psi to 300 psi. The break was repaired within 72 hours.

Chapter 1: Findings - National Need

2007 Total National Need

The 20-year national infrastructure need estimated by the 2007 Assessment is $334.8 billion. The breakout of the national need by system size and type is presented in Exhibit 1.1.

The results were derived from the responses to a probability sample of approximately 3,250 community water systems[1] (CWSs). The results for the not-for-profit noncommunity water systems[2] (NPNCWSs) and American Indian and Alaskan Native Village water systems were extrapolated from a similar assessment conducted in 1999. The total national need also includes the costs associated with meeting recently proposed or promulgated regulations that are too new to be a consideration in water systems' investment plans; those costs are derived from EPA's economic analyses (EAs) supporting each regulation.

The need reported in the Assessment includes projects for expanding, replacing, or rehabilitating existing infrastructure.

Exhibit 1.1: Total National 20-Year Need (in billions of January 2007 dollars)

System Size and Type	Need
Large Community Water Systems* (serving over 100,000 persons)	$116.3
Medium Community Water Systems* (serving 3,301-100,000 persons)	$145.1
Small Community Water Systems (serving 3,300 and fewer persons)	$59.4
Not-for-Profit Noncommunity Water Systems†	$4.1
Total State Need	**$324.9**
American Indian and Alaskan Native Village Water Systems†	$2.9
Costs Associated with Proposed and Recently Promulgated Regulations	$7.0
Total National Need	**$334.8**

Note: Numbers may not total due to rounding.
* "Large" and "medium" systems are defined differently for this Assessment than previous Assessments. See Appendix A for more information.
† Based on 1999 Assessment findings adjusted to 2007 dollars.

Montana Department of Environmental Quality

Construction at the Fort Peck-Dry Prairie Regional Water System in northwest Montana.

1 A community water system is a public water system that serves at least 15 connections used by year-round residents or that regularly serves at least 25 residents year-round. Cities, towns, and small communities such as retirement homes are examples of community water systems.

2 A noncommunity water system is a public water system that is not a community water system and that serves a nonresidential population of at least 25 individuals daily for at least 60 days of the year. Schools and churches are examples of noncommunity water systems.

It also includes projects to construct new infrastructure in order to preserve the physical integrity of water systems and to convey drinking water to existing residential, commercial, and industrial customers. Projects vary greatly in scale, complexity, and cost—from rehabilitating a small storage tank, to replacing an entire treatment plant, to constructing a high-capacity pipeline.

The results presented in this report will determine the allocation of DWSRF capitalization grants for federal fiscal years 2010 through 2013. Therefore, the need does not include projects that are ineligible for DWSRF funding. A summary of the types of projects included in the Assessment, as well as specific unallowable projects, is presented in Appendix B. EPA recognizes that projects not eligible for DWSRF funding can be significant, if not critical, water system needs, but they are outside the scope of this Assessment. In addition, the Assessment does not seek to capture information on the financing alternatives being pursued or considered by systems for individual projects. The DWSRF is in fact intended as a supplement to, not a replacement for funding by states, localities, and rate payers.

The approach and methodologies for discerning needs are further detailed in Appendix A. The specific project allowability criteria are discussed in Appendix B.

The $334.8 billion represents the need associated with thousands of miles of pipe, thousands of treatment plant and source projects, and billions of gallons of storage. Investments in water systems not only provide assurances of continued delivery of safe drinking water to our homes, schools, and places of business, they are key to local economies across our nation.

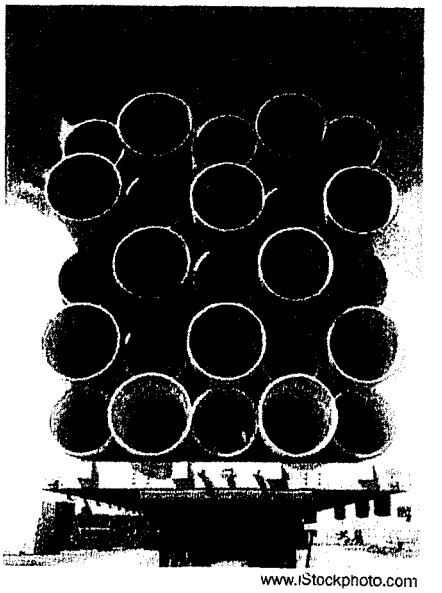
As stated in a recent report by the U.S. Conference of Mayors:

> "The estimates exhibit a wide range, but the consensus is that public infrastructure investment yields positive returns, and investment in water and sewer infrastructure has greater returns than most other types of public infrastructure.
>
> - A recent study estimates that one dollar of water and sewer *infrastructure investment* increases private output (Gross Domestic Product, GDP) in the *long-term* by $6.35.
> - With respect to *annual general revenue and spending* on operating and maintaining water and sewer systems, the US Department of Commerce's Bureau of Economic Analysis estimates that for each additional dollar of *revenue (or the economic value of the output)* of the water and sewer industry, the increase in *revenue (economic output)* that occurs in all industries is $2.62 in that year.
> - The same analysis estimates that adding 1 job in water and sewer creates 3.68 jobs in the national economy to support that job."

The U.S. Conference of Mayors. *Local Government Investment in Municipal Water And Sewer Infrastructure: Adding Value To The National Economy.* Richard A. Krop, Ph.D., Charles Hernick, and Christopher Frantz. The Cadmus Group, Inc. August 14, 2008.

Additional Source:
Pereira, A.M. "Is all public capital created equal?" *Review of Economics and Statistics*, 82:3 (2000): 513–518.

2007 Total National Need Compared to EPA's Previous Assessments


www.iStockphoto.com

The 2007 total national need of $334.8 billion is comparable to the 2003 estimate of $331.4 billion (as adjusted to 2007 dollars), continuing the earlier Assessment's success in better capturing previously underreported longer term needs for infrastructure rehabilitation and replacement. Both the 2003 and 2007 Assessments clearly point to the nation's water systems having entered a "rehabilitation and replacement era" in which much of water utilities' existing infrastructure has reached or is approaching the end of its useful life.

Exhibit 1.2 compares the need from this Assessment to past Assessments. Cost indices were used to adjust previous needs to the 2007 Assessment's month and year. Although there are numerous cost indices available, EPA used the Construction Cost Index (CCI) compiled by McGraw Hill Construction because it includes adjustments for labor rates as well as the cost of materials. It is worth noting that the CCI shows a cost increase of approximately 3 percent per year from 1995 through 2003, but an approximately 5 percent increase per year from 2003 through 2007.

While the 2007 Assessment shares a similar approach and total national finding with the 2003 Assessment, the results of this most recent effort were derived from survey policies purposefully designed to ensure more consistent application of need-estimating methodologies across all states and water systems. These 2007 Assessment policies, including required documentation to support survey acceptance of projects, are detailed in Appendix C.

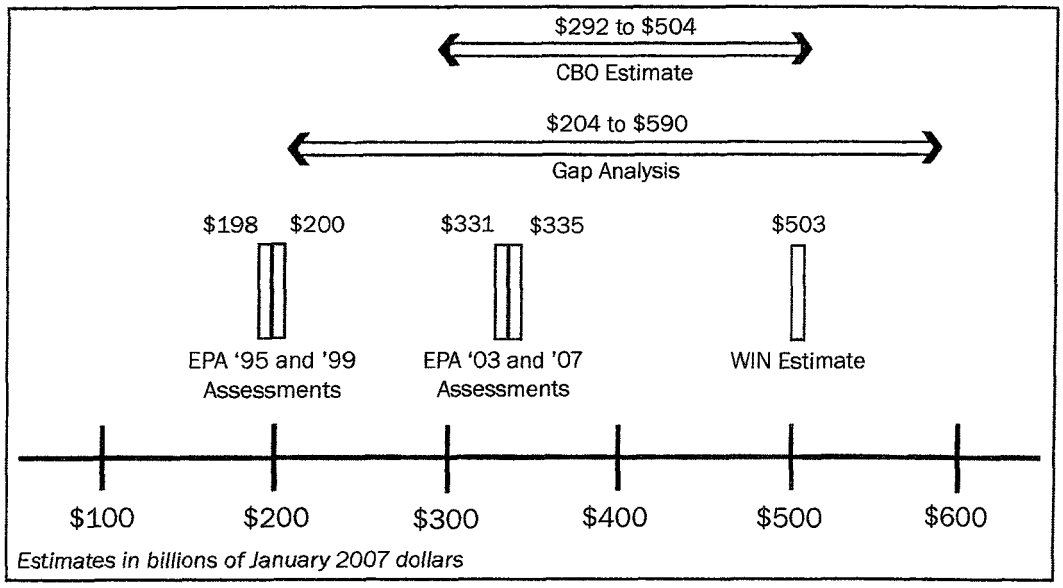
Exhibit 1.2: Total National 20-Year Need Comparison to Previous DWINSA Findings (in billions of dollars)

	1995	1999	2003	2007
Total National Need (as listed in Assessment Year's Report to Congress)	$138.4	$150.9	$276.8	$334.8
Cost adjustment factor to January 2007 dollars (based on Construction Cost Index)	44.8%	31.3%	19.7%	-
Total National Need (adjusted to January 2007 dollars)	$200.4	$198.2	$331.4	$334.8

Exhibit 1.3 compares the EPA Assessments to other important assessment efforts. All estimates are presented in 2007 dollars. EPA's DWINSA continues to estimate a need within the range identified in these reports:

- The Congressional Budget Office (CBO) report "Future Investment in Drinking Water and Wastewater Infrastructure," which estimates annual water system needs of $14.6 billion to $25.2 billion. This extrapolates to a 20-year need in the range of $292 to $504 billion.[3]
- EPA's "Clean Water and Drinking Water Infrastructure Gap Analysis," which estimated drinking water systems' 20-year capital needs in the range of $204 billion to $590 billion with a point estimate of $363 billion.[4]
- The Water Infrastructure Network's (WIN's) "Clean and Safe Water for the 21st Century - A Renewed National Commitment to Water and Wastewater Infrastructure," which estimates water system needs of $25 billion annually. This extrapolates to $503 billion over 20 years.[5]

Exhibit 1.3: Total 20-Year Need Comparison to Other Assessments

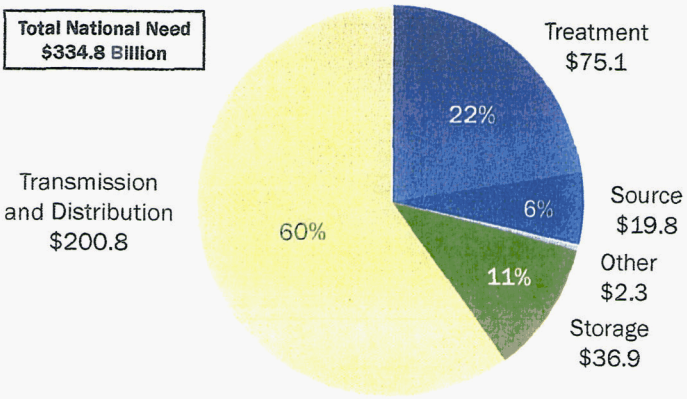


3 Congressional Budget Office, "Future Investment in Drinking Water and Wastewater Infrastructure," (November 2002), p. ix. Needs were reported in 2001 dollars and have been adjusted to January 2007 dollars for comparison purposes.
4 U.S. Environmental Protection Agency, "Clean Water and Drinking Water Infrastructure Gap Analysis," (September 2002), p. 5. Needs were assumed to be in 1999 dollars based on the date of the report and planning period used. Needs have been adjusted to January 2007 dollars for comparison purposes.
5 Water Infrastructure Network, "Clean and Safe Water for the 21st Century - A Renewed National Commitment to Water and Wastewater Infrastructure," (undated), p. 3-1. Needs were assumed to be in 1999 dollars based on the planning period and data used. Needs have been adjusted to January 2007 dollars for comparison purposes.

Total National Need by Project Type

Infrastructure needs of water systems can be grouped into four major categories based on project type. These project types are source, transmission and distribution, treatment, and storage. Each category fulfills an important function in delivering safe drinking water to the public. Most needs were assigned to one of these categories. An additional "other" category is composed of projects that do not fit into one of the four categories. Exhibit 1.4 shows the total national need by project type. Exhibit 1.5 shows the total national need by water system size and type, as well as by project type.

Exhibit 1.4: Total 20-Year Need by Project Type (in billions of January 2007 dollars)



Note: Numbers may not total due to rounding.

Exhibit 1.5: Total 20-Year Need by System Size and Type and Project Type (in billions of January 2007 dollars)

System Size and Type	Distribution and Transmission	Treatment	Storage	Source	Other	Total Need
Large Community Water Systems (serving over 100,000 persons)*	$72.5	$26.6	$9.9	$6.5	$0.9	$116.3
Medium Community Water Systems (serving 3,301 to 100,000 persons)*	$91.5	$29.8	$15.9	$7.1	$0.8	$145.1
Small Community Water Systems (serving 3,300 and fewer persons)	$34.7	$10.3	$8.5	$5.2	$0.6	$59.4
Not-for-Profit Noncommunity Water Systems†	$0.5	$0.8	$1.9	$0.8	$0.0	$4.1
Total State Need	**$199.2**	**$67.6**	**$36.3**	**$19.6**	**$2.3**	**$324.9**
American Indian and Alaskan Native Village Water Systems†	$1.6	$0.6	$0.6	$0.2	$0.0	$2.9
Costs Associated with Proposed and Recently Promulgated Regulations (taken from EPA economic analyses)		$7.0				$7.0
Total National Need	**$200.8**	**$75.1**	**$36.9**	**$19.8**	**$2.3**	**$334.8**

Note: Numbers may not total due to rounding.
* "Large" and "medium" community water systems are defined differently for this Assessment than in previous Assessments. See Appendix A for more information.
† Based on 1999 Assessment findings adjusted to 2007 dollars.

Transmission and Distribution Needs

Transmission and distribution projects are the largest category of need at $200.8 billion over the next 20 years (60 percent of the total need). Although the least visible component of a public water system, the buried pipes of a transmission and distribution network generally account for most of a system's capital value. Even small rural systems may have several hundred miles of pipe. In larger cities, replacement or rehabilitation of even small segments of the extensive underground networks of water supply pipes can be costly, both from the perspective of the cost of construction and the costs related to disruption to the city's commerce. Regardless of water system size, projects dealing with water mains and related infrastructure present challenges. Pipe projects are typically driven by a utility's need to continue providing potable water to its customers while preventing contamination of the water prior to delivery.

The majority of this $200.8 billion need is for replacing or refurbishing aging or deteriorating transmission and distribution mains. These projects are critical to the delivery of safe drinking water and can help ensure compliance with many regulatory requirements. Failures in transmission and distribution lines can interrupt the delivery of water and possibly allow contamination of the water.

The rate at which water mains require replacement or rehabilitation varies greatly by pipe material, age of the pipe, soil characteristics, weather conditions, and construction methods. Systems that have been unable to rehabilitate or replace mains may have proportionally more aged infrastructure, and therefore a higher level of need. In addition, some pipe materials tend to degrade prematurely; galvanized pipe is particularly susceptible to corrosion in certain soils, and unlined cast iron pipe is susceptible to internal corrosion. Furthermore, health concerns associated with asbestos during pipe repair make asbestos cement pipe undesirable for some systems. Many water suppliers are replacing these types of mains with ductile iron or polyvinyl chloride pipe.

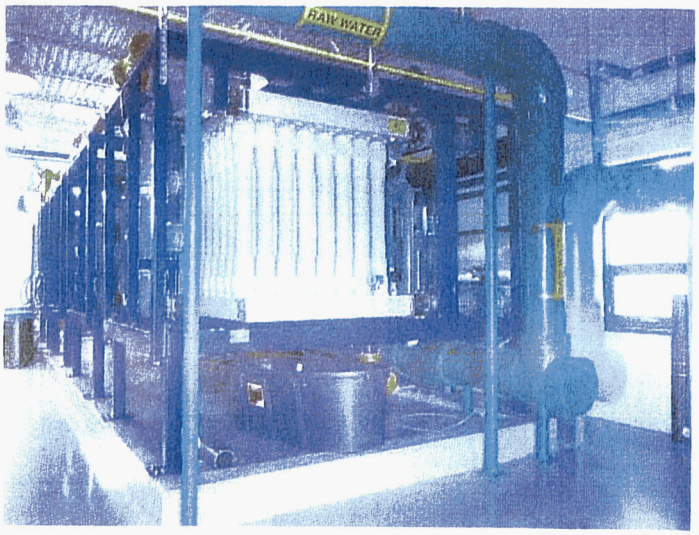
Ray Kvalheim, EPA Region 2

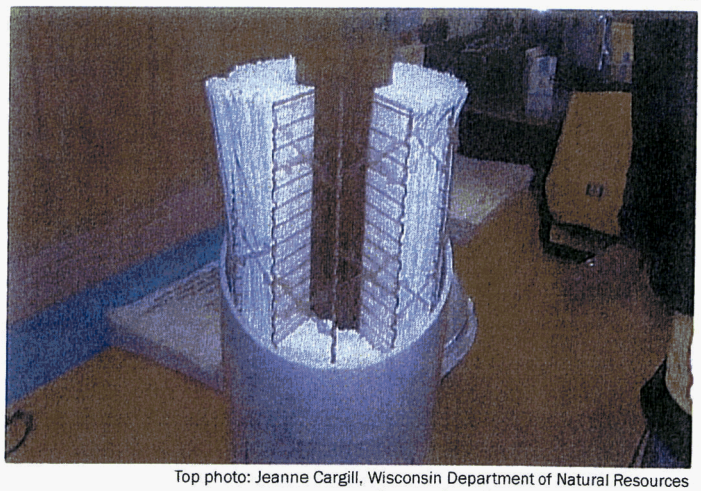
Minerals can build up in old water mains, leading to pressure and bacteriological problems. Pipe can be replaced, or it can be rehabilitated using a "pig" to scour the inside of the pipe and remove the deposits.

Other projects in the transmission and distribution category are; installing new pipe to loop dead end mains to avoid stagnant water, installing water mains in areas where existing homes do not have a safe and adequate water supply, and installing or rehabilitating pumping stations to maintain adequate pressure. This category also includes projects to address the replacement of appurtenances, such as valves that are essential for controlling flows and isolating problem areas during repairs, hydrants to flush the distribution system to maintain water quality, backflow-prevention devices to avoid contamination, and meters to record flow and water consumption.

Treatment Needs

The total 20-year national need for treatment is estimated to be $75.1 billion. This category includes the construction, expansion, and rehabilitation of infrastructure to reduce contamination through various treatment processes (e.g., filtration, disinfection, corrosion control). A large percentage of the regulatory need is in this category. Treatment facilities vary significantly depending on the quality of their source water and type of contamination present. Treatment systems range from a simple chlorinator for disinfection to a complete conventional treatment system with coagulation and flocculation (processes that cause particles suspended in the water to combine for easier removal), sedimentation, filtration, disinfection, laboratory facilities, waste handling, and computer automated monitoring and control devices.





Top photo: Jeanne Cargill, Wisconsin Department of Natural Resources
Bottom photo: Charles Pycha, EPA Region 5

Membrane technologies continue to advance as a viable treatment alternative as systems strive to produce higher quality finished water.

Treatment technologies are used to remove or inactivate disease-causing organisms, or to remove or prevent the formation of harmful chemicals.

The treatment category also includes projects to remove contaminants that adversely affect the taste, odor, and color of drinking water. Treatment for these "secondary contaminants" often involves softening the water to reduce magnesium and calcium levels, or applying chemical sequestrants for iron or manganese contamination. Although not a public health concern, the aesthetic problems caused by secondary contaminants may prompt some consumers to seek more palatable, but less safe or affordable sources of water.

Source Needs

The total 20-year national need for source water infrastructure is estimated at $19.8 billion. The source category includes needs for constructing or rehabilitating surface water intake structures, drilled wells, and spring collectors. Needs for dams and raw water reservoirs are excluded from DWSRF funding and this Assessment.

Drinking water comes from either ground water or surface water sources. Wells typically are considered ground water sources. Rivers, lakes, other open bodies of water, and wells under the direct influence of surface water are considered surface water sources. Whether drinking water originates from ground or surface water sources, its raw water quality is an

Drought

An emerging need encountered in the 2007 Assessment is new source water infrastructure to offset existing and anticipated drought conditions. In the past several years, water systems across the United States have been adversely affected by drought. Because drought is not always long-term or permanent, the DWSRF-eligibility of projects based on speculated continuation of the drought condition was not clear. EPA does not question that water systems are being affected by drought conditions. However, only a small percentage of the systems participating in the Assessment have completed plans to address the drought impacts. When documentation was lacking or nonexistent, EPA had to decide whether a speculative permanent solution or a less costly temporary solution should be considered for inclusion in the Assessment. EPA also investigated the drought-related projects to ensure they were primarily to provide drinking water to existing consumers and not for projected growth demand. EPA believes the drought-related needs reported in the 2007 Assessment capture a small portion of the drought-related need water utilities may face in the future.

Jim McRight, North Carolina Department of Environment and Natural Resources

Construction of a 2 million gallon clearwell at the new water treatment plant west of Kinston, North Carolina, funded partially by the DWSRF.

important component in protecting public health. A high-quality water supply can minimize the possibility of microbial or chemical contamination and may not require extensive treatment facilities. Many source water needs involve construction of new surface water intake structures or drilling new wells to obtain higher quality raw water.

A water source should provide an adequate supply to enable the water system to maintain minimum pressures. Low water pressure may result in the intrusion of contaminants into the distribution system. The 2007 Assessment includes projects to expand the capacity of intake structures and add new wells to address supply deficiencies facing existing customers.

Storage Needs

The 20-year national need estimated for storage projects is $36.9 billion. This category includes projects to construct, rehabilitate, or cover finished water storage tanks, but it excludes dams and raw water reservoirs (unless the raw water basins are onsite and part of the treatment process) because they are specifically excluded from DWSRF funding. It is critical that water systems have sufficient storage to provide adequate supplies of treated water to the public, particularly during periods of peak demand. This storage enables the system to maintain the minimum pressure required throughout the distribution system to prevent the intrusion of contaminants into the distribution network.

Other Needs

Needs not included in the previous four categories are grouped as "other" needs. These needs account for $2.3 billion of the total 20-year national need. Examples of "other" projects are system-wide telemetry, supervisory control and data acquisition (SCADA) systems, and water system security measures that were not assigned to another category.

Need by System Size

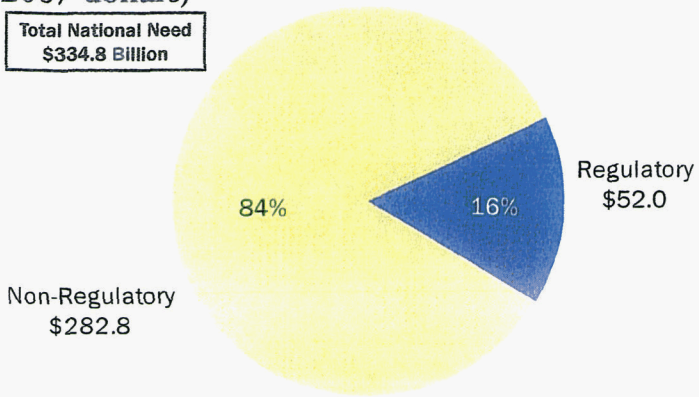
Exhibit 1.6 shows the relationship between infrastructure need, population served, and the number of community water systems by size category. As this exhibit demonstrates, large systems account for a small portion of the number of community water systems in the country, but they serve 45 percent of the population receiving water from community water systems and account for 36 percent of the drinking water infrastructure investment need. Small systems cannot take advantage of economies-of-scale like large systems and so have higher costs per customer. Small systems represent, by far, the largest number of systems, but they account for only 9 percent of the population served. In addition, in relation to population served, they account for a disproportionate 19 percent of the community water system need. Medium systems represent the largest portion of the need, and their need is more proportional to the population served.

Exhibit 1.6: Community Water System 20-Year Need by Size and Population*

System Size	CWS Need		Water Systems		Population Served	
	$ Billions†	% of CWS Need	Number of Systems‡	% of Water Systems‡	Population (millions)§	% of Population Served§
Large Community Water Systems (serving over 100,000 persons)**	$116.3	36%	584	1%	128.6	45%
Medium Community Water Systems (serving 3,301 to 100,000 persons)**	$145.1	45%	8,749	17%	130.7	46%
Small Community Water Systems (serving 3,300 and fewer persons)	$59.4	19%	41,748	82%	24.1	9%

Note: Numbers may not total due to rounding.
* This exhibit reports the need for community water systems. It does not discuss findings for not-for-profit noncommunity systems, needs associated with proposed or recently promulgated regulations, or needs for American Indian or Alaskan Native Village water systems.
† Need reported in billions of January 2007 dollars.
‡ Based on the DWINSA sample frame as discussed in Appendix A of this report.
§ Data on population served from EPA's Factoid: Drinking Water and Ground Water Statistics for 2007. EPA 816-K-07-004. March 2008. Does not include populations for systems defined as "Federal Systems" or "Native American," but does include populations served by Alaskan Native Village water systems. Factoid distinguished system sizes for "very small," "small," "medium," "large," and "very large," allowing direct comparisons to system size in the Assessment.
** "Large" and "medium" community water systems are defined differently for this Assessment than in previous Assessments. See Appendix A for more information.

Exhibit 1.7: Total Regulatory vs. Non-Regulatory 20-Year Need (in billions of January 2007 dollars)



Note: Numbers may not total due to rounding.

Needs Associated with SDWA Regulations

As shown in Exhibit 1.7, 16 percent of the total national need, $52.0 billion, is for compliance with the SDWA regulations. This need includes existing regulations as well as regulations which are proposed or recently promulgated (see below). Although all of the projects in the Assessment are needed to further the goals of the SDWA, most needs are not for obtaining or maintaining compliance with a specific regulation. Most infrastructure projects are needed to ensure continued provision of potable water to a utility's customers. Projects that are directly attributable to specific SDWA regulations are collectively referred to as the "regulatory need." Most of the regulatory need involves the upgrade, replacement, or installation of treatment technologies.

The Assessment divides the regulatory need in several ways: existing regulations, proposed and recently promulgated regulations, and microbial or chemical regulations. Exhibit 1.8 provides a matrix of the regulatory needs by these categories.

Existing Regulations

Microbial Contaminants.

The surface water treatment regulations (Surface Water Treatment Rule, Interim Enhanced Surface Water Treatment Rule, Filter Backwash Recycling Rule, Long Term 1 Enhanced Surface Water Treatment Rule, and covers for finished water reservoirs required by the Long Term 2 Enhanced Surface Water Treatment Rule) and the Total Coliform Rule are existing SDWA regulations that address microbial contamination. Treatment requirements for the Long Term 2 Enhanced Surface Water Treatment Rule are included in the proposed and recently promulgated regulation need. Stage 1 Disinfectants/Disinfection Byproducts

Exhibit 1.8: Total 20-Year National Regulatory Need (in billions of January 2007 dollars)

Regulation Type	Microbial Regulations	Chemical Regulations	Total Regulatory Need
Existing Regulations	$29.4	$15.6	$45.0
Proposed or Recently Promulgated Regulations	$3.6	$3.3	$7.0
Total Regulatory Need	**$33.0**	**$19.0**	**$52.0**

Note: Numbers may not total due to rounding.

Assigning Arsenic Needs for Small Systems in the 2007 DWINSA

In January 2001, EPA revised the arsenic standard to a maximum contaminant level (MCL) of 10 µg/L. Systems that cannot meet the revised MCL may have capital improvement needs to address arsenic in their source water. The 2007 DWINSA requested that systems identify their needs associated with the revised arsenic standard on their surveys.

Because the sample of small systems is a national sample, and because of the non-uniform distribution of arsenic throughout the country, the DWINSA workgroup was concerned that the findings of the small system survey would not be representative of specific states' need. In short, states with more arsenic problems should be assigned a higher small system "arsenic need."

To account for these needs, EPA took a threefold approach.

- First, small systems with arsenic-related needs were identified. EPA used the national water system database (SDWIS) and enlisted the help of states to determine which small systems will have to address the revised arsenic standard.
- Second, a "need" associated with addressing the high arsenic levels was estimated for individual small systems based on information provided by the states and the DWINSA cost models.
- Third, these two factors were used to calculate each state's total need for small systems to address the revised arsenic standard.

Rule regulates the maximum disinfectant and disinfection byproducts levels in distribution systems and is commonly grouped with the microbial rules.

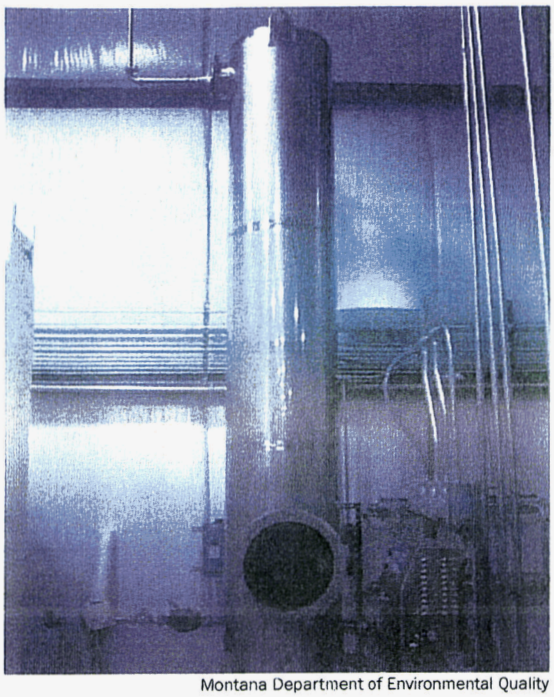
Projects for compliance with existing regulations were reported by systems in the Assessment and account for more than half of the total regulatory need and almost all of the microbial contaminant-related need. This reflects the fact that the majority of the nation's large municipal systems use surface water sources. Under all of these regulations, systems using surface water sources must provide treatment to minimize microbial contamination. In most cases, this means installing, upgrading, or rehabilitating treatment plants to control pathogens, such as the bacterium *E. coli*, the virus Hepatitis A, and the protozoans *Giardia lamblia* and *Cryptosporidium*. Disinfection also helps protect the system from Total Coliform Rule violations.

Chemical Contaminants.

This estimate includes projects attributable to the Nitrate/Nitrite Standard, the revised Arsenic Standard, the Lead and Copper Rule, and other regulations that set maximum contaminant levels (MCLs) or treatment techniques for organic and inorganic chemicals. Examples of projects are, infrastructure that aerates water to remove volatile organic compounds such as tetrachloroethylene, or ion exchange units that remove contaminants from the water. This category includes regulations governing more than 80 inorganic or organic chemicals for which infrastructure projects may be needed.

Proposed or Recently Promulgated Regulatory Needs

In general, water systems can readily identify the infrastructure needs required for compliance with existing regulations, but most systems have not determined the infrastructure needed to comply with proposed or recently promulgated regulations. Therefore, relying on systems to report the infrastructure needs for proposed or recently promulgated regulations might



Montana Department of Environmental Quality

To meet the Long Term 2 Enhanced Surface Water Treatment Rule, systems may need to provide additional disinfection infrastructure. This ozone contact chamber is an example of a type of disinfection that may be applied. Treatment needs for recently promulgated regulations were estimated separate from the states' surveys, through EAs.

misstate the true need. Consequently, EPA derived the capital infrastructure estimates from the EA that the Agency published when proposing each regulation, or from the final EA if the regulation has been recently promulgated.

However, since the EAs rely on regional data, they are not appropriate predictors of state-specific needs. Therefore, the costs associated with the proposed or recently promulgated regulations are allocated at a national level, not apportioned to each state.

The proposed or recently promulgated regulations included in the 2007 Assessment are:

- Proposed Radon Rule
- Final Stage 2 Disinfectants/Disinfection Byproducts Rule
- Final Long Term 2 Enhanced Surface Water Treatment Rule (treatment needs only)
- Final Ground Water Rule

The total cost of complying with these regulations is included in the 2007 Assessment as future regulatory needs. The capital cost estimates for each of these rules are provided in Exhibit 1.9.

Exhibit 1.9: Total National 20-Year Need for Proposed and Recently Promulgated Regulations (in billions of January 2007 dollars)

Proposed or Recently Promulgated Regulation	Estimated Total Regulatory Need*
Long Term 2 Enhanced Surface Water Treatment Rule	$2.2
Stage 2 Disinfectants/Disinfection Byproducts Rule	$1.0
Ground Water Rule	$0.4
Radon Rule†	$3.3
Total Proposed or Recently Promulgated Regulatory Need	**$7.0**

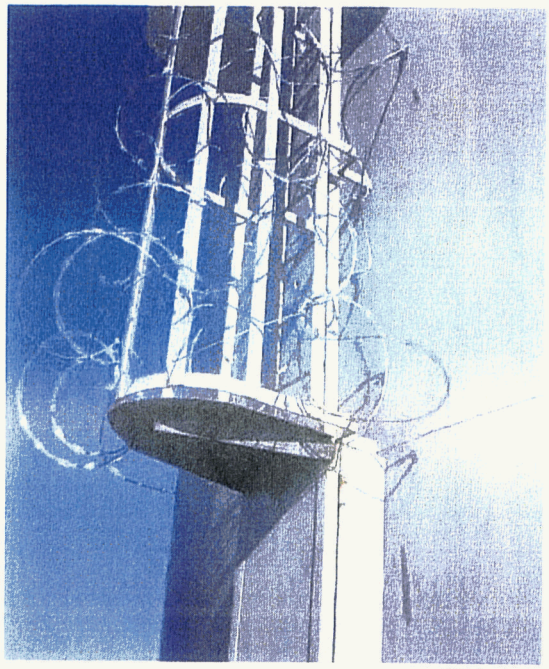
* Estimates obtained from the appropriate Final or Proposed Rule "Economic Analysis." These estimates include only capital costs (i.e., they exclude operation and maintenance costs).
† The total capital costs were determined by averaging the capital costs from the Economic Analysis for the proposed Radon Rule.

Security Needs

Vulnerability assessments and the identification of security needs for water systems are rapidly evolving. Since the September 11, 2001 attacks, there has been a concentrated national focus on our vulnerabilities, and water systems are no exception. The Public Health Security and Bioterrorism Preparedness and Response Act of 2002 requires any community water system that serves a population of more than 3,300 to prepare a vulnerability assessment. For many water systems, particularly the large systems, security measures have become fully integrated into the capital costs of major infrastructure improvements.

Projects in the 2007 Assessment that were specifically listed as security need account for $422.0 million. However, the total cost that systems incur to protect their infrastructure and their customers' water quality is likely far greater because many of these costs are now commonly incorporated into the construction cost of infrastructure projects rather than considered separately. The majority of security needs are mostly "hidden" in the other needs reported by this Assessment.

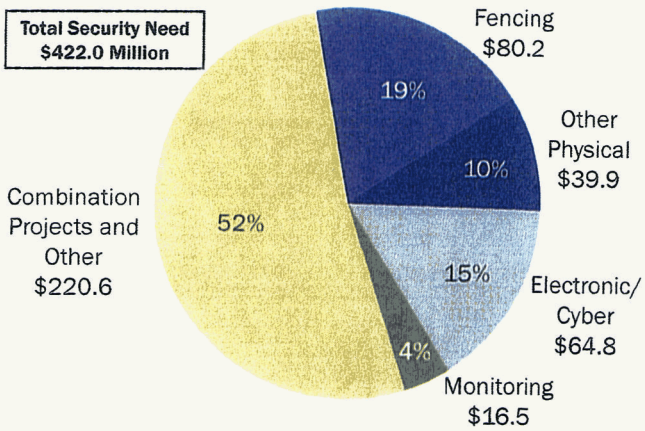
Exhibit 1.10 shows the breakdown of the stand-alone security needs by type of project, including fencing, electronic or cyber security, other physical security measures, monitoring equipment, and other projects listed as having multiple types of security needs. Note that these categories are slightly different from those reported in the 2003 Assessment. They were changed to align with the categories now used within the water supply industry.



EPA Region 9

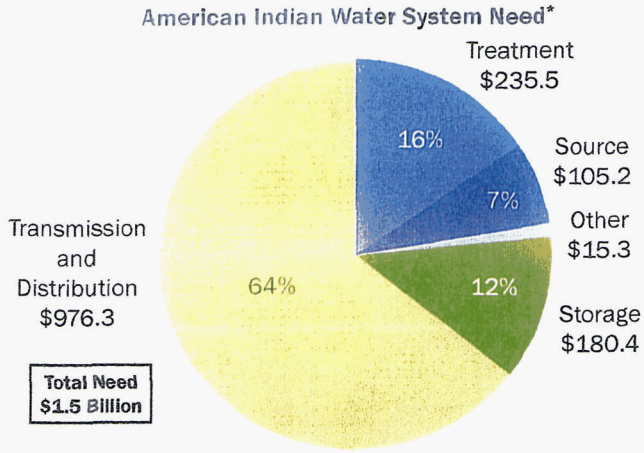
Storage tanks are equipped with caged ladders for safety and are secured to deter trespassers.

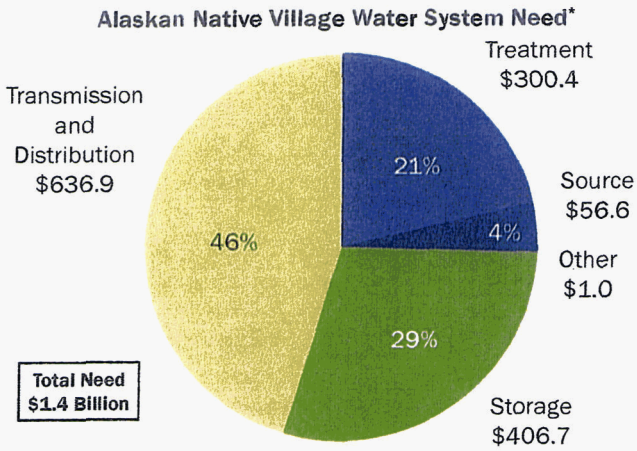
Exhibit 1.10: Total National 20-Year Security Needs (in millions of January 2007 dollars)



Note: Numbers may not total due to rounding.

Exhibit 1.11: Total 20-Year American Indian and Alaskan Native Village Water System Need by Project Type (in millions of January 2007 dollars)





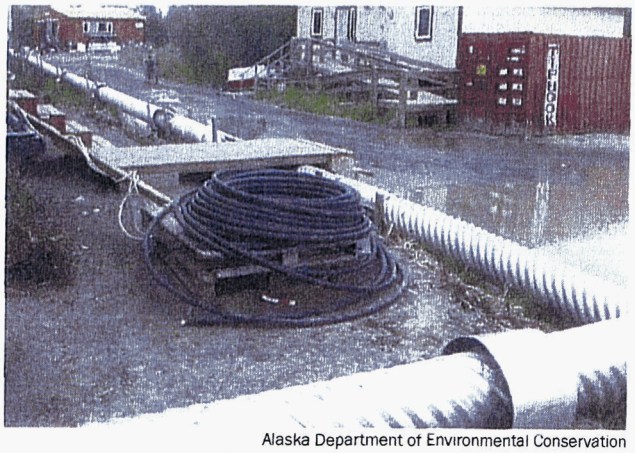
Note: Numbers may not total due to rounding.

*These numbers do not include the need associated with the Arsenic Rule.

American Indian and Alaskan Native Village Water System Needs

Because of the effort invested in the 1999 Assessment and the high confidence level in the data from that effort, EPA did not resurvey the American Indian and Alaskan Native Village water systems for the 2007 Assessment. Instead, the need established in 1999 was adjusted to 2007 dollars and used as an estimate for the 2007 need. Accordingly, the American Indian and Alaskan Native Village water systems need to invest an estimated $2.9 billion in capital improvements over the next 20 years.

The total 20-year need for American Indian water systems is $1.5 billion. The total 20-year need for Alaskan Native Village water systems is $1.4 billion. These estimates do not include the need associated with the revised Arsenic Standard. Exhibit 1.11 shows the total American Indian and Alaskan Native Village water system need by project type.



Alaska Department of Environmental Conservation

Residents fill up at a coin-operated watering point in Tuluksak, Alaska. The terrain and permafrost conditions require above-ground pipes in some parts of the state.

The remote locations of many widely dispersed communities and the limited availability of water resources are among the logistical challenges that account for the high per-household need of American Indian water systems.

The need for Alaskan Native Village water systems differs from more typical community water systems in that costs for storage in Alaskan Native Village water systems exceed those for treatment needs. These water systems face higher costs because of their remote arctic locations and the unique design and construction standards required in permafrost conditions.

Exhibit 1.12 presents the American Indian and Alaskan Native Village water system need by EPA Region.

Exhibit 1.12: 20-Year American Indian and Alaskan Native Village Water System Need by EPA Region (in millions of January 2007 dollars)

Region	Total American Indian and Alaskan Native Village Water System Need
Region 1	$5.2
Region 2	$7.9
Region 3*	$0.0
Region 4	$23.4
Region 5	$206.6
Region 6	$199.5
Region 7	$18.8
Region 8	$175.1
Region 9†	$720.8
Region 10‡	$155.4
Alaskan Native Systems	$1,401.6
Need to Comply with the Revised Arsenic Standard	$17.6
Total	**$2,931.8**

* There are no American Indian water systems in EPA Region 3.
† Navajo water systems are located in EPA Regions 6, 8, and 9, but for purposes of this report, all Navajo water system needs are reported in EPA Region 9.
‡ Needs for Alaskan Native Village water systems are not included in the EPA Region 10 total.

EPA Region 9

A well pump house and storage tank at a small water system in Arizona.

California Department of Health Services

Construction of a 0.75 million gallon storage tank in Kerman, California.

Chapter 2: Findings - State Need

State-Specific Needs

Since federal fiscal year 1998, the SDWA has required EPA to allot DWSRF grants to each state based on the findings of the most recent DWINSA. Because of this Assessment's role in determining DWSRF capitalization grant allocations, obtaining highly credible and statistically valid estimates of each state's need is crucial. Exhibits 2.1 and 2.2 show the total DWSRF-eligible need for states, Puerto Rico, Washington, D.C., and the U.S. Territories by project type and system size. Exhibit 2.3 is a map indicating each state's 20-year total need.

DWSRF capitalization grants for fiscal years 2010 through 2013 will be allocated to states based on the findings of the 2007 Assessment. The funding is allocated by first setting aside a 1.5 percent allotment to American Indian and Alaskan Native Village water systems and a 0.33 percent allotment to the U.S. Territories (the U.S. Virgin Islands, Guam, the Commonwealth of the Northern Mariana Islands, and American Samoa); the Assessment findings are used to help divide these set-asides among these entities. The remaining funds are then divided among the states, Puerto Rico, and Washington, D.C. based on the Assessment's determination of each state's relative percentage of the total "state need" with each receiving no less than the 1 percent minimum allotment.

States that received the minimum allocation of 1 percent in the most recent allocation were given the option of a lower level of participation in the Assessment. These states' needs are reported as one group referred to as "partially surveyed" states. This option is explained later in this chapter.

The state need does not include costs associated with proposed or recently promulgated regulations or the need of American Indian or Alaskan Native Village water systems.

Partnership for Determining State Need

The substantial effort involved in collecting data and calculating water systems' 20-year needs relies on a partnership between EPA, the states, and the utilities themselves. Each partner makes a valuable contribution to estimating the DWSRF-eligible needs of drinking water systems.

Water System. Operators and managers of water utilities have on-the-ground knowledge of their system's infrastructure and condition. These personnel are in the best position to assess their infrastructure needs.

States. State personnel often have considerable knowledge of the systems in their state, and states have staffs whose members are trained to assist systems in completing this Assessment. The states work with EPA towards consensus development of Assessment policies and methods to ensure consistency across the states.

EPA. EPA's primary roles are to serve as the quality assurance agent for the data collection effort, to ensure that survey policies and methodologies are met, and to serve as a technical resource to assist with capturing complete and accurate 20-year needs. EPA provides checks and balances for survey submittals to encourage full reporting, to ensure consistency and fairness between states, and to control any state bias.

Jeanne Cargill, Wisconsin Department of Natural Resources

This new microfiltration plant in Ashland, Wisconsin replaced a treatment plant that was over 100 years old.

Exhibit 2.1: State 20-Year Need Reported by Project Type (in millions of January 2007 dollars)

State	Transmission/ Distribution	Source	Treatment	Storage	Other	Total
Alabama	$3,343.9	$71.6	$386.5	$285.3	$12.0	$4,099.4
Alaska	$478.2	$56.4	$121.3	$150.0	$6.5	$812.4
Arizona	$3,819.0	$460.3	$2,150.2	$900.1	$81.1	$7,410.7
Arkansas	$3,667.5	$149.3	$966.0	$478.3	$17.4	$5,278.5
California	$22,988.5	$2,515.3	$7,549.7	$5,735.6	$257.3	$39,046.3
Colorado	$3,156.7	$371.7	$2,150.2	$696.7	$24.8	$6,400.1
Connecticut	$807.1	$134.9	$280.6	$151.6	$19.7	$1,394.0
District of Columbia	$836.8	$0.0	$0.4	$35.5	$1.5	$874.2
Florida	$7,234.9	$887.3	$3,552.1	$975.4	$173.5	$12,823.1
Georgia	$6,295.6	$406.2	$1,390.5	$751.5	$93.9	$8,937.7
Illinois	$8,982.0	$1,576.3	$2,907.8	$1,386.7	$164.2	$15,017.1
Indiana	$3,814.2	$353.8	$1,096.1	$648.5	$31.8	$5,944.4
Iowa	$4,356.8	$271.9	$990.8	$467.2	$26.4	$6,113.1
Kansas	$2,784.4	$187.1	$684.1	$339.7	$35.0	$4,030.2
Kentucky	$3,643.6	$121.7	$699.0	$474.8	$38.9	$4,978.1
Louisiana	$5,100.7	$305.7	$1,024.8	$427.4	$41.3	$6,900.1
Maryland	$3,497.6	$180.6	$1,134.5	$606.0	$24.7	$5,443.4
Massachusetts	$4,456.4	$340.9	$1,130.1	$823.4	$39.1	$6,790.0
Michigan	$7,657.6	$529.6	$2,548.5	$1,035.8	$71.3	$11,842.8
Minnesota	$2,819.3	$372.0	$1,982.9	$770.3	$43.9	$5,988.4
Mississippi	$1,604.4	$284.7	$907.2	$429.8	$17.2	$3,243.3
Missouri	$4,801.8	$324.7	$1,281.2	$635.7	$42.3	$7,085.6
Nebraska	$1,017.7	$140.5	$309.2	$300.8	$8.4	$1,776.6
Nevada	$1,116.4	$892.3	$202.2	$460.6	$19.8	$2,691.3
New Jersey	$4,722.9	$307.1	$1,850.4	$1,056.7	$24.7	$7,961.6
New York	$15,417.0	$1,915.5	$6,986.2	$2,707.8	$110.9	$27,137.3
North Carolina	$6,037.1	$670.7	$2,237.7	$1,032.7	$77.1	$10,055.2
Ohio	$8,374.2	$564.2	$2,235.6	$1,330.4	$94.6	$12,599.0
Oklahoma	$2,603.5	$142.0	$858.9	$493.5	$14.1	$4,112.1
Oregon	$1,520.6	$156.3	$546.1	$536.0	$26.2	$2,785.3
Pennsylvania	$7,644.9	$557.1	$1,834.5	$1,284.2	$58.7	$11,379.3
Puerto Rico	$1,079.5	$80.6	$1,037.4	$325.2	$14.8	$2,537.5
South Carolina	$1,102.7	$75.2	$222.3	$210.2	$17.9	$1,628.3
Tennessee	$2,356.3	$109.2	$692.8	$368.0	$21.2	$3,547.6
Texas	$15,950.2	$1,600.3	$5,785.2	$2,695.8	$99.2	$26,130.8
Virginia	$3,806.3	$196.0	$1,293.3	$722.8	$43.6	$6,061.9
Washington	$5,765.5	$717.3	$1,580.0	$1,502.7	$190.6	$9,756.0
Wisconsin	$3,550.5	$385.1	$1,467.5	$758.7	$24.2	$6,186.0
Partially Surveyed States*	$10,478.1	$1,131.1	$3,347.3	$2,099.5	$136.3	$17,192.4
Subtotal	***$198,690.3***	***$19,542.3***	***$67,421.3***	***$36,091.3***	***$2,246.3***	***$323,991.4***
American Samoa	$43.7	$10.6	$15.9	$22.0	$0.6	$92.8
Guam	$223.6	$2.0	$8.6	$29.7	$0.0	$263.9
Commonwealth of the Northern Mariana Islands	$123.2	$28.7	$61.8	$65.8	$9.7	$289.3
U.S. Virgin Islands	$138.3	$7.1	$45.9	$59.8	$2.3	$253.3
Subtotal	***$528.8***	***$48.4***	***$132.2***	***$177.2***	***$12.7***	***$899.4***
Total State Need	**$199,219.1**	**$19,590.7**	**$67,553.5**	**$36,268.5**	**$2,259.0**	**$324,890.8**

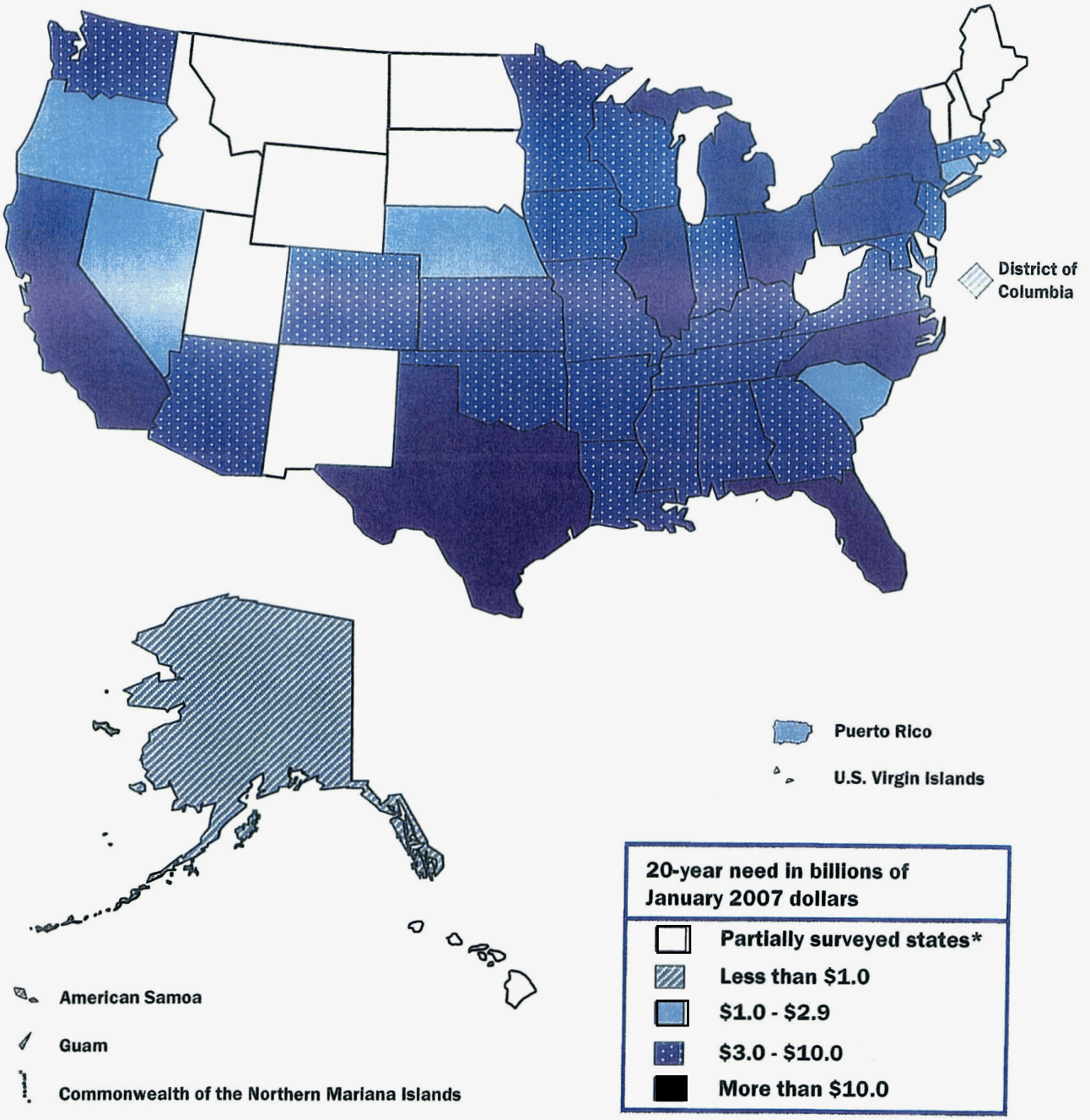
* For the 2007 DWINSA the need for states that opt out of the medium system portion of the survey is presented cumulatively and not by state. The list of the 14 partially surveyed states can be seen in Exhibit 2.4.

Exhibit 2.2: State 20-Year Need Reported by System Size (in millions of January 2007 dollars)

State	Large	Medium	Small	NPNCWS	Total
Alabama	$998.5	$2,709.8	$387.2	$3.8	$4,099.4
Alaska	$85.1	$302.3	$363.8	$61.1	$812.4
Arizona	$4,381.4	$2,121.3	$889.4	$18.5	$7,410.7
Arkansas	$443.6	$3,854.3	$973.3	$7.3	$5,278.5
California	$21,345.9	$14,098.1	$3,500.9	$101.4	$39,046.3
Colorado	$2,079.0	$3,246.6	$1,073.2	$1.3	$6,400.1
Connecticut	$288.3	$451.2	$627.0	$27.5	$1,394.0
District of Columbia	$874.2	$0.0	$0.0	$0.0	$874.2
Florida	$5,135.7	$5,769.3	$1,790.4	$127.7	$12,823.1
Georgia	$2,663.4	$4,716.0	$1,544.5	$13.8	$8,937.7
Illinois	$5,248.1	$7,006.7	$2,652.2	$110.2	$15,017.1
Indiana	$1,417.2	$3,291.0	$1,059.9	$176.3	$5,944.4
Iowa	$458.2	$4,190.3	$1,446.2	$18.4	$6,113.1
Kansas	$766.5	$2,017.8	$1,242.3	$3.5	$4,030.2
Kentucky	$757.5	$3,879.0	$340.5	$1.1	$4,978.1
Louisiana	$3,354.7	$2,249.4	$1,281.0	$14.9	$6,900.1
Maryland	$3,924.1	$853.3	$567.8	$98.2	$5,443.4
Massachusetts	$1,683.3	$4,649.7	$424.0	$32.9	$6,790.0
Michigan	$4,952.6	$4,677.0	$1,740.9	$472.2	$11,842.8
Minnesota	$672.0	$3,631.7	$1,416.5	$268.3	$5,988.4
Mississippi	$227.0	$1,432.2	$1,574.5	$9.6	$3,243.3
Missouri	$1,342.2	$3,860.3	$1,844.0	$39.1	$7,085.6
Nebraska	$379.0	$632.2	$749.4	$16.0	$1,776.6
Nevada	$2,098.2	$291.2	$287.7	$14.2	$2,691.3
New Jersey	$3,636.5	$3,502.2	$619.4	$203.6	$7,961.6
New York	$17,956.6	$5,434.9	$3,619.7	$126.2	$27,137.3
North Carolina	$3,043.9	$4,907.5	$1,734.1	$369.7	$10,055.2
Ohio	$3,172.1	$7,449.7	$1,695.0	$282.2	$12,599.0
Oklahoma	$714.8	$1,917.2	$1,457.9	$22.3	$4,112.1
Oregon	$674.2	$958.2	$1,097.3	$55.6	$2,785.3
Pennsylvania	$3,950.8	$4,542.2	$2,604.6	$281.8	$11,379.3
Puerto Rico	$823.6	$1,109.4	$603.3	$1.2	$2,537.5
South Carolina	$295.4	$806.1	$510.6	$16.2	$1,628.3
Tennessee	$555.8	$2,224.9	$738.1	$28.8	$3,547.6
Texas	$7,614.8	$13,376.3	$5,091.9	$47.7	$26,130.8
Virginia	$2,474.4	$2,216.5	$1,279.4	$91.7	$6,061.9
Washington	$2,686.7	$4,586.7	$2,366.6	$116.1	$9,756.0
Wisconsin	$1,299.2	$3,074.9	$1,328.4	$483.5	$6,186.0
Partially Surveyed States*	$1,664.1	$8,537.0	$6,686.7	$304.5	$17,192.4
Subtotal	***$116,139.0***	***$144,574.7***	***$59,209.6***	***$4,068.2***	***$323,991.4***
American Samoa	$0.0	$59.5	$33.3	$0.0	$92.8
Guam	$203.1	$60.8	$0.0	$0.0	$263.9
Commonwealth of the Northern Mariana Islands	$0.0	$158.6	$130.6	$0.0	$289.3
U.S. Virgin Islands	$0.0	$197.4	$55.9	$0.0	$253.3
Subtotal	***$203.1***	***$476.4***	***$219.9***	***$0.0***	***$899.4***
Total State Need	**$116,342.1**	**$145,051.1**	**$59,429.5**	**$4,068.2**	**$324,890.8**

* For the 2007 DWINSA the need for states that opt out of the medium system portion of the survey is presented cumulatively and not by state. The list of the 14 partially surveyed states can be seen in Exhibit 2.4.

Exhibit 2.3: Overview of 20-Year Need by State



* The list of the 14 partially surveyed states can be seen in Exhibit 2.4.

- Does not include needs for American Indian and Alaskan Native Village water systems.
- The needs for American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, and the U.S. Virgin Islands are less than $1 billion each.

States that received the minimum DWSRF allotment of 1 percent in the most recent allocation were given the option of surveying only the large systems in their state, and not collecting data for medium-sized systems. (Small system data were collected by EPA.) This option was provided to reduce the burden on these states and allow for resources to be focused on the large systems. Of the 24 states (including Washington, D.C. and Puerto Rico) that received the minimum allocation based on the 2003 DWINSA findings, 14 chose this "partially surveyed" option. For these states, the medium system need was estimated based on data from fully surveyed states. Because this method does not meet the Assessment's stringent data quality objectives at the state level, the needs of these states contribute to the estimate of the total national need but are not reported individually by state. Exhibit 2.4 shows the large and small system need estimated by state, and the total medium system need for the partially surveyed states.

Exhibit 2.4: State 20-Year Need Reported for Partially Surveyed States (in millions of January 2007 dollars)

State	Large CWSs	Medium CWSs	Small CWSs	NPNCWSs
Delaware	$22.0		$258.0	$3.2
Hawaii	$30.1		$160.0	$1.0
Idaho	$114.2		$738.5	$37.7
Maine	$63.1		$442.2	$34.5
Montana	$83.6		$687.6	$50.7
New Hampshire	$98.7		$686.6	$61.9
New Mexico	$230.0		$687.5	$15.4
North Dakota	$0.0		$401.3	$5.3
Rhode Island	$342.3		$70.0	$16.1
South Dakota	$72.0		$462.9	$5.1
Utah	$517.7		$490.7	$13.0
Vermont	$0.0		$453.0	$0.2
West Virginia	$90.4		$860.9	$48.2
Wyoming	$0.0		$287.4	$12.2
Total Partially Surveyed State Need	**$1,664.1**	**$8,537.0**	**$6,686.7**	**$304.5**

More of the need of the partially surveyed states is for small and medium systems than among the rest of the nation. Large system need makes up a relatively small share of the total among partially surveyed states because these states generally do not have as many systems serving more than 100,000 persons as other states.

Changes in State-Specific Need through Assessment Cycles

As shown in Exhibit 2.5, the state-specific results of the 2007 Assessment, when compared to previous Assessments, show that states' needs change, and some change more significantly than others during the 4-year intervals between Assessments. Changes in relative needs of states from one Assessment to the next can be attributed to two primary factors:

- Changes in Projects Planned, Initiated, and Completed. Congress specified that the DWINSA be repeated at 4-year intervals to capture changes in system infrastructure needs. Changes in the reported needs of individual systems from one survey period to the next can have a significant effect on the overall state need. For instance, in one Assessment a state may have a large system that has identified a project with very substantial costs. During that Assessment cycle, that state's need may be increased due to this large project. However, if construction of this project begins prior to the next Assessment cycle, those needs would no longer be included, and this state's need may be lower. In addition, conditions within a state may change dramatically over a 4-year period and have an impact on that state's need. For example, Louisiana's needs increased substantially from 2003 to 2007 to address the post-Hurricane Katrina infrastructure needs of water systems in New Orleans and the surrounding area.
- **Changes in National and State Assessment Approaches.** State-specific needs will be affected by how the Assessment has evolved since the first Assessment was conducted in 1995. The Assessment's "bottom-up" approach of submitting and accepting documented needs on a project-by-project basis for each individually sampled system has remained essentially unchanged. However, significant changes that can have an impact on individual states needs have been implemented regarding the parties responsible for data collection, the type of documentation required to support acceptance of an identified need, and policies and approaches implemented to ensure complete and quality data collection by the states. The 2003 Assessment provided flexibility to the states and water systems regarding approaches for estimating longer term rehabilitation and replacement needs. States not only used different assumptions for estimating those needs but also invested different levels of effort into conducting the Assessment. The 2007 Assessment put considerable emphasis on gaining consistency across all states and water systems in both the means and the level of effort for these estimations. This was done through the establishment of well-defined policies on project documentation requirements and mechanisms to track each state's progress in achieving a complete assessment of needs. The policies and mechanisms are described in Appendix C. The impact of the policies varied by state, depending on their approach to the previous Assessment.

Adele Basham, Nevada Department of Environmental Protection

Raw water and finished water transmission mains are laid for an arsenic treatment project in Nevada's Moapa Valley.

Exhibit 2.5: Historic State Need Reported for Each DWINSA (20-year need in millions of January 2007 dollars)

State	1995	1999	2003	2007
Alabama	$2,402.1	$1,419.6	$2,022.2	$4,099.4
Alaska	$1,116.5	$768.6	$816.0	$812.4
Arizona	$1,959.8	$2,130.8	$10,920.0	$7,410.7
Arkansas	[illegible]	$2,014.7	[illegible]	$5,278.5
California	$27,237.6	$22,969.0	$33,372.9	$39,046.3
Colorado	[illegible]	[illegible]	[illegible]	[illegible]
Connecticut	$1,964.1	$1,322.1	$782.0	$1,394.0
Delaware	$538.0	$399.3	$388.4	*
District of Columbia	$190.5	$543.8	$178.9	$874.2
Florida	$6,276.3	$4,891.3	$18,009.5	$12,823.1
Georgia	$4,770.0	$3,160.4	$10,797.5	$8,937.7
Hawaii	$623.8	$192.6	$972.9	*
Idaho	$854.5	$677.6	$870.4	*
Illinois	$7,744.9	$8,076.4	$16,160.9	$15,017.1
Indiana	$2,424.5	$2,224.2	$4,827.7	$5,944.4
Iowa	$3,265.9	$3,738.6	$4,195.5	$6,113.1
Kansas	$2,861.4	$2,161.6	$2,312.1	$4,030.2
Kentucky	$3,220.0	$2,323.7	$3,363.2	$4,978.1
Louisiana	$2,828.1	$1,671.7	$4,917.4	$6,900.1
Maine	$1,253.0	$654.8	$996.0	*
Maryland	$1,859.9	$2,194.6	$4,745.5	$5,443.4
Massachusetts	$8,606.9	$7,717.7	$10,243.3	$6,790.0
Michigan	$6,423.3	$8,915.4	$13,543.7	$11,842.8
Minnesota	$3,529.0	$4,070.6	$6,538.3	$5,988.4
Mississippi	$2,281.8	$1,787.1	$1,969.1	$3,243.3
Missouri	$2,720.1	$2,862.8	$7,134.3	$7,085.6
Montana	$959.3	$1,145.1	$945.1	*
Nebraska	$1,379.5	$1,092.8	$1,621.3	$1,776.6
Nevada	$759.9	$791.2	$1,092.2	$2,691.3
New Hampshire	$1,038.0	$655.9	$713.2	*

State	1995	1999	2003	2007
New Jersey	$5,230.9	$4,805.3	$8,280.6	$7,961.6
New Mexico	$1,509.5	$1,308.4	$1,104.5	*
New York	$14,596.7	$17,277.3	$17,736.3	$27,137.3
North Carolina	[illegible]	[illegible]	[illegible]	[illegible]
North Dakota	$849.7	$643.3	$726.6	*
Ohio	[illegible]	[illegible]	[illegible]	[illegible]
Oklahoma	$2,940.9	$3,074.2	$5,752.4	$4,112.1
Oregon	$3,110.0	$4,557.9	$5,110.0	$2,785.5
Pennsylvania	$6,885.4	$6,905.8	$13,159.6	$11,379.3
Puerto Rico	$3,263.2	$2,589.7	$2,728.6	$2,537.5
Rhode Island	$950.7	$757.9	$482.1	*
South Carolina	$2,114.8	$1,077.6	$1,491.5	$1,628.3
South Dakota	$823.3	$577.5	$1,185.2	*
Tennessee	$2,709.0	$1,851.9	$3,317.3	$3,547.6
Texas	$17,900.6	$17,161.7	$33,729.8	$26,130.8
Utah	$1,513.5	$674.9	$846.4	*
Vermont	$664.9	$403.1	$472.7	*
Virginia	$4,262.0	$2,699.4	$3,430.6	$6,061.9
Washington	$5,835.5	$5,184.2	$7,988.6	$9,756.0
West Virginia	$1,578.3	$1,339.6	$1,032.1	*
Wisconsin	$2,703.2	$4,068.7	$7,110.2	$6,186.0
Wyoming	$565.6	$580.8	$357.0	*
Partial Participation States*	*	*	*	$17,192.4
Subtotal	***$197,882.0***	***$182,564.5***	***$315,746.0***	***323,991.4***
American Samoa	$32.5	$47.8	$38.7	$92.8
Guam	$154.5	$150.6	$334.0	$263.9
Commonwealth of the North Mariana Islands	$50.7	$98.3	$236.9	$289.3
U.S. Virgin Islands	$323.0	$212.3	$216.0	$253.3
Subtotal	***$560.7***	***$508.9***	***$825.6***	***$899.4***
Total	**$198,442.7**	**$183,073.4**	**$316,571.6**	**$324,890.8**

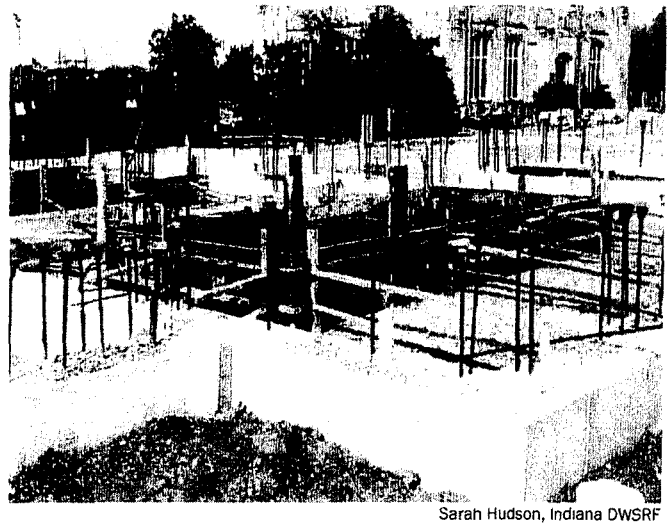
* For the 2007 DWINSA the need for partially surveyed states that opted out of the medium system portion of the survey is presented cumulatively and not by state.

Continuing Evolution of the DWINSA

Each DWINSA's approach, policies, and guidelines influenced the total national need and individual state needs reported for that effort. In all cases, specific project documentation requirements and data quality objectives were set by a workgroup of state and EPA stakeholders and maintained by EPA. If the 2003 Assessment represented a success in better capturing longer term needs than the 1995 and 1999 efforts, the 2007 Assessment's achievement was in helping guide states toward a more consistent methodology in assessing those types of needs. EPA believes the development and implementation of the more refined and specific project allowability policies (further outlined in Appendix C) resulted in the 2007 Assessment representing the most thoroughly planned and comprehensive of the four Assessments conducted.

EPA's quadrennial Assessment will continue to evolve, with each cycle providing valuable input as to how the next Assessment can be improved. In addition, it is anticipated that challenges which may not have been significant in previous Assessments will arise and affect water utilities. EPA will work with the states to improve each survey while maintaining the integrity of the Assessment.

One objective of the 2007 Assessment was to improve the consistency of needs estimates across states and water systems. These project estimates rely heavily on required supporting documentation. Based on the documentation provided, many water systems are using asset management strategies to better understand their longer term infrastructure investment needs and to implement more decisive and compelling planning. This planning helps achieve the necessary support from rate payers, investors, and local and state governments to gain adequate financial support to address these needs. However, it is also clear that for a number of systems there remains a significant gap between identifying their inventory of assets and their knowledge of that infrastructure's condition or remaining useful life. For the 2011 Assessment, EPA will work with the states to examine how the exercise can not only capture an updated status of asset planning by water systems but also further the adoption of such planning.



Sarah Hudson, Indiana DWSRF

The City of Fort Wayne, Indiana constructed a new pump building to remedy poor pumping configurations, allowing storage facilities to be more fully used.

Key Observations on Each Assessment's Approach

1995

For the first survey, conducted in 1995, the DWSRF was not yet in existence and EPA worked directly with many utilities to complete the survey with limited involvement from the states. A state/EPA workgroup helped plan and design the Assessment. Some states participated in data collection; however, many were unable to invest resources beyond encouraging system cooperation. In addition, the 1995 Assessment included needs for raw water dams and reservoirs, projects that were later determined to be DWSRF-ineligible for future Assessments. (Note – while needs for dams and reservoirs were included in 1995 Assessment, these needs were removed in the calculation for the 1998 through 2001 DWSRF allotments.)

1999

For the 1999 Assessment, the federal DWSRF program had been established and project-eligibility criteria were defined that specifically excluded raw water dams and reservoirs. Therefore these infrastructure needs were not included in the 1999 Assessment. The DWINSA workgroup established Assessment policies regarding water meters, backflow-prevention devices, and service lines. Although these needs were considered allowable for the Assessment, constraints were placed on documentation of ownership and whether projects for their replacement could be included. New to the 1999 Assessment was the inclusion of the need of not-for-profit noncommunity water systems. Also, state programs were expected to participate in data collection for this Assessment.

2003

Refinements made to the survey instrument in 2003 encouraged systems and states to think more broadly about systems' existing infrastructure condition and deficiencies, particularly in regard to long-term needs for replacing or rehabilitating their existing infrastructure assets. Considerable effort was invested in promoting a comprehensive approach to inventorying existing assets and estimating the needs for likely rehabilitation or replacement over the next 20 years. EPA provided flexibility to surveyed water systems and their states to forecast these longer term needs. In the 2003 Assessment, states and systems responded with varying means of determining asset inventories and with different assumptions about the life cycles of those assets (e.g., estimates of when buried pipe would need to be replaced or rehabilitated). In addition, the workgroup amended policies regarding the replacement of water meters as an allowable need. In 1999, meter replacements were allowed only if documentation was provided indicating that the system owned the meter. In 2003, documentation of ownership was not required. These changes resulted in a significant increase in the total national need and an increase in most states' individual state needs. EPA's objective to better capture the true 20-year need was met, but the states and EPA agreed that a more consistent methodology should be pursued in the next Assessment effort.

2007

In planning for the 2007 Assessment, EPA and the states came to a consensus that more consistency was needed across the states in regard to both methods for determining needs and each state's approach to capturing those needs. Building on the methods and approaches used by the states in the 2003 effort, consensus was reached on consistent policies regarding replacement and rehabilitation assumptions and documentation requirements to support survey-allowable projects. EPA's quality assurance reviews included significant efforts to ensure the policies were followed by all states.

Unique Needs of Water Systems in U.S. Territories

Under SDWA §1452(a)(1)(D)(ii), Congress allocates 0.33 percent of DWSRF monies to the U.S. Territories (e.g., American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and the U.S. Virgin Islands) to be used as grants for water systems. For the 2007 Assessment, EPA mailed questionnaires to all large systems and to a probability sample of medium-sized systems in the U.S. Territories to assess the needs of water systems on these islands.

Exhibit 2.6: 20-Year Need Reported by U.S. Territories

Territory	Total Need*
American Samoa	$92.8
Guam	$263.9
Commonwealth of the Northern Mariana Islands	$289.3
U.S. Virgin Islands	$253.3

*20-year need in millions of January 2007 dollars.

The Assessment data showed that water systems in the territories face unique challenges in providing safe drinking water to their citizens. While drinking water issues can vary from island to island, the overall challenges for all of the U.S. Territories include:

- **Rapidly Deteriorating Infrastructure.** In many island climates, corrosive soils and years of delivering previously untreated water have contributed to a prematurely deteriorated distribution system. Inadequate storage and lack of redundancy in the water systems make it difficult to take infrastructure off line for required maintenance or replacement.
- **Seasonal, Transient Customers.** A high volume of tourists creates considerable fluctuations in seasonal water demand that are difficult to design for. Cruise ships and other forms of tourism present huge peak demands on water systems already working at capacity.
- **Limited Source Options.** The ability to serve existing homes as well as a growing population is limited by a lack of quality sources of water. The islands' water supplies are dependent upon limited fresh water sources, ground water aquifers which are susceptible to contamination, and the use of rainwater catchments.
- **Ground Water Contamination.** Aquifer contamination from waste and sediment runoff, on-site wastewater treatment systems, illegal dumping, and salt water intrusion threatens the quality and quantity of water pumped from aquifers.

U.S. Virgin Islands

Due to limited ground water supply and aging infrastructure, the U.S. Virgin Islands, including the islands of St. Croix, St. John, and St. Thomas, face current and future water shortages. On St. Croix many homes have requested new water service from the island's single municipal water system, but their requests cannot be met due to inadequate supply and the lack of piping to connect them to the system. Approximately 85 percent of St. Croix's pipe is ductile iron. Much of this pipe was installed over 50 years ago, has corroded, and must be replaced. In addition, desalinization plants on all three islands must be replaced because many have been in operation for over 20 years (well beyond manufacturer recommendations) and are in disrepair due to age and little or no maintenance. Fluctuations in demand from seasonal, transient customers on cruise ships also significantly strain undersized water treatment facilities on St. John and St. Thomas. Demand for water on St. John fluctuates from 100,000 gallons per day during the low-demand season to over 300,000 gallons per day when demand is high. This situation leads to operational problems and water shortages.

American Samoa

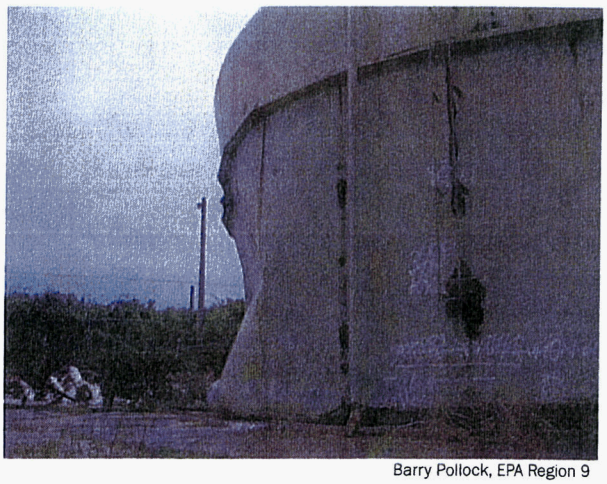
EPA has estimated that up to 50 percent of the population of American Samoa lacks safe drinking water. This shortage is due, in part, to ground water contamination which is becoming a concern because the main aquifer lies beneath the fastest growing area in the territory, the Tafuna Plains. In addition to the strain on the aquifer from increased withdrawals, population development has resulted in increasing human and animal pollution. Already 17 percent of residents tested positive for leptospirosis, a potentially deadly waterborne disease associated with animal waste. Contributing further to the problem, the vegetative buffer mitigating the amount of pollutants reaching the ground water is decreasing with the increase in building construction.

Commonwealth of the Northern Mariana Islands (CNMI)

The Commonwealth Utility Corporation in Saipan, the largest island in CNMI, is unable to provide 24-hour water service to over 40 percent of its customers because of the inadequate number and poor condition of its water sources, coupled with system leakage caused by extremely old and dilapidated infrastructure. Many water system facilities, including transmission and distribution mains and storage tanks, pre-date World War II and require replacement. Salt water intrusion threatens the quality of ground water sources and is a serious issue on Saipan, where it has led to exceedingly high salinity levels in the drinking water. Due to the high salinity of the water, most residents drink bottled water.

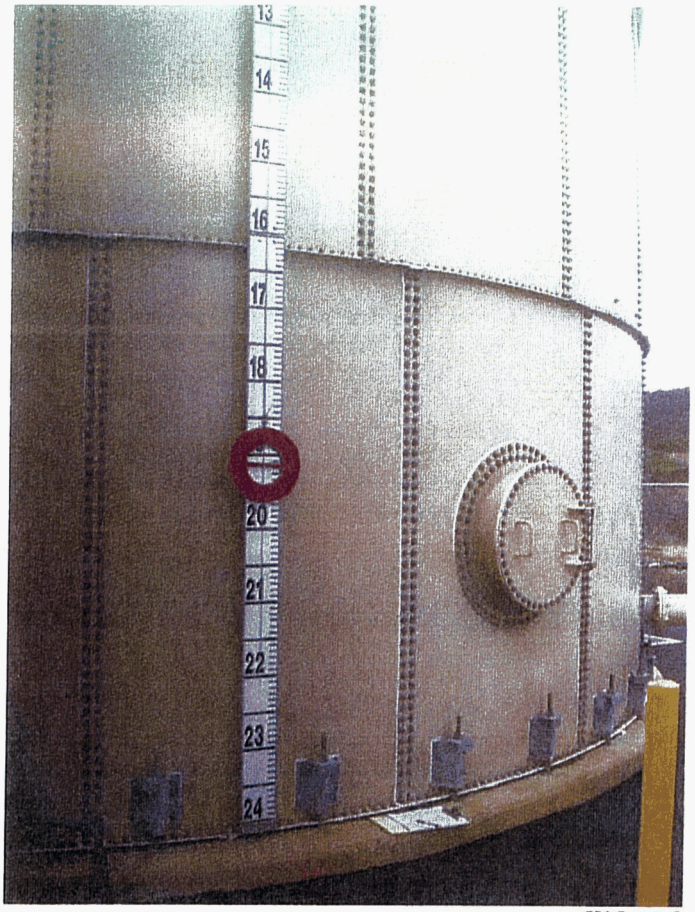
Guam

Guam faces significant challenges posed by pollutants entering drinking water sources both from unmanaged sewage, including many unsewered areas with individual on-site systems only, and from problems associated with erosion and runoff. The sole source limestone/karstic aquifer that serves most of Guam is highly susceptible to surface contamination and, based on further study, may be designated as ground water under the direct influence of surface water. Guam's water system also suffers from general dilapidation of infrastructure.



Barry Pollock, EPA Region 9

In 2005, the catastrophic failure of a 1 million gallon storage tank in Guam (left) damaged two neighboring tanks, knocking one of them out of service (right) and reducing the system's storage capacity by 25 percent.

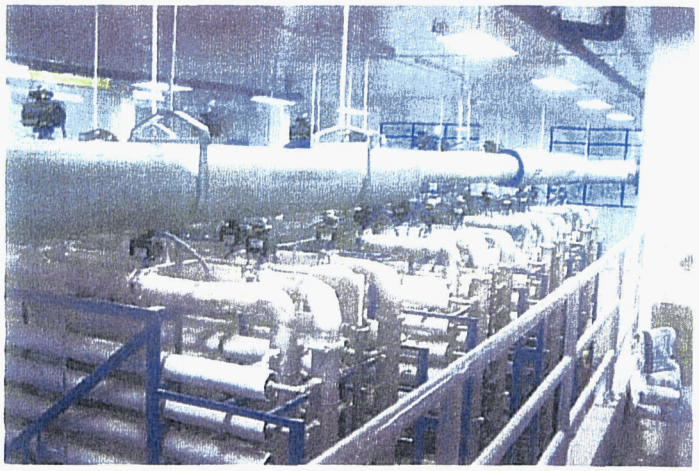


EPA Region 9

A water tank level gauge displays the water level in the tank using a floating buoy to move the gauge. This tank has 19 feet of water in it and can hold up to 24 feet.

Appendix A - Survey Methods

The 20-year period captured by the 2007 Drinking Water Needs Survey and Assessment (DWINSA) runs from January 1, 2007, through December 31, 2026. The Assessment is based on a survey of approximately 3,250 community water systems and an adjustment of findings from previous surveys for the needs of not-for-profit noncommunity water systems and water systems serving American Indian communities and Alaskan Native Villages. Except where noted, the statistical and survey methodologies of the 2007 Assessment are identical to those used in the 1995, 1999, and 2003 Assessments. The most significant change is related to the survey of medium systems, which is described in more detail later in this Appendix.



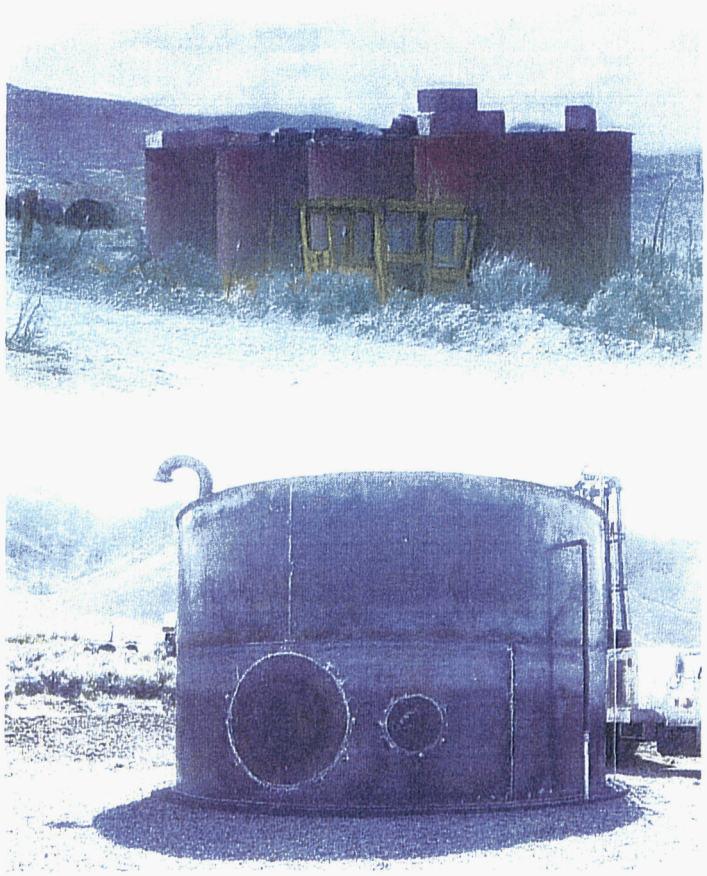
Charles Pycha, EPA Region 5

Construction of a microfiltration treatment plant in Mankato, Minnesota. This project was funded by the DWSRF.

U.S. Environmental Protection Agency (EPA), with input from a workgroup of state representatives, developed the methods for the 2007 Assessment. The questionnaire used in the 2007 Assessment was essentially the same as the 2003 Assessment questionnaire. However, the workgroup revised some of the project documentation policies and data collection procedures in order to ensure that a more comprehensive and consistent approach was applied by all of the states (see Appendix C for additional information on documentation requirements.)

Assessing the Needs of Water Systems in States and U.S. Territories

The 1996 Safe Drinking Water Act (SDWA) Amendments direct EPA to assess the needs of water systems and to use the results of the quadrennial Assessment to allocate Drinking Water State Revolving Fund (DWSRF) monies. The DWSRF monies are allocated based on each state's share of the total state need with a minimum of 1 percent of the state allotment guaranteed to each state, Puerto Rico, and the District of Columbia. The need represents all community water systems as well as not-for-profit noncommunity systems in the states, Puerto Rico, and the District of Columbia. The results of the Assessment are also used to allocate the 0.33 percent of the DWSRF appropriation designated for the U.S. Territories. Therefore, the Assessment was designed to generate separate estimates of need for the U.S. Virgin Islands and the Pacific island territories (Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands).



Adele Basham, Nevada Department of Environmental Protection

These substandard tanks (top) at the Three T Water system in Nevada were replaced with a new tank (bottom) using a DWSRF disadvantaged zero percent interest loan.

Frame

The frame is a list of all members (sampling units) of a population from which a sample will be drawn for a survey. For this Assessment, the frame consisted of all community water systems in each state, Puerto Rico, the District of Columbia, and the U.S. Territories. To ensure that the survey accounted for all community water systems in the nation, the universe of water systems was obtained from the federal Safe Drinking Water Information System (SDWIS-FED). SDWIS-FED is EPA's centralized database of public water systems. It includes the inventory of all public water systems and provides information regarding population served and whether a system uses ground water, surface water, or both.

Each state was asked to review the frame and verify or correct all information on each system's source water type and population served. EPA used this updated information to create a database of the universe of community water systems. A sample of systems was then selected from this updated frame.

Because there are thousands of water systems in the nation, EPA must rely on a random sampling of the systems identified in the frame. EPA set a precision target of ± 10 percent with 95 percent confidence. To meet this target, all large systems were surveyed, a random sample of medium systems was selected in each fully surveyed state, and a national random sample of small systems was selected.

Stratified Sample

To determine state need, water systems are grouped (stratified) by size (population served) and by source (surface or ground water). Exhibit A.1 shows the possible population and source water strata.

For the purposes of assigning a population to each system, consecutive populations are included in the system population because of the assumption that, in general, critical infrastructure of the selling-system would need to be sized to accommodate the demand of the population directly served by the system and the consecutive population.

Systems are categorized as surface water if they have at least one source that is surface water or ground water under the direct influence of surface water (GWUDI). Systems are categorized as ground water if they do not have a surface water or GWUDI source. The ground water

category includes ground water systems and systems that do not have a source of their own and purchase finished water from another system (regardless of whether the purchased water comes from a surface water or ground water source). The decision to include purchased water systems in the ground water systems category was based on the 1995 Assessment's findings that, in general, indicated the needs of purchased water systems more closely resemble those of ground water systems than of surface water systems with source water treatment.

Conducting the Survey of Large Systems

For the 2007 Assessment, a large system is defined as serving more than 100,000 persons, either through direct connections or as a wholesale water system. Because of the unique nature of systems in this size category and because they represent a large portion of the nation's need, these systems are sampled with certainty, meaning that all systems receive a questionnaire. In the previous Assessments (1995, 1999, 2003), the large system category was defined as systems serving populations of more than 40,000 or 50,000. The 2007 Assessment set this category at a higher threshold to reduce costs and burden on the states. The overall precision targets were still met. Systems serving 50,000 to 100,000 persons were included in the approach for medium systems.

Exhibit A.1: Community Water System Stratification for the 2007 Assessment

	Population		Surface Water	Ground Water
Large	> 100,000		Sampled with certainty - All systems receive questionnaire	
Medium	50,001 - 100,000		State-specific samples for participating states	
	25,001 - 50,000	or 10,001 - 50,000*		
	10,001 - 25,000			
	3,301 - 10,000			
Small	501 - 3,300		National sample for small systems	
	101 - 500			
	< 100			

*In some states, systems serving 10,001 - 50,000 can be considered one stratum and precision targets can be met. The most efficient sample is drawn from each state.

Exhibit A.2: Medium and Large Community Water System Sample Size

State	Total Number of Systems in Inventory			Number of Systems Selected in Sample		
	Population Served			Population Served		
	3,301 - 100,000	> 100,000	Total	3,301 - 100,000	> 100,000	Total
Alabama	336	18	**354**	131	18	**149**
Alaska	17	1	18	14	1	15
Arizona	117	10	**127**	22	10	**32**
Arkansas	171	3	174	93	3	96
California	562	114	**676**	93	114	**207**
Colorado	147	12	159	33	12	45
Connecticut	52	7	**59**	43	7	**50**
Delaware	23	3	26		3	3
District of Columbia	-	1	**1**	-	1	**1**
Florida	338	44	**382**	75	44	**119**
Georgia	202	16	**218**	48	16	**64**
Hawaii	28	2	**30**	-	2	**2**
Idaho	44	1	**45**	-	1	**1**
Illinois	443	19	**462**	76	19	**95**
Indiana	200	13	**213**	98	13	**111**
Iowa	132	3	**135**	44	3	**47**
Kansas	113	6	**119**	39	6	**45**
Kentucky	259	7	**266**	107	7	**114**
Louisiana	216	8	**224**	91	8	**99**
Maine	34	1	**35**	-	1	**1**
Maryland	50	5	**55**	21	5	**26**
Massachusetts	226	12	**238**	52	12	**64**
Michigan	292	14	**306**	51	14	**65**
Minnesota	158	2	**160**	63	2	**65**
Mississippi	195	2	**197**	164	2	**166**
Missouri	201	6	**207**	84	6	**90**
Montana	33	1	**34**	-	1	**1**
Nebraska	42	2	**44**	22	2	**24**
Nevada	31	5	**36**	10	5	**15**
New Hampshire	35	2	**37**	-	2	**2**

Each large system was asked to complete the questionnaire and return it along with accompanying documentation to its state coordinator. The state coordinators reviewed the questionnaires to ensure that the systems included all their needs, the information entered on the questionnaire was correct, and the projects were eligible for DWSRF funding. During their state reviews, states often contacted systems to obtain additional information. The states then submitted the questionnaire and all documentation to EPA for a final review.

Of the 584 large systems that received a survey for the 2007 Assessment, 570 completed the questionnaire—a response rate of 97 percent. Exhibit A.2 shows the number of large systems in the frame as well as the sample size for each state.

Exhibit A.2: Medium and Large Community Water System Sample Size, cont.

State	Total Number of Systems in Inventory			Number of Systems Selected in Sample		
	Population Served			Population Served		
	3,301 - 100,000	> 100,000	Total	3,301 - 100,000	> 100,000	Total
New Jersey	215	12	**227**	55	12	**67**
New Mexico	59	1	60	-	1	1
New York	326	28	**354**	37	28	**65**
North Carolina	248	20	268	34	20	54
North Dakota	31	-	**31**	-	-	-
Ohio	300	14	314	77	14	91
Oklahoma	156	4	**160**	58	4	**62**
Oregon	101	8	109	41	8	49
Pennsylvania	313	27	**340**	56	27	**83**
Puerto Rico	114	8	**122**	55	8	63
Rhode Island	26	2	**28**	-	2	**2**
South Carolina	158	9	**167**	43	9	**52**
South Dakota	41	1	**42**	-	1	**1**
Tennessee	264	18	**282**	105	18	**123**
Texas	922	46	**968**	74	46	**120**
Utah	98	7	**105**	-	7	**7**
Vermont	34	-	**34**	16	-	**16**
Virginia	145	18	**163**	32	18	**50**
Washington	187	12	**199**	47	12	**59**
West Virginia	107	3	**110**	-	3	**3**
Wisconsin	172	5	**177**	54	5	**59**
Wyoming	27	-	**27**	-	-	-
Subtotal	***8,741***	***583***	***9,324***	***2,258***	***583***	***2,841***
American Samoa	1	-	**1**	1	-	**1**
Guam	2	1	**3**	2	1	**3**
Commonwealth of the Northern Mariana Islands	2	-	**2**	2	-	**2**
U.S. Virgin Islands	3	-	**3**	3	-	**3**
Subtotal	***8***	***1***	***9***	***8***	***1***	***9***
Total	**8,749**	**584**	**9,333**	**2,266**	**584**	**2,850**

Conducting the Survey of Medium Systems

Medium systems, as defined for the 2007 Assessment, serve between 3,301 and 100,000 persons. Exhibit A.2 shows the number of medium systems in the frame and sample by state. States with a dash in the medium system sample column opted not to collect data for these systems.

For the 2007 Assessment, states that received the minimum 1-percent DWSRF allotment in the 2003 Assessment were given the option of not participating in data collection for medium-sized systems. This option was provided in order to reduce burden on the small

states that receive the same allotment regardless of the findings of the survey. Of the minimum allocation states, 14 chose not to participate in this portion of the survey. The medium system need for states that chose this option was estimated based on data from participating states. Because this method does not meet the Assessment's formal precision targets at the state level, the needs of these partially surveyed states contribute to the estimate of the total national need, but medium system need is not reported individually by state.

For states that participated in the medium system portion of the survey, the data collection process was similar to that of large systems with the system completing the survey, the state providing input, and the final review conducted by EPA.

Once the need for systems in the fully surveyed states was calculated, it was used to determine the need for the partially surveyed states. An average need per stratum from fully surveyed states was calculated and applied to the inventory of systems in the partially surveyed states.

Of the 2,266 medium systems that were randomly selected and received a survey, 2,082 completed the questionnaire for a response rate of 92 percent.

Conducting the Survey of Small Systems

Exhibit A.3 shows the total inventory and sample size for the national sample of small systems. Small systems, as defined for the 2007 Assessment, serve 3,300 or fewer persons. Because small systems often lack the resources to complete information collection requests and do not always have the resources to produce longer term planning documents, EPA does not ask these systems to complete a questionnaire. Instead, EPA collects the data by sending qualified, trained professionals to interview system personnel and document project needs. This process was used for small systems in the 1995 and 1999 Assessments as well as the 2007 Assessment. In 2003, in an effort to reduce costs, EPA used the 1999 need estimates adjusted to 2003 dollars.

For the small system survey, a national sample of 600 systems was selected to represent the national need of the 41,748 small systems. To select this sample, EPA used two-stage probability proportional-to-size sampling (PPS) with six strata. Systems were stratified based on population served (i.e., less than or equal to 100, 101 to 500, and 501 to 3,300 persons)

Exhibit A.3: Small Community Water System Sample Size

	Total Number of Systems in Inventory	Number of Systems in Selected Sample
Systems Serving 3,300 or Fewer Persons	41,748	600

and source water type (i.e., ground or surface water.) Systems were grouped by county or clusters of counties. In the first stage, a random sample of counties or cluster of counties were selected. The probability that a county or county cluster was selected was proportional to the number of small systems in each stratum in the county or county cluster. In the second stage, five systems were selected randomly from each county or county cluster. This approach minimized travel and expenses for site visits. A total of 600 systems were selected.

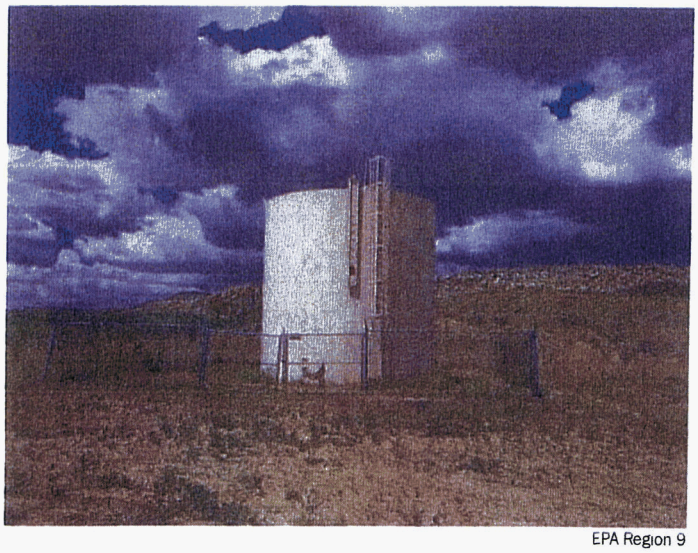
Needs data from the 600 small systems were collected by EPA contractors. To ensure that the data collected were as accurate as possible, EPA contracted with water industry professionals, including engineers, operators, and state primacy agency experts, to complete the small system surveys. These site visitors participated in a 2-day training session on the Assessment methodology and were trained to assess the current condition of a small water system and to estimate its 20-year needs.

Since trained and qualified contractors completed the surveys on-site with the system representatives, there was a high confidence in the surveys. The surveys were submitted directly to EPA for review rather than first going through a state representative. After data collection, the needs of small systems were assigned to each state by multiplying the average need per stratum by the number of small systems in that stratum (from the inventory of small systems in each state). It is important to note that conducting a field survey in this manner allows for consistent estimation of project needs across all surveyed systems.

System Weight

As in the previous efforts, the 2007 Assessment assigned weights to the findings from each surveyed water system to determine total state needs. Because all large systems are included in the survey, each large system has a weight of 1. The state need for large systems was determined by summing the cost of each project for each system and then summing the need for each large system in the state. Systems were not re-weighted for nonresponse.

For medium systems, EPA determined the number of water systems that must be included in each stratum in order to achieve the desired level of precision. The surveyed systems were selected and assigned an initial weight for their specific state equal to the total number



EPA Region 9

of systems in that stratum divided by the number of systems in that stratum's sample. A final weight was recalculated for each stratum with adjustments for non-response and systems changing stratum (population or source changes). Each fully surveyed state's need for medium systems was determined by summing the cost of each project for each system, and then multiplying each system's need by the system's final weight.

The number of medium sized water systems selected from each stratum was determined by the total number of systems in that stratum (shown in Exhibit A.1), the percentage of that state's need represented by that stratum in the most recent Assessment, and the relative variance of the need within that stratum in the most recent Assessment. The sample is allocated among the strata in a manner that lets the survey achieve the desired level of precision with the smallest sample size for each state.

Small system weighting was conducted in a manner similar to the medium systems, but was assigned on a national scale rather than a state-level scale. The small system national need is determined by summing the cost of each project for each system and then multiplying each system's need by the system's final weight. The small system state need was estimated by determining the average system need for a stratum and multiplying the average by the number of small systems a given state has in that stratum.

In compliance with the Paperwork Reduction Act (PRA) (44U.S.C. 3501 et seq.), the survey design and instrument were reviewed and approved by the Office of Management and Budget (OMB). The Information Collection Request (ICR) for the survey can be accessed in the Federal Register/Vol. 71, No.206/Wednesday, October 25, 2006/Notices p62439.

Assessing the Need of Not-for-Profit Noncommunity Systems

Not-for-profit noncommunity water systems (NPNCWS) are eligible for DWSRF funding. The 2007 need for NPNCWSs was based on the findings of the 1999 Assessment in which a statistical survey of these systems was conducted. These findings were adjusted to January 2007 dollars using the Construction Cost Index (CCI).

During the 1999 Assessment, EPA collected data from a national sample of 100 NPNCWSs through site visits. Unlike the sampling design for community water systems, the NPNCWS sample was not stratified into size and source categories because EPA lacked the empirical information on variance necessary for developing strata. The sample used for the 1999 Assessment for NPNCWSs was designed to provide a 95 percent confidence interval that is within a range of +/- 30 percent of the estimated need.

The national need for NPNCWSs was allocated among the states in proportion to the inventory of NPNCWSs in each state in a manner similar to that used for small systems.

Alaska Department of Environmental Conservation

Alaskan Native Village water systems require specialized infrastructure to prevent freezing in permafrost conditions. Many Alaskan Natives rely on water hauling stations such as this one to obtain their water for domestic use.

Assessing the Need of American Indian and Alaskan Native Village Water Systems

The infrastructure need reported for American Indian and Alaskan Native Village water systems was based on the findings of the 1999 Assessment. Because of the high level of confidence in the findings from 1999 and resource constraints, EPA did not survey these systems again in 2007. Instead, EPA used the CCI to adjust the estimated need from 1999 to 2007 dollars to estimate the 2007 needs for these systems. The results are used to help determine how to allocate monies that are available through the DWSRF to American Indian and Alaskan Native Village water systems.

American Indian Water Systems

In 1999, all American Indian systems serving populations of 3,301 to 50,000 were sampled. These systems were given the choice of either completing the survey themselves or participating in an interview to capture their needs. For systems serving 3,300 or fewer persons, a random sample of systems were chosen and site visits were conducted by qualified and trained professionals.

Alaskan Native Village Water Systems

All Alaskan Native Village water systems were sampled in the 1999 Assessment. The medium systems, serving populations of 3,301 to 50,000, were mailed a questionnaire. The needs of small systems, serving 3,300 or fewer, were developed by a roundtable of representatives from the Alaskan Native Villages, Village Safe Water, and the Indian Health Services (IHS), with assistance from EPA. Site visits to five Alaskan Native Village water systems were performed to confirm the roundtable's findings.

Appendix B - Data Collection

To determine the scope of water systems' 20-year need, data are collected in the form of capital improvement projects. States and other agencies work with the surveyed systems to identify applicable projects. To be included in EPA's Assessments, each project had to meet each of the following four criteria:

- The project must be for a capital improvement.
- The project must be eligible for Drinking Water State Revolving Fund (DWSRF) funding.
- The project must be in furtherance of the public health protection goals of the Safe Drinking Water Act (SDWA).
- The project must be submitted with supporting information that documents the three other criteria are met.

Projects included in the Assessment generally fall into one of two categories that describe the reason for the project:

- Replacement or rehabilitation of existing infrastructure due to age or deterioration.
- New or expanded infrastructure to meet an unmet need for the current population or to comply with an existing regulatory requirement.

Projects for infrastructure generally expected to need rehabilitation or replacement in the 20-year period covered by the Assessment were accepted with minimal documentation describing their scope and the reason for the need. However, other types of projects required independently generated documentation that not only identified the need but also showed clear commitment to the project by the water system's decision-makers. Exhibit B.1 summarizes the types of projects that were included and the types that were unallowable.

For the purposes of assigning a cost to each need, the survey required that the water system either provide an existing documented cost estimate or the information necessary for EPA to assign a cost. This information was referred to as the "design parameter" and is discussed in more detail in this Appendix.

Photo by Robert Barles

Survey Instrument

As with previous Assessments, the 2007 questionnaire was the survey instrument for reporting all needs. All large water systems and a random sample of medium systems were mailed a survey package, which included the questionnaire, instructions for completing the

Exhibit B.1: DWINSA Allowable and Unallowable Projects

DWINSA Allowable Projects	DWINSA Unallowable Projects
Criteria: • Eligible for DWSRF funding • Capital improvement needs • In furtherance of the public health goals of the SDWA • Within the Assessment time frame • Adequate documentation Project Types: • New or expanded/upgraded infrastructure to meet the needs of existing customers • Replacement or rehabilitation of existing undersized or deteriorated infrastructure	• Raw water reservoir- or dam-related needs • Projects needed primarily to serve future population growth • Projects solely for fire suppression • Projects for source water protection • Non-capital needs (including studies, operation and maintenance) • Needs not related to furthering the SDWA's public health objectives • Acquisition of existing infrastructure • Projects not the responsibility of the water system • Needs associated with compliance with proposed or recently promulgated regulations (Derived instead from EPA's economic analyses and added to the national total) • Projects or portions of projects started prior to January 1, 2007 • Projects or portions of projects needed after December 31, 2026

questionnaire, and a list of codes used to convert the information to a database format. These documents were also used by the site visitors for recording small system needs.

The instructions provided to the water systems included information on the background and purpose of the Assessment as well as how to identify projects that should be included in the questionnaire. In addition to infrastructure needs, the survey also requested basic information from the water systems such as the size of the population served, the number of service connections, the production capacity, the source water type, and the system's ownership type. This information was compared to the information used for the sample frame. Discrepancies in source and population were investigated to ensure accurate information was used for the statistical sample.

Project Documentation

Each project listed on the questionnaire was required to have accompanying written documentation of its scope and why it was needed. Written documentation included master plans, capital improvement plans, sanitary survey reports, and other sources of project information. Whether the documentation could be written for the 2007 Assessment or had to be pre-existing depended on the type of project that was described. All documentation for every project was reviewed by EPA to ensure that the project met the allowability criteria for the Assessment. See Appendix C for more information on the project allowability policies.

Cost Estimates and Modeling

As with previous Assessments, costs assigned to projects were obtained in one of two ways. If the system had an existing documented cost estimate that met the documentation criteria of the survey, this cost was adjusted to 2007 dollars and used for that system's need. This is the preferred approach for assigning a cost to a project. If no cost estimate was available, the system was asked to provide information (design parameters) necessary for EPA to model the cost of the project. Cost models were built from the documented cost estimates provided by other survey respondents.

Acceptable forms of documentation for cost estimates were capital improvement plans, master plans, preliminary engineering reports, facility plans, bid tabulations, and engineer's estimates that were not developed for the 2007 Assessment. Each project with an associated cost was required to provide the month and year of the cost estimate in order to allow an adjustment of the cost to January 2007 dollars.

Systems that had cost estimates were encouraged to submit design parameters regarding size or capacity of the infrastructure. For example, a tank is described in terms of volume in millions of gallons, treatment plants are based on capacity in millions of gallons per day, pipe parameters are diameter and length. Over 70 project types of need were used to describe projects and link design parameters to cost. This combination of the specific type of project, costs, and parameters was used as input to develop cost models. Prior to input to the cost models, the cost estimates were normalized for both time frame and location. Cost estimates prior to January 2007 were adjusted to January 2007 dollars using the Construction Cost Index (CCI). Regional variations in construction costs were normalized by location using the RS Means "Location Factors Index." RS Means is a subsidiary of Reed Construction which publishes an annual index used to calculate construction costs for a specific location. The factor multiplier is expressed as a relationship to the national average of 1.

Although over 70 different types of need were used, a few project types could not be modeled. These types of need were unique to individual systems and did not lend themselves to modeling (examples include de-stratification of a surface water source, pump controls and telemetry, and security features other than fencing).

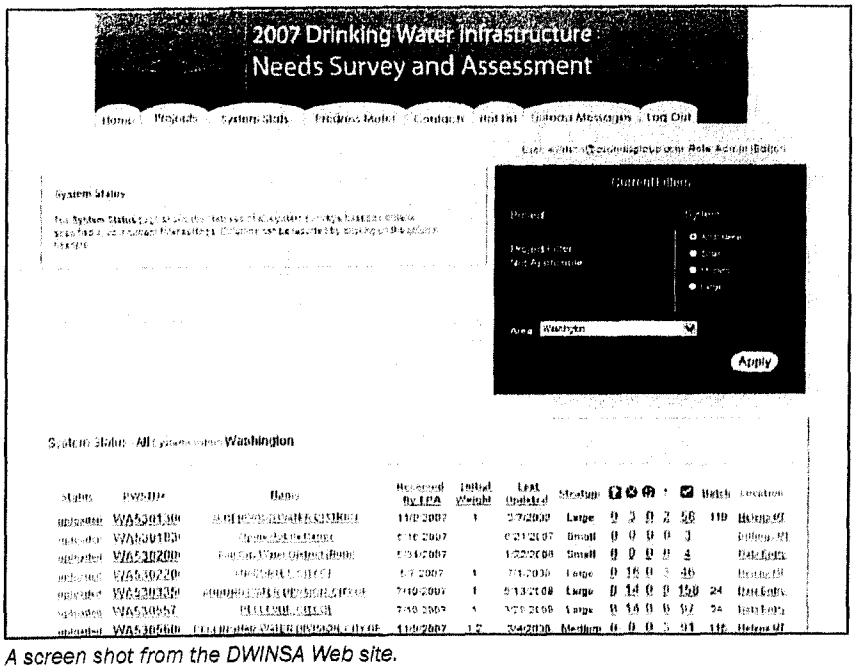
Ultimately some projects were not able to be assigned a cost because a cost estimate from the system was not provided and project information submitted on the survey did not include the necessary design parameters required for modeling.

Photo by Michelle Lee

Web Site and Database

EPA used a 2007 surevy-specific Web site to provide an efficient method of tracking and monitoring questionnaire responses for states and Regions. The Web site allowed controlled viewing of survey information and provided a means for states to provide additional project information if needed. Water systems, state contacts, and EPA had secure login access to the Web site. The Web site was a modification of the one used successfully for the 2003 Assessment.

Once logged into the Web site, water systems had access to their own project data, states had access to all project data for the water systems in their state, and EPA regional offices had access to the project data of states within their region. Web site users were given "read only" or "read/write" access depending on whether information posted to the Web site could be changed by that entity. This created a transparent process and open communication between systems, states, and EPA while also maintaining a secure environment so that persons without reason to see the data did not have access.



A screen shot from the DWINSA Web site.

The Web site also served as a means of communication between states and EPA. As EPA completed the quality assurance reviews of each questionnaire, the information was uploaded to the Web site database along with specific indications of any changes that had been made to the projects and why the changes were implemented.

Each state was able to view all its systems' projects and submit additional information for projects that had been changed or deemed unallowable through EPA's quality assurance review.

Quality Assurance

As with all three earlier Assessments, the findings of the 2007 Assessment are reinforced by adherence throughout the project to the principles embodied in the EPA Guidelines for Ensuring and Maximizing Information Quality. The most fundamental assurance of the high degree of information quality is the implementation of the Agency's Quality System. EPA implements the system through the development of a quality assurance project plan (QAPP) for each project, which details the specific procedures for quality assurance and quality control.

Because the Agency uses the results of this Assessment to allocate DWSRF capitalization grants to states, this Assessment (like those that preceded it in 1995, 1999, and 2003) sought to maximize the accuracy of the state-level estimates of infrastructure needs. Decisions about precision levels, policies, and procedures were established by a state/EPA workgroup that met regularly during the 2007 Assessment.

Accuracy was maximized at the national, state, system, and project levels through the following steps. First, since this was a sample survey, the workgroup established targets for precision of estimates in the sampling to shape the national sample design. These precision targets are discussed in Appendix A.

Second, EPA used quality assurance procedures from the QAPP to ensure that "eligible infrastructure" was clearly defined and that documentation standards were rigorously enforced. As noted previously, for a project to be included in the 2007 Assessment, systems and states had to submit documentation describing the purpose and scope of each project. The documentation was reviewed by EPA to determine whether each project met the eligibility criteria. The workgroup established the documentation requirements so that uniform criteria were applied to all questionnaires.

Of the 94,852 projects submitted to the survey, EPA accepted 79 percent. The 21 percent that were not allowed failed to meet the documentation criteria or appeared to be ineligible for DWSRF funding. Some projects were adjusted to correct a variety of measurement problems, such as overlaps between two projects (raising the issue of double-counting), inconsistency of recorded data with project documentation, and the use of overly aggressive (short) infrastructure life cycles by states where system planning documents were not used or available.

Third, after the survey review process, the project data were entered into a database using dual data entry procedures to ensure the information was correctly transferred. The uploaded data then went through a systematic verification process to identify any outliers or data-entry errors. Each project, the systems' source water type, total pipe length, population, and number of connections were reviewed for any unusual entries. The data were then compared at the state and national levels to identify any outliers in the data. EPA investigated the outliers by reviewing the system's project documentation. If the documentation did not provide enough information to verify the project, EPA contacted the state or the system for confirmation.

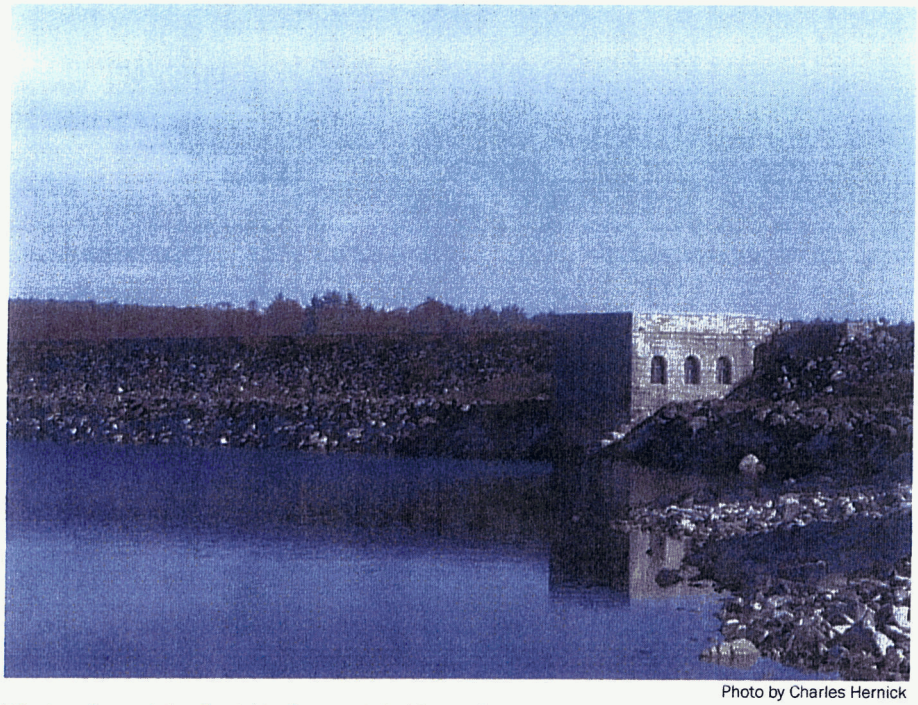
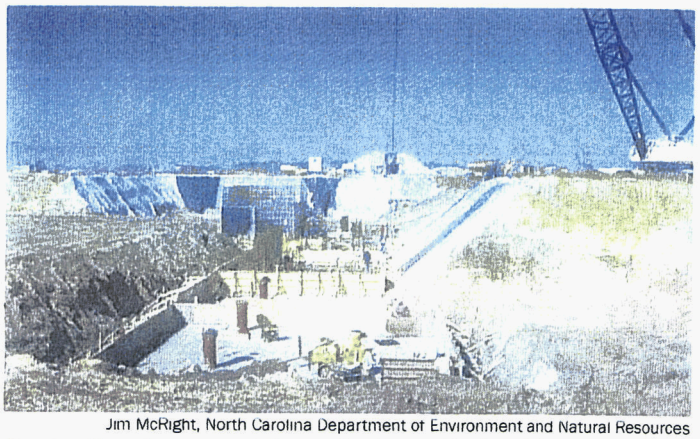


Photo by Charles Hernick

Windsor Dam at the Quabbin Reservoir in Massachusetts.

Appendix C - Policies

EPA recognizes that it is critical to the credibility of the 2007 Assessment and fairness to the states that EPA work with the DWINSA workgroup to set clear and well-defined data collection policies and for EPA to apply these policies consistently to all systems and states. The policies are aimed at ensuring that the Assessment meets its Congressional intent, maintains the credibility of the findings, and establishes a level playing field for the states. To this end, the policies developed ensure two essential criteria - that only allowable needs be included, and that all needs be adequately documented according to Assessment criteria.



Jim McRight, North Carolina Department of Environment and Natural Resources

Construction of a pump station at the Neuse Regional Water and Sewer Authority in Kinston, North Carolina. This project was identified in the 2003 Assessment and partially funded by the DWSRF.

Project Allowability

Because the findings of the Assessment are used to allocate DWSRF monies, only needs associated with DWSRF-eligible projects are included in the findings. Eligibility criteria for the DWSRF are established in the Safe Drinking Water Act. SDWA Section 1452(a)(2) states that DWSRF funds may be used:

> *"only for expenditures (not including monitoring, operation, and maintenance expenditures) of a type or category which the Administrator has determined, through guidance, will facilitate compliance with national primary drinking water regulations applicable to the system under Section 1412 or otherwise significantly further the health protection objectives of this title...."*

Needs are submitted in the form of capital infrastructure projects. To be considered an allowable need, a project must be eligible for DWSRF funding, be in furtherance of the public health protection objectives of SDWA, fall within the prescribed 20-year time frame (January 1, 2007, through December 31, 2026), and be adequately documented.

Projects Must Be for a Capital Improvement Need

Projects that do not address a specific, tangible capital infrastructure need are not included. Non-capital needs include operational and maintenance costs, water rights or fee payments, conducting studies, computer software for routine operations, and employee wages and other administrative costs.

Projects Must Be Eligible for DWSRF Funding

Projects ineligible for DWSRF funding are identified in the DWSRF regulation and include:

- Dams or the rehabilitation of dams.
- Water rights.
- Raw water reservoirs or rehabilitation of reservoirs (except for finished water reservoirs and reservoirs that are part of the treatment process and are on the property where the treatment facility is located).
- Projects needed primarily for fire protection.
- Projects needed primarily to serve future population growth. (Projects needed to address a deficiency affecting current users must be sized only to accommodate a reasonable amount of population growth expected to occur over the useful life of the facility.)

Projects Must Be in Furtherance of the Public Health Goals of the SDWA

Projects that are driven by objectives, not based on public health protection and the goals of the SDWA, are not included in the survey. These needs can include projects for improving appearances, infrastructure demolition, buildings and parking facilities not essential to providing safe drinking water, acquisition of land for an unallowable project, and infrastructure needed to extend service to homes that currently have an adequate drinking water supply.

Projects Must Fall Within the 20-Year Period of the Assessment

Projects for which construction began prior to January 1, 2007, and projects that are not needed until after December 31, 2026, fell outside the time frame for the Assessment and were not included.

Projects Must Be Adequately Documented

Project documentation is a critical piece of the Assessment's credibility and fairness to states. It is described in more detail later in this Appendix.

Other Unallowable Needs

Besides the project criteria discussed above, other limitations established by the workgroup were:

- Infrastructure needs that occur more than once during the 20-year survey period could be listed only once on the survey.
- Multiple projects meeting the same need, such as rehabilitating a tank and later replacing the same tank, could not all be included.

- Projects for compliance with specific proposed or recently promulgated regulations were not accepted from water systems. These costs were instead estimated and added to the national total by EPA directly.
- Projects driven solely by a non-water-related issue such as a highway relocation were not included.
- Projects to acquire existing infrastructure were not considered capital infrastructure costs.
- Most vehicles and tools were considered operation and maintenance costs.
- Projects that are not the responsibility of the public water system, such as homeowners' portions of service line replacements, were not included.

If projects associated with an unallowable need were submitted, they were excluded from the Assessment by EPA. EPA understands that these projects often represent legitimate and even critical needs that a water system must pursue to continue to provide service to its customers. However, because they do not meet the allowability criteria they are not the subject of the DWINSA.

Documentation Requirements

EPA and the workgroup implemented improvements for the 2007 Assessment based on the lessons learned in the 2003 Assessment. Revisions to the DWINSA approach primarily centered on the documentation requirements for certain types of projects and were driven by the desire to ensure a consistent approach to data collection and to the assessment of need applied by each state.

High-quality documentation is required to justify the need for a project, defend cost estimates provided by the water system, provide a defensible assessment of national need, and ensure fair allotment of DWSRF monies. The documentation of need and cost for each project was carefully reviewed to ensure that the criteria set in the DWINSA approach and established by consensus of EPA and the workgroup were met.

Photo by Jenna Wang

A clamp used to repair a water main break.

Types of Documentation

In an effort to ensure more consistency in each state's approach to the assessment of its water systems' needs, the workgroup defined for the 2007 Assessment three types of documentation that could be provided to describe a need or provide a cost:

- **Independent Documentation.** A document or report generated through a process independent of the Assessment. Because these documents were not generated specifically for the Assessment, it is assumed that there is no intentional bias of over reporting of need.
- **Survey-generated Documentation.** A statement or document discussing the need for a project generated specifically for the Assessment by the system or the state.
- **Combination Documentation.** A combination of independent and survey-generated documentation to justify project need or cost. Independent documentation does not always directly address the reason a project is being pursued by a system and therefore may not establish allowability criteria. Systems often added survey-generated documentation to independent documents to clarify the need for the project.

Documentation of Need

Documentation of need explains the scope of the project, explains why the project is needed, and gives an indication of the public health need that would be addressed by the project. In order for the project to be accepted, the documentation of need must:

- Provide sufficient information for EPA to review the allowability of the project.
- Provide adequate data to check the accuracy of the data entered on the questionnaire.
- Be dated and be less than 4 years old.

One of the primary changes in approach from the 2003 Assessment was that EPA and the DWINSA workgroup defined the type of documentation required for each specific project type. These minimum requirements were set to allow a minor level of effort by states and water systems to document straight-forward projects. Doing so made more resources available to identify and document projects in which allowability was more questionable. Projects fell into the following levels of documentation requirements:

- Projects that required independent documentation of need.
- Projects for which survey-generated documentation was permitted but to which a weight-of-evidence review was applied.
- Projects accepted with any forms of documentation.

Weight of Evidence

Documentation must include adequate system-specific and project-specific details to verify that the project meets the allowability criteria and to justify that the project is needed. Reviewers weighed the evidence provided to determine if the submitted project met the criteria.

The level of documentation required depended on the type of project and whether the project was for new infrastructure or for the replacement, rehabilitation, or expansion/upgrade of existing infrastructure. Any of the three forms of documentation were acceptable for projects to rehabilitate or replace infrastructure assumed to have a life-cycle of 20 years or less.

Projects likely to be driven by a need that is not DWSRF-eligible (such as to accommodate growth or meet fire suppression needs) generally required independent documentation. Most projects for the installation of new infrastructure fell into this category. For those projects, such as the construction of a new treatment system or new storage tank, the independent documentation was reviewed and EPA applied a "weight-of-evidence" approach to determine whether the project could be included in the Assessment.

Projects for Which Independent Documentation was Required

Generally, projects that required independent documentation of need were likely to be unallowable needs (such as projects to meet anticipated growth) or for infrastructure likely to have an expected life of more than 20 years (such as a water main). EPA and the workgroup assumed that systems pursuing needs in this category are often in the process of formal planning and therefore independent documents are likely to exist. Projects requiring independent documentation included:

- Sources – installation of a new surface water source or new aquifer storage and recovery wells.
- Treatment – installation, replacement, or expansion/upgrade of a complete treatment plant.
- Pipe – rehabilitation or replacement of a substantial portion of the system's water mains (in excess of 10 percent of the total system based on a rate of 0.5 percent annually).

Montana Department of Environmental Quality

Corrosion on a wellhead indicates well rehabilitation may be necessary in the near future.

Projects for Which Survey-Generated Documentation was Allowed, but a Weight of Evidence Review was Applied

Needs that were subject to a weight-of-evidence review included projects that were significant in scope or that may be for unallowable need (such as anticipated growth), but are not necessarily likely to be included in a planning document. For these projects, systems were asked to provide enough information for the reviewer to ascertain whether the project was for an allowable need. These projects included:

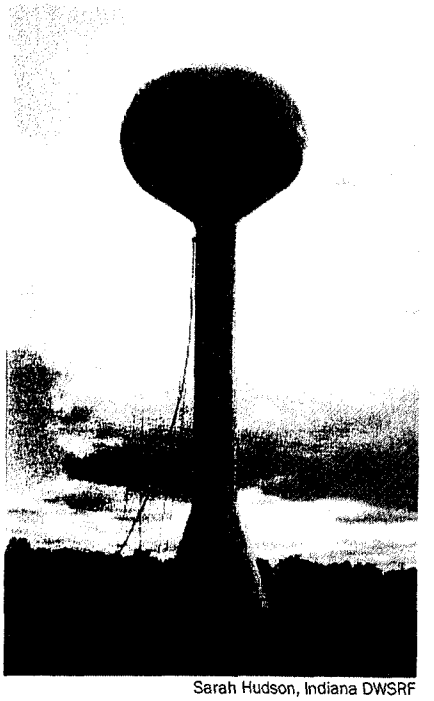
- Sources – construction of new wells or springs and replacement or rehabilitation of any source.

- Treatment – installation of a new ultraviolet (UV) treatment or membrane filtration system (for projects not solely for compliance with the Long Term 2 Enhanced Surface Water Treatment Rule).
- Storage – construction or replacement of a finished water storage tank.
- Pipe – installation of new water mains and any new water main appurtenances such as valves and hydrants.
- Security – motion detector, in-line monitoring devices, or other sophisticated security system components.

Projects for Which All Forms of Documentation Were Accepted

Projects for infrastructure that is generally expected to require rehabilitation or replacement within a 20-year period were accepted with minimum documentation of need. Survey-generated documentation was sufficient for these projects, which included:

- Sources – installation, replacement or rehabilitation of well pumps, raw water pumps, and other miscellaneous source projects.
- Treatment – rehabilitation of a complete treatment plant or installation of any treatment system components (other than new UV and new membrane filtration).
- Storage – rehabilitation of any finished water storage tank, cover of finished water storage tank, and installation of hydropneumatic tanks and cisterns.
- Pumping – installation, replacement, or rehabilitation of any pump or pump station.
- Pipe – rehabilitation or replacement of water mains up to 10 percent of the system's total pipe inventory.
- Other infrastructure such as replacement of lead service lines and installation of control valves, backflow prevention, meters, controls, and emergency power.



Sarah Hudson, Indiana DWSRF

Elevated storage tank in Greensburg, Indiana.

Documentation of Cost

To estimate a 20-year national and individual state need, every project must have an estimated cost. There were two primary methods for assigning costs to a project:

- Systems provided an independent cost estimate.

- Systems provided adequate information for EPA to estimate a cost using a cost model.

For systems that provided a cost estimate, the documentation must:

- Include the date the estimate was derived.
- Be generated through a process independent of the Assessment.
- Be no more than 10 years old (earlier than January 1, 1997).
- Not include loan origination fees, finance charges, bond issuance fees or costs, interest payments on a loan, or inflationary multipliers for future projects.

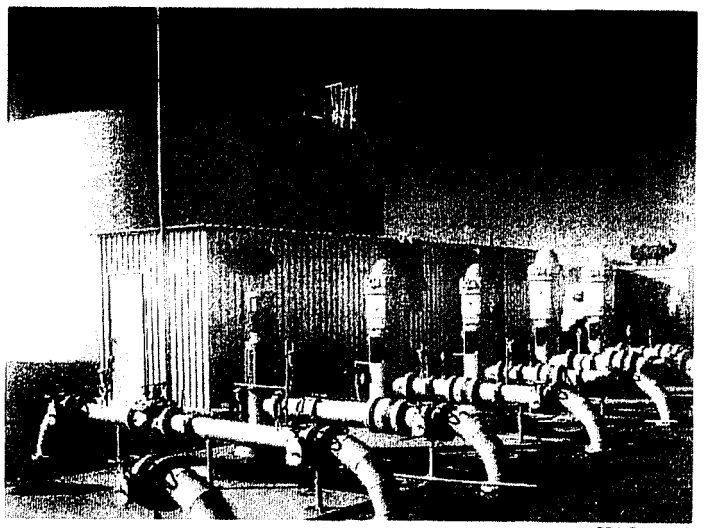
Since projects with adequately documented costs were the basis of the cost models, systems were encouraged to provide both cost and design parameters for as many projects as possible so that the data could be used to build new cost models.

If a cost was not provided, key information on design parameters and project type was required for EPA to assign a cost to the project using a cost model. However, EPA was unable to model a few types of infrastructure projects (e.g., projects that were too unique or site-specific). In those cases, a documented cost estimate was required in order for the cost to be included in the Assessment.

As with previous Assessments, EPA will publish a document detailing the costs models developed and used in the 2007 Assessment. The publication should be available by mid-2009.

Appendix D - Accuracy, Precision, and Uncertainty

Uncertainty, precision, and bias affect the accuracy of an estimate based on a statistical sample. While a sample can be designed to meet certain precision targets, other sources of uncertainty and potential biases may diminish the accuracy of estimates.



EPA Region 9

A 300,000 gallon storage tank and pumping facility at a water system in Arizona.

Uncertainty

There are two types of uncertainty at play in the DWINSA. Real uncertainties are created as survey respondents predict future needs. EPA is asking systems not only to provide their existing needs, but also to anticipate what their future needs will be. It is difficult to predict future needs. Since no one knows, for example, when a pump will fail or exactly what it will cost to fix or replace it when it does fail, there is real uncertainty about the accuracy of estimates of future investment needs.

A second source of uncertainty is the use of a probability sample to estimate need. Uncertainties are created due to the inherent limitations of statistical analyses. The use of a random sample and cost models create such stochastic (i.e., random or arising from chance) uncertainties in the survey. In assessing the impact that the sample has on the estimate, EPA distinguishes between two sources of stochastic uncertainty: precision and bias.

Precision

Precision is the degree to which additional measures would produce the same or similar results. Two factors affect the precision of sample-based estimates. First is the inherent variability of the data. If systems' needs are similar, the margin of error will be smaller than if needs vary greatly across systems. The second factor is the size of the sample. Larger samples produce more precise estimates than smaller ones.

The use of a random sample introduces uncertainty in the estimate. A different sample would lead to a different estimate of each state's need, since there will always be some variability among different systems selected in a sample. Because the DWINSA relies on a random sample, the sample should provide an unbiased estimate of the total need. The level of confidence in the estimate is reflected in the confidence interval.

EPA's goal is to be 95 percent confident that the margin of error for the survey is +/- 10 percent of the total need for systems serving more than 3,300 persons for each fully surveyed

state, assuming that the data provided are unbiased. (The estimates for individual partially surveyed states do not meet these precision targets. DWINSA also has separate precision targets for systems serving 3,300 or fewer persons.)

If the systems that responded to the survey reported the cost of their investment needs for all projects, sampling error would be the only stochastic source of uncertainty. But systems do not have cost estimates for most of the projects they reported. EPA imputed the cost of these projects using cost models based on cost estimates submitted for other projects. As with sampling, there is a degree of predictable error associated with such modeling.

Bias

Sampling error is random. It is as likely to lead to an estimate that is greater than the true value as it is lower than the true value. Bias, however, is not random. An estimator is biased if its expected value is different from the true value. An estimator is upwardly biased if it consistently leads to an estimate that is greater than the true value. It is downwardly biased if it consistently leads to an estimate that is less than the true value. The DWINSA has both upwards and downward biases. EPA implemented policies and procedures to mitigate the impact of these biases.

Downward bias

Past DWINSAs and studies of these Assessments have shown that systems are likely to underestimate their needs. There is little theory or empirical evidence to suggest that systems overstate their needs. This understatement is brought on for two primary reasons. One is that the bulk of a system's infrastructure is underground in the form of transmission and distribution mains. It is difficult to assess the need for addressing these out-of-sight assets. The second is that the survey assesses systems' 20-year need. Many systems have not undertaken the long-term planning necessary to identify future infrastructure needs.

Photo by Rudd Coffey

Water main break repair in Watertown, Massachusetts.

Upward bias

In part to help address the downward bias introduced by systems' underestimating their needs, EPA enlisted the help of states in the data collection effort. However, because states are the recipients of the capitalization grants determined by the Assessment, there is an incentive for states to overestimate their systems' needs. This situation introduces a possible upward bias in the estimate of the needs generated by systems with state input.

This bias likely does not apply to the DWINSA estimate of small system need. The small system survey is conducted by EPA, without states' direct involvement.

For this reason, there is no upward bias in this portion of the survey. In addition, because small system surveys are conducted by trained professionals, EPA expects very little downward bias.

Approximately 25 states and territories and the District of Columbia have needs of less than 1 percent of the national need. These states receive the minimum DWSRF allocation regardless of the need reported (1 percent for states, Puerto Rico, and the District of Columbia; 0.33 percent for U.S. Territories). For this reason, there is likely no upward bias in the allocation for these states, and only the downward bias discussed above influences need in these states.

With input from states as well as a peer-review process, EPA implemented policies to help address both upward and downward bias. These policies included:

- Projects to rehabilitate or replace infrastructure generally considered in need of attention within a 20-year period were allowed based on system- or state-signed statements and project descriptions. States encouraged systems to consider their entire inventory and document all such needs if legitimate.
- Projects to rehabilitate or replace infrastructure not necessarily considered in need of attention within a 20-year period were allowed with documentation independent of the Assessment or a system or state's statement if it included additional project-specific information such as an assessment of age, current condition, and maintenance history.
- Projects that include the installation/construction of new infrastructure generally received a high degree of scrutiny to ensure that they met allowability criteria
- Some infrastructure was only allowed if independent documentation was provided. They included new surface water sources, new treatment plants, the replacement or expansion of an existing treatment plant, and widespread replacement or rehabilitation of the distribution system (defined as more than 10 percent of the existing pipe inventory).

Appendix E - Summary of Findings for Systems Serving 10,000 and Fewer Persons

Community Water Systems Serving 10,000 People and Fewer

The SDWA requires that states use at least 15 percent of their DWSRF funding for financial assistance to community water systems (CWS) serving populations of 10,000 and fewer. The Assessment shows that the vast proportion of needs, $320.1 billion of the total national needs of $334.8 billion, are for CWSs. The not-for-profit noncommunity water systems make up the much smaller portion of the total needs. Of the $320.1 billion, CWSs serving 10,000 and fewer persons represent 31.2 percent or approximately $100 billion of needs (includes CWSs in U.S. Territories). Exhibit E.1 presents the 20-year needs for these smaller community systems by state and project type. It also compares the reported need of these systems to the state's total community water system need. All data in Exhibit E.1 exclude needs related to not-for-profit noncommunity water systems.

Exhibit E.1: 2007 State Need Reported by Project Type for CWSs Serving a Population of 10,000 and Fewer (20-year need in millions of 2007 dollars)

State	CWSs Serving 10,000 or Fewer People							
	Transmission/ Distribution	Source	Treatment	Storage	Other	Total 20-Year Need of CWS Serving 10,000 or Fewer People.*	Total 20-Year Need of All CWS*	% of CWS Need Related to Systems Serving 10,000 or Fewer Persons.*
Alabama	$1,022.1	$38.0	$100.7	$110.4	$3.6	$1,274.7	$4,095.6	31.1%
Alaska	$382.5	$42.8	$106.4	$99.3	$6.0	$637.0	$751.3	84.8%
Arizona	$695.2	$124.5	$305.9	$217.8	$8.7	$1,352.0	$7,392.1	18.3%
Arkansas	$1,740.7	$107.2	$364.6	$255.7	$9.4	$2,477.7	$5,271.2	47.0%
California	$3,383.5	$521.7	$839.4	$791.7	$74.6	$5,610.9	$38,944.9	14.4%
Colorado	$958.1	$177.3	$562.4	$247.7	$12.5	$1,958.0	$6,398.8	30.6%
Connecticut	$367.9	$103.2	$108.9	$87.3	$8.1	$675.4	$1,366.5	49.4%
District of Columbia	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	$874.2	0.0%
Florida	$1,802.7	$218.9	$335.3	$332.6	$34.4	$2,723.7	$12,695.5	21.5%
Georgia	$1,486.6	$202.5	$402.8	$288.6	$29.5	$2,410.0	$8,924.0	27.0%
Illinois	$2,880.2	$283.1	$920.7	$650.6	$32.3	$4,766.8	$14,907.0	32.0%
Indiana	$1,570.9	$124.7	$310.1	$259.0	$12.3	$2,277.1	$5,768.1	39.5%
Iowa	$1,159.8	$173.0	$476.8	$279.9	$14.9	$2,104.4	$6,094.7	34.5%
Kansas	$1,663.1	$130.4	$378.9	$246.4	$12.2	$2,430.9	$4,026.7	60.4%
Kentucky	$952.4	$40.2	$154.5	$161.5	$9.4	$1,318.0	$4,977.0	26.5%
Louisiana	$1,546.1	$161.9	$358.6	$269.4	$24.5	$2,360.5	$6,885.2	34.3%
Maryland	$390.4	$77.1	$152.8	$125.0	$15.9	$761.3	$5,345.2	14.2%
Massachusetts	$799.2	$114.6	$166.5	$207.6	$8.2	$1,296.1	$6,757.1	19.2%
Michigan	$1,921.8	$302.8	$754.1	$392.2	$33.0	$3,403.8	$11,370.6	29.9%
Minnesota	$1,241.1	$174.6	$605.7	$318.0	$14.5	$2,353.9	$5,720.1	41.2%
Mississippi	$1,283.4	$186.0	$515.7	$332.9	$14.1	$2,332.1	$3,233.7	72.1%
Missouri	$2,811.5	$216.3	$479.9	$400.8	$21.3	$3,929.9	$7,046.5	55.8%
Nebraska	$616.6	$93.7	$165.4	$253.0	$7.5	$1,136.1	$1,760.6	64.5%
Nevada	$232.6	$33.9	$71.5	$108.9	$6.7	$453.7	$2,677.1	16.9%
New Jersey	$672.3	$87.2	$222.9	$195.8	$6.3	$1,184.5	$7,758.1	15.3%

* Excludes NPNCWS

Exhibit E.1: 2007 State Need Reported by Project Type for CWSs Serving a Population of 10,000 and Fewer (20-year need in millions of 2007 dollars), cont.

State	CWSs Serving 10,000 or Fewer People							% of CWS Need Related to Systems Serving 10,000 or Fewer Persons.*
	Transmission/ Distribution	Source	Treatment	Storage	Other	Total 20-Year Need of CWS Serving 10,000 or Fewer People.*	Total 20-Year Need of All CWS*	
New York	$2,837.3	$369.8	$978.1	$588.2	$39.0	$4,812.3	$27,011.1	17.8%
North Carolina	$1,776.3	$233.5	$416.3	$395.0	$28.4	$2,849.5	$9,685.5	29.4%
Ohio	$2,196.2	$191.3	$739.1	$406.7	$31.2	$3,564.5	$12,316.8	28.9%
Oklahoma	$1,580.1	$121.4	$421.6	$301.7	$13.2	$2,437.9	$4,089.8	59.6%
Oregon	$697.2	$110.0	$268.0	$182.3	$15.1	$1,272.5	$2,729.8	46.6%
Pennsylvania	$2,262.9	$367.7	$644.0	$474.6	$29.2	$3,778.3	$11,097.6	34.0%
Puerto Rico	$370.1	$42.2	$181.5	$104.9	$11.3	$710.1	$2,536.3	28.0%
South Carolina	$324.3	$48.0	$95.1	$74.3	$5.3	$547.0	$1,612.1	33.9%
Tennessee	$1,185.8	$62.4	$200.5	$164.1	$8.4	$1,621.2	$3,518.8	46.1%
Texas	$5,579.0	$735.9	$1,816.3	$1,214.3	$57.4	$9,402.9	$26,083.1	36.0%
Virginia	$1,106.8	$142.5	$343.0	$270.1	$21.5	$1,883.9	$5,970.2	31.6%
Washington	$2,009.8	$409.5	$682.9	$581.9	$57.4	$3,741.5	$9,640.0	38.8%
Wisconsin	$1,193.0	$168.1	$459.3	$290.7	$14.5	$2,125.6	$5,702.6	37.3%
Partially Surveyed States†	$5,756.9	$792.6	$1,802.8	$1,272.4	$92.6	$9,717.2	$16,887.9	57.5%
Subtotal	***$60,456.5***	***$7,530.2***	***$17,909.0***	***$12,953.0***	***$844.3***	***$99,693.0***	***$319,923.3***	***31.2%***
American Samoa	$18.7	$2.9	$6.7	$4.7	$0.3	$33.3	$92.8	35.9%
Guam	$12.5	$0.0	$8.5	$11.6	$0.0	$32.6	$263.9	12.3%
Commonwealth of the Northern Mariana Islands	$100.1	$19.9	$24.7	$33.1	$2.9	$180.6	$289.3	62.4%
U.S. Virgin Islands	$31.3	$7.1	$9.7	$6.9	$0.9	$55.9	$253.3	22.1%
Subtotal	***$162.5***	***$29.8***	***$49.6***	***$56.3***	***$4.1***	***$302.4***	***$899.4***	***33.6%***
Total	**$60,619.0**	**$7,560.1**	**$17,958.6**	**$13,009.3**	**$848.4**	**$99,995.4**	**$320,822.6**	**31.2%**

* Excludes NPNCWS

† For the 2007 DWINSA the need for states that opt out of the medium system portion of the survey is presented cumulatively and not by state. The list of the 14 partially surveyed states can be seen in Exhibit 2.4.

Glossary

Capital Improvement Plan (CIP): a document produced by a local government, utility, or water system that thoroughly outlines, for a specified period of time, all needed capital projects, the reason for each project, and the projects' costs.

Coliform bacteria: a group of bacteria whose presence in a water sample indicates the water may contain disease-causing organisms.

Community water system (CWS): a public water system that serves at least 15 connections used by year-round residents or that regularly serves at least 25 residents year-round. Examples include cities, towns, and communities such as retirement homes.

Current infrastructure needs: new facilities or deficiencies in existing facilities identified by the state or system for which water systems would begin construction as soon as possible to avoid a threat to public health.

Engineer's report: a document produced by a professional engineer that outlines the need and cost for a specific infrastructure project.

Existing regulations: drinking water regulations promulgated by EPA under the authority of the Safe Drinking Water Act; existing regulations can be found at Title 40 Part 141, the Code of Federal Regulations (40 CFR 141).

Finished water: water that is considered safe to drink and suitable for delivery to customers.

Future infrastructure needs: infrastructure deficiencies that a system expects to address in the next 20 years because of predictable deterioration of facilities. Future infrastructure needs do not include current infrastructure needs. Examples are storage facility and treatment plant replacement where the facility currently performs adequately but will reach the end of its useful life in the next 20 years. Needs solely to accommodate future growth are not included in the DWINSA.

Ground water: any water obtained from a source beneath the surface of the ground, which has not been classified as ground water under the direct influence of surface water.

Growth: The expansion of a water system to accommodate or entice future additional service connections or consumers. Needs planned solely to accommodate projected future growth are not included in the Assessment. Eligible projects, however, can be designed for growth expected during the design-life of the project. For example, the Assessment would allow a treatment plant needed now and expected to treat water for 20 years. Such a plant could be designed for the population anticipated to be served at the end of the 20-year period.

Infrastructure needs: the capital costs associated with ensuring the continued protection of public health through rehabilitating or constructing facilities needed for continued provision of safe drinking water. Categories of infrastructure need include source development and rehabilitation, treatment, storage, and transmission and distribution. Operation and maintenance needs are not considered infrastructure needs and are not included in this document.

Large water system: in this document, this category comprises community water systems serving more than 100,000 persons.

Medium water system: in this document, this category comprises community water systems serving from 3,301 to 100,000 persons.

Microbiological contamination: the occurrence of protozoan, bacteriological, or viral contaminants in a water supply.

Noncommunity water system: a public water system that is not a community water system and that serves a nonresidential population of at least 25 individuals daily for at least 60 days of the year. Examples of not-for-profit noncommunity water systems include schools and churches.

Public water system: a system that provides water to the public for human consumption through pipes or other constructed conveyances, if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year.

Regulatory need: a capital expenditure required for compliance with Safe Drinking Water Act regulations.

Safe Drinking Water Act (SDWA): a law passed by Congress in 1974 and amended in 1986 and 1996 to ensure that public water systems provide safe drinking water to consumers (42 U.S.C.A. §300f to 300j-26).

Small water system: in this document, this category comprises community water systems serving up to 3,300 persons.

Source rehabilitation and development: a category of need that includes the costs involved in developing or improving sources of water for public water systems.

State: in this document, state refers to all 50 states of the United States plus Puerto Rico, the District of Columbia, American Samoa, Guam, the Commonwealth of Northern Mariana Islands, and the U.S. Virgin Islands.

Storage: a category of need that addresses finished water storage for public water systems.

Supervisory Control and Data Acquisition (SCADA): an advanced control system that collects all system information and allows an operator, through user-friendly interfaces, to view all aspects of the system from one place.

Surface water: all water that is open to the atmosphere and subject to surface run-off, including streams, rivers, and lakes.

Transmission and distribution: a category of need that includes installation, replacement, or rehabilitation of transmission or distribution lines that carry drinking water from the source to the treatment plant or from the treatment plant to the consumer.

Treatment: a category of need that includes conditioning water or removing microbiological or chemical contaminants. Filtration of surface water, pH adjustment, softening, and disinfection are examples of treatment.

Watering point: a central source from which people who do not have piped water can obtain drinking water for transport to their homes.

Jim McRight, North Carolina Department of Environment and Natural Resources

A view of a treatment plant and underground pipe gallery in North Carolina.

FKS-RB7

Dawn of the Replacement Era

Reinvesting in Drinking Water Infrastructure

An Analysis of Twenty Utilities' Needs for Repair and Replacement of Drinking Water Infrastructure

American Water Works Association
Dedicated to Safe Drinking Water

A Study Sponsored by The AWWA Water Industry Technical Action Fund

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Reinvesting in Drinking Water Infrastructure

Dawn of the Replacement Era

TABLE OF CONTENTS

Title	Page
Executive Summary	5
Introduction	9
Findings	10
• Pipes are expensive, but invisible	10
• Pipes are hearty, but ultimately mortal	10
• Back to the future: pipe replacement needs are "demographic echo"	12
• Water infrastructure is local and therefore vulnerable to demographic changes	14
• Replacement of water treatment plants is also coming due	16
• Increased expenditures are needed to climb the ramp and avoid a gap	17
• Addressing affordability is the heart of the challenge	19
Recommendations	22
• Measures by utilities and local governments	22
• Reform of state programs	23
• A significant increase in federal assistance	23
Conclusion	24
20 Sets of Nessie Curves	App A
Acknowledgments	App B

Reinvesting in Drinking Water Infrastructure

Dawn of the Replacement Era

EXECUTIVE SUMMARY

The importance of safe drinking water to public health and the nation's economic welfare is undisputed. However, as we enter the 21st Century, water utilities face significant economic challenges. For the first time, in many of these utilities a significant amount of buried infrastructure—the underground pipes that make safe water available at the turn of a tap—is at or very near the end of its expected life span. The pipes laid down at different times in our history have different life expectancies, and thousands of miles of pipes that were buried over 100 or more years ago will need to be replaced in the next 30 years. Most utilities have not faced the need to replace huge amounts of this infrastructure because it was too young. Today a new age has arrived. We stand at the dawn of the replacement era.

Extrapolating from our analysis of 20 utilities, we project that expenditures on the order of $250 billion over 30 years might be required nationwide for the replacement of worn-out drinking water pipes and associated structures (valves, fittings, etc). This figure does not include wastewater infrastructure or the cost of new drinking water standards. Moreover, the requirement hits different utilities at different times and many utilities will need to accelerate their investment. Some will see rapidly escalating infrastructure expenditure needs in the next 10–20 years. Others will find their investment decisions subject to a variety of factors that cause replacement to occur sooner or at greater expense, such as urban redevelopment, modernization, coordination with other city construction, increasing pipe size, and other factors.

Overall, the findings confirm that replacement needs are large and on the way. There will be a growing conflict between the need to replace worn-out infrastructure and the need to invest in compliance with new regulatory standards under the Safe Drinking Water Act. In addition, the concurrent demands for investment in wastewater infrastructure and compliance with new Clean Water Act regulations, including huge needs for meeting combined sewer overflow (CSO) and stormwater requirements, will compete for revenue on the same household bill.

Ultimately, the rate-paying public will have to finance the replacement of the nation's drinking water infrastructure either through rates or taxes. AWWA expects local funds to cover the great majority of the nation's water infrastructure needs and remains committed to the principle of full-cost recovery through rates. However, many utilities may face needs that are large and unevenly distributed over time. They must manage a difficult transition between today's level of investment and the higher level of investment that is required over the long term. Facing an inexorable rise in infrastructure replacement needs driven by demographic forces that were at work as much as 100 years ago, compounded by the negative effects of changing demographics on per-capita costs in center cities, many utilities face a significant challenge in keeping water affordable for all the people they serve.

Meeting this challenge requires a new partnership in which utilities, states, and the federal government all have important roles. Utilities need to examine their rate structures to assure long-term viability. States need to streamline their programs. And the federal government needs to significantly increase assistance for utilities.

To better understand this problem, the American Water Works Association undertook studies of 20 large and medium utilities. The findings and recommendations of this report provide the basis for this new partnership to achieve the goal to which we all aspire—the provision of safe and affordable drinking water for all Americans.

Findings:

- Water utilities must make a substantial reinvestment in infrastructure over the next 30 years. The oldest cast iron pipes, dating to the late 1800s, have an average life expectancy of about 120 years. Because of changing materials and manufacturing techniques, pipes laid in the 1920s have an average life expectancy of about 100 years, and pipes laid in the post-World War II boom can be expected to last about 75 years. The replacement bill for these pipes will be hard on us for the next three decades and beyond.

- Most utilities are just now beginning to face significant investments for infrastructure replacement. Indeed, it would have been economically inefficient to make large replacement investments before now. The utilities we studied are well managed and have made the right decisions. But the bills are now coming due, and they loom large.

- On average, the replacement cost value of water mains is about $6,300 per household in today's dollars in the relatively large utilities studied. If water treatment plants, pumps, etc., are included, the replacement cost value rises to just under $10,000 per household, on average.

- Demographic shifts are a significant factor in the economics of reinvestment. In some older cities, the per-capita replacement value of mains is more than three times higher than the average in this sample due to population declines since 1950.

- By 2030, the average utility in the sample will have to spend about three and a half times as much on pipe replacement due to wear-out as it spends today. Even so, the average utility will also spend three times as much on repairs in that year as it spends today, as the pipes get older and more prone to breakage.

- The water utilities studied concurrently face the need to replace infrastructure and upgrade treatment plants to comply with a number of new regulations to be implemented under the Safe Drinking Water Act. Many municipalities also face significant needs for investments in wastewater infrastructure and compliance. This concurrent demand significantly increases the financial challenge they face.

- Overall, in the 20 utilities studied, infrastructure repair and replacement requires additional revenue totaling about $6 billion above current spending over the next 30 years. This ranges from about $550 per household to almost $2,300 per house-

hold over the period. These household impact figures do not include compliance with new regulations or the cost of infrastructure replacement and compliance for wastewater.

- The pattern and timing of the need for additional capital will be different in each community, depending on its demographically driven replacement "wave."
- Household impacts will be two to three times greater in smaller water systems ($1,100 to $6,900 per household over 30 years) due to disadvantages of small scale and the tendency for replacement needs to be less spread out over time.
- Because of demographic changes, rate increases will fall disproportionately on the poor, intensifying the challenge that many utilities face keeping water affordable to their customers.

Recommendations:

America needs a new partnership for reinvesting in drinking water infrastructure. There are important roles at all levels of government.

1) Measures by Utilities and Local Governments

Although the AWWA analysis has looked at the infrastructure issue in the aggregate, many key issues must be addressed at the local utility level. Utilities should develop a comprehensive local strategy that includes:

- Assessing the condition of the drinking water system infrastructure.
- Strengthening research and development
- Working with the public to increase awareness of the challenge ahead, assess local rate structures, and adjust rates where necessary.
- Building managerial capacity.

2) Reform of State Programs

The states too have an important role to play in addressing our infrastructure funding needs. States may need to match an appropriate share of any new federal funds that are provided for infrastructure assistance. Moreover, states need to reform their existing programs to make them more effective. States should commit to:

- Respecting the universal eligibility of all water systems for federal assistance.
- Streamlining their programs for delivery of assistance and allow alternative procurement procedures that save money.
- Making their financing mechanisms more attractive by committing to grants and very low or negative interest loans.
- Using federal funds in a timely fashion or face the reprogramming of those funds to other states.

3) A Significant Increase in Federal Assistance

The federal government has a critical role to play in preventing the development of a gap in water infrastructure financing. AWWA recommends either changing and expanding the existing Drinking Water State Revolving Fund and other drinking water programs, or creating a new, infrastructure-focused fund. The federal role should include:

- Significantly increased federal funding for projects to repair, replace, or rehabilitate drinking water infrastructure.
- An increase in federally supported research on infrastructure management, repair and replacement technologies.
- Steps to increase the availability and use of private capital.

Reinvesting in Drinking Water Infrastructure

Dawn of the Replacement Era

Introduction

The importance of safe drinking water to the nation's public health and economic welfare is undisputed. About 54,000 community drinking water systems provide drinking water to more than 250 million Americans. By keeping water supplies free of contaminants that cause disease, our public water systems reduce sickness and related health costs as well as absenteeism in the workforce. By providing safe and sufficient supplies of water, America's public water systems create direct economic value across nearly every sector of the economy and every region of the country. However, significant economic changes are confronting the water profession as we enter the 21st Century. The new century poses new challenges in sustaining the infrastructure—particularly the underground pipes—that provides the broad public benefits of clean and safe water.

Recognizing that we are at the dawn of a major change in the economics of water supply, the American Water Works Association (AWWA) has undertaken an analysis of the infrastructure challenge facing utilities. The project involved correlating the estimated life of pipes with actual operations experience in a sample of 20 utility systems geographically distributed throughout the nation (see Figure 1). Projecting future investment needs for pipe replacement in those utilities yields a forecast of the annual replacement needs for a particular utility, based on the age of the pipes and how long they are expected to last in that utility. This analysis graphically portrays the nature of the challenge ahead of us. It also serves as the foundation for AWWA's call for a new national partnership to address the looming need to reinvest in our drinking water infrastructure.

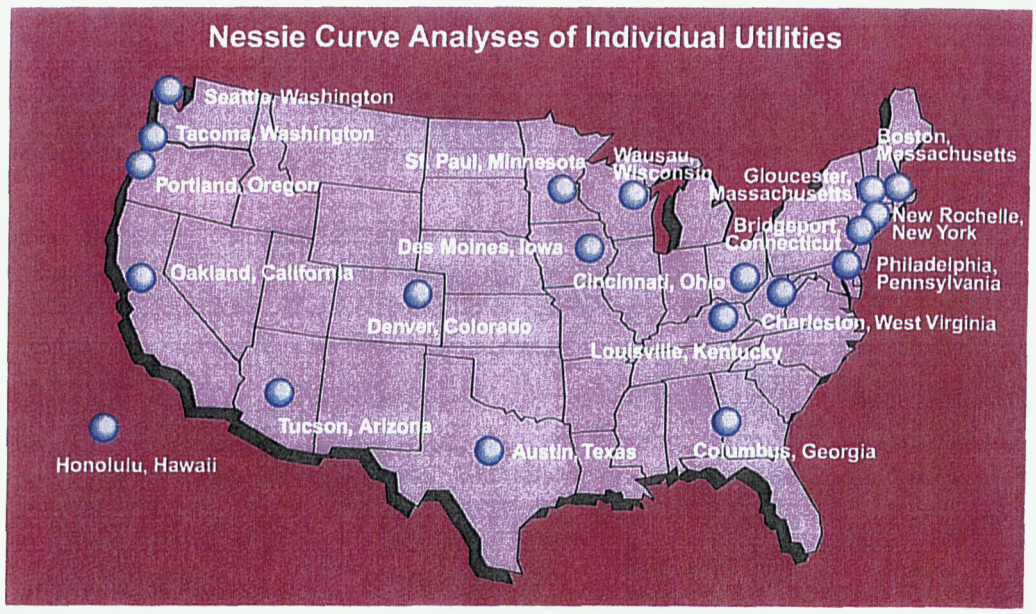


Figure 1

Pipes are expensive, but invisible.

Most people do not realize the huge magnitude of the capital investment that has been made to develop the vast network of distribution mains and pipes—the infrastructure—that makes clean and safe water available at the turn of a tap. Water is by far the most capital intensive of all utility services, mostly due to the cost of these pipes, water infrastructure that is literally a buried treasure beneath our streets. But buried means out of sight. And as the old saying goes, out of sight means out of mind. Moreover, most of our pipes were originally installed and paid for by previous generations. They were laid down during the economic booms that characterized the last century's periods of growth and expansion. So not only do we take these pipes for granted because we can't see them, we also take them for granted because, for the most part, we didn't pay for them initially. What's more, they last a long time (some more than a century) before they cost us very much in maintenance expense near the end of their useful lives or ultimately need replacement. For the most part, then, the huge capital expense of the pipes is a cost that today's customers have never had to bear. It has always been there, but it's always been invisible to us.

The original pattern of water main installation from 1870 to 2000 in 20 utilities analyzed by AWWA is graphically presented in Figure 2. This graph reflects the total cost in current dollars of replacing the pipes laid down between 1870 and 1998 in the 20 utilities studied. It is a reflection of the development of these utilities, and in turn, mirrors the overall pattern of population growth in large cities across the country. There was an 1890s boom, a World War I boom, a roaring '20s boom, and the massive post-World War II baby boom.

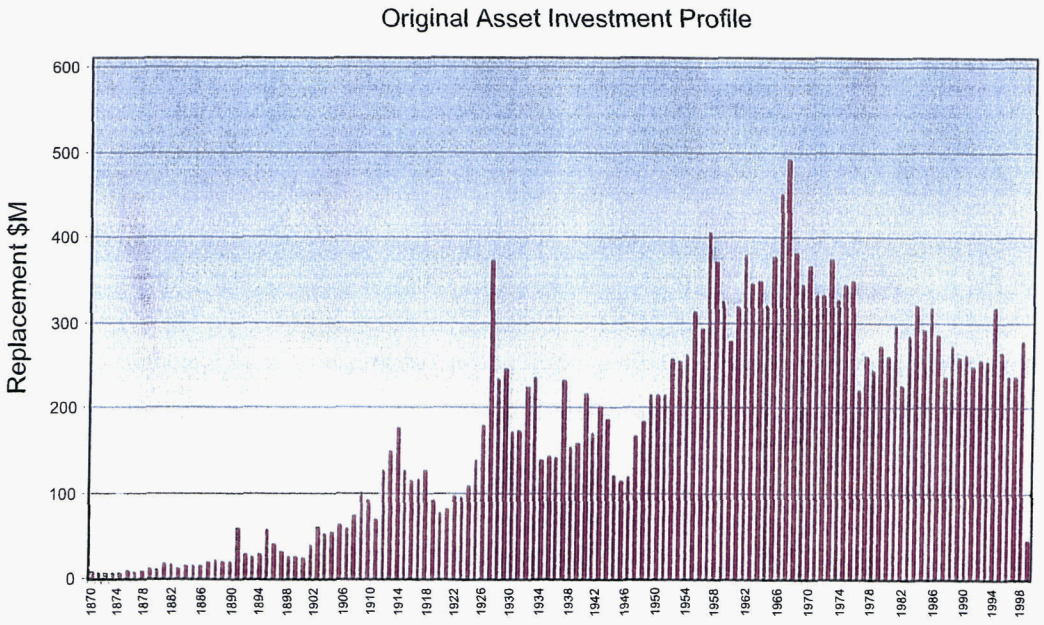


Figure 2

The cumulative replacement cost value of water main assets (that is, the cost of replacing water mains in constant year 2000 dollars) has increased steadily over the last century in our sample of 20 utilities. In aggregate across our sample of utilities, the replacement value of water mains in today's dollars is about $6,300 per household. If water treatment plants, pumps, etc., are included, this figure rises to just under $10,000 per household. This is more than three times what it was in 1930 in constant dollar terms. The difference is not due to inflation; rather, there is simply more than three times as much of this infrastructure today as there was in 1930, in order to support improved service standards and the changing nature of urban development.

In general, then, there is a lot more water infrastructure in place today on a per-capita basis, implying an increased per-capita share of the liability for replacing these assets as they wear out. This invisible replacement liability has been accumulating gradually over several generations of water system customers, managers and governing boards. They have not had to recognize this liability because the bill was not yet due. For many utilities, board/council/commission relationships and customer relationships have developed in recent decades in the absence of a recognized need for significant investment in replacing the utility's assets as they age and wear out.

Pipes are hearty, but ultimately mortal.

The oldest cast iron pipes—dating to the late1800s—have an average useful life of about 120 years. This means that, as a group, these pipes will last anywhere from 90 to 150 years before they need to be replaced, but on average they need to be replaced after they have been in the ground about 120 years. Because manufacturing techniques and materials changed, the roaring '20s vintage of cast-iron pipes has an average life of about 100 years. And because techniques and materials continued to evolve, pipes laid down in the Post-World War II boom have an average life of 75 years, more or less. Using these average life estimates and counting the years since the original installations shows that these water utilities will face significant needs for pipe replacement over the next few decades.

The modern public water supply industry has come into being over the course of the last century. From the period known as the "Great Sanitary Awakening," that eliminated waterborne epidemics of diseases such as cholera and typhoid fever at the turn of the last century, we have built elaborate utility enterprises consisting of vast pipe networks and amazing high-tech treatment systems. Virtually all of this progress has been financed through local revenues. But in all this time, there has seldom been a need to provide for more than modest amounts of pipe replacement, because the pipes last so very long. We have been on an extended honeymoon made possible by the long life of the pipes and the fact that our water systems are relatively young. Now that honeymoon is over. From now on and forevermore, utilities will face significant requirements for pipe repair, rehabilitation, and replacement. Replacement of pipes installed from the late1800s to the 1950s is now hard upon us, and replacement of pipes installed in the latter half of the 20th Century will dominate the remainder of the 21st.

We believe that we stand today at the dawn of a new era—the replacement era—for water utilities. Over the next three decades, utilities will be in an adjustment period during which they will incorporate the costs of pipe replacement in routine utility spending. This will require significant adjustments in utility revenues. The magnitude of the need and the

invisibility of that need to the person on (top of) the street will make this a particularly challenging adjustment. The need for significantly greater investment in pipe replacement is all the more difficult to convey because it was never there before. It's hard to explain why it's going to cost more to do the same job in the future than it cost in the past.

Many water systems all across America have seen this day coming and have already begun to ramp up their expenditures on pipe rehabilitation and replacement. But for many utilities this problem is just emerging and is enormous in scope. For them the water supply business will never be the same.

Back to the future: pipe replacement needs are a "demographic echo."

To understand the nature and scope of the emerging infrastructure challenge, AWWA undertook an analysis of 20 utilities throughout the nation. The analysis projects future investment needs for pipe replacement in the 20 utilities and provides a forecast called a "Nessie Curve." The Nessie Curve is a graph of the annual replacement needs in a particular utility, based on when pipes were installed and how long they are expected to last in that utility before it becomes economically efficient to replace them. There are, of course, a number of factors that can require the replacement investment to be made earlier. In many cities, for example, there are urban redevelopment efforts or similar major construction projects that could require up-sizing or other modernization of the pipe network before the pipes reach the end of their useful lives.

Data on repair and replacement needs for each of the 20 cities in our sample is presented in Appendix A. This information is presented for each city as a "Nessie Curve," that is, a projection of the city's economically efficient investment in pipe repair and replacement, based on the city's original pipe installation profile and how long the pipes last in that utility. The aggregate Nessie Curve for all 20 utilities is presented in Figure 3. The rising wave shape suggests why the curve is named after the Loch Ness Monster.

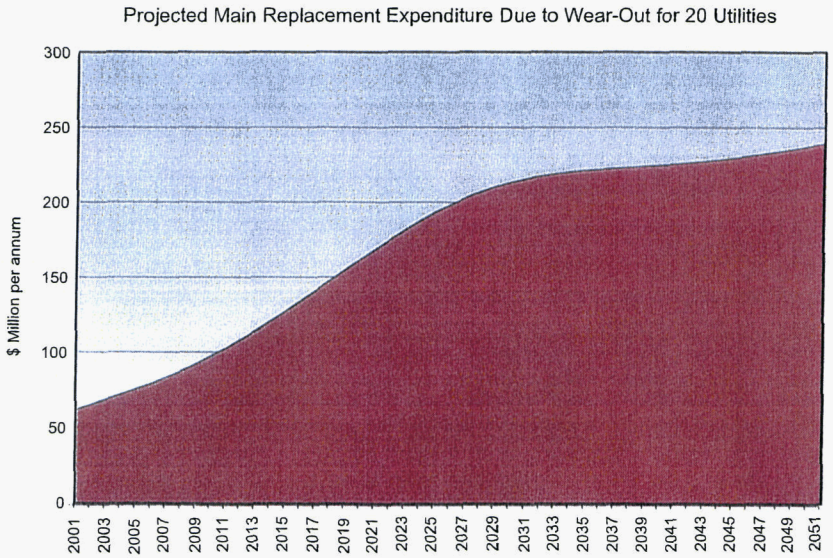


Figure 3

The Nessie Curve reflects an "echo" of the original demographics that shaped a particular utility. It is very similar to the echo of demographics that predicts future liabilities for the Social Security Trust Fund. Indeed, this is exactly the same type of problem that faces Social Security. Historical demographic trends—in our case, pipes laid down as long as a century ago—created a future financial obligation that is now coming due. By modeling the demographic pattern and knowing the life expectancy of the pipes, we can estimate the timing and magnitude of that obligation.

Just as in Social Security, a threat to affordability arises when there were powerful demographic and economic trends at work originally, but the liability arrives at a later time when the demographic and economic conditions have changed. In the water business, the challenge is magnified by pipes that last through several generations of customers before they need to be replaced.

Reflecting the pattern of population growth in large cities over the last 120 years, the Nessie Curves in Appendix A forecast investment needs that will rise steadily like a ramp, extending throughout the 21st Century. The curves show that replacement expenditures will have to rise steadily for the next 30 years. By 2030, the utilities in our sample of 20 will have to spend on average over three-and-a-half times as much per year as they do now (in constant dollars) to replace pipes that have reached the end of their economic lives. Some of the utilities in our sample will encounter the steepest part of the incline in the first 10 years. Others will encounter most of the rise over 20 years, while some will experience a sustained increase over 30 years.

Of course, every city has a different demographic history. In addition, numerous local factors will affect the life of a utility's pipes and therefore its Nessie Curve. Each utility has a unique set of circumstances and therefore a different set of infrastructure funding challenges in the future. Nonetheless, demographics will produce the same type of lagged replacement schedule in any major city.

If that were not enough of a challenge, there is an important corollary. As pipe assets age, they tend to break more frequently. But it is not cost-effective to replace most pipes before, or even after, the first break. Like the old family car, it is cost-efficient for utilities to endure some number of breaks before funding complete replacement of their pipes.

Considering the huge wave of aging pipe infrastructure created in the last century, we can expect to see significant increases in break rates and therefore repair costs over the coming decades. This will occur even when utilities are making efficient levels of investment in replacement that may be several times today's levels. In the utilities studied by AWWA, there will be a three-fold increase in repair costs by the year 2030 despite a concurrent increase of three and a half times in annual investments to replace pipes.

It is important to note that a Nessie Curve is a prediction, not a destiny. That is, a utility can choose to manage its infrastructure replacement needs in various ways. For example, the utility may accept increased break repair costs up to a point and delay the replacement of an old pipe, rehabilitate certain pipes to "buy time," or adopt other asset management techniques to extend the life of the pipes as long as possible. Nevertheless, it appears inevitable that many utilities will face substantial increases in infrastructure investments over the next 30 years, to replace pipes laid down as long as 120 years ago.

A final observation from our sample of 20 Nessie Curves is that the large "demographic wave" of replacement needs is only just now upon us. We are just now at the time when there is a compelling need to significantly increase the levels of replacement spending in most utilities. Importantly, there is no evidence that utilities are "behind the curve" or that America is in ruins. That is not the nature of the challenge. We are not faced with making up for a historical gap in the level of replacement funding. In fact, break rates in our sample of 20 utilities are within a range that is considered representative of best management practices for water utilities, indicating that the utilities have made efficient decisions and managed well up to this point. The challenge is ramping up utility budgets to prevent a "replacement gap" from developing in the near future. Unfortunately, keeping up with replacement needs is about to get a lot harder than ever before, and it's going to stay that way. We are coming face-to-face with a serious challenge that could become a crisis if we ignore it.

Water infrastructure is local and therefore vulnerable to demographic changes.

Water utilities are the last natural monopolies. The large investment required in pipe networks makes it impossible to have more than a single provider of water service within a given area. These large investments are also a major source of financial vulnerability for water utilities as the result of the very fixed nature of the assets and the very mobile nature of the customers. When populations grow, the infrastructure is expanded, but when people move away, the pipe assets and the liability for repair and replacement remain behind, creating a financial burden on the remaining customers.

Figure 4 is a plot of U.S. Census population data for Philadelphia from 1850 to 1996. Over the 100 years from 1850 to 1950, the population grew from 100,000 to 2 million people. But from 1950 to the end of the century, Philadelphia lost 25 percent of its population, dropping to 1.5 million. This picture tells a story that was replicated again and again

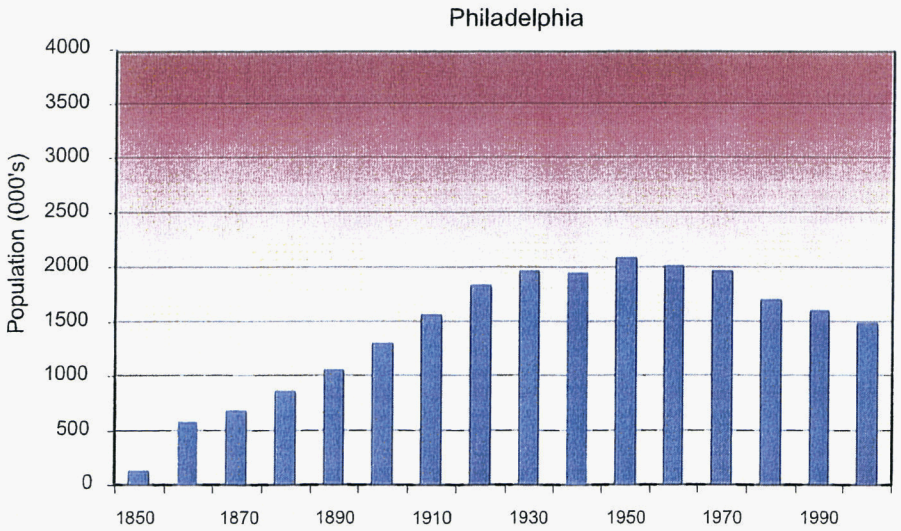


Figure 4

throughout the Rustbelt cities of the Northeast and Midwest. The effect is to significantly increase the burden of replacement funding on the remaining residents of the city.

As previously discussed, the average per-capita value of water main assets in place today across our sample of 20 utilities is estimated to be three times the amount that was present in 1930. In Philadelphia, however, that ratio is almost eight times the value in 1930 due to population declines since about 1950. This problem, known as "stranded capacity" (essentially, capital facilities that are not matched by rate revenue from current customers), is typical of Rustbelt demographics and adds considerably to the challenge of funding replacement in these cities.

Urban demographic history also explains many other dimensions of the infrastructure replacement challenge facing the water industry. Both gains and losses in urban populations created small system infrastructure problems in their wake. During the first half of the 20th Century, many of the people swelling the populations of the urban centers came from smaller rural towns, leaving small water system infrastructure behind to struggle with fewer customers. In the latter half of the century, the departure of big city residents for the suburbs fueled an explosion of new, small water systems in suburban areas. Today about half of all small water systems are within Standard Metropolitan Statistical Areas defined by the U.S. Census. Built in boom times, many of these suburban systems were not built to enduring standards, creating another liability. When these systems are absorbed by larger metropolitan systems, it is commonly necessary to completely rebuild them.

The pattern reflected in Sunbelt cities is the other side of the story from that in the Rustbelt. These cities are experiencing rapid growth and expansion which places capital financing demands upon them that are truly the opposite side of the coin. When water utilities are expanding, they must build some of the most expensive components—new source development, storage facilities, transmission mains, and treatment plants—in advance of population growth in order to serve people when they arrive. This is, in effect, another form of stranded capacity—capital facilities that must be paid for despite the fact the customers are not yet in place. Investor-owned utilities are, in fact, generally prohibited by state regulatory commissions from recovering such costs in rates.

Demographic change thus places financial strain on all our public water systems. It is the same whether they are large or small; urban or rural or suburban; and Rustbelt or Sunbelt. The inescapable fact is that water infrastructure is fixed while populations are mobile. The result is a form of "market failure"—an adverse side effect of market activity that creates an unfunded liability. America derives tremendous economic strength from the fact that it has a highly mobile labor force. When people move around, however, there are costs imposed on the local water infrastructure. It is the same whether it is people moving from rural towns to the city, from the city to the suburbs, or from the Rustbelt to the Sunbelt. Our labor mobility imposes a significant cost on water utilities on both the giving end and the receiving end of this market process, while the benefits are generally disseminated throughout the national economy.

Replacement of water treatment plants is also coming due.

Replacement of water treatment assets presents a different picture from that of the pipes, but greatly complicates infrastructure funding for utilities. Major investments in water and wastewater treatment plants were made in several waves following the growing understanding of public health and sanitary engineering that evolved during the 20th Century. Of course, the installation pattern of treatment assets also reflects major population growth trends. But whereas pipes can be expanded incrementally to serve growth, treatment must be built in larger blocks. Investments in treatment thus present a more concentrated financing demand than investments in pipes.

Treatment assets are also much more short-lived than pipes. Concrete structures within a treatment plant may be the longest lasting elements in the plant, and may be good for 50 to 70 years. However, most of the treatment components themselves typically need to be replaced after 25 to 40 years or less. Replacement of treatment assets is therefore within the historical experience of today's utility managers. Even so, many treatment plants built or overhauled to meet EPA standards over the last 25 years are too young to have been through a replacement cycle. Many are about due for their first replacement in the next decade or so.

The concurrent need to finance replacement of pipes and of treatment plants greatly increases the challenge facing utilities. Figure 5 presents a Nessie Curve showing both pipe replacement and treatment replacement needs for the Bridgeport Hydraulic Company. Similar Nessie curves for a number of other utilities are included in Appendix A.

The distinguishing characteristic of this graph is the manner in which spending for the replacement of pipes rises like a ramp over the first part of the century, pushing up the overall level of annual expenditure required. Whereas pipe repair and replacement are generally funded out of current revenues, treatment costs are typically debt-financed. As

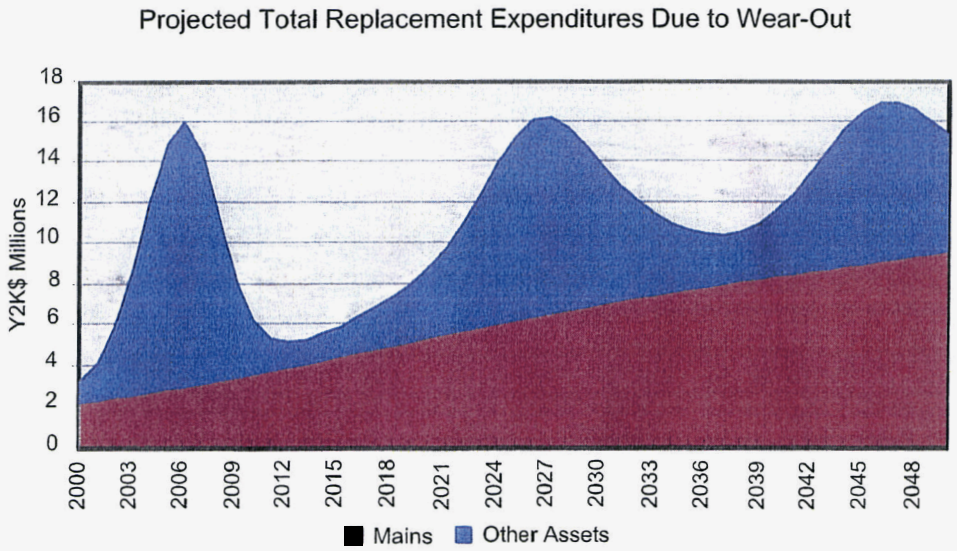


Figure 5

utilities face ever rising costs for repair and replacement of pipes, more and more of the utility's rate revenue will be required for those investments. This will leave the utility with increasingly weakened credit every time it gets to another "treatment hump," unless rates can be raised to match the slope of the curve. A final point to note about the treatment cost estimates used in developing Figure 5 and others like it in Appendix A is that these do not include the cost of new drinking water regulations likely to be implemented over the coming decades.

Increased expenditures are needed to climb the ramp and avoid a gap.

The Water Infrastructure Network (WIN) has developed a "gap analysis" to estimate the total increased spending that is required by water and wastewater utilities in order to avoid getting behind in funding infrastructure replacement over the next 20 years.[1] The first step in the WIN estimate is accomplished by extrapolating from Census data on historical utility expenditures for 20 years into the future. The resulting baseline expenditure forecast is then examined to see how much it must be increased in order to meet new expenditure "needs" for both new EPA compliance requirements and infrastructure repair and replacement over the same 20-year period. The "gap" between the baseline expenditure forecast and the future "needs" forecast is the amount of additional expenditure that must be forthcoming in order for water and wastewater utilities to maintain their critical infrastructure in a healthy condition.

The findings of this "gap analysis" indicate that the baseline expenditures of water utilities must be increased by about $300 billion over 20 years to keep up with both compliance and infrastructure needs. In similar fashion, the baseline expenditure trend in wastewater utilities must be increased by about $400 billion to meet such needs. Taken together, and accounting for the cost of capital, WIN has estimated that water and wastewater utilities together need to increase their investments in infrastructure by almost $1 trillion over the next 20 years.

The WIN "gap analysis" is easily misunderstood. Many have interpreted it to mean that a trillion-dollar deficiency already exists. It is important to stress that the gap estimate represents the challenge ahead—the ramp that we must climb—in increasing utility expenditures in order to avoid such a deficiency. The AWWA Nessie Curve analysis of 20 utilities indicates that we are not now behind in maintaining our water infrastructure. There is no current crisis in these 20 utilities. Rather, they are challenged with finding significant additional funds over the next 30 years for investments in repair and replacement, in order to avoid getting behind.

Extrapolation from aggregate baseline trends, such as in the WIN gap analysis, is akin to "technical analysis" of the stock market using charts, graphs and trending techniques. Investment analysts typically like to supplement such "technical analysis" with "fundamental analysis" of the situation existing within individual companies. The AWWA Nessie Curve analysis provides this type of supplemental perspective on increased expenditure needs.

[1]Water Infrastructure Network (WIN), Clean & Safe Water for the 21st Century, April 2000.

As illustrated in Figure 5, the Nessie Curve analysis indicates that expenditures on infrastructure repair and replacement must be significantly ramped-up over a period extending from 2000 through 2030. The steep rise is shown to level off after that, but it does not go away. Expenditures will have to continue to climb, albeit more gradually, throughout most of the rest of the 21st Century. This shape is the signature pattern of the new replacement era that we have entered. It is not a short-term "hump" that we have to get over. The shape of the challenge is that of a sustained rise in expenditures. This period of ramping-up is going to be a period of significant adjustments.

The Nessie Curves of the individual utilities shown in Appendix A present wide-ranging needs for increased expenditure for replacement of pipes and treatment assets due to wear-out. In the 20 utilities studied, such needs total about $6 billion above current spending over the next three decades. On a household basis, needs range from $550 to $2,300 over 30 years. These figures do not include the prospective costs of numerous new SDWA regulations likely to be implemented over the coming decade, nor any costs from the wastewater or stormwater side of the urban utility business. Moreover, as seen in Appendix A, the utilities vary widely in the timing of these needs; some face sharp needs in the next 10 years, while others don't face their highest needs for 10 or 20 years. The slope and the "humpy" patterns of increasing capital requirements are unique to each utility.

Our sample of 20 utilities represents relatively large water utilities. On a per household basis, the total 20-year capital needs for replacement illustrated in our sample is about the same as that estimated by EPA for large water systems in their newly released Drinking Water Needs Survey.[2]

The EPA Drinking Water Needs Survey uses a site visit methodology and a large sampling program to document needs in small systems and is probably the best information available on small system needs. Extrapolating from EPA's estimated 20-year capital need for small systems, we project the total 30-year expenditure for infrastructure repair and replacement in small systems might be in a range of $1,490 per household to $6,200 per household.

The result of this "fundamental analysis" using Nessie Curves is not inconsistent with the order of magnitude of the need that WIN estimates to be facing water utilities ($300 billion over 20 years). Extrapolation from our 20 sets of Nessie Curves suggests that the need might be on the order of $250 billion nationally and extend over three decades. However, the Nessie Curve forecast is based on an assumption that pipes are left in the ground until their economic life is over. The reality in utility operation is that myriad other influences can cause the replacement need to arise sooner. These include urban redevelopment, modernization, coordination with other city construction schedules, increasing pipe size, and other factors.

[2] U.S. Environmental Protection Agency, 1999 Drinking Water Infrastructure Needs Survey (EPA 816-R-01-004), February 2001.

Addressing affordability is the heart of the challenge.

The central question for policy makers and utilities is whether the increased rate of infrastructure spending that utilities must face over the next 30 years can be financed by the utilities themselves at rates customers can afford. AWWA remains, committed to the principle that utilities should be self-sustaining through their rates. For many utilities, however, the degree of change involved in adapting to the dawning replacement era, the adverse effect of demographic change on per household costs, and the competing demand for investment in wastewater and other municipal services, will combine to present a significant affordability challenge.

There are two related dimensions to the affordability concern. First is the ability of utilities to finance the needed additional expenditures within their rates. Second is the impact of higher rates on households.

In developing this study, AWWA brought together a group of utility managers from across the country to discuss infrastructure issues. This group characterized the question from a local perspective as an "affordability gap" or a "reality gap" and defined it as "the difference between what you think you should be spending on infrastructure and what you or your customers can afford to spend in reality." This characterization of the problem reflects the difficulty of obtaining significant utility rate increases. Rate increases are best received when implemented gradually in a number of installments over several years. Unfortunately, the rate increases required to meet the challenges of pipe replacement that utilities now face cannot be smoothly implemented in many cases.

There is small likelihood that the $550 to $2,300 per household projected to be required for infrastructure repair and replacement in our 20 utilities over the next 30 years can be spread evenly or taken on gradually over that period. As illustrated in Appendix A, some Nessie curves present a steeper funding challenge and some present a gentler slope due to local variations in the historical demographic trends. There are "humps" on the up-ramp for replacement of treatment plants and other equipment. Additional "humpy" expenditures for compliance with anticipated new regulations are not included. In small systems, the estimated $1,490 to $6,200 range of household impact is likely to be even more concentrated since the original demographics were themselves more concentrated.

Compliance-driven requirements to replace treatment plants and invest to meet new mandates will also dominate expenditures and push aside the more subtle need for investments in pipe replacement. This is exacerbated by the fact that the costs of water and wastewater service appear on the same bill in most communities. Thus, the needs to replace wastewater treatment plants and to replace wastewater lines compete with drinking water needs for the same consumer dollar. Sewer pipes generally impose higher unit replacement costs than water pipes, owing to their inherent characteristics (size, depth, etc.). Figure 6 presents a Nessie curve for a combined water and wastewater utility showing replacement funding needs for both water and wastewater pipes and other assets (treatment, pumping, etc.). The figure illustrates the typical relationship between water supply and wastewater costs—wastewater facilities cost noticeably more to replace.

The combined repair and replacement needs for water and wastewater infrastructure amount to a significant financing challenge in their own right. But the cost of compliance

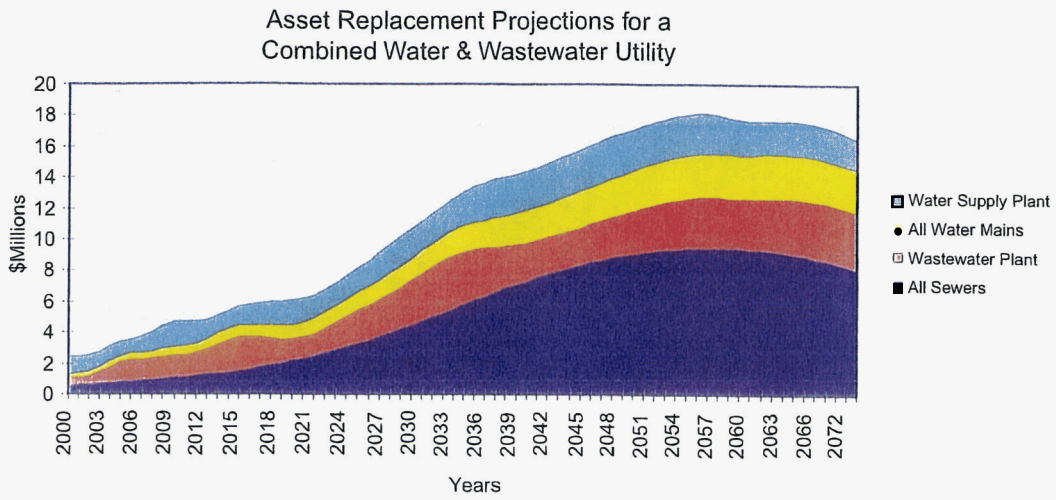


Figure 6

with combined sewer overflow (CSO) and stormwater regulations may dwarf everything else in water and wastewater utilities. The scale of the expenditure required in these programs may sweep everything else aside in some utilities, causing deferral of other needs and allowing a "gap" to open up. Note that CSO and stormwater compliance costs are not included in Figure 6.

To avoid an infrastructure gap, utilities are going to have to increase expenditures to keep up with both compliance requirements and infrastructure replacement. If rate increases do not keep pace with the increased rate of expenditures, the financial ratios used to evaluate a utility's creditworthiness will deteriorate, making it more difficult and more expensive to raise capital.

If a utility attempts to balance a deficiency in allowable rates by deferring infrastructure expenditures, then the stage is set for an infrastructure investment gap to begin to develop, creating a future liability for the utility and its customers. With the new accounting requirements being implemented under the Governmental Accounting Standards Board Statement No. 34 (GASB 34), such a deferral of infrastructure expenditures will be reported to the financial markets and begin to impair the utility's credit rating and ability to raise capital.

Since the Nessie Curve represents replacement timing based on the economic life of the pipes, it follows that deferral of replacement will produce higher overall costs due to increased repairs than would be the case if replacement occurred on time. If replacement is deferred too far beyond the economic trade-off point between replacement and repair costs, the repair cost burden will spiral upwards and have significant impacts on utility cash flows. Such a scenario will indeed impair a utility's ability to repay debt and will be made plain to the credit markets by the new GASB 34 requirements.

In either of these scenarios—rates that don't keep up with expenditures or expenditures that don't keep up with needs—the bottom line is the same. If both expenditures and rate revenues cannot be increased at the required rate, then the utility's credit may be impaired, and it may face even higher costs as a result. For some utilities, there is the potential for this to become a vicious cycle—a financial trap. These systemic financial risks are the reason why we have a clear and present need for an enhanced partnership between utilities, states and the federal government. We need to provide the means to assist utilities "up the ramp and over the humps." We need to minimize the credit risks utilities face over the next three decades as we make the adjustments in rates required to assure sustainability in the new replacement era.

The second, and all important, dimension of the affordability challenge is the bottom-line impact of increased water rates on household budgets. AWWA believes it is critical to avoid sudden and significant changes in rates that can induce "rate shock" among customers. The broader issue involved in rate shock ties back to the pivotal role of safe drinking water in promoting public health.

America has by far the safest drinking water in the world. Standards promulgated under the Safe Drinking Water Act aspire to the highest levels of technology and treatment optimization known to science. As we push farther into the limits of science and technology, we unavoidably encounter diminishing returns in terms of quantifiable health benefits at the same time that we must take on increasing marginal costs. Many new standards relate to very subtle health concerns that are difficult to substantiate and quantify. Yet, to be protective of health, there is a tendency to err on the side of safety, especially when the threats may relate to sensitive subpopulations such as children, the unborn, the elderly and the health-impaired.

This is where the issue of rate shock must be brought into focus as a public health concern. Whenever the sensitive subpopulations we are striving to protect are also among the low-income segment of the population and are forced to forego medical care or nutrition in order to pay their utility bills, we could be doing more harm than good. The fact that we are now entering a significantly more expensive replacement era in water infrastructure makes it all the more difficult to maintain the right balance in this aspect of public health. By some comparisons, it may appear that water is still cheap and there is room to increase water rates. But such comparisons are not relevant to low-income households. The only comparison that matters in these households is the size of the incremental increase. If it is large enough to trigger a budget substitution that negatively affects family health—for example, giving up a prenatal visit in order to pay a utility bill—then we may be losing ground.

Over the past decade, utilities have formed an increasingly closer partnership with EPA, states, the environmental community, the public health community and other groups to continue to make progress for public health despite significant scientific challenges. This partnership must now be broadened to address the financial challenges of infrastructure replacement in order to preserve the fruits of our labors in the public health arena.

RECOMMENDATIONS

Considering all of these facts, the American Water Works Association believes it is time for a new American partnership for clean and safe water. This partnership requires that all levels of government and utilities play a role in working through the significant challenges ahead. Specifically, we recommend:

1) Measures by Utilities and Local Governments

The infrastructure funding issue varies from place to place, reflecting the age, character and history of the community. Although AWWA has looked at the infrastructure issue in the aggregate, many key questions must be asked and answered at the local utility level. The development of a comprehensive local strategy can bring these elements into focus and create a new "reality" that will help make infrastructure repair and replacement more affordable. Such a comprehensive strategy includes:

- **Assessing the condition of the drinking water system infrastructure.** Over the last few decades, utilities around the world have been developing innovative new approaches to managing long-lived buried infrastructure. In North America and overseas, some utilities are already taking advantage of tools such as geographic information systems, using new information to advance the state of the art and aggressively managing infrastructure replacement. Planning tools can help identify and plan for needed investment decades in advance of the actual need for funds. We should learn from, adapt, and use such tools.
- **Strengthening research and development.** Although there is not likely to be a single "silver bullet" to solve infrastructure management problems, an impressive array of technological tools have been moving through the research and development process in recent years. Efforts to develop and deliver such tools should be strengthened.
- **Working with the public to increase awareness of the challenge ahead, assess local rate structures, and adjust rates as necessary.** For many years, water and wastewater utilities have been nicknamed "the silent service." Utilities have quietly provided an extremely reliable supply of high-quality water at relatively low rates compared to other public utilities and services. Partly as a result, a large number of utilities, particularly smaller ones, do not have appropriate rate structures. The 1996 SDWA requirement for Consumer Confidence Reports provides a vehicle for many utilities to take the first step in broadening their dialogue with customers and the public at-large. Comprehensive, focused, and strategic communications programs serve the dual function of providing consumers with important information about their water systems and building support for needed investments in infrastructure.
- **Building the managerial capacity of many water systems.** Congress took new steps in the 1996 SDWA Amendments to assure the institutional capacity of small systems applying for state revolving fund loans. Much more remains to be done in this area. EPA, in conjunction with water associations, could sponsor training programs on appropriate rate structures, designed specifically to deliver assistance to small systems in planning for full cost recovery through rates.

2) Reform of State Programs

The states, too, have an important role to play in addressing our infrastructure funding needs. States may need to match an appropriate share of any new federal funds that are provided for infrastructure assistance. Moreover, they need to reform their existing programs to make them more effective. For example, some states have not allowed larger systems to access the existing state revolving fund, or have excluded investor-owned systems. Some states encumber their revolving funds with nonproductive red tape, charge high loan origination and other fees, or charge loan rates that are equivalent to market rates. Some states preclude the use of alternate procurement methods that minimize infrastructure procurement costs. For example, the "design/build" process for infrustructure procurement has been documented to save 20–40% of construction costs for new treatment plants in some cases. Public procurement laws in many states, while not explicitly banning design/build, mandate a process that prevents its use where local authorities have determined it would be advantageous.

The result is that, in many states, revolving loan funds have not proved to be useful or attractive even to drinking water utilities desperately in need of capital. States should commit to:

- Respecting the universal eligibility of all water systems for federal assistance.
- Streamlining their programs for delivery of assistance and allowing alternative procurement procedures that save money.
- Making their financing mechanisms more attractive by committing to grants and very low or negative interest loans.
- Using federal funds in a timely fashion or facing the reprogramming of those funds to other states.

3) A Significant Increase in Federal Assistance

After accounting for the cost savings that can come from best practices in asset management, the development of new technologies, efforts to increase ratepayer awareness and support, and possible alternative compliance scenarios, for many utilities there is likely to remain a gap between the required expenditure increases and the practical ability to raise water rates. This gap could grow over the next few decades as infrastructure built in the late-1800s to mid-1900s must be repaired, replaced, and rehabilitated at the same time that we are trying to enhance the level of water treatment under the Safe Drinking Water Act (SDWA).

AWWA remains committed to the principle that utility operations should be fully supported by rates. In the long run, the objectives must be to manage the costs of replacing pipes and treatment plants and ensure financial sustainability through local rate structures. However, many utilities are going to face a period of adjustment in adapting to the new reality of the replacement era described in this report. Many utilities and their customers will need additional assistance in working through extraordinary replacement needs in the next 20 years.

The difference between drinking water utilities' current expenditures for infrastructure replacement and the needed level of expenditure is estimated by WIN to be about $11 billion per year over the next 20 years. If the federal government were to provide half the cost of this gap, the federal share of total utility spending would amount to under 12 percent of total utility spending. For comparison, the federal share of investment in roads, bridges, and airports is 80 percent.

To prevent the development of a gap in critical water infrastructure financing, AWWA recommends either changing and expanding the existing Drinking Water State Revolving Fund and other drinking water programs or creating a new, infrastructure-focused fund. Such a fund should provide:

- Significantly increased federal funding.
- Clear eligibility of projects to repair, replace, or rehabilitate drinking water infrastructure.
- Universal eligibility of all water systems, both public and investor owned, regardless of size.
- Ability to make grants or loans in any combination and to use other financing tools to leverage public and private capital.
- Reasonable terms and conditions such as demonstration of system viability and ability to repay a loan.
- Streamlined procedures for those accessing the funds.

Research is a critical component of a comprehensive federal program on infrastructure. Research stimulates the development of new techniques and unleashes American ingenuity. It offers the chance to save billions of dollars over the years to come through more efficient management, repair, and replacement technologies. The federal government should significantly increase its support for research on infrastructure management, repair and replacement technologies, methods for extending pipe life, and other means of advancing the art while lowering the cost of infrastructure management.

Finally, the federal government should take other important steps to better access and leverage public and private capital. Congress should consider:

- Development of a national water infrastructure financing bond bank similar to Fannie Mae.
- Tax code and other reforms to increase the availability and use of private capital. This could include steps such as the removal of constraints on private activity bonds, development of subsidized bond insurance, provision of federal loan guarantees, and improved investment tax credit incentives.

CONCLUSION

Considering when pipes were laid down in many water systems and how long they can be expected to last, it is clear that a new age—the replacement era—has arrived for water utilities. Over the next 30 years, infrastructure replacement needs will compete with compliance needs for limited resources. Clearly, infrastructure needs and compliance with the Safe Drinking Water Act can't be approached as separate issues, but need to be addressed together.

Only in the true spirit of a new partnership, as outlined in this report, can we think most broadly about these issues. Only in this spirit can we achieve the goals to which we all aspire: the provision of safe and affordable water to all Americans.

Reinvesting in Drinking Water Infrastructure

Dawn of the Replacement Era

APPENDIX A

20 Sets of Nessie Curves

This appendix presents results of infrastructure expenditure needs analyses conducted for 20 water utilities across the United States. The "Nessie Curve" technique employed in this study produces a forecast of water main and other asset repair and replacement expenditure requirements based on how those assets "wear out" over the course of their economic life. While this study has focused on projecting economically efficient replacement and repair costs from wear-out, there are other reasons why assets might be replaced sooner, such as needs relating to urban redevelopment, system improvements, coordination with other city construction, and increasing pipe size. The curves also focus only on existing assets and take no account of new assets needed to support growth or compliance with new SDWA regulations in the coming decades.

For each utility, results are summarized in several Nessie Curves illustrating different perspectives. For each utility there is an estimate of the total replacement cost value of the utility's assets in today's dollars. There is also an indication of whether the utility was studied with respect to mains only, or whether it was studied with respect to a wider range of assets (including treatment plants). In viewing the charts, it is important to remember whether the utility is an "apple" (mains only) or an "orange" (all assets).

The charts presented cover the next 50 years, primarily to better illustrate the characteristic shapes of the replacement "echo" while also identifying differences in the timing of major replacement requirements between the participating utilities. All values are constant year 2000 dollars. The forecasts assume zero inflation.

The first chart is entitled. "Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)." In this graph, the total cost for replacement and repair due to aging is projected over the next 50 years at the household level.

The second chart, entitled "Projected Total Expenditures Due to Wear-Out" is similar to the first chart, showing the relative requirements for replacement expenditures and repair expenditures for the assets studied in each utility, expressed in total dollar outlays for the utility.

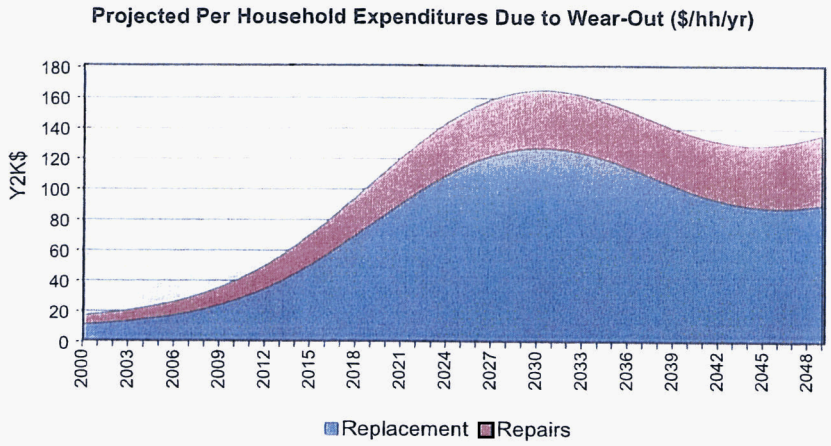
For the utilities that were studied with respect to all assets, there is a third chart on the page entitled, "Projected Total Replacement Expenditures Due to Wear-Out." This chart projects replacement investment only, showing the relative contributions to 50-year replacement needs of mains versus other assets (treatment, pumping, etc.). For utilities that were studied only with respect to mains, this third chart is omitted from the summary page for that utility.

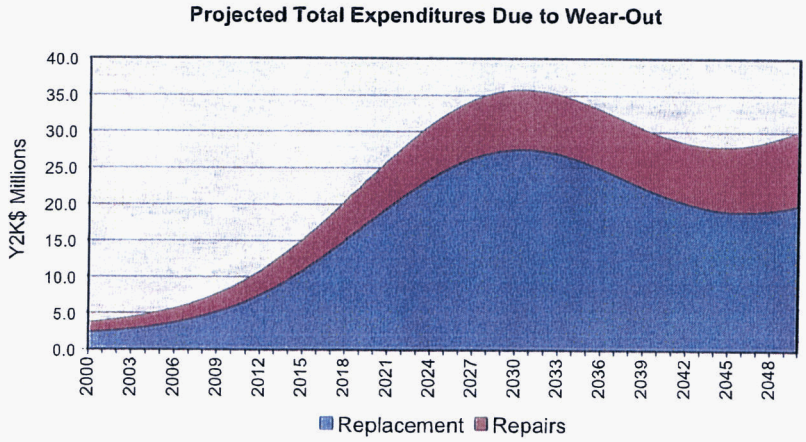
Index of Nessie Curves

Utility	Page
Austin, Texas	A-3
Boston, Massachusetts	A-4
BHC, Bridgeport, Connecticut	A-5
West Virgina American, Charleston, West Virginia	A-6
Cincinnati, Ohio	A-7
Columbus, Georgia	A-8
Denver, Colorado	A-9
Des Moines, Iowa	A-10
East Bay MUD, Oakland, California	A-11
Gloucester, Massachusetts	A-12
Honolulu, Hawaii	A-13
Louisville, Kentucky	A-14
United Water, New Rochelle, New York	A-15
Philadelphia, Pennsylvania	A-16
Portland, Oregon	A-17
St. Paul, Minnesota	A-18
Seattle, Washington	A-19
Tacoma, Washington	A-20
Tucson, Arizona	A-21
Wausau, Wisconsin	A-22

Austin, Texas

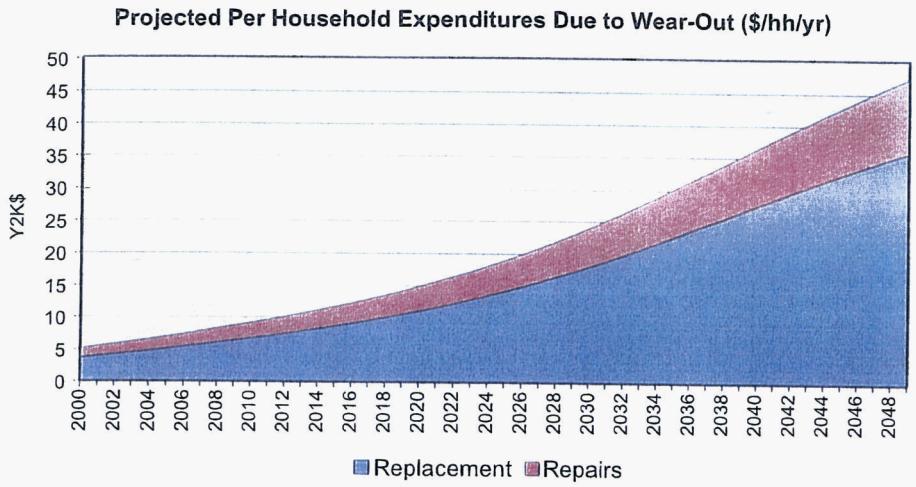
Asset Sets Modeled: Water Mains — Estimated Replacement Value $2,348 M

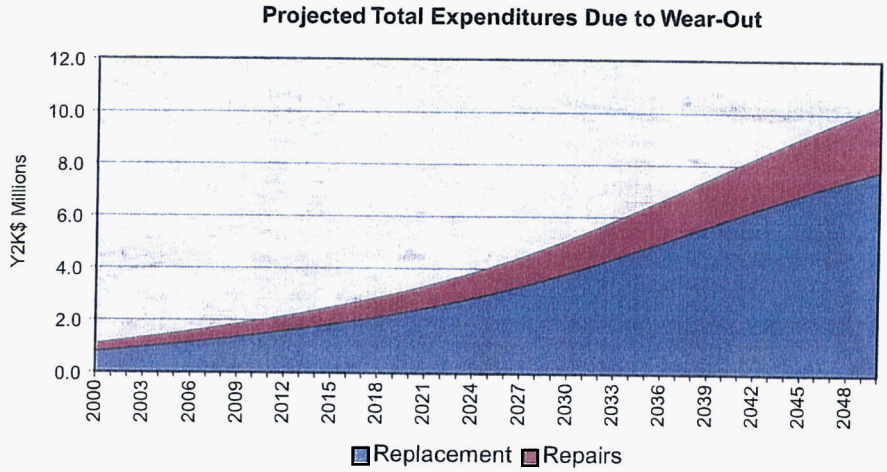




Boston, Massachusetts

Asset Sets Modeled: Water Mains —
Estimated Replacement Value $694 M

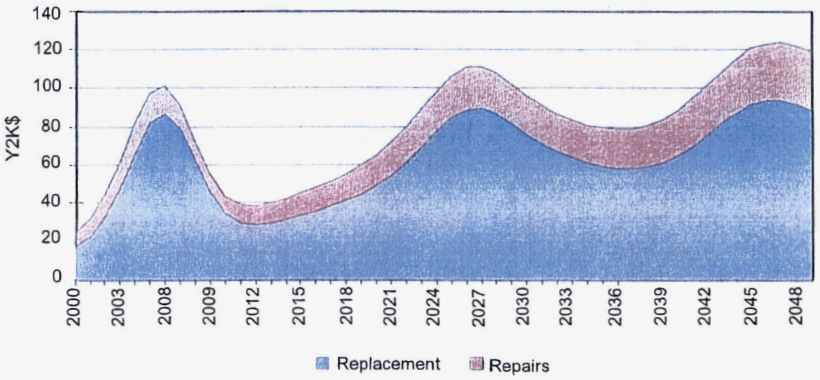




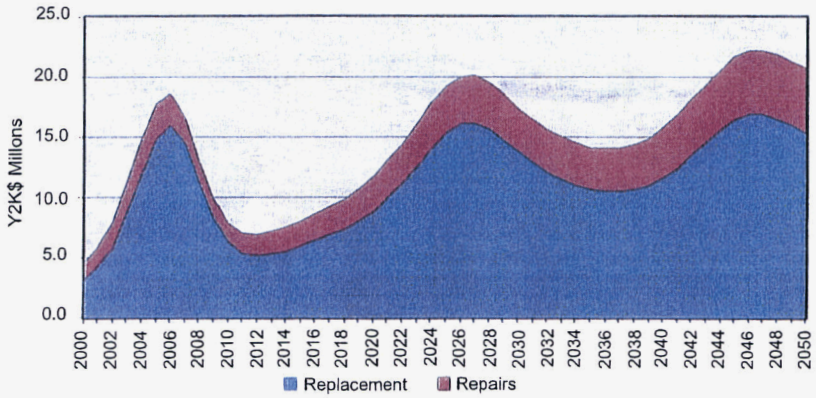
BHC, Bridgeport, Connecticut

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $1,663 M

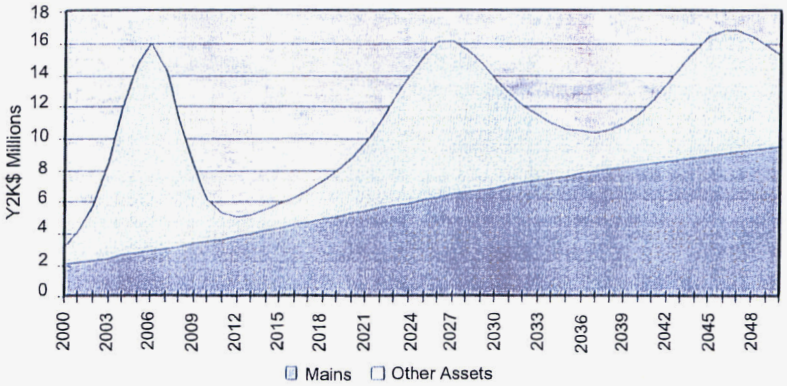
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



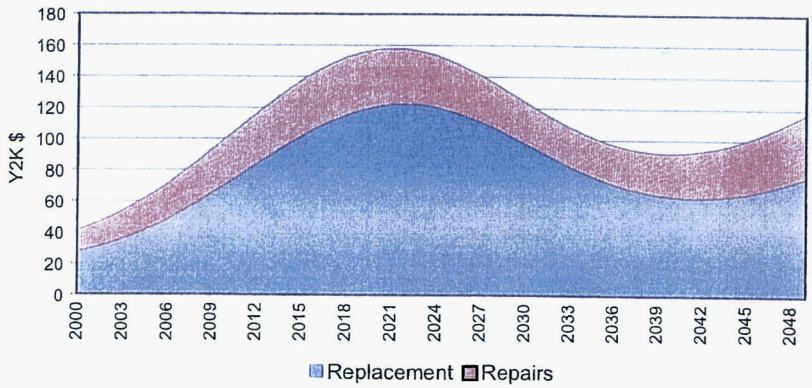
Projected Total Replacement Expenditures Due to Wear-Out



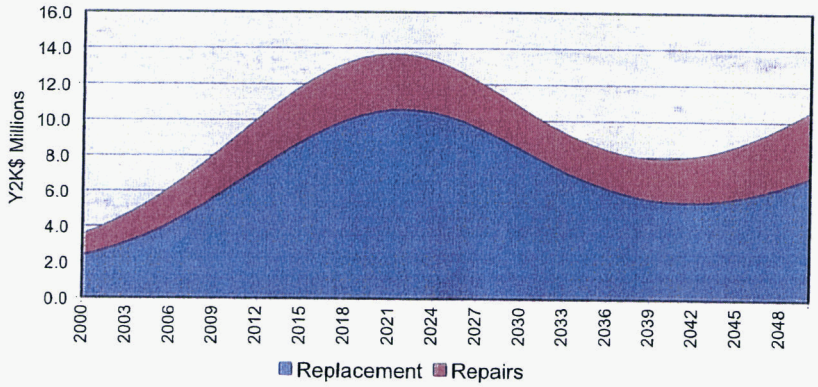
West Virginia American, Charleston, WV

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $650 M

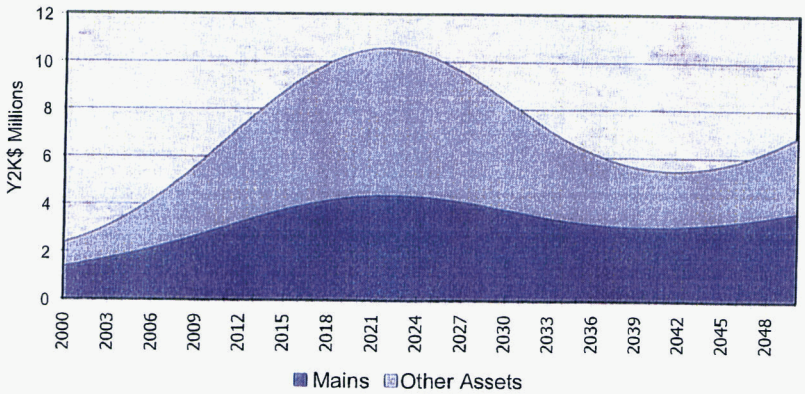
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



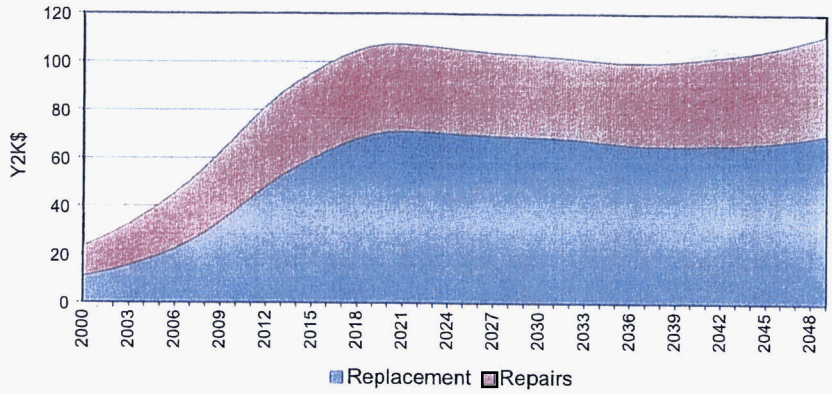
Projected Total Replacement Expenditures Due to Wear-Out



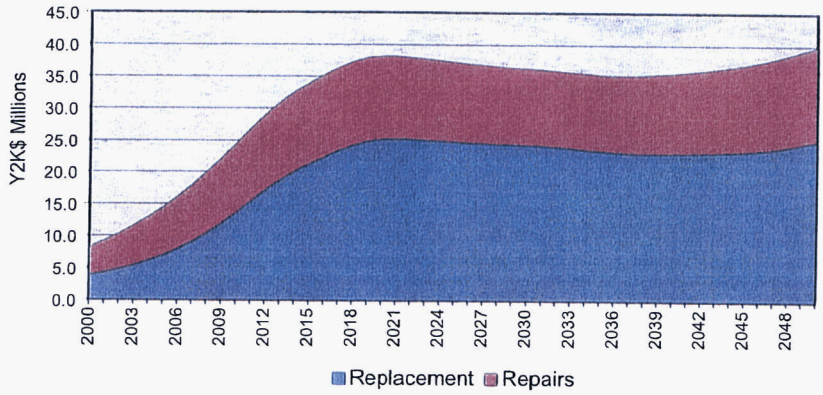
Cincinnati, Ohio

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $2,042 M

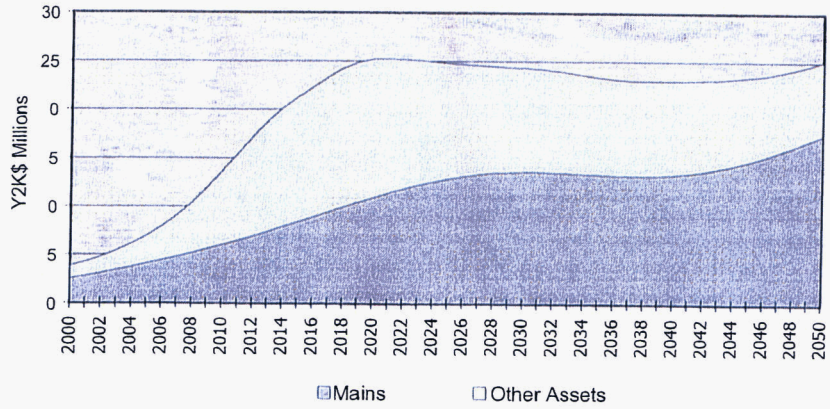
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



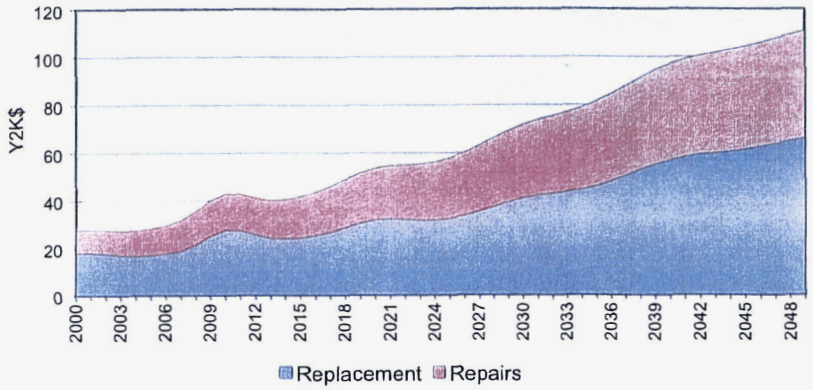
Projected Total Replacement Expenditures Due to Wear-Out



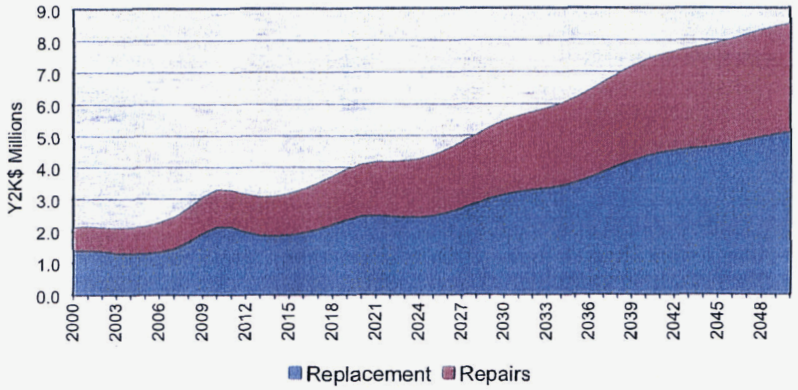
Columbus, Georgia

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $648 M

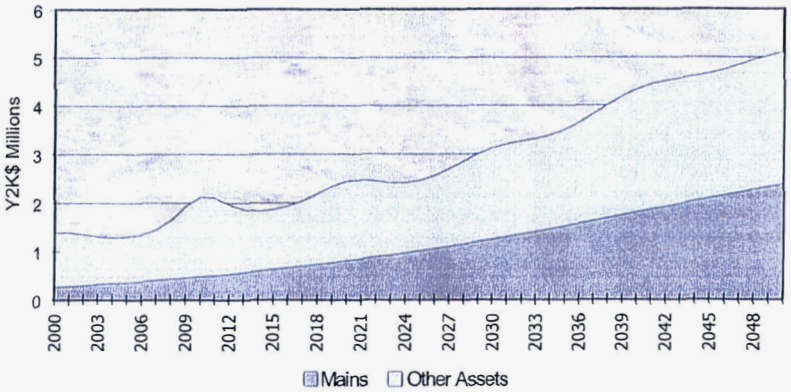
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



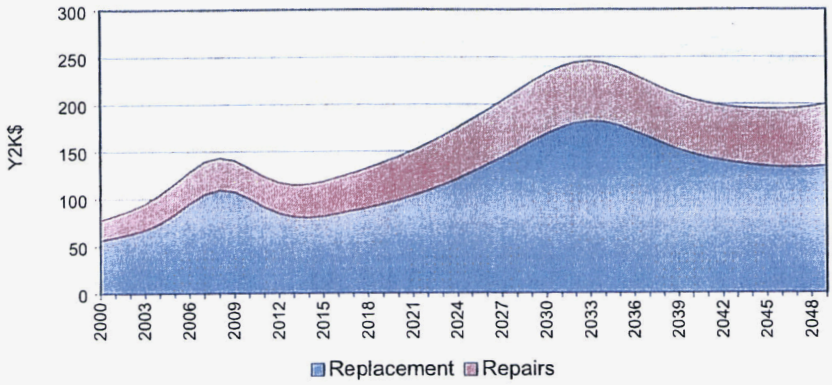
Projected Total Replacement Expenditures Due to Wear-Out



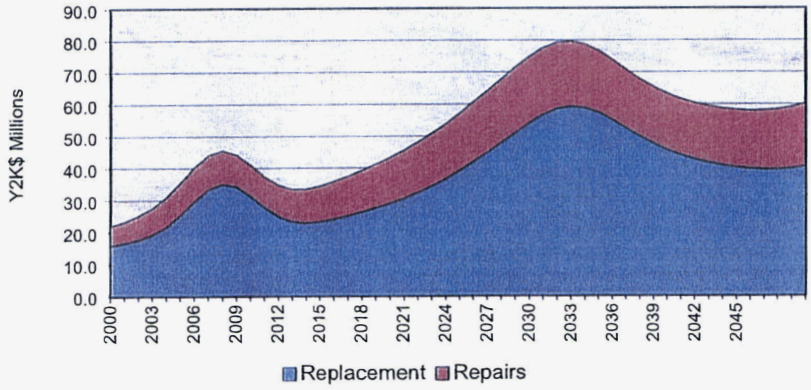
Denver, Colorado

Asset Sets Modeled: Water Mains & Water Supply Plant —
Estimated Replacement Value $5,583 M (Includes Major Dams)

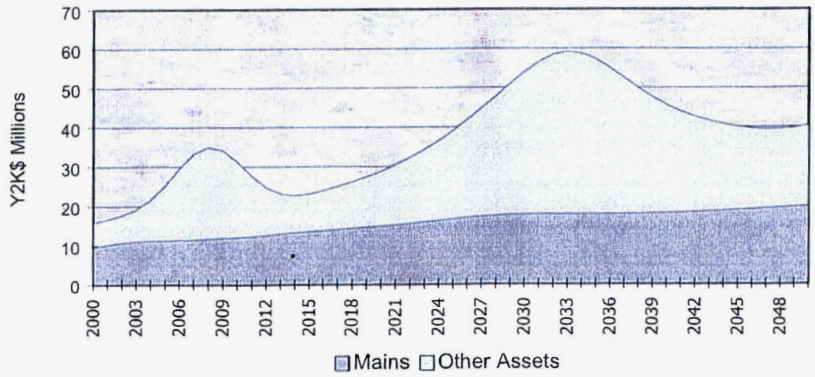
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



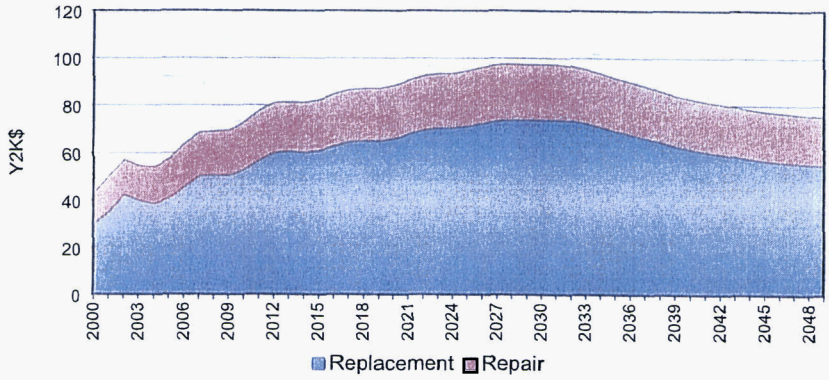
Projected Total Replacement Expenditures Due to Wear-Out



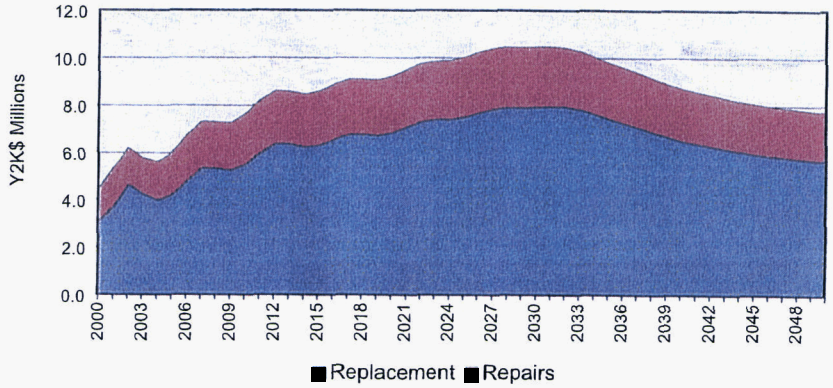
Des Moines, Iowa

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $524 M

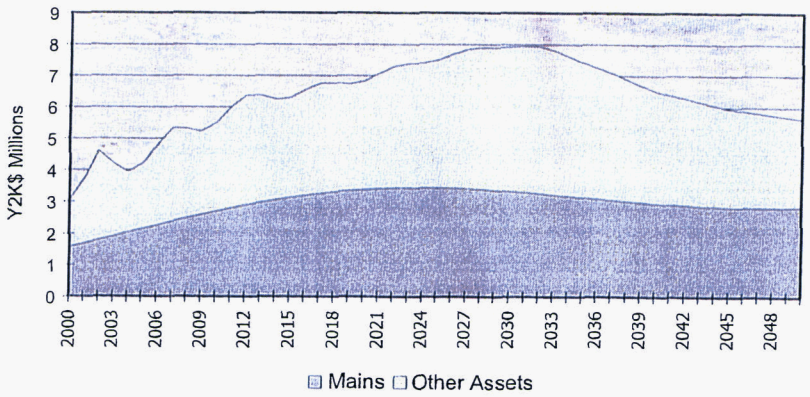
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



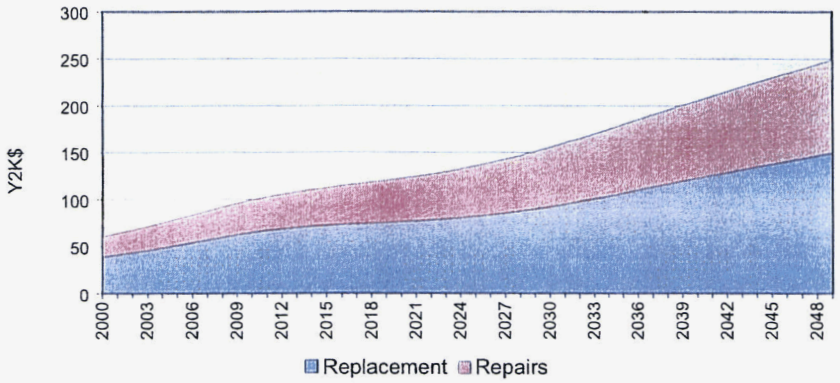
Projected total Replacement Expenditures Due to Wear-Out



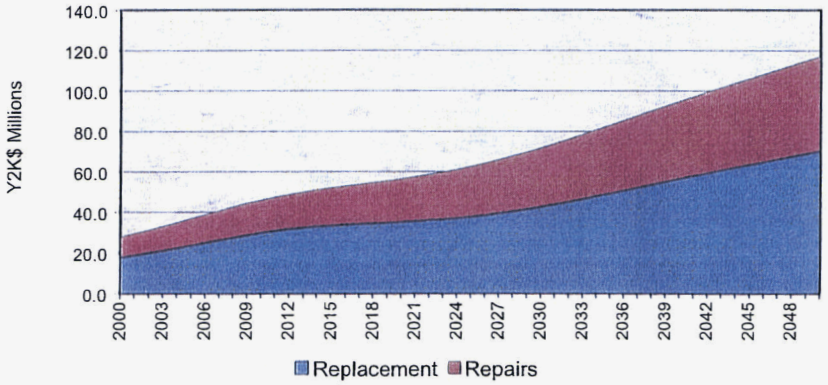
East Bay MUD, Oakland, California

Asset Sets Modeled: Water Mains & Water Supply Plant —
Estimated Replacement Value $8,110 M

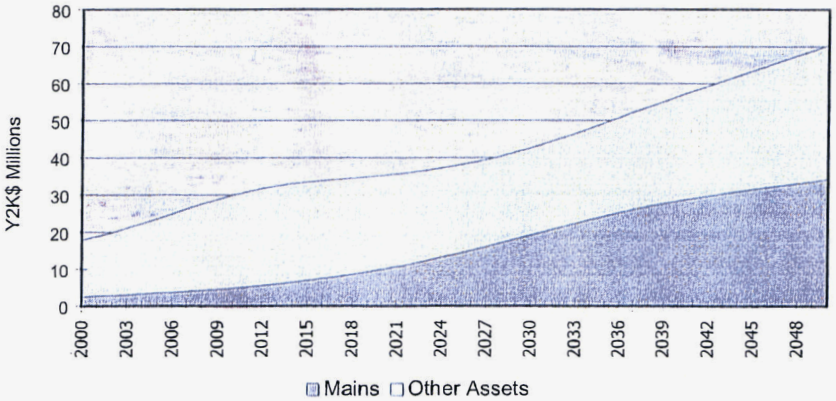
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



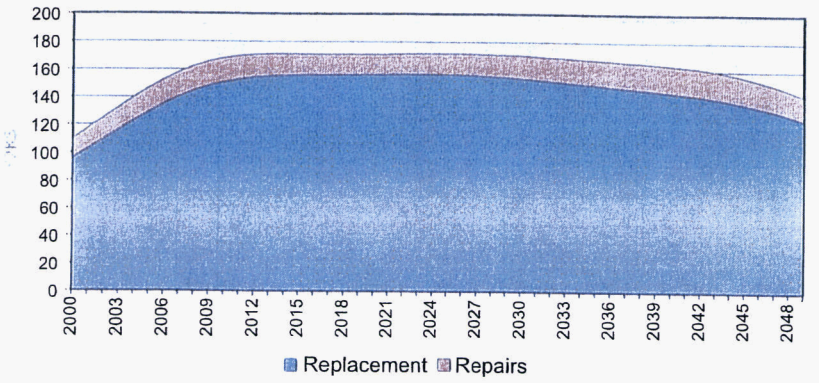
Projected Total Replacement Expenditures Due to Wear-Out



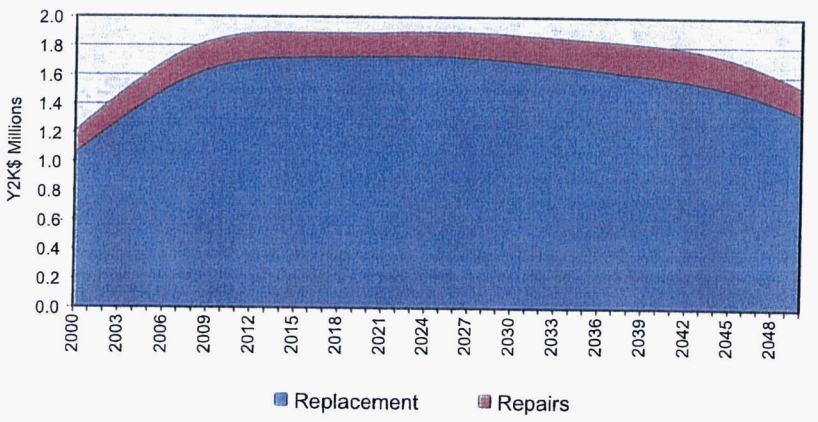
Gloucester, Massachusetts

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $116 M

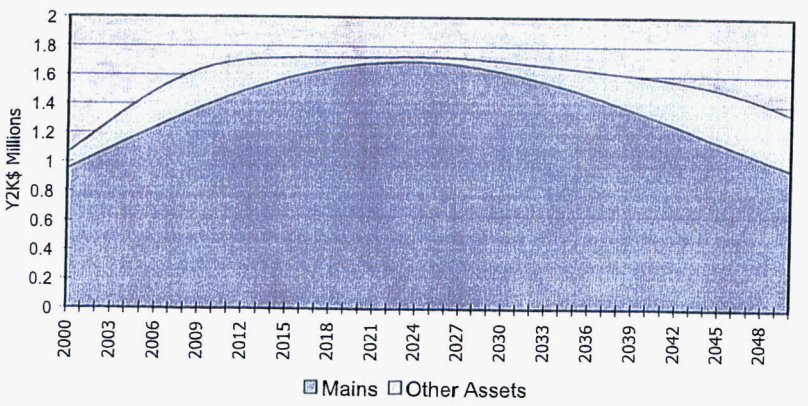
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



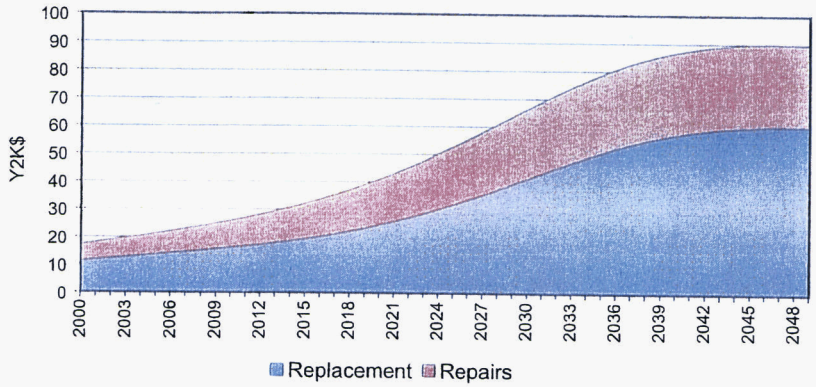
Projected Total Replacement Expenditures Due to Wear-Out



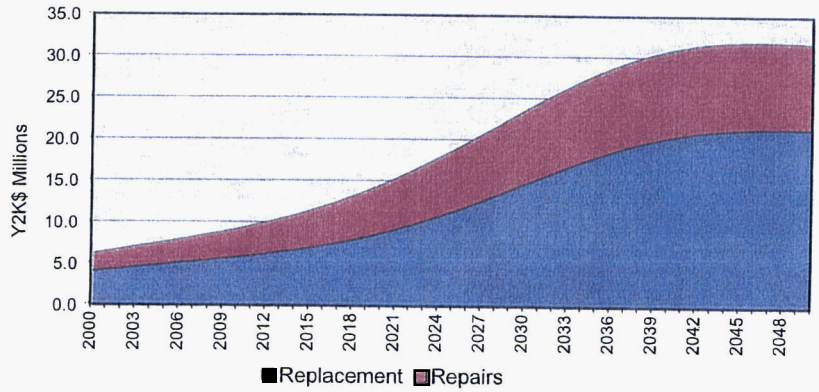
Honolulu, Hawaii

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $1,272 M

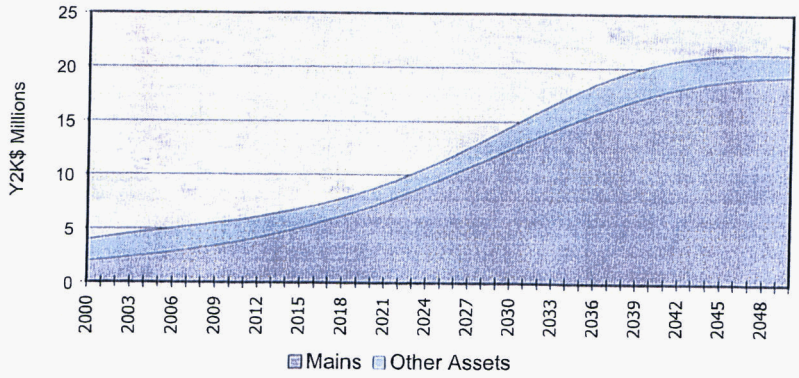
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



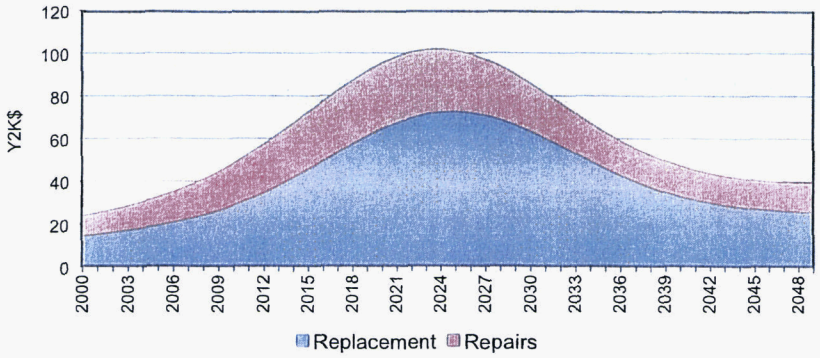
Projected Total Replacement Expenditures Due to Wear-Out



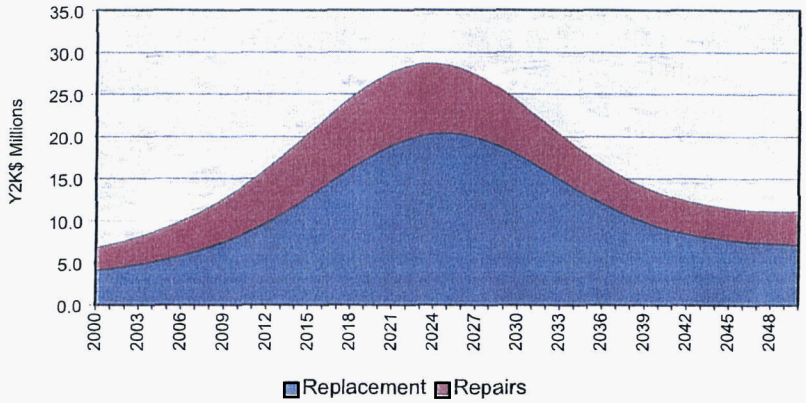
Louisville, Kentucky

Asset Sets Modeled: Water Mains — Estimated Replacement Value $1,343 M

Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



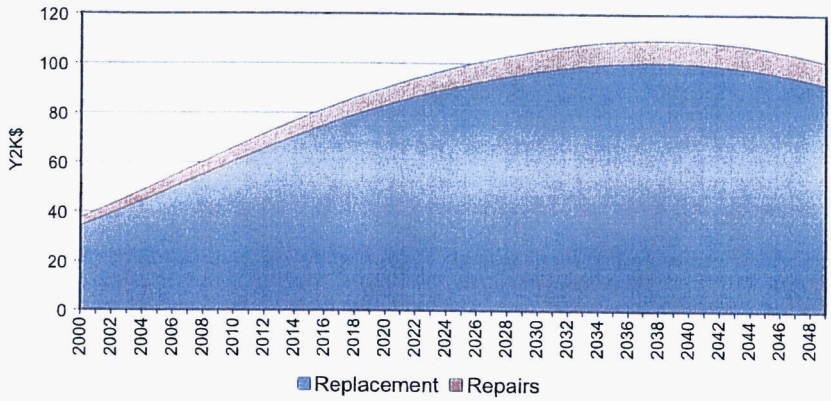
Projected Total Expenditures Due to Wear-Out



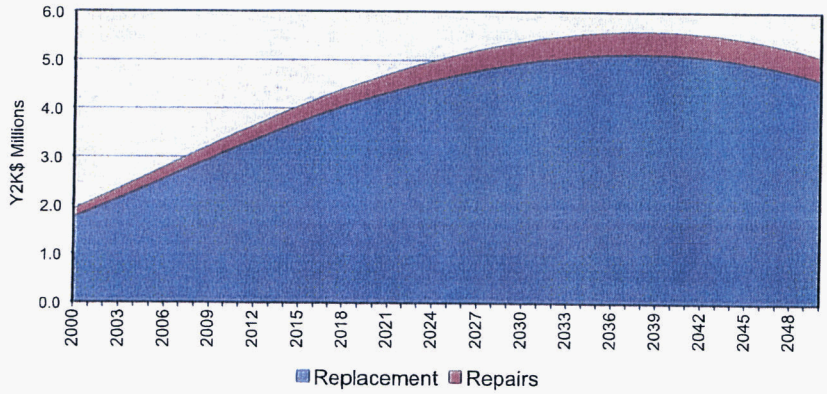
United Water, New Rochelle, New York

Asset Sets Modeled: Water Mains — Estimated Replacement Value $325 M

Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



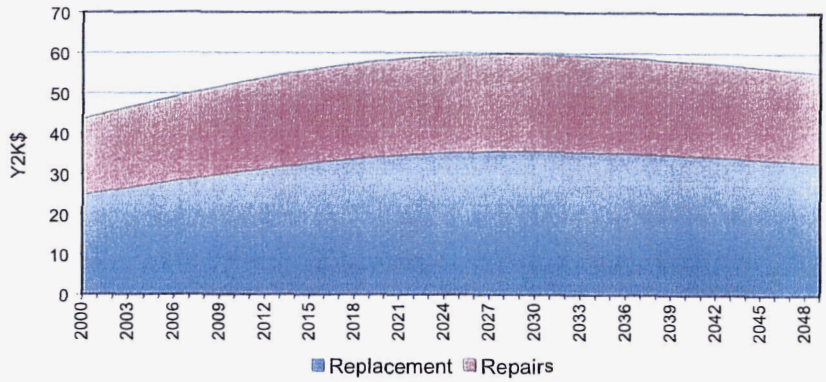
Projected Total Expenditures Due to Wear-Out



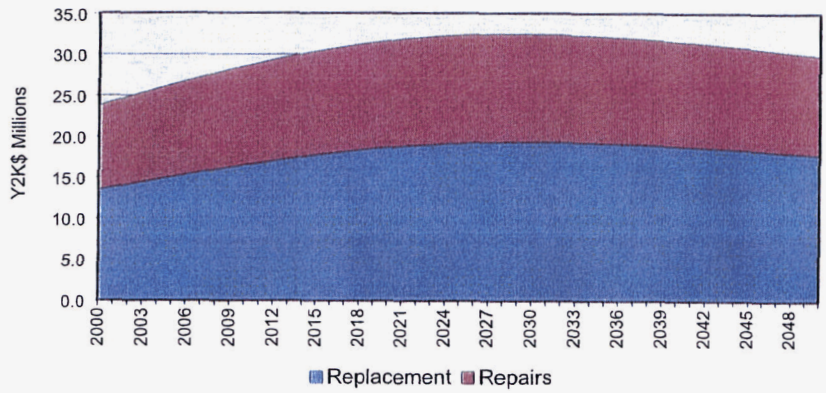
Philadelphia, Pennsylvania

Asset Sets Modeled: Water Mains —
Estimated Replacement Value $2,438 M

Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



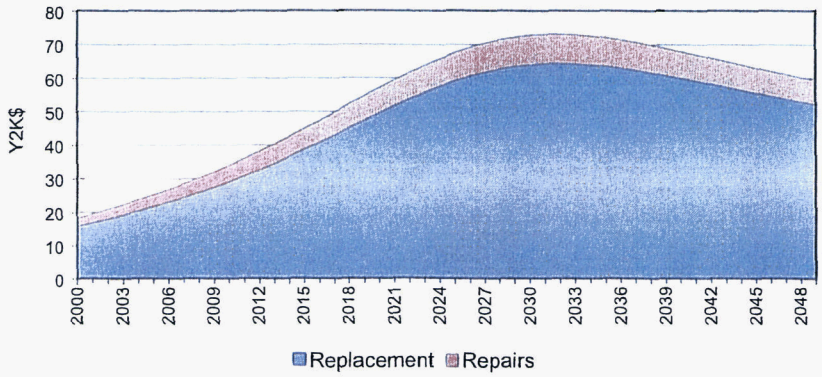
Projected Total Expenditures Due to Wear-Out



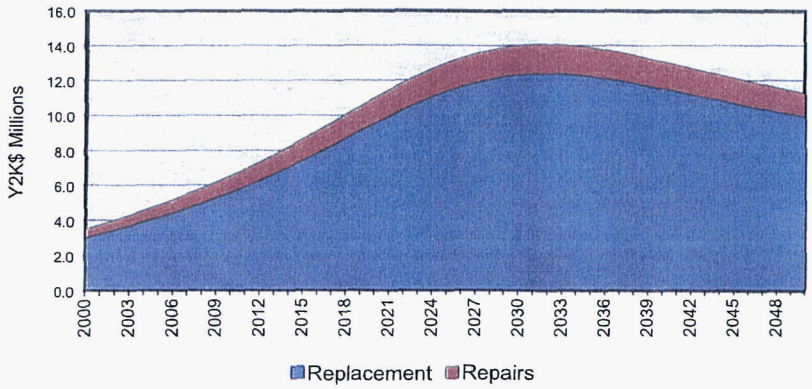
Portland, Oregon

Asset Sets Modeled: Water Mains — Estimated Replacement Value $1,257 M

Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



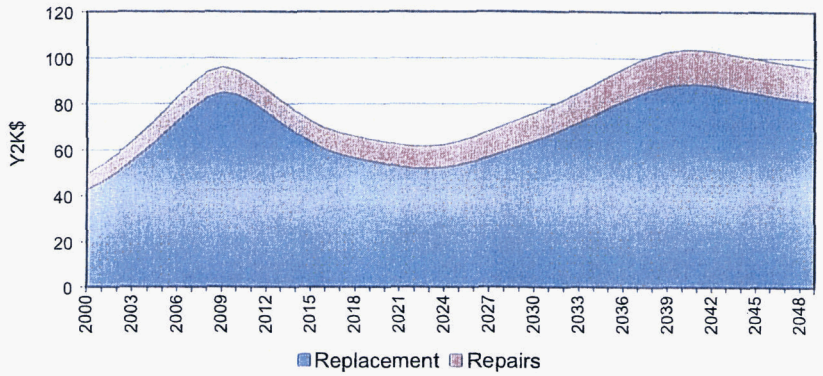
Projected Total Expenditures Due to Wear-Out



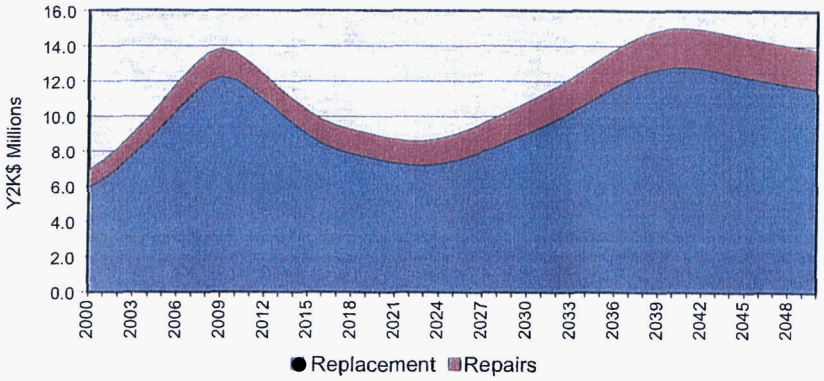
St. Paul, Minnesota

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $1,005 M

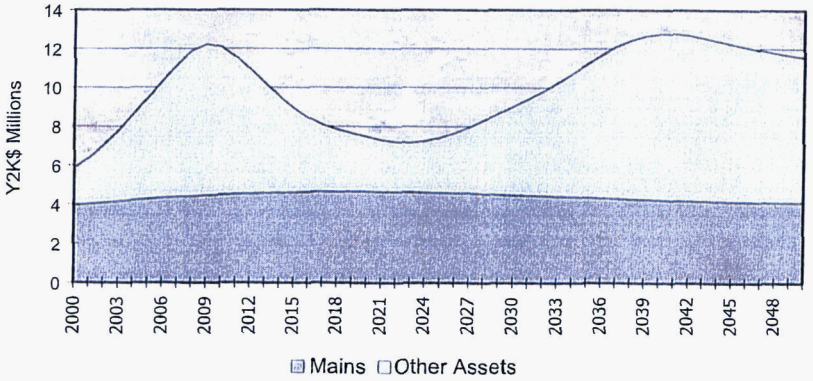
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out

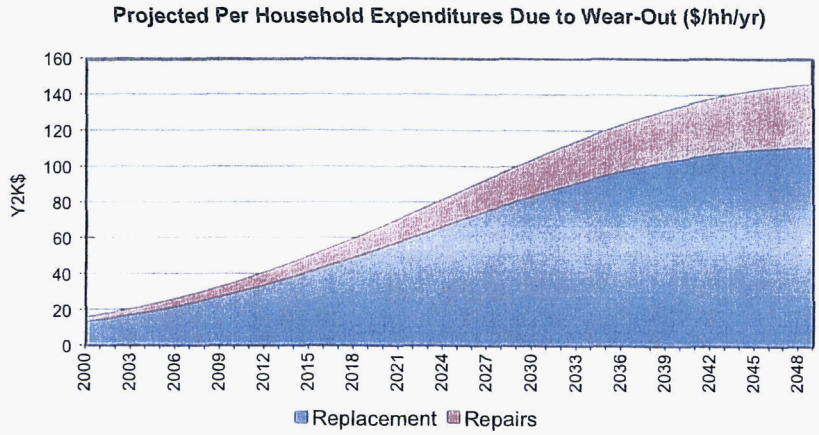


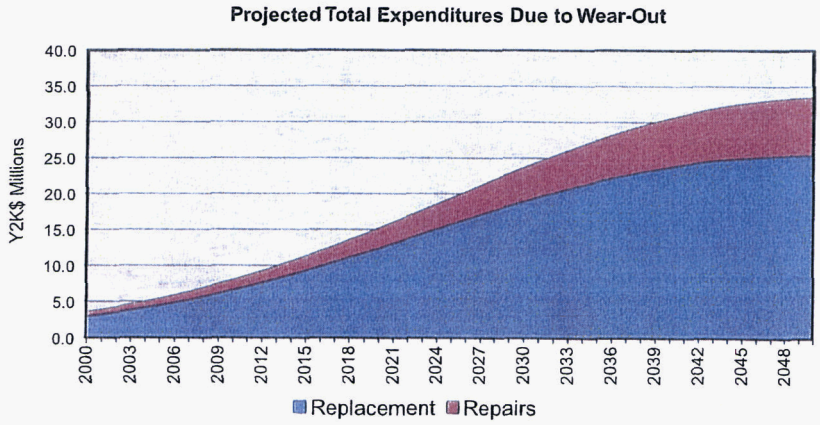
Projected Total Replacement Expenditures Due to Wear-Out



Seattle, Washington

Asset Sets Modeled: Water Mains —
Estimated Replacement Value $1,713 M

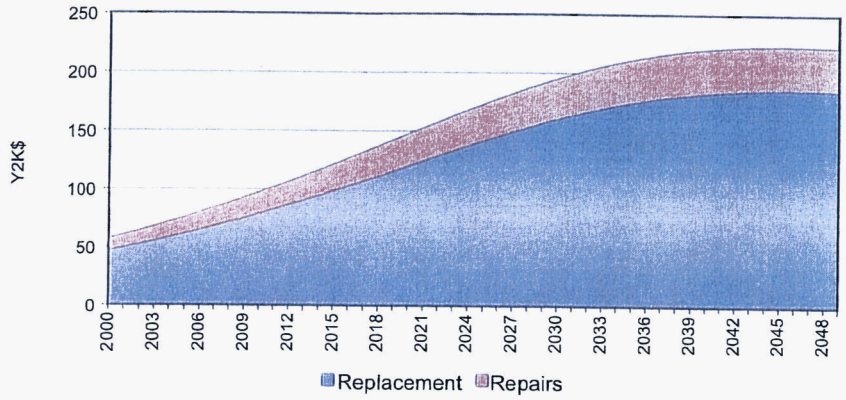




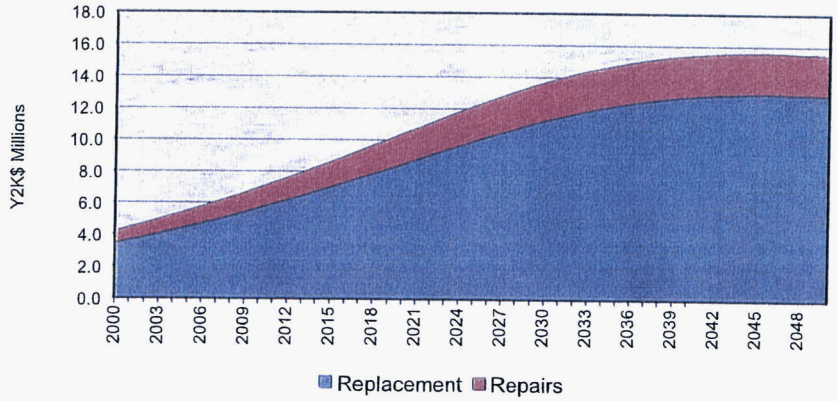
Tacoma, Washington

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $1,100 M

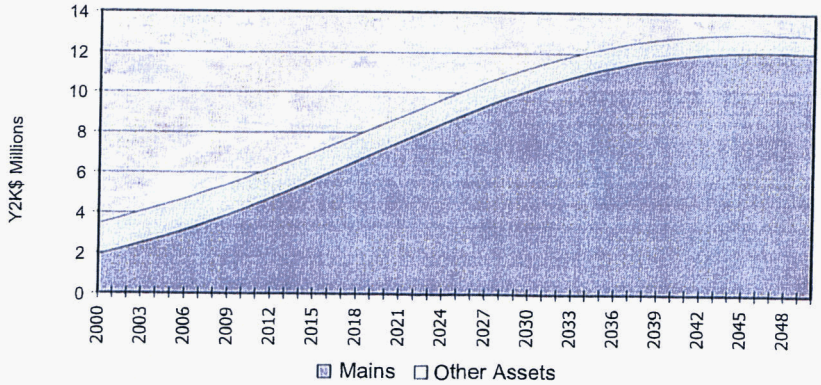
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



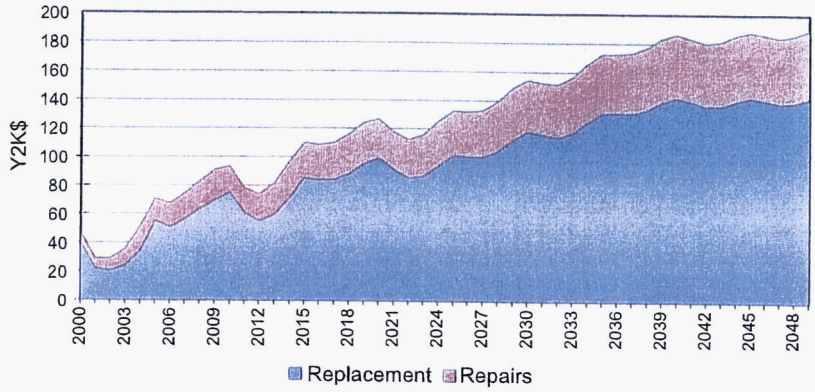
Projected Total Replacement Expenditures Due to Wear-Out



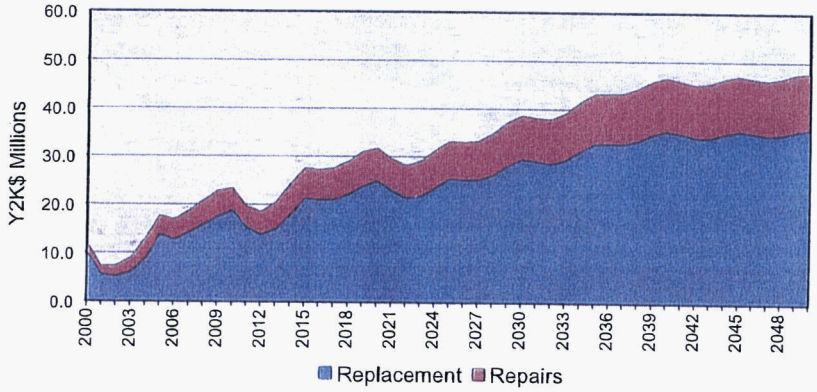
Tucson, Arizona

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $1,852 M

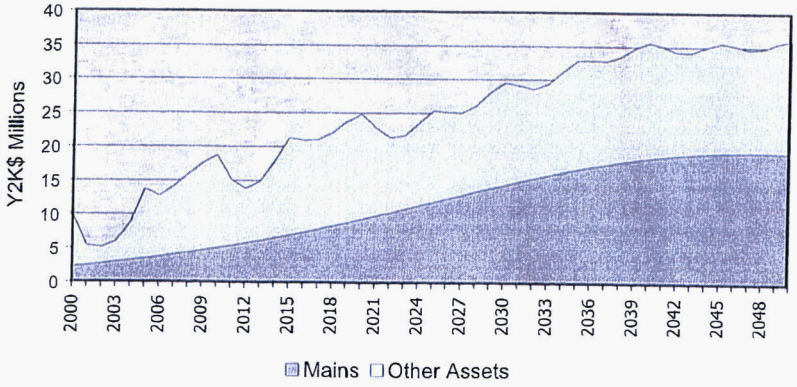
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



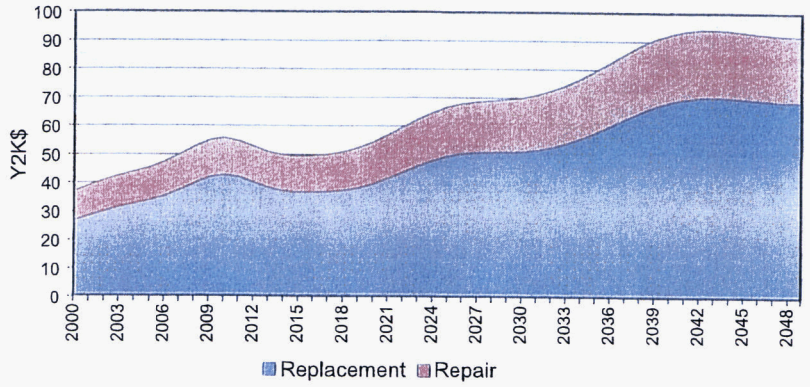
Projected Total Replacement Expenditures Due to Wear-Out



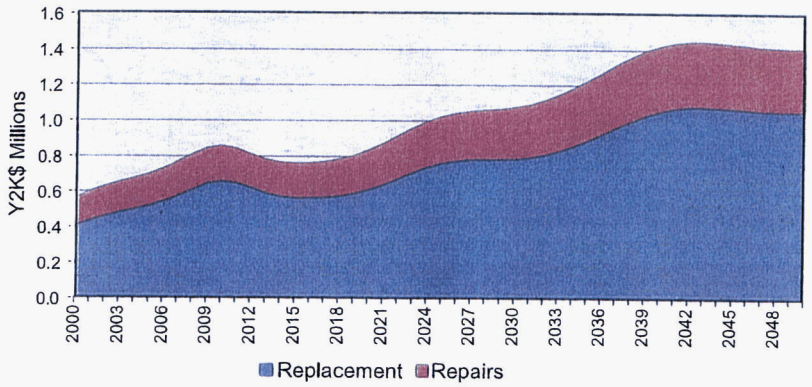
Wausau, Wisconsin

Asset Sets Modeled: Water Mains & Water Supply Plant — Estimated Replacement Value $84 M

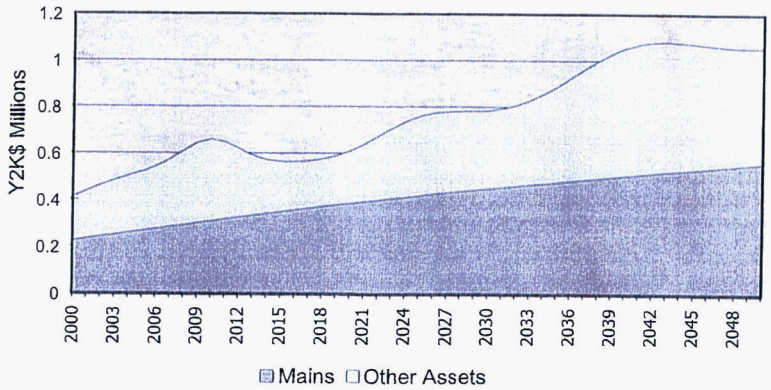
Projected Per Household Expenditures Due to Wear-Out ($/hh/yr)



Projected Total Expenditures Due to Wear-Out



Projected Total Replacement Expenditures Due to Wear-Out



APPENDIX B

ACKNOWLEDGMENTS

The following people contributed the preparation of this report:

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Louisville, Kentucky

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Boston, Massachusetts

John Trax
National Rural Water Association
Washington, D.C.

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Kansas City, Missouri

James McInerney, Chairman
BHC
Bridgeport, Connecticut

Howard Neukrug, Director, Office of Watersheds
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Philadelphia, Pennsylvania

Clair Olivers, Public Works Director
City of Everett
Everett, Washington

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Poulsbo, Washington

PARTICIPATING UTILITIES

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A REPORT ON ARIZONA WATER COMPANY'S PLAN TO REDUCE WATER LOSSES

Water Systems Evaluated in this Report

PWSID No. 11-707	Coolidge Airport
PWSID No. 09-018	Pinetop Lakes
PWSID No. 09-004	Overgaard
PWSID No. 04-002	Miami
PWSID No. 13-046	Rimrock
PWSID No. 02-001	Bisbee
PWSID No. 03-002	Pinewood

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Date: December 30, 2011

1.0 EXECUTIVE SUMMARY **6**
2.0 PURPOSE **7**
3.0 MEASURES TO IDENTIFY AND REDUCE WATER LOSSES TO LESS THAN 10 PERCENT **7**
3.1 Locating and Detecting Leaks 7
3.1.1 Leak Detection Equipment 8
3.1.2 Documentation of Leak Data 9
3.2 Leak Repair 10
3.3 Meter Maintenance Program 11
3.4 Meter Selection Review 12
4.0 COOLIDGE AIRPORT WATER SYSTEM **13**
4.1 Overview of Water System 13
4.2 Causes of Water Losses 13
4.3 Additional Steps Taken to Reduce Water Losses 13
4.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses 14
4.5 Additional Steps to be Taken in the Future to Reduce Water Losses 14
5.0 PINETOP LAKES WATER SYSTEM **15**
5.1 Overview of Water System 15
5.2 Causes of Water Losses 15
5.3 Additional Steps Taken to Reduce Water Losses 15
5.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses 16
5.5 Additional Steps to be Taken in the Future to Reduce Water Losses 16
5.6 Cost Benefit Analysis of Reducing Water Losses 16
5.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent – Pinetop Lakes 18
6.0 OVERGAARD WATER SYSTEM **19**
6.1 Overview of Water System 19
6.2 Causes of Water Losses 19
6.3 Additional Steps Taken to Reduce Water Losses 20
6.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses 20
6.5 Additional Steps to be Taken in the Future to Reduce Water Losses 20
6.6 Cost Benefit Analysis of Reducing Water Losses 21

6.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent - Overgaard 23
7.0 MIAMI WATER SYSTEM 24
7.1 Overview of Water System 24
7.2 Causes of Water Losses 24
7.3 Additional Steps Taken to Reduce Water Losses 25
7.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses 25
7.5 Additional Steps to be Taken in the Future to Reduce Water Losses 26
7.6 Cost Benefit Analysis of Reducing Water Losses 26
7.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent - Miami 28
8.0 RIMROCK WATER SYSTEM 29
8.1 Overview of Water System 29
8.2 Causes of Water Losses 29
8.3 Additional Steps Taken to Reduce Water Losses 30
8.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses 30
8.5 Additional Steps to be Taken in the Future to Reduce Water Losses 30
8.6 Cost Benefit Analysis of Reducing Water Losses 31
8.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent - Rimrock 33
8.6.2 Cost Benefit Analysis of Reducing Water Losses to 15 Percent - Rimrock 34
9.0 BISBEE WATER SYSTEM 35
9.1 Overview of Water System 35
9.2 Causes of Water Losses 35
9.3 Additional Steps Taken to Reduce Water Losses 36
9.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses 36
9.5 Additional Steps to be Taken in the Future to Reduce Water Losses 36
9.6 Cost Benefit Analysis of Reducing Water Losses 37
9.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent - Bisbee 39
9.6.2 Cost Benefit Analysis of Reducing Water Losses to 15 Percent - Bisbee 40
10.0 PINEWOOD WATER SYSTEM 41
10.1 Overview of Water System 41
10.2 Causes of Water Losses 41

10.3 Additional Steps Taken to Reduce Water Losses 42
10.4 Assessment of Effect on Water Losses from Steps Taken to Reduce Water Losses 42
10.5 Additional Steps to be Taken in the Future to Reduce Water Losses 42
10.6 Cost Benefit Analysis of Reducing Water Losses 43
10.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent - Pinewood 45
10.6.2 Cost Benefit Analysis of Reducing Water Losses to 15 Percent - Pinewood 46
11.0 CONCLUSIONS 47
12.0 APPENDICES 48
12.1 METER REPLACEMENT SCHEDULE 49
12.2 COST BENEFIT ANALYSES 51
12.2.1 Cost Benefit of Reducing Water Losses in the Pinetop Lakes Water System to 10 Percent over Life of Infrastructure Replacement 52
12.2.2 Cost Benefit of Reducing Water Losses in the Overgaard Water System to 10 Percent over Life of Infrastructure Replacement 53
12.2.3 Cost Benefit of Reducing Water Losses in the Miami Water System to 10 Percent Over Life of Infrastructure Replacement 54
12.2.4 Cost Benefit of Reducing Water Losses in the Rimrock Water System to 10 Percent over Life of Infrastructure Replacement 55
12.2.5 Cost Benefit of Reducing Water Losses in the Rimrock Water System to 15 Percent Over Life of Infrastructure Replacement 56
12.2.6 Cost Benefit of Reducing Water Losses in the Bisbee Water System to 10 Percent over Life of Infrastructure Replacement 57
12.2.7 Cost Benefit of Reducing Water Losses in the Bisbee Water System to 15 Percent Over Life of Infrastructure Replacement 58
12.2.8 Cost Benefit of Reducing Water Losses in the Pinewood Water System to 10 Percent over Life of Infrastructure Replacement 59
12.2.9 Cost Benefit of Reducing Water Losses in the Pinewood Water System to 15 Percent Over Life of Infrastructure Replacement 60
12.3 INFRASTRUCTURE REPLACEMENT PROJECT COST ESTIMATES 61
12.3.1 10-Year Infrastructure Replacement Preliminary Cost Estimate – Pinetop Lakes Water System 62
12.3.2 10-Year Infrastructure Replacement Preliminary Cost Estimate – Overgaard Water System 63
12.3.3 10-Year Infrastructure Replacement Preliminary Cost Estimate – Miami Water System 64
12.3.4 10-Year Infrastructure Replacement Preliminary Cost Estimate – Rimrock Water System 65

12.3.5 10-Year Infrastructure Replacement Preliminary Cost Estimate – Bisbee Water System 66
12.3.6 10-Year Infrastructure Replacement Preliminary Cost Estimate – Pinewood Water System 67

1.0 EXECUTIVE SUMMARY

This report on Arizona Water Company's (the "Company") Plan to Reduce Water Losses was prepared for the Company's water systems that had not achieved a water loss rate of less than 10 percent by July 1, 2011, pursuant to Arizona Corporation Commission (the "Commission") Decision No. 71845, dated August 25, 2010. The Commission directed the Company to evaluate these water systems and prepare a report demonstrating how the Company plans to reduce water losses to less than 10 percent, or why it is not cost effective to do so in Decision No. 71845. Water systems with water losses greater than 10 percent, which are the subject of this report, include the Coolidge Airport, Pinetop Lakes, Overgaard, Miami, Rimrock, Bisbee and Pinewood water systems.

The Company has made a significant effort to reduce water losses by monitoring its water systems, detecting and repairing leaks, replacing infrastructure, performing meter maintenance and selecting the most appropriate meters for each application. This report shows that the frequency of water main and service line leaks and breaks is increasing due to the effects of aging and that failing water mains and services should be replaced.

There are over 320 miles of water mains currently in service in the seven water systems contained in this report. Different types of materials have been used for water mains throughout the past 100 years, with steel, galvanized steel, cast iron, cement asbestos and ductile iron pipe first used in the 1900s, 1910s, 1920s, 1930s and 1986, respectively. Ductile iron pipe has been used almost exclusively for new water main installations since 1986. Other less common types of water mains have also been used, but account for only a small percentage of water mains installed in these water systems.

The seven systems contained in this report currently have over 15,600 active water service connections. Different types of materials have also been used for water service lines including copper, galvanized steel, polybutylene, polyethylene and PVC; with the newest water service lines made from copper materials.

Water mains and service lines must be monitored and repaired to manage and minimize water losses. The Company's highly trained employees use state-of-the-art leak detection equipment to identify the sources of such water losses and follow up with repairs or replacements of leaking water mains and service lines. However, for several water systems aging water mains and water service lines are failing faster than the Company's ability to locate and repair leaks and breaks at current rates of replacement.

The Company has concluded that a more aggressive distribution infrastructure replacement program is needed to further reduce water losses. The Company estimates that it will cost $84 million to replace water mains and service lines that are at or nearing the end of their useful lives for these seven water systems alone. Because of the enormity of this additional level of capital expenditure, the Company is requesting that the Commission authorize the establishment of a Distribution System Improvement Charge ("DSIC") (*See* Attachment 1) for all of its water systems. A DSIC will enable the Company to replace critical infrastructure with gradual changes in rates. Without the approval of a DSIC, the Company cannot adequately replace aging infrastructure critical to the Company's compliance with the Commission's directives in Decision No. 71845.

Although the magnitude of the infrastructure replacement program is quite large, and the solutions will require a long-term commitment, the Company needs to start now in order to make additional progress towards replacing aging and failing infrastructure.

2.0 PURPOSE

In Commission Decision No. 71845, dated August 25, 2010, the Commission directed the Company to do the following:

> "Arizona Water Company shall reduce the non-account water for each of its systems to less than 10 percent by July 1, 2011. For those systems that have not achieved a water loss rate of less than 10 percent by July 1, 2011, AWC should evaluate the systems and prepare a report demonstrating how the Company plans to reduce water losses to less than 10 percent. If the Company contends that reducing water losses to less than 10 percent is not cost effective, it should submit a detailed cost analysis and explanation demonstrating why the water loss reduction to less than 10 percent is not cost effective. Absent extraordinary circumstances, and with compelling supporting documentation, no system should be permitted to maintain non-account water above 15 percent."

One purpose of this report is to demonstrate how, after evaluating its water systems, the Company plans to reduce water losses to less than 10 percent for its water systems that, by July 1, 2011, had not achieved a water loss rate of less than 10 percent pursuant to Commission Decision No. 71845.

A second purpose is to provide a detailed cost analysis and explanation demonstrating that reducing water losses to less than 10 percent for the Company's Pinetop Lakes, Overgaard, Miami, Rimrock, Bisbee and Pinewood water systems is not cost effective.

A third purpose is to identify, describe and document the extraordinary circumstances that prevent the Company from reducing water losses to 15 percent for its Rimrock, Bisbee and Pinewood water systems.

This report also focuses on the necessity of a surcharge mechanism to address the Company's replacement of aging and failing water mains and service lines. A DSIC will enable the Company to replace its failing infrastructure with gradual increases in rates, thereby providing greater rate stability and avoiding steep increases in rates.

3.0 MEASURES TO IDENTIFY AND REDUCE WATER LOSSES TO LESS THAN 10 PERCENT

This section focuses on measures the Company uses to reduce water losses for the seven water systems that are the subject of this report.

3.1 Locating and Detecting Leaks

Company meter readers report service line and water main leaks and breaks they observe while reading meters. In reporting leaks and breaks, meter readers provide real time information from which timely repairs can be made. As part of their routine duties, meter readers visually inspect the entire water system for leaks and breaks. When a meter reader observes a leak or break, the information is entered into a handheld meter-reading device and then downloaded. Each local office generates a service order from each leak or break that is

reported. If the leak or break requires immediate attention, the meter reader immediately contacts the local office to dispatch a repair crew. In this manner, the repair of leaks and breaks can be started even before the meter readers complete their normal shift.

3.1.1 Leak Detection Equipment

In addition to visual inspections conducted by meter readers, the Company uses three complementary types of leak detection equipment which help the Company's employees identify the location of water leaks more efficiently than other more labor-intensive methods.

The first type of leak detection equipment is a listening device, such as an acoustic noise amplifier or a geophone. The acoustic noise amplifier is a highly sensitive electronic set of "earphones" equipped with signal amplifiers and noise filters to isolate water leak sound vibrations from extraneous background noise. While the acoustic noise amplifier is usually placed on the surface of the ground above the water main, it can also be placed in contact with meters or valves or directly onto the water main. In addition to a disc-shaped listening device, many models can be fitted with a listening "rod" to make contact with meters, valves or water mains otherwise inaccessible and help to locate the source of the leak more precisely.

Geophones are similar to an acoustic noise amplifier, but are mechanical devices and work in much the same manner; i.e. the listening device is placed on the surface of the ground or above the water main and the operator listens for the sound of a leak.

Another type of leak detection equipment, the digital leak detection logger, uses multiple data loggers to survey a larger portion of the distribution system to locate potential leaks that would otherwise go undetected by visual inspection or through the use of other less technological types of listening devices. Each data logger is used in conjunction with other data loggers to collect leak noise data during low noise times (such as between midnight and 3 a.m.) when water use and traffic noises are at a minimum. The use of multiple data loggers helps to triangulate the locations of suspected leaks identified by each data logger used.

The digital leak detection logger uses up to eight data loggers strategically placed on valves, fire hydrants, water meters or directly on the water mains throughout the water system. The data loggers are programmed to communicate with each other at three scheduled time intervals to listen for the sound of any leaks. The information is then downloaded and analyzed to determine if there was any leak "noise" identified between the loggers. If a leak noise is identified, a "correlation spike" will present itself in the data. The operator then inputs the pipe size, material type and distance between the loggers into the laptop and the location of the leak is displayed.

The third type of leak detection equipment, the digital leak correlator, is used to pinpoint the location of the leak noise on a real-time basis, as well as confirming or validating locations of suspected leaks identified through surveys conducted by using a digital leak detection logger, acoustic noise amplifier and/or geophones.

The digital leak correlator system consists of one main processor and two signal transmitters. The main processor receives and processes signals from two transmitters, which are placed on valves, fire hydrants or water meters by a special sensor-mounting device, or directly on the water main itself. When searching for or pinpointing leaks the size, material type and length of each section of pipe that is located between the transmitters must be entered

into the main processor. If leak noise is observed, a spike appears on the main processor screen and the calculated distance from the leak to each of the transmitters is displayed.

The Company's employees use digital leak correlators to confirm the validity of the data generated by the main processor by moving the transmitters to different locations, which can help to confirm or validate the original reported location of the leak. When comparing the location of the suspected leak determined from each leak noise or spike correlation, locating or predicting the same point of leak confirms with greater accuracy the point where repair crews should begin to focus their efforts and excavate for repairs.

The Company has several or more of each type of leak detection equipment throughout its water systems as shown in Table 3.1.

Table 3.1: Leak Detection Equipment

Leak Detection Equipment by Type	
Correlators:	8
Loggers:	4
Geophones/Acoustic Noise Amplifiers:	14

The Company's employees undergo extensive training in the proper operation, use and interpretation of results generated from each type of leak detection equipment. The use of this equipment is effective for locating water main and service line leaks and breaks, facilitating repairs, reducing the overall cost of repairs and helping to reduce water losses. In 2011, the Company purchased an additional leak detection logger and an acoustic noise amplifier for use by its employees in its Pinewood and Rimrock water systems, increasing the availability of such equipment. When the Company's employees need to share leak detection equipment with the rest of the Verde Valley Division, locating and making repairs may be unavoidably delayed.

3.1.2 Documentation of Leak Data

To assist in the systematic collection and tracking of water leak data, the Company also documents water leaks through the use of a Water Loss Control form, (*See* Figure 3.1). This data tracking form is completed each time a leak or break is discovered and repaired, providing a detailed accounting of the leak or break and its repair, including the location, pipe condition, cause of leak or break, labor-hours expended and other related costs. The information entered on this form is used to identify high frequency leak or break areas where additional leak detection efforts are prioritized. This information also helps to determine the timing and priority of water main and service line replacements as well as the preparation of infrastructure replacement budgets. Since 2010, over 1,000 Water Loss Control forms have been completed by Company employees.

Figure 3.1: Water Loss Control Form

ARIZONA WATER COMPANY

WATER LOSS CONTROL FORM

DATE: **SYSTEM:** **PWSID AND NAME:** **LEAK #:**

TYPE OF LEAK: **SERVICE** ☐ **MAIN** ☐ **FITTING** ☐ **VOLUME (GPM)**

LOCATION OF LEAK: **LEGAL DESCRIPTION:** ¼ **SEC.** _____ **SEC.** _____ **T.** _____ **R.** _____

ADDRESS #: _____ **STREET NAME:** _____

LOT#: **SUBDIVISION NAME:**

LOCATION:

SERVICE/MAIN/FITTING CONDITION:

YEAR: **MATERIAL:** **SIZE:** **LENGTH:** **FITTING TYPE:** **DEPTH OF COVER:**

EXTERIOR CONDITION: **BAD** **POOR** **FAIR** **GOOD** **EXCELLENT**

EXTERIOR CONDITION DESCRIPTION:

POLY-WRAPPED: **YES** ☐ **NO** ☐

INTERIOR CONDITION: **BAD** **POOR** **FAIR** **GOOD** **EXCELLENT**

INTERIOR CONDITION DESCRIPTION:

DESCRIPTION OF LEAK:

CAUSE OF LEAK:

DESCRIPTION OF REPAIRS MADE:

REQUIRED ATTACHMENT: COPY OF ¼ ATLAS WITH LOCATION OF LEAK MARKED WITH A RED "X"
REQUIRED ATTACHMENT: MATERIAL(S) LIST AND COST(S)
REQUIRED DIGITAL PHOTOS: RENAME FILE TO (LEAK #-YR-PIC#)
PLACE DIGITAL PHOTOS IN THE LEAK DETECTION DIRECTORY UNDER THE APPROPRIATE DIVISION/SYSTEM ON THE COMPANY'S SHARED DRIVE

TOTAL LABOR HOURS:

TOTAL MATERIAL COST: $ _____

LEAK DETECTION EQUIPMENT USED (Y/N):

3.2 Leak Repair

Detecting and locating leaks and breaks are necessary steps prior to initiating repairs. The Company reduces water losses through timely maintenance and repair of leaks and breaks. The Company schedules repairs of smaller water main and service line leaks as soon as possible, while water main breaks are repaired on an expedited or emergency basis. Water main leaks are generally much more difficult to locate than water main breaks as the rates of leakage are typically much less and not easily located, except through more advanced methods of detection, such as through the use of listening devices, leak detection equipment and/or by conducting leak surveys. For the first nine months of 2011, nearly 500 leaks and breaks were

located and repaired in the seven water systems that are the subject of this report, as shown in Table 3.2.

Table 3.2: Company Leaks and Breaks – 2011

Leaks and Breaks by Type and Water System Jan-Sept 2011		
Water System	**Water Mains**	**Service Lines**
Coolidge Airport	1	2
Pinetop Lakes	3	1
Overgaard	4	48
Miami	106	98
Rimrock	32	20
Bisbee	106	31
Pinewood	29	11
Total	**281**	**211**

3.3 Meter Maintenance Program

The Company has established the criteria for meter repairs and/or replacement as part of its meter maintenance program. The Company does not repair or replace water meters based solely on years in service, but also considers gallonage and water quality as additional repair/replacement factors, thus effectively and efficiently using resources. The Company's meter shop, through its many years of experience both testing and repairing water meters, has established comprehensive meter maintenance criteria based on meter size, meter type, gallonage, length of time in service and water quality (*See* Appendix 12.1). Water quality varies between systems and can even vary within a system. These variances can affect meter accuracy and the useful life of a water meter. For example, sand and other fine materials can cause abrasive wear on meters and build up or deposits from hard water can increase friction on moving parts, causing a meter to "run slow" and increasing water losses.

The Company's meter shop also performs approximately 1,000 random annual meter tests to provide an ongoing assessment which helps to establish the most appropriate meter maintenance criteria for each system. In this way, the Company ensures that meter accuracy is cost-effectively maintained for each water system, verified through random meter testing, while still keeping water losses due to meter inaccuracies low. The Company's meter maintenance and testing programs benefit all of the Company's water systems. For the 12 months ending September 2011, nearly 1,000 meters were either repaired or replaced in these seven water systems, as detailed in Table 3.3.

Table 3.3: Meter Change-Out by System/Year

Meter Change Out by System and Year			
Water System	**2009**	**2010**	**2011**
Coolidge Airport	7	--	--
Pinetop Lakes	37	45	63
Overgaard	47	259	329
Miami	196	294	171
Rimrock	91	46	20
Bisbee	232	119	290
Pinewood	167	21	123
Total	**777**	**784**	**996**

3.4 Meter Selection Review

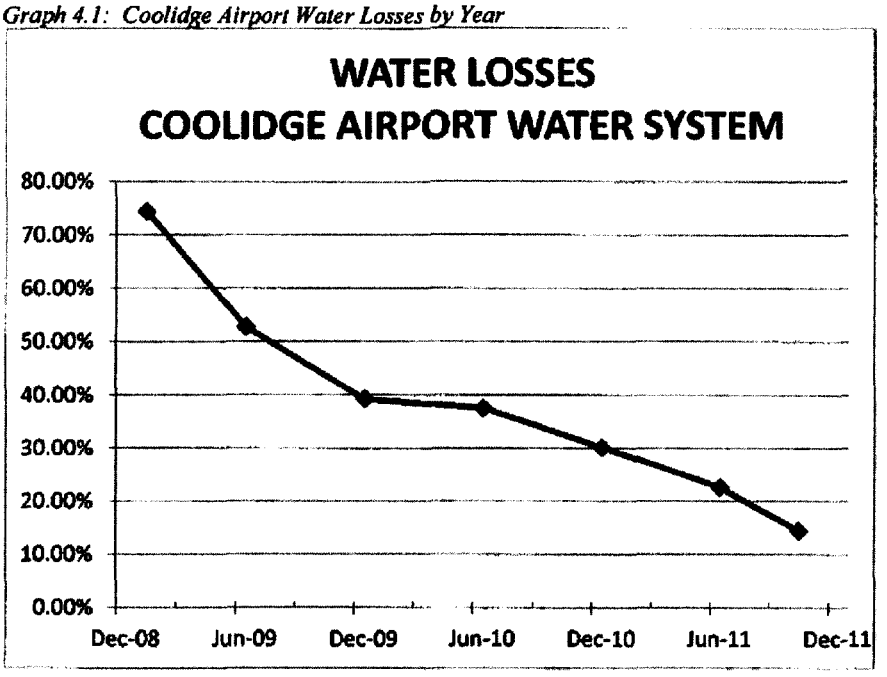
Following guidelines provided by the Company's meter shop, the Company's engineering department reviews new meter applications prior to establishing water service. Typically, 5/8 x 3/4-inch water meters are installed for residential customers in new subdivisions. Residential and non-residential meter applications that require one-inch or larger water meters can result in a wide range of flows, with the largest meter applications typically including fire flows. As a result, the Company's engineering department determines the most appropriate size and type of meter for each specific meter application to meet the service needs and accurately measure all water provided throughout the anticipated range of flows. Again, water losses are minimized when the correct meter is chosen for the particular application.

4.0 COOLIDGE AIRPORT WATER SYSTEM

4.1 Overview of Water System

The Coolidge Airport water system, located approximately 10 miles southeast of the City of Coolidge has been operated and maintained by the Company since February 2008. As shown in Graph 4.1 below, water losses were greater than 70 percent at the beginning of the Company's operation of this water system. Initially, the Coolidge Airport water distribution system was constructed primarily of cement asbestos and PVC pipe and service lines were constructed primarily of PVC materials. The Company replaced a significant portion of the oldest mains and new water mains are constructed of C-900 PVC pipe. Seven of nine service line connections have been replaced and all service lines are now constructed from copper materials. Graph 4.1 also shows the benefits that can be achieved when aging and failing water mains and service lines are replaced.

Graph 4.1: Coolidge Airport Water Losses by Year



4.2 Causes of Water Losses

The Company discovered several unmetered services and inaccurate meters which contributed to water losses. The Company's employees installed water meters for the unmetered services and replaced the existing water meters with new water meters. Additionally, the Company's employees located and repaired three water main breaks and three service line leaks since 2008.

4.3 Additional Steps Taken to Reduce Water Losses

1. The Company replaced approximately 3,400 LF of aging and failing PVC water mains where the largest source of breaks and leaks occurred.

2. The Company replaced seven of nine water services that were in poor condition and a likely cause of water losses.

3. The Company constructed a replacement booster pump station, an automatic control system and a 15,000-gallon water storage tank to provide more stable water pressure and reduce the frequency of water leaks and breaks potentially caused by fluctuating water pressure.

4.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses

The Company expects that the additional steps taken to reduce water losses identified in Section 4.3 will cause water losses to drop from 15 percent to less than 10 percent. This reduction in water losses would not have been possible without the replacement of a significant portion of water mains, service lines and meters. The approximate cost to replace this infrastructure was $141,000.

4.5 Additional Steps to be Taken in the Future to Reduce Water Losses

1. Manage Coolidge Airport water system water losses by tracking ongoing water losses each month and follow up with corrective actions to help mitigate any upward trends in water losses.

2. If water losses do not drop below 10 percent or if losses trend back upwards, the Company will direct its employees to increase the use of digital leak detection loggers to locate and repair leaks and breaks.

3. The Company budgeted $215,000 in 2012 for its Pinal Valley Division, which includes the Company's Coolidge Airport water system, for use in replacing water mains, water services, water meters and fire hydrants, as needed for specific projects.

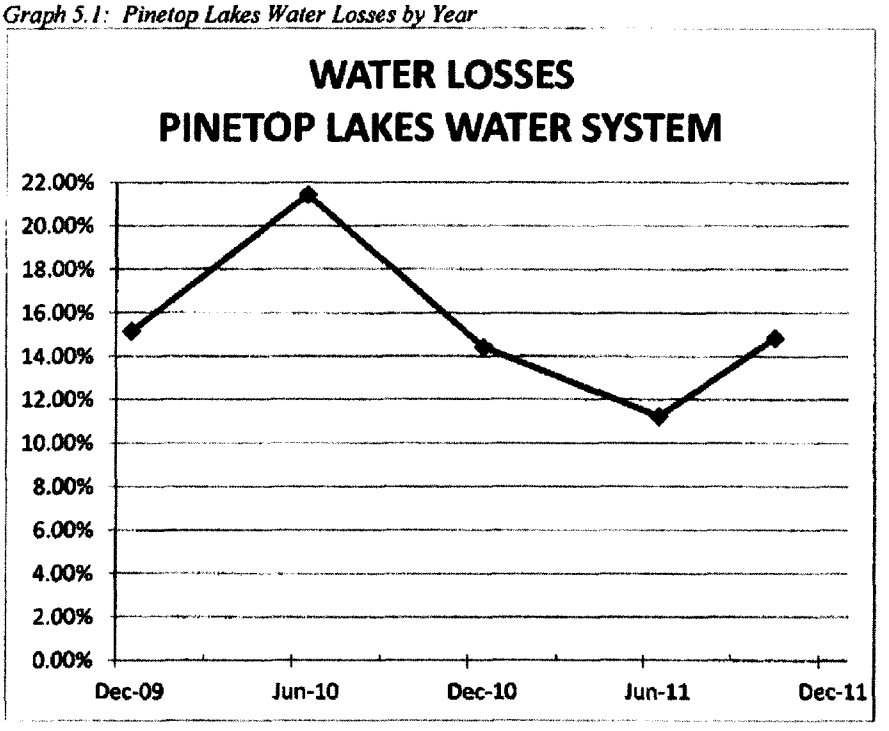
4. If in the future the Company's assessment of the Coolidge Airport water system shows that additional water distribution system infrastructure needs to be replaced, the Company will include such replacement infrastructure in the Company's infrastructure replacement plan, subject to budget constraints.

5.0 PINETOP LAKES WATER SYSTEM

5.1 Overview of Water System

The Pinetop Lakes water system, located in the Pinetop-Lakeside area in Arizona, is one of the water systems in the Company's Navajo Division. As shown in Graph 5.1 below, water losses have exceeded 10 percent since 2009. There are over 84,000 LF (16 miles) of water mains in service varying in size and material, including cement asbestos, ductile iron and PVC materials. There are approximately 1,000 water service lines in service constructed primarily of polybutylene, polyethylene and copper materials.

Graph 5.1: Pinetop Lakes Water Losses by Year



5.2 Causes of Water Losses

Water losses in the Pinetop Lakes water system are caused by a combination of water main and service line leaks and breaks. In the past two years, five large non-surfacing leaks and breaks caused by failing water distribution infrastructure were located and repaired using electronic leak detection equipment in the Pinetop Lakes water system. These leaks and breaks are estimated to have accounted for over 900,000 gallons of water losses per month.

5.3 Additional Steps Taken to Reduce Water Losses

1. As part of the Company's plan to reduce water losses, the Company measured and mapped the entire Pinetop Lakes water system to help expedite future surveys using digital leak detection loggers.

2. The Company increased the number of system-wide leak surveys by 50 percent, from two per year to three per year in its Pinetop Lakes water system using digital leak detection loggers.

5.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses

The Company expects that the additional steps taken to reduce water losses identified in Section 5.3 will reduce water losses for its Pinetop Lakes water system, but additional steps may be necessary to reduce water losses to less than 10 percent.

5.5 Additional Steps to be Taken in the Future to Reduce Water Losses

1. Manage Pinetop Lakes water system water losses by tracking ongoing water losses each month and follow up with corrective actions to help mitigate any upward trends in water losses.

2. If water losses do not drop below 10 percent or if losses trend back upwards, the Company will direct its employees to increase the use of digital leak detection loggers to locate and repair leaks and breaks.

3. The Company budgeted $64,000 for 2012 for its Navajo Division, which includes the Company's Pinetop Lakes water system, for use in replacing water mains, water services, water meters and fire hydrants, as needed for specific projects.

5.6 Cost Benefit Analysis of Reducing Water Losses

The Company's engineers analyzed the Pinetop Lakes water system and determined that in order to reduce water losses to below 10 percent nearly 9,000 feet of aging water mains and 800 failing polybutylene and polyethylene water service lines need to be replaced. The preliminary cost estimate to replace these facilities is nearly $4.2 million as shown in the table on page 62 of Appendix 12.3.1.

If these replacements are made water losses should drop to 10 percent or below. Table 5.6.1, Column B, Lines 16 – 18 shows that at a current water loss rate of 11.2 percent the amount of water lost annually is 7,061.8 thousand gallons. Reducing water losses to 10 percent would result in 6,292.9 thousand gallons lost annually or a savings of 768.9 thousand gallons of water each year.

The total cost of producing this volume of water is shown in Table 5.6.1, Column B, Lines 2 – 6. When the total cost of production $61,618 is divided by the number of thousand gallons produced 62,929, the cost per thousand gallons produced of $0.98 results.

To determine the annual potential savings from reducing water losses to 10 percent, the cost per thousand gallons produced is multiplied by the reduction in lost water or 768.9 thousand gallons resulting in a potential annual savings of $753.

Table 5.6.1, Column D, Lines 2 – 10 calculates the required annual revenue requirement associated with investing $4.2 million to replace nearly 9,000 feet of water mains and 800 services, which is the cost of reducing water losses in the Pinetop Lakes water system to 10 percent or below. The resulting annual revenue requirement would be $614,000. When compared to the amount of annual potential savings the annual revenue requirement for replacing this infrastructure would be greater by $613,000, meaning that rates would increase by over $600,000 or over 15 percent in order to save 769 thousand gallons of water. Since Overgaard

and Pinetop Lakes are in the same consolidated rate system reducing water loss to 10 percent or below for both water systems would result in an increase in rates of over 61 percent.

When evaluated over the life of the replacement assets (Table 5.6.1, Column D, Lines 26 – 30) the total savings in production costs, assuming an annual inflation factor of 3.4 percent would be $131,072 compared to a revenue requirement of $19,240,000 or a net cost of $19.1 million.

Based on the analysis above and on Tables 5.6.1 and Appendix 12.2.1 page 52 the cost of reducing water losses in the Pinetop Lakes system to 10 percent or below far exceeds the potential benefits.

5.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent – Pinetop Lakes

Pinetop Lakes Water System

Line No.	(A)	(B)	(C)	(D)
1.	**Production Costs**		**Infrastructure Replacement Cost**	
2.	Supply Costs	$ 5,658	Required Investment to Lower Water Loss to 10%	$ 4,200,000
3.	Pumping Costs	45,546	Required Rate of Return	7.87%
4.	Treatment Costs	10,414	Required Operating Income	$ 330,540
5.			Tax Multiplier	1.6286
6.	TOTAL	$ 61,618	Revenue Requirement - Return on Investment	$ 538,317
7.				
8.	Production (MGALS)	62,929.0	Depreciation Expense at 1.79%	75,180
9.				
10.	Pumping Cost per MGAL	$ 0.98	Total Revenue Requirement	$ 613,497
11.				
12.				
13.				
14.				
15.	**Water Loss Reduction (MGAL)**		**Net Benefit / (Cost) of Reducing Water Loss**	
16.	Production (MGALS)	62,929.0	Water Loss Reduction (MGAL) (Column B, line 22)	768.9
17.	Current Water Loss Percent	11.2%	Cost per MGAL (Column B, line 10)	$ 0.98
18.	Amount of Water Loss (MGAL)	7,061.8	Annual Potential Savings	$ 752.88
19.				
20.	Water Loss at 10% (MGAL)	6,292.9	Annual Required Revenue Needed for Plant Investment (Column D, line 10)	$ 613,497
21.				
22.	Water Loss Reduction (MGAL)	768.9	Annual Net Benefit / (Cost) of Reducing Water Loss	$ (612,745)
23.				
24.				
25.				
26.	Savings over life of investment (Table 12.2.1, Column M, line 59)			$ 131,072
27.				
28.	Revenue requirement over life of investment (Table 12.2.1, column J, line 59)			19,236,712
29.				
30.	Net Benefit / (Cost) over life of investment			$ (19,105,640)

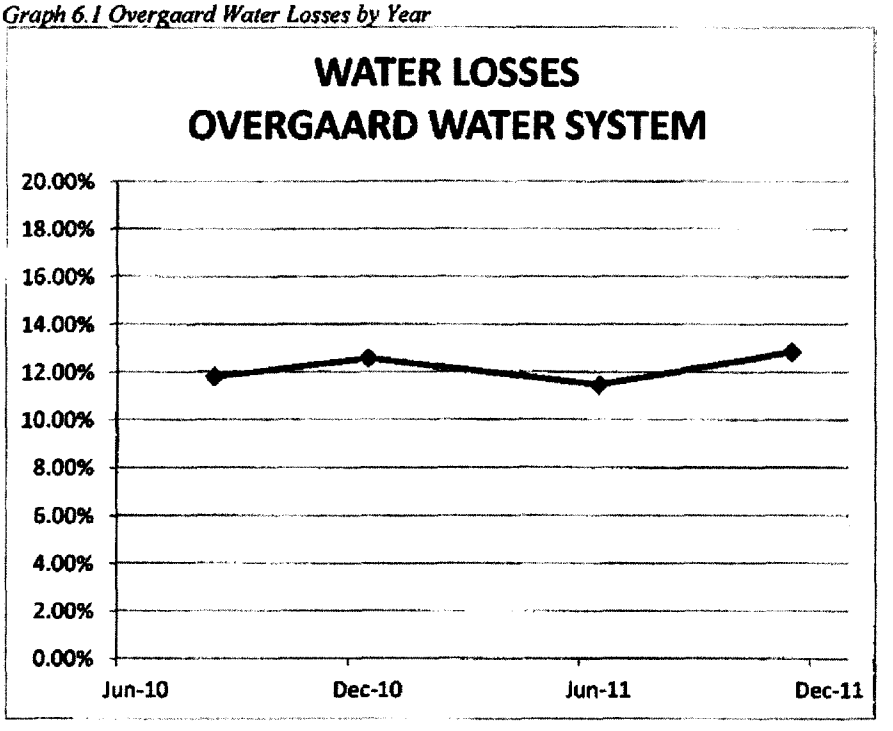
Please See Appendix 12.3.1 on page 62 for detailed costs of Pinetop Lakes Infrastructure Improvements

6.0 OVERGAARD WATER SYSTEM

6.1 Overview of Water System

The Overgaard water system, located in the Heber-Overgaard area in Arizona, is another water system in the Company's Navajo Division. As shown in Graph 6.1 below, water losses have exceeded 10 percent since August 2010. There are over 500,000 LF (97 miles) of water mains in service varying in size and material, including cement asbestos, ductile iron, PVC, steel and galvanized steel materials. There are approximately 4,200 water service lines in service constructed primarily of polybutylene, polyethylene and copper materials.

Graph 6.1 Overgaard Water Losses by Year



6.2 Causes of Water Losses

A common cause of water losses in the Overgaard water system is frozen water meters caused by cold winter weather, damaging the water meters and causing leaks. Service line leaks and breaks are another common cause of water losses for the Overgaard water system. Since 2007, over 280 leaks and breaks have been located and repaired in the Overgaard water system. 263 of these leaks and breaks were identified as either frozen water meters or service line leaks or breaks, as shown in Table 6.1 below.

Table 6.1: Overgaard Leaks by Type/Year

Water Leaks by Type and Year - Overgaard Water System			
Year	**Main Leaks**	**Service Leaks**	
		Meter	**Service Line**
2007	1	60	4
2008	5	4	73
2009	5	14	16
2010	3	23	21
2011	4	15	33
Total	**18**	**263**	

6.3 Additional Steps Taken to Reduce Water Losses

1. The Company identified the areas where freeze-damaged water meters are most common and has taken steps to reduce the risks of freezing by insulating meters by placing materials such as foam, sawdust or fiberglass within the meter boxes.

2. The Company increased the use of leak detection loggers by 50 percent, from two days per week to three days per week.

3. The Company purchased 20 anti-theft locks for fire hydrants located in the remote areas of the Overgaard water system to reduce the risk of unauthorized water use and potentially reduce water losses caused by theft.

4. The Company's employees have conducted a system-wide leak survey of its Overgaard water system using leak detection equipment described in Section 3 of this report. Although several small leaks were located and repaired, no areas were identified that would account for any significant percentage of water losses that currently exist for this water system.

6.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses

The Company expects that the additional steps taken to reduce water losses identified in Section 6.3 will help to reduce water losses for its Overgaard water system, but additional steps may be necessary in the future to reduce water losses to less than 10 percent.

6.5 Additional Steps to be Taken in the Future to Reduce Water Losses

1. Manage the Overgaard water system water losses by tracking ongoing water losses each month and follow up with corrective actions to help mitigate any upward trends in water losses.

2. If water losses do not drop below 10 percent or if losses trend back upwards, the Company will direct its employees to increase the use of digital leak detection loggers to locate and repair leaks and breaks.

3. The Company budgeted $64,000 for 2012 for its Navajo Division, which includes the Company's Overgaard water system, for use in replacing water mains, water services, water meters and fire hydrants, as needed for specific projects. The Company also

plans to purchase 10 additional anti-theft locks for fire hydrants for its Overgaard water system in 2012.

4. The Company budgeted $50,000 for 2012 to construct additional freeze protection for 75 water meters and related meter box assemblies for its Overgaard water system.

5. The Company budgeted $40,000 for 2012 to replace a failing automatic control system for its Zane Grey pump station. This project will reduce automatic control failures that have been one of the causes of water losses for the Overgaard water system.

6. The Company budgeted $25,000 for 2012 for its Navajo Division, which includes the Overgaard water system, to purchase additional leak detection equipment.

6.6 Cost Benefit Analysis of Reducing Water Losses

The Company's engineers analyzed the Overgaard water system and determined that in order to reduce water losses to below 10 percent, over 18,000 feet of aging water mains and 2,100 failing polybutylene and polyethylene water service lines need to be replaced. Additionally, 4,200 meter boxes need to be retrofitted with insulating materials to provide better freeze protection. The preliminary cost estimate to replace these facilities is nearly $12.5 million as shown in the table on page 63 of Appendix 12.3.2.

If these replacements are made water losses should drop to 10 percent or below. Table 6.6.1, Column B, Lines 16 – 18 shows that at a current water loss rate of 11.5 percent the amount of water lost annually is 17,060.4 thousand gallons. Reducing water losses to 10 percent would result in 14,885.5 thousand gallons lost annually or a savings of 2,174.9 thousand gallons of water each year.

The total cost of producing this volume of water is shown in Table 6.6.1, Column B, Lines 2 – 6. When the total cost of production $140,841 is divided by the number of thousand gallons produced 148,855, the cost per thousand gallons produced of $0.95 results.

To determine the annual potential savings from reducing water losses to 10 percent the cost per thousand gallons produced is multiplied by the reduction in lost water or 2,174.9 thousand gallons resulting in a potential annual savings of $2,058 (Table 6.6.1, Column D, Line 17).

Table 6.6.1, Column D, Lines 2 – 10 calculates the required annual revenue requirement associated with investing $12.5 million to replace 18,000 feet of water mains and 2,100 service lines and retrofitting 4,200 meter boxes to provide better freeze protection, which is the cost of reducing water losses in the Overgaard system to 10 percent or below. The resulting annual revenue requirement would be $1,826,000. When compared to the amount of annual potential savings the revenue requirement for replacing this infrastructure would be greater by $1,824,000, meaning that rates would increase by over $1.8 million or nearly 46 percent in order to save 2,175 thousand gallons of water. Since Overgaard and Pinetop Lakes are in the same consolidated rate system reducing water loss to 10 percent or below for both these systems would result in an increase in rates of over 61 percent.

When evaluated over the life of the replacement assets (Table 6.6.1, Column D, Lines 26 – 30) the total savings in production costs, assuming an annual inflation factor of 3.4 percent would be $358,257 compared to a revenue requirement of $57 million or a net cost of $56.9 million.

Based on the analysis above and on Tables 6.6.1 and Appendix 12.2.2 page 53 the cost of reducing water losses in the Overgaard system to 10 percent or below far exceeds the potential benefits.

6.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent - Overgaard

Overgaard Water System

Line No.	(A)	(B)	(C)	(D)
	Production Costs		**Infrastructure Replacement Cost**	
1.	Supply Costs	$ 12,932	Required Investment to Lower Water Loss to 10%	$ 12,500,000
2.	Pumping Costs	104,105	Required Rate of Return	7.87%
3.	Treatment Costs	23,804	Required Operating Income	$ 983,750
4.			Tax Multiplier	1.6286
5.	TOTAL	$ 140,841	Revenue Requirement - Return on Investment	$ 1,602,135
6.				
7.	Production (MGALS)	148,855.0	Depreciation Expense at 1.79%	223,750
8.				
9.	Pumping Cost per MGAL	$ 0.95	Total Revenue Requirement	$ 1,825,885
10.				
11.				
12.				
13.				
14.	**Water Loss Reduction (MGAL)**		**Net Benefit / (Cost) of Reducing Water Loss**	
15.	Production (MGALS)	148,855.0	Water Loss Reduction (MGAL) (Column B, line 22)	2,174.9
16.	Current Water Loss Percent	11.5%	Cost per MGAL (Column B, line 10)	$ 0.95
17.	Amount of Water Loss (MGAL)	17,060.4	Annual Potential Savings	$ 2,057.81
18.				
19.	Water Loss at 10% (MGAL)	14,885.5	Annual Required Revenue Needed for Plant Investment (Column D, line 10)	$ 1,825,885
20.				
21.	Water Loss Reduction (MGAL)	2,174.9	Annual Net Benefit / (Cost) of Reducing Water Loss	$ (1,823,827)
22.				
23.				
24.				
25.	Savings over life of investment (Table 12.2.2, Column M, line 59)			$ 358,257
26.				
27.	Revenue requirement over life of investment (Table 12.2.2, column J, line 59)			57,252,124
28.				
29.	Net Benefit / (Cost) over life of investment			$ (56,893,867)

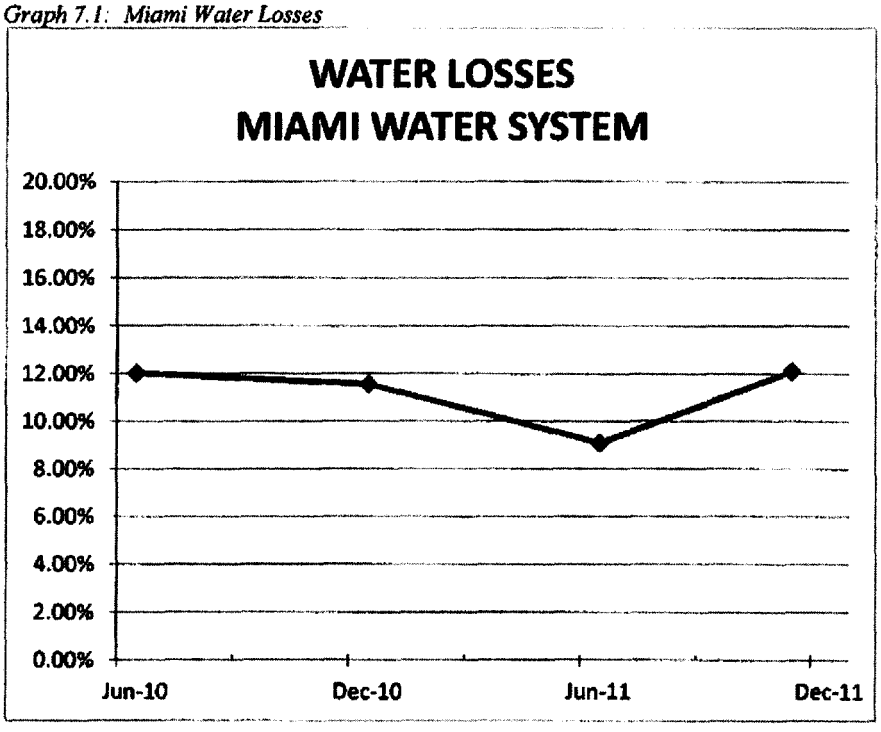
Please see Appendix 12.3.2 on page 63 for detailed costs of Overgaard Infrastructure Improvements

7.0 MIAMI WATER SYSTEM

7.1 Overview of Water System

The Miami water system, located in Gila County, Arizona is one of three Superstition Division water systems. As shown in Graph 7.1 below, water losses exceeded 10 percent from June 2010 until June 2011 when water losses dropped below 10 percent, however water losses increased above 10 percent again in July of 2011. There are over 380,000 LF (72 miles) of water mains in service varying in size and materials, including cement asbestos, cast iron, ductile iron, copper, steel, galvanized steel and PVC materials. There are approximately 3,000 water service lines in service constructed primarily of galvanized steel, polybutylene and polyethylene materials.

Graph 7.1: Miami Water Losses



7.2 Causes of Water Losses

1. Service leaks and breaks make up over two-thirds of all leaks and breaks within the Miami water system and are a significant cause of water losses. The majority of these leaks and breaks are caused by aging infrastructure and are commonly observed where polybutylene, polyethylene and galvanized steel service lines are in use.

2. Unplanned tank overflows, caused by automatic control signal failures at the Bandy Heights water storage tank are another cause of water losses.

3. Locations where failing water mains have been identified:

a. Approximately 1,300 LF section of galvanized steel water main in an area near Bloody Tanks Wash.

b. Approximately 1,645 LF of cement asbestos water main along Live Oak Street, which was installed in 1953.

c. Galvanized steel water mains in the downtown area of Miami and in the Central Heights area installed between the 1930s and the 1950s.

Numerous leaks in the past few years were located and repaired in these three areas. Nine leaks in the past six years were located and repaired along Live Oak Street alone. Of the nearly 800 leaks and breaks located and repaired in the Miami water system during the past five years, as shown in Table 7.1 below, more than half were observed in the three areas described above.

Table 7.1: Miami Leaks by Type/Year

WATER LEAKS BY TYPE AND YEAR - MIAMI WATER SYSTEM		
Year	**Main Leaks**	**Service Leaks**
2007	23	42
2008	30	100
2009	36	131
2010	73	155
2011	106	98
Total	**268**	**526**

7.3 Additional Steps Taken to Reduce Water Losses

1. The Company replaced approximately 1,645 LF of failing cement asbestos water main on Live Oak Street with new ductile iron pipe.

2. The Company replaced approximately 1,400 LF of failing eight-inch cement asbestos water main with new eight-inch ductile iron pipe along U.S. 60 from Cordova to Reppy Avenue.

3. The Company replaced failing radio controls at the Bandy Heights water storage tank to eliminate or reduce unplanned tank overflows caused by automatic control signal failures.

4. The Company's employees conducted leak surveys of its Miami water system using digital leak detection loggers on the galvanized steel water mains in the Bloody Tanks Wash, downtown Miami and Central Heights areas.

7.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses

The Company expects that the additional steps taken to reduce water losses identified in Section 7.3 will help to reduce water losses for its Miami water system, but additional steps may be necessary in the future to reduce water losses to less than 10 percent.

7.5 Additional Steps to be Taken in the Future to Reduce Water Losses

1. Manage Miami water system water losses by tracking ongoing water losses each month and follow up with corrective actions to mitigate any upward trends in water losses.

2. If water losses do not drop below 10 percent or if water losses trend back upwards, the Company will direct its employees to increase use of digital leak detection loggers to locate and repair leaks and breaks.

3. The Company budgeted $307,500 for 2012 for its Superstition Division, which includes the Company's Miami water system, for use in replacing water mains, water services, water meters and fire hydrants, as needed for specific projects.

4. The Company budgeted $50,000 for 2012 for its Miami water system to replace 400 LF of six-inch of failing steel water main in Bloody Tanks Wash with new six-inch ductile iron pipe.

5. The Company's employees will continue to perform leak surveys in the downtown Miami and Central Heights areas where galvanized steel water mains installed from the 1930s through the 1950s have shown signs of failure and where leaks and breaks have been observed.

7.6 Cost Benefit Analysis of Reducing Water Losses

The Company's engineers analyzed the Miami water system and determined that in order to reduce water losses to below 10 percent, over 113,000 feet of aging water mains and 2,000 failing service lines need to be replaced. The preliminary cost estimate to replace this aging infrastructure is over $18.3 million as shown in the table on page 64 of Appendix 12.3.3.

If these replacements are made water losses should drop to 10 percent or below. Table 7.6.1, Column B, Lines 16 – 18 show that at a current water loss rate of 12.1 percent the amount of water lost annually is 39,756.9 thousand gallons. Reducing water losses to 10 percent would result in 32,899.7 thousand gallons lost annually or a savings of 6,857.2 thousand gallons of water each year.

The total cost of producing this volume of water is shown in Table 7.6.1, Column B, Lines 2 – 6. When the total annual cost of production $307,697 is divided by the number of thousand gallons produced annually 328, 997.2, the cost per thousand gallons produced of $0.94 results.

To determine the annual potential savings from reducing water losses to 10 percent, the cost per thousand gallons produced is multiplied by the reduction in lost water or 6,857.2 thousand gallons resulting in a potential annual savings of $6,413.

Table 7.6.1, Column D, Lines 2 – 10 calculates the required annual revenue requirement associated with investing $18.3 million to replace over 113,000 feet of water mains and 2,100 services, which is the cost of reducing water losses in the Miami system to 10 percent or below. The resulting annual revenue requirement would be $2.7 million. When compared to the amount of annual potential savings the revenue requirement for replacing this infrastructure would be greater by $2.667 million, meaning that rates would increase by nearly $2.7 million or 16 percent in order to save 6,857 thousand gallons of water.

When evaluated over the life of the replacement assets (Table 7.6.1, Column D, Lines 26 – 30) the total savings in production costs, assuming an annual inflation factor of 3.4 percent would be $1.1 million compared to a revenue requirement of $83.8 million or a net cost of $82.7 million.

Based on the analysis above and on Tables 7.6.1 and Appendix 12.2.3 page 54 the cost of reducing water loss in the Miami system to 10 percent or below far exceeds the potential benefits.

7.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent - Miami

Miami Water System

Line No.	(A)	(B)	(C)	(D)
	Production Costs		**Infrastructure Replacement Cost**	
1.	Supply Costs	$ 76,015	Required Investment to Lower Water Loss to 10%	$ 18,300,000
2.	Pumping Costs	191,316	Required Rate of Return	7.87%
3.	Treatment Costs	40,364	Required Operating Income	$ 1,440,210
4.			Tax Multiplier	1.6286
5.	TOTAL	$ 307,697	Revenue Requirement - Return on Investment	$ 2,345,526
6.				
7.	Production (MGALS)	328,997.2	Depreciation Expense at 1.79%	327,570
8.				
9.	Pumping Cost per MGAL	$ 0.94	Total Revenue Requirement	$ 2,873,096
10.				
11.				
12.				
13.				
14.	**Water Loss Reduction (MGAL)**		**Net Benefit / (Cost) of Reducing Water Loss**	
15.	Production (MGALS)	328,997.2	Water Loss Reduction (MGAL) (Column B, line 22)	8,857.2
16.	Current Water Loss Percent	12.1%	Cost per MGAL (Column B, line 10)	$ 0.94
17.	Amount of Water Loss (MGAL)	39,756.9	Annual Potential Savings	$ 6,413.23
18.				
19.	Water Loss at 10% (MGAL)	32,899.7	Annual Required Revenue Needed for Plant Investment (Column D, line 10)	$ 2,673,096
20.				
21.	Water Loss Reduction (MGAL)	6,857.2	Annual Net Benefit / (Cost) of Reducing Water Loss	$ (2,666,683)
22.				
23.				
24.				
25.	Savings over life of investment (Table 12.2.3, Column M, line 59)			$ 1,116,524
26.				
27.	Revenue requirement over life of investment (Table 12.2.3, column J, line 59)			83,817,107
28.				
29.	Net Benefit / (Cost) over life of investment			$ (82,700,583)

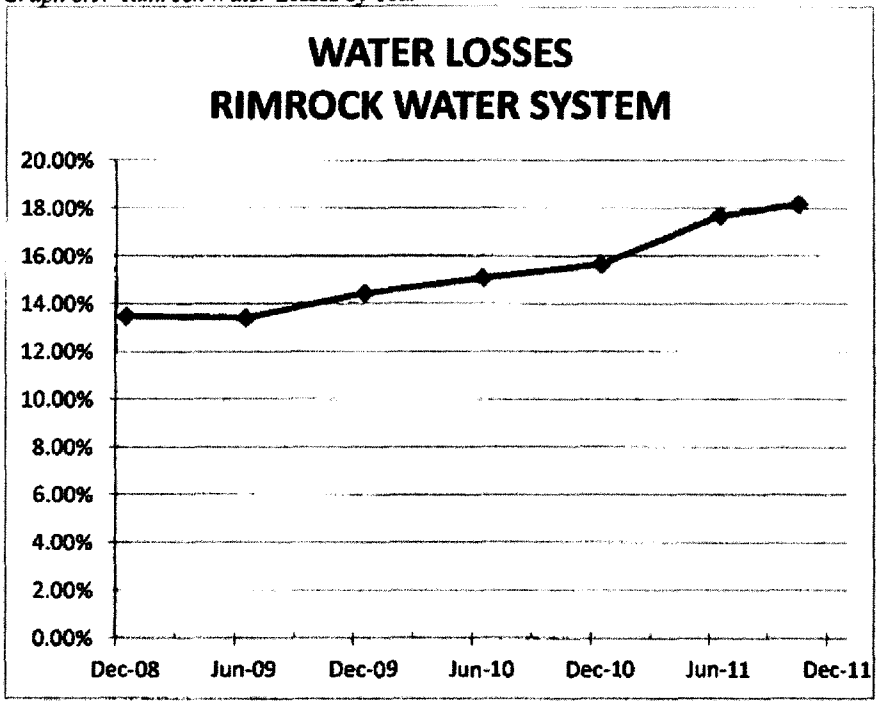
Please See Appendix 12.3.3 on page 64 for detailed costs for Miami Infrastructure Improvements

8.0 RIMROCK WATER SYSTEM

8.1 Overview of Water System

The Rimrock water system is one of four Verde Valley Division water systems. As shown in Graph 8.1 below, water losses have exceeded 10 percent for the last four years and have increased above 15 percent over the past 18 months. There are over 165,000 LF (31 miles) of water mains in service varying in size, material and age, including cement asbestos, cast iron, copper, ductile iron, galvanized steel, PVC and steel materials. There are 1,225 water service lines in service which are constructed from copper, galvanized steel, polybutylene and polyethylene materials.

Graph 8.1: Rimrock Water Losses by Year



8.2 Causes of Water Losses

Galvanized steel and cement-asbestos water mains installed in the 1960s were the predominant materials used for water mains, representing over 75 percent of all water mains currently in service in the Rimrock water system. Most of these water mains are at or near the end of their useful service lives. The Company's repair history shows that nearly two-thirds of all leak repairs and replacements were on water mains alone. As shown in Table 8.1 below, the number of water main leaks has increased from three leaks in 2007 to 32 leaks for the first nine months of 2011. The number of service leaks has also increased over this same time period.

Table 8.1: Rimrock Leaks by Type/Year

Water Leaks by Type and Year - Rimrock Water System		
Year	**Main Leaks**	**Service Leaks**
2007	3	5
2008	0	0
2009	15	8
2010	41	19
2011	32	20
Total	**91**	**52**

The Company has determined that approximately 32,000 LF of water main will be at or near the end of its useful life within the next 10 years. Using information gathered from the Water Loss Control forms plotted on a map of the Rimrock water system, the Company has identified seven geographic areas in the Rimrock water system where water mains are at or beyond their useful service lives and need to be replaced.

8.3 Additional Steps Taken to Reduce Water Losses

1. The Company replaced a failing galvanized steel water main on Paiute Trail with 275 LF of ductile iron pipe, one of the seven geographic areas identified from information gathered from the Water Loss Control forms.

2. The Company increased the amount of time spent performing leak detection surveys of the Rimrock water system with digital leak detection loggers from one day per week to two days per week.

8.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses

The Company expects that the additional steps taken to reduce water losses identified in Section 8.3 will help to reduce water losses, however, additional steps will be necessary in the future to further reduce water losses to below 15 percent. Reducing water losses to below 10 percent will require the Company to increase infrastructure replacement through development of a long-term infrastructure replacement plan.

Even with the recent completion of a water main replacement project at a cost of $40,000, the Company does not project that water losses will drop below 10 percent or 15 percent. Failing infrastructure is the primary cause for water losses in the Rimrock water system. If the Company is able to increase the rate of infrastructure replacement the Company should be able to reduce water losses below 10 percent.

8.5 Additional Steps to be Taken in the Future to Reduce Water Losses

1. Manage the Rimrock water system water losses by tracking ongoing water losses each month and follow up with corrective actions to help mitigate any upward trends in water losses.

2. If water losses do not drop below 10 percent or if water losses trend back upwards, the Company will direct its employees to increase the use of digital leak detection loggers to locate and repair leaks and breaks.

3. The Company budgeted $97,000 for 2012 for its Verde Valley Division, which includes the Company's Rimrock water system, for use in replacing water mains, water services, water meters and fire hydrants, as needed for specific projects.

4. The Company budgeted $75,000 for 2012 to replace failing galvanized steel pipe with 750 LF of six-inch ductile iron pipe and replace 23 water services on Cliffside Trail for its Rimrock water system.

5. The Company budgeted $50,000 for 2012 to replace failing galvanized steel pipe with 800 LF of six-inch ductile iron pipe and replace six water services on Antigua Way for its Rimrock water system.

8.6 Cost Benefit Analysis of Reducing Water Losses

The Company's engineers analyzed the Rimrock water system and determined that in order to reduce water losses to below 10 percent, over 40,000 feet of aging water mains and 940 failing polybutylene and polyethylene water service lines need to be replaced. The preliminary cost estimate to replace this aging infrastructure is nearly $7.8 million as shown in the table on page 65 of Appendix 12.3.4.

If these replacements are made water losses should drop to 10 percent or below. Table 8.6.1, Column B, Lines 16 – 18 shows that at a current water loss rate of 17.7 percent the amount of water lost annually is 17,359.1 thousand gallons. Reducing water losses to 10 percent would result in 9,824.2 thousand gallons lost annually or a savings of 7,534.9 thousand gallons of water each year.

The total cost of producing this volume of water is shown in Table 8.6.1, Column B, Lines 2 – 6. When the total annual cost of production $187,359 is divided by the number of thousand gallons produced annually 98,242, the cost per thousand gallons produced of $1.91 results.

To determine the annual potential savings from reducing water losses to 10 percent, the cost per thousand gallons produced is multiplied by the reduction in lost water or 7,535 thousand gallons resulting in a potential annual savings of $14,370.

Table 8.6.1, Column D, Lines 2 – 10 calculates the required annual revenue requirement associated with investing $7.8 million to replace 40,000 feet of water mains and 940 services which is the cost of reducing water losses in the Rimrock system to 10 percent or below. The resulting annual revenue requirement would be $1.14 million. When compared to the amount of annual potential savings the revenue requirement for replacing this infrastructure would be greater by $1,125,000, meaning that rates would increase for the consolidated Verde Valley system (Sedona, Valley Vista, Rimrock and Pinewood) by over $1.1 million or over 8 percent in order to save 7,535 thousand gallons of water. Since Rimrock and Pinewood are in the same consolidated rate system reducing water losses to 10 percent or below for both these systems would result in an increase in rates of over 27 percent.

When evaluated over the life of the replacement assets (Table 8.6.1, Column D, Lines 26 – 30) the total savings in production costs, assuming an annual inflation factor of 3.4

percent would be $2.5 million compared to a revenue requirement of $35.7 million or a net cost of $33.2 million.

Based on the analysis above and on Tables 8.6.1 and Appendix 12.2.4 page 55 the cost of reducing water losses in the Rimrock system to 10 percent or below far exceeds the potential benefits.

Because the Rimrock system is above 15 percent, the Company analyzed the potential savings and costs of reducing water loss to 15 percent or below. These results are presented in Table 8.6.2 and show that the potential annual savings would be $5,000 compared to a revenue requirement of $394,000 or a net increase in rates for the consolidated Verde Valley system (Sedona, Valley Vista, Rimrock and Pinewood) of $389,000. As with the analysis for reducing water losses to 10 percent the cost of reducing water losses in Rimrock to 15 percent or below far exceeds the potential benefits.

8.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent - Rimrock

Rimrock Water System

Line No.	(A)	(B)	(C)	(D)
	Production Costs		**Infrastructure Replacement Cost**	
1.	Supply Costs	$ 2,733	Required Investment to Lower Water Loss to 10%	$ 7,800,000
2.	Pumping Costs	59,880	Required Rate of Return	7.87%
3.	Treatment Costs	124,746	Required Operating Income	$ 613,860
4.			Tax Multiplier	1.6286
5.	TOTAL	$ 187,359	Revenue Requirement - Return on Investment	$ 999,732
6.				
7.	Production (MGALS)	98,242.0	Depreciation Expense at 1.79%	139,620
8.				
9.	Pumping Cost per MGAL	$ 1.91	Total Revenue Requirement	$ 1,139,352
10.				
11.				
12.				
13.				
14.	**Water Loss Reduction (MGAL)**		**Net Benefit / (Cost) of Reducing Water Loss**	
15.	Production (MGALS)	98,242.0	Water Loss Reduction (MGAL) (Column B, line 22)	7,534.9
16.	Current Water Loss Percent	17.7%	Cost per MGAL (Column B, line 10)	$ 1.91
17.	Amount of Water Loss (MGAL)	17,359.1	Annual Potential Savings	$ 14,369.94
18.				
19.	Water Loss at 10% (MGAL)	9,824.2	Annual Required Revenue Needed for Plant Investment (Column D, line 10)	$ 1,139,352
20.				
21.	Water Loss Reduction (MGAL)	7,534.9	Annual Net Benefit / (Cost) of Reducing Water Loss	$ (1,124,982)
22.				
23.				
24.				
25.	Savings over life of investment (Table 12.2.4, Column M, line 59)			$ 2,501,766
26.				
27.	Revenue requirement over life of investment (Table 12.2.4, column J, line 59)			35,725,326
28.				
29.	Net Benefit / (Cost) over life of investment			$ (33,223,560)

Please see Appendix 12.3.4 on page 65 for detailed costs for Rimrock Infrastructure Improvements

8.6.2 Cost Benefit Analysis of Reducing Water Losses to 15 Percent - Rimrock

Rimrock Water System

Line No.	(A)	(B)
	Production Costs	
1.	Supply Costs	$ 2,733
2.	Pumping Costs	59,880
3.	Treatment Costs	124,746
4.		
5.	TOTAL	$ 187,359
6.		
7.	Production (MGALS)	98,242.0
8.		
9.	Pumping Cost per MGAL	$ 1.91
10.		
11.		
12.		
13.		
14.	**Water Loss Reduction (MGAL)**	
15.	Production (MGALS)	98,242.0
16.	Current Water Loss Percent	17.7%
17.	Amount of Water Loss (MGAL)	17,359.1
18.		
19.	Water Loss at 15% (MGAL)	14,736.3
20.		
21.	Water Loss Reduction (MGAL)	2,622.8
22.		
23.		
24.		
25.	Savings over life of investment (Table 12.2.5, Column M, line 59)	
26.		
27.	Revenue requirement over life of investment (Table 12.2.5, column J, line 59)	
28.		
29.	Net Benefit / (Cost) over life of investment	
30.		

(C)	(D)
Infrastructure Replacement Cost	
Required Investment to Lower Water Loss to 15%	$ 2,700,000
Required Rate of Return	7.87%
Required Operating Income	$ 212,490
Tax Multiplier	1.6286
Revenue Requirement - Return on Investment	$ 346,061
Depreciation Expense at 1.79%	48,330
Total Revenue Requirement	$ 394,391
Net Benefit / (Cost) of Reducing Water Loss	
Water Loss Reduction (MGAL) (Column B, line 22)	2,622.8
Cost per MGAL (Column B, line 10)	$ 1.91
Annual Potential Savings	$ 5,001.99
Annual Required Revenue Needed for Plant Investment (Column D, line 10)	$ 394,391
Annual Net Benefit / (Cost) of Reducing Water Loss	$ (389,389)
	$ 870,832
	12,366,464
	$ (11,495,632)

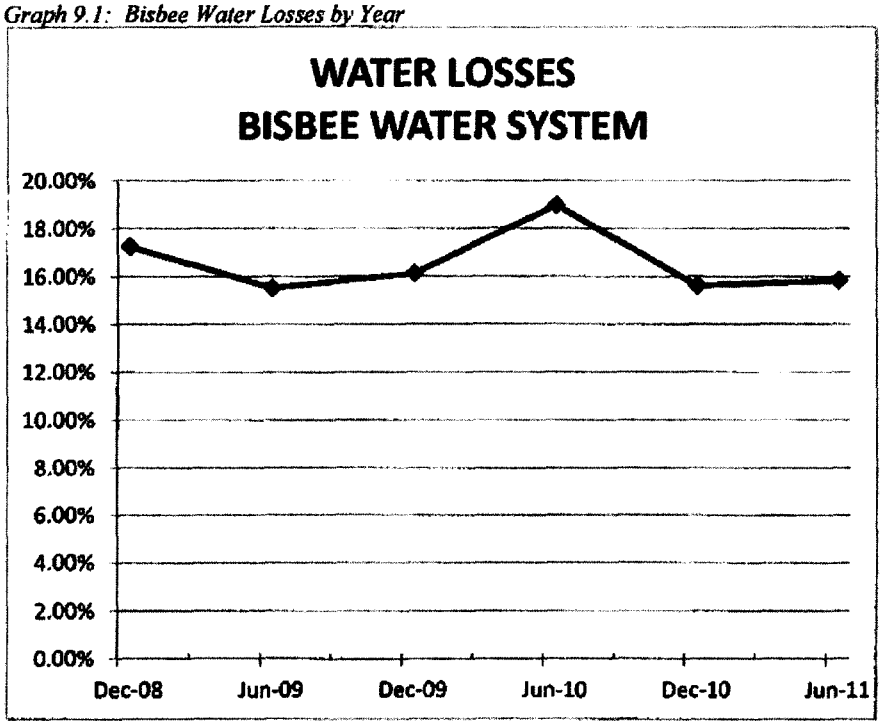
Please see Appendix 12.3.4 on page 65 for detailed costs for Rimrock Infrastructure Improvements

9.0 BISBEE WATER SYSTEM

9.1 Overview of Water System

The Bisbee water system is one of the oldest water systems in Arizona, dating back to the late 1800s, with the oldest water mains in service today dating back to 1901. The Bisbee water system is part of the Cochise Division, which also includes the Sierra Vista water system. As shown in Graph 9.1 below, water losses have exceeded 10 percent for the last 20 years, and have exceeded 15 percent for the past four years. There are nearly 380,000 LF (72 miles) of water mains in service varying in size, material and age, including cement asbestos, cast iron, copper, ductile iron, galvanized steel, PVC and steel materials. There are approximately 3,400 water service lines in service which are constructed from ductile iron, galvanized steel, polybutylene, polyethylene, steel and copper materials.

Graph 9.1: Bisbee Water Losses by Year



9.2 Causes of Water Losses

Steel and galvanized steel were the predominant materials used for water mains in the Bisbee water system from the early 1900s to the late 1960s. The oldest water mains are over 100 years old. Most of these water mains are either at, near or beyond the end of their useful service lives as shown by the fact that 80 percent of the leaks and breaks in the Bisbee water system are on steel and galvanized steel water mains. Additional analysis shows that approximately 180,000 LF, or nearly 50 percent of the water mains currently in service in the Bisbee water system need to be replaced.

As shown in Table 9.1 below, the number of leaks and breaks per year in the Bisbee water system has increased by more than one leak or break per week over the past four years, showing further signs of deterioration and an increasing need for replacement.

Table 9.1: Bisbee Leaks by Type/Year

Water Leaks by Type and Year - Bisbee Water System			
Year	**Main Leaks**	**Service Leaks**	**Number of Leaks/Week**
2007	83	11	1.9
2008	76	23	2.0
2009	147	43	3.8
2010	106	39	2.9
2011	106	31	3.3
Total	**518**	**147**	- -

9.3 Additional Steps Taken to Reduce Water Losses

1. The Company hired an additional employee in 2011 to provide additional resources to locate and repair leaks and breaks.

2. The Company replaced a failing steel water main and 45 services which were originally installed in 1908, with 1,960 LF of six-inch ductile iron pipe and 45 new copper services.

3. The Company replaced a failing steel water main and 17 services which were originally installed in 1908, with 1,140 LF of six-inch ductile iron pipe and 17 new copper services.

9.4 Assessment of Effect on Water Losses from Additional Steps Taken to Reduce Water Losses

The Company expects that the additional steps taken to reduce water losses identified in Section 9.3 will help to reduce water losses; however, additional steps may be necessary in the future to further reduce water losses to below 15 percent. Reducing water losses to less than 10 percent will require the Company to significantly increase the rate of infrastructure replacement through development of a long-term infrastructure replacement plan.

Even with the recent completion of water main and service line replacements at a cost of $442,000, the Company does not project that water losses will drop below 10 percent or even possibly 15 percent. Failing infrastructure is the primary cause of water losses in the Bisbee water system. If the Company is able to increase the rate of infrastructure replacement the Company should be able to reduce water losses to less than 15 percent and 10 percent.

9.5 Additional Steps to be Taken in the Future to Reduce Water Losses

1. Manage the Bisbee water system water losses by tracking ongoing water losses each month and follow up with corrective actions to help mitigate any upward trends in water losses.

2. If water losses do not continue to drop or if water losses trend back upwards, the Company will direct its employees to increase the use of digital leak detection loggers to locate and repair leaks and breaks.

3. The Company budgeted $136,000 for 2012 for its Cochise Division, which includes the Company's Bisbee water system, for use in replacing water mains, water services, water meters and fire hydrants, as needed for specific projects.

4. The Company budgeted $200,000 for 2012 to replace old failing waterlines in conjunction with City of Bisbee paving projects.

5. The Company budgeted $125,000 for 2012 to replace 340 LF of failing steel pipe on Church Street with new six-inch ductile iron pipe for its Bisbee water system.

6. The Company budgeted $100,000 for 2012 to replace 1,950 LF of failing galvanized steel mains on Bowers Street with new six-inch ductile iron pipe.

7. The Company budgeted $70,000 for 2012 to replace 700 LF of failing mains with new six-inch ductile iron pipe on Ocotillo Street.

8. The Company budgeted $15,000 for 2012 to replace a portion of a failing discharge pipe header at a booster station located at Tombstone Canyon.

9. The Company budgeted $30,000 for 2012 to replace 200 LF of failing 10-inch steel and 14-inch steel water mains at the Naco Warehouse Booster Station.

10. The Company budgeted $25,000 for 2012 for its Cochise Division which includes the Bisbee water system to purchase additional leak detection equipment.

9.6 Cost Benefit Analysis of Reducing Water Losses

The Company's engineers analyzed the Bisbee water system and determined that in order to reduce water losses to below 10 percent, over 188,000 feet of aging water mains and over 1,700 failing polybutylene and polyethylene water service lines need to be replaced. The preliminary cost estimate to replace this aging infrastructure is over $23.5 million as shown in the table on page 66 of Appendix 12.3.5.

If these replacements are made water losses should drop to 10 percent or below. Table 9.6.1, Column B, Lines 16 – 18 show that at a current water loss rate of 15.8 percent the amount of water lost annually is 61,009.4 thousand gallons. Reducing water losses to 10 percent would result in 38,538.7 thousand gallons lost annually or a savings of 22,470.7 thousand gallons of water each year.

The total cost of producing this volume of water is shown in Table 9.6.1, Column B, Lines 2 – 6. When the total annual cost of production $300,368 is divided by the number of thousand gallons produced annually 385,387, the cost per thousand gallons produced of $0.78 results.

To determine the annual potential savings from reducing water losses to 10 percent, the cost per thousand gallons produced is multiplied by the reduction in lost water or 22,470.7 thousand gallons resulting in a potential annual savings of $17,514.

Table 9.6.1, Column D, Lines 2 – 10 calculates the required annual revenue requirement associated with investing $23.5 million to replace over 188,000 feet of water mains and over 1,700 services which is the cost of reducing water losses in the Bisbee system to 10

percent or below. The resulting annual revenue requirement would be $3.4 million. When compared to the amount of annual potential savings the revenue requirement for replacing this infrastructure would be greater by $3,415,000, meaning that rates would increase for the consolidated Cochise system (Bisbee and Sierra Vista) by over $3.4 million or over 101 percent in order to save 22,471 thousand gallons of water annually.

When evaluated over the life of the replacement assets (Table 9.6.1, Column D, Lines 26 – 30) the total savings in production costs, assuming an annual inflation factor of 3.4 percent would be $3.1 million compared to a revenue requirement of $107.6 million or a net cost of $104.6 million.

Based on the analysis above and on Tables 9.6.1 and Appendix 12.2.6 page 57 the cost of reducing water losses in the Bisbee system to 10 percent or below far exceeds the potential benefits.

Because the Bisbee system is above 15 percent, the Company analyzed the potential savings and costs of reducing water loss to 15 percent or below. These results are presented in Table 9.6.2 and show that the potential annual savings would be $2,500 compared to a revenue requirement of $482,000 or a net increase in rates for the consolidated Cochise system (Bisbee and Sierra Vista) of $480,000. As with the analysis for reducing water losses to 10 percent the cost of reducing water losses in Bisbee to 15 percent or below exceeds the potential benefits.

9.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent - Bisbee

Bisbee Water System

Line No.	(A)	(B)	(C)	(D)
	Production Costs		**Infrastructure Replacement Cost**	
1.	Supply Costs	$ 14,782	Required Investment to Lower Water Loss to 10%	$ 23,500,000
2.	Pumping Costs	245,362	Required Rate of Return	7.87%
3.	Treatment Costs	40,224	Required Operating Income	$ 1,849,450
4.			Tax Multiplier	1.6286
5.	TOTAL	$ 300,368	Revenue Requirement - Return on Investment	$ 3,012,014
6.				
7.	Production (MGALS)	385,387.0	Depreciation Expense at 1.79%	420,650
8.				
9.	Pumping Cost per MGAL	$ 0.78	Total Revenue Requirement	$ 3,432,664
10.				
11.				
12.				
13.				
14.	**Water Loss Reduction (MGAL)**		**Net Benefit / (Cost) of Reducing Water Loss**	
15.	Production (MGALS)	385,387.0	Water Loss Reduction (MGAL) (Column B, line 22)	22,470.7
16.	Current Water Loss Percent	15.8%	Cost per MGAL (Column B, line 10)	$ 0.78
17.	Amount of Water Loss (MGAL)	61,009.4	Annual Potential Savings	$ 17,513.51
18.				
19.	Water Loss at 10% (MGAL)	38,538.7	Annual Required Revenue Needed for Plant Investment (Column D, line 10)	$ 3,432,664
20.				
21.	Water Loss Reduction (MGAL)	22,470.7	Annual Net Benefit / (Cost) of Reducing Water Loss	$ (3,415,151)
22.				
23.				
24.				
25.	Savings over life of investment (Table 12.2.6, Column M, line 59)			$ 3,049,056
26.				
27.	Revenue requirement over life of investment (Table 12.2.6, column J, line 59)			107,633,991
28.				
29.	Net Benefit / (Cost) over life of investment			$ (104,584,935)

Please see Appendix 12.3.5 on page 66 for detailed cost for Bisbee Infrastructure Improvements

9.6.2 Cost Benefit Analysis of Reducing Water Losses to 15 Percent - Bisbee

Bisbee Water System

Line No.	(A)	(B)	(C)	(D)
	Production Costs		**Infrastructure Replacement Cost**	
1.	Supply Costs	$ 14,782	Required Investment to Lower Water Loss to 15%	$ 3,300,000
2.	Pumping Costs	245,362	Required Rate of Return	7.87%
3.	Treatment Costs	40,224	Required Operating Income	$ 259,710
4.			Tax Multiplier	1.6286
5.	TOTAL	$ 300,368	Revenue Requirement - Return on Investment	$ 422,964
6.				
7.	Production (MGALS)	385,387.0	Depreciation Expense at 1.79%	59,070
8.				
9.	Pumping Cost per MGAL	$ 0.78	Total Revenue Requirement	$ 482,034
10.				
11.				
12.				
13.				
14.	**Water Loss Reduction (MGAL)**		**Net Benefit / (Cost) of Reducing Water Loss**	
15.	Production (MGALS)	385,387.0	Water Loss Reduction (MGAL) (Column B, line 22)	3,201.4
16.	Current Water Loss Percent	15.8%	Cost per MGAL (Column B, line 10)	$ 0.78
17.	Amount of Water Loss (MGAL)	61,009.4	Annual Potential Savings	$ 2,495.11
18.				
19.	Water Loss at 15% (MGAL)	57,808.1	Annual Required Revenue Needed for Plant Investment (Column D, line 10)	$ 482,034
20.				
21.	Water Loss Reduction (MGAL)	3,201.4	Annual Net Benefit / (Cost) of Reducing Water Loss	$ (479,539)
22.				
23.				
24.				
25.	Savings over life of investment (Table 12.2.7, Column M, line 59)			$ 434,390
26.				
27.	Revenue requirement over life of investment (Table 12.2.7, column J, line 59)			15,114,563
28.				
29.	Net Benefit / (Cost) over life of investment			$ (14,680,173)

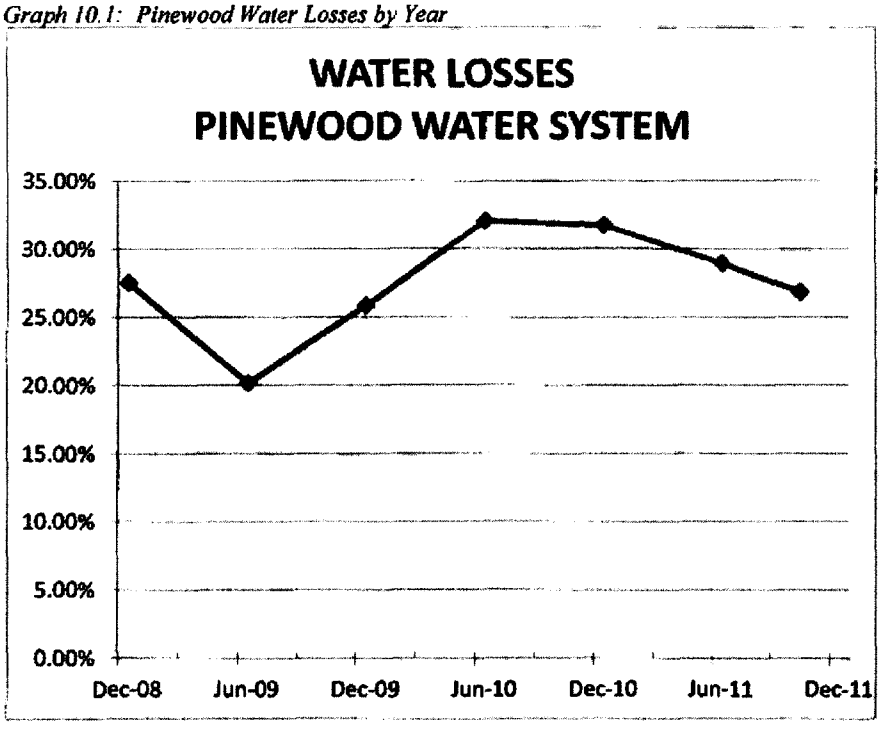
Please see Appendix 12.3.5 on page 66 for detailed cost for Bisbee Infrastructure Improvements

10.0 PINEWOOD WATER SYSTEM

10.1 Overview of Water System

The Pinewood water system serves the Munds Park area in Northern Arizona, and is one of four water systems in the Verde Valley Division. As shown in Graph 10.1 below, water losses have exceeded 10 percent for the last 10 years and have exceeded 15 percent for the past five years. There are over 167,000 LF (32 miles) of water mains in service varying in size, material and age, including cement asbestos, ductile iron and galvanized steel materials. There are approximately 2,900 water service lines in service which are constructed primarily from polybutylene and polyethylene materials although replacement service lines are constructed of copper materials.

Graph 10.1: Pinewood Water Losses by Year



10.2 Causes of Water Losses

Over 75 percent of the leaks requiring repair or replacement in the Pinewood water system were caused by failing polybutylene and polyethylene service lines. These types of service line materials were commonly used by the water industry from the 1960s to the 1980s.

Unfortunately, unlike copper service lines, polybutylene and polyethylene service lines suffer from environmental stress cracking, which cause service line failures. As a result, the service lines installed from the 1960s through the 1980s are failing at an increasing rate. Temporary repairs can be made to these types of services, but further degradation continues and eventually replacement is necessary. As shown in Table 10.1 below, since 2007, service line leaks and breaks have more than doubled for the Company's Pinewood water system.

Table 10.1: Pinewood Leaks by Type/Year

Water Leaks by Type and Year - Pinewood Water System		
Year	**Main Leaks**	**Service Leaks**
2007	8	13
2008	14	38
2009	14	31
2010	6	31
2011	11	29
Total	**53**	**142**

10.3 Additional Steps Taken to Reduce Water Losses

1. The Company increased leak detection efforts in its Pinewood water system through increased use of digital leak detection loggers from three days per week to four days per week.

2. The Company replaced 40 failing services in areas with the highest instances of service leaks.

10.4 Assessment of Effect on Water Losses from Steps Taken to Reduce Water Losses

The Company expects that the additional steps taken to reduce water losses identified in Section 10.3 will help to reduce water losses; however, additional steps will be necessary in the future to further reduce water losses below 15 percent. Reducing water losses to less than 10 percent will require the Company to significantly increase the rate of infrastructure replacement through development of a long-term infrastructure replacement plan.

Even with the recent completion of service line replacements at a cost of approximately $200,000, the Company does not project that water losses will drop below 10 percent or 15 percent. Failing infrastructure is the primary cause of water losses in the Pinewood water system. If the Company is able to increase the rate of infrastructure replacement, the Company should be able to reduce water losses to less than 15 percent and 10 percent.

10.5 Additional Steps to be Taken in the Future to Reduce Water Losses

1. Manage the Pinewood water system water losses by tracking ongoing water losses each month and follow up with corrective actions to help mitigate any upward trends in water losses.

2. If water losses do not continue to drop or if water losses trend back upwards, the Company will direct its employees to increase the use of digital leak detection loggers to locate and repair leaks and breaks.

3. The Company budgeted $97,000 for 2012 for its Verde Valley Division, which includes the Company's Pinewood water system, for use in replacing water mains, water services, water meters and fire hydrants, as needed for specific projects.

4. The Company budgeted $200,000 for 2012 to replace failing water services for its Pinewood water system.

10.6 Cost Benefit Analysis of Reducing Water Losses

The Company's engineers analyzed the Pinewood water system and determined that in order to reduce water losses to 10 percent or below, 15,400 feet of aging water mains and 2,400 failing polybutylene and polyethylene water service lines need to be replaced. The preliminary cost estimate to replace this aging infrastructure is nearly $17.5 million, as shown in the table on page 67 of Appendix 12.3.6.

If these replacements are made water losses should drop to 10 percent or below. Table 10.6.1, Column B, Lines 16 – 18 show that at a current water loss rate of 29.0 percent the amount of water lost annually is 36,255.3 thousand gallons. Reducing water losses to 10 percent would result in 12,522 thousand gallons of lost water annually or a savings of 23,733.3 thousand gallons of water each year.

The total cost of producing this volume of water is shown in Table 10.6.1, Column B, Lines 2 – 6. When the total annual cost of production $138,033 is divided by the number of thousand gallons produced annually 125,220, the cost per thousand gallons produced of $1.10 results.

To determine the annual potential savings from reducing water losses to 10 percent the cost per thousand gallons produced is multiplied by the reduction in lost water or 23,733.3 thousand gallons resulting in a potential annual savings of $26,162.

Table 10.6.1, Column D, Lines 2 – 10 calculates the required annual revenue requirement associated with investing $17.5 million to replace 15,400 feet of water mains and 2,400 services, which is the cost of reducing water losses in the Pinewood system to 10 percent or below. The resulting annual revenue requirement would be $2.6 million. When compared to the amount of annual potential savings the revenue requirement for replacing this infrastructure would be greater by $2,530,000, meaning that rates would increase for the consolidated Verde Valley system (Sedona, Valley Vista, Rimrock and Pinewood) by over $2.5 million or nearly 19 percent in order to save 23,733 thousand gallons of water annually. Since Rimrock and Pinewood are in the same consolidated rate system reducing water losses to 10 percent or below for both these systems would result in an increase in rates of over 27 percent.

When evaluated over the life of the replacement assets (Table 10.6.1, Column D, Lines 26 – 30) the total savings in production costs, assuming an annual inflation factor of 3.4 percent would be $4.6 million compared to a revenue requirement of $80.2 million or a net cost of $75.6 million.

Based on the analysis above and on Tables 10.6.1 and Appendix 12.2.8 page 59 the cost of reducing water losses in the Pinewood system to 10 percent or below far exceeds the potential benefits.

Because the Pinewood system is above 15 percent, the Company analyzed the potential savings and costs of reducing water loss to 15 percent or below. These results are presented in Table 10.6.2 and show that the potential annual savings would be $19,300 compared to a revenue requirement of $1,884,000 or a net increase in rates for the consolidated Verde Valley system (Sedona, Rimrock and Pinewood) of $1.9 million. As with the analysis for

reducing water loss to 10 percent, the cost of reducing water loss in Pinewood to 15 percent or below far exceeds the potential benefits.

10.6.1 Cost Benefit Analysis of Reducing Water Losses to 10 Percent - Pinewood

Pinewood Water System

Line No.	(A)	(B)	(C)	(D)
	Production Costs		**Infrastructure Replacement Cost**	
1.	Supply Costs	$ 3,514	Required Investment to Lower Water Loss to 10%	$ 17,500,000
2.	Pumping Costs	76,988	Required Rate of Return	7.87%
3.	Treatment Costs	57,531	Required Operating Income	$ 1,377,250
4.			Tax Multiplier	1.6286
5.	TOTAL	$ 138,033	Revenue Requirement - Return on Investment	$ 2,242,989
6.				
7.	Production (MGALS)	125,220.0	Depreciation Expense at 1.79%	313,250
8.				
9.	Pumping Cost per MGAL	$ 1.10	Total Revenue Requirement	$ 2,556,239
10.				
11.				
12.				
13.				
14.	**Water Loss Reduction (MGAL)**		**Net Benefit / (Cost) of Reducing Water Loss**	
15.	Production (MGALS)	125,220.0	Water Loss Reduction (MGAL) (Column B, line 22)	23,733.3
16.	Current Water Loss Percent	29.0%	Cost per MGAL (Column B, line 10)	$ 1.10
17.	Amount of Water Loss (MGAL)	36,255.3	Annual Potential Savings	$ 26,161.78
18.				
19.	Water Loss at 10% (MGAL)	12,522.0	Annual Required Revenue Needed for Plant Investment (Column D, line 10)	$ 2,556,239
20.				
21.	Water Loss Reduction (MGAL)	23,733.3	Annual Net Benefit / (Cost) of Reducing Water Loss	$ (2,530,078)
22.				
23.				
24.				
25.	Savings over life of investment (Table 12.2.8, Column M, line 59)			$ 4,554,693
26.				
27.	Revenue requirement over life of investment (Table 12.2.8, column J, line 59)			80,152,975
28.				
29.	Net Benefit / (Cost) over life of investment			$ (75,598,282)

Please see Appendix 12.3.6 on page 67 for detailed cost for Pinewood Infrastructure Improvements

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10.6.2 Cost Benefit Analysis of Reducing Water Losses to 15 Percent - Pinewood

Pinewood Water System

Line No.	(A)	(B)
	Production Costs	
1.	Supply Costs	$ 3,514
2.	Pumping Costs	76,988
3.	Treatment Costs	57,531
4.		
5.	TOTAL	$ 138,033
6.		
7.	Production (MGALS)	125,220.0
8.		
9.	Pumping Cost per MGAL	$ 1.10
10.		
11.		
12.		
13.		
14.	**Water Loss Reduction (MGAL)**	
15.	Production (MGALS)	125,220.0
16.	Current Water Loss Percent	29.0%
17.	Amount of Water Loss (MGAL)	36,255.3
18.		
19.	Water Loss at 15% (MGAL)	18,783.0
20.		
21.	Water Loss Reduction (MGAL)	17,472.3
22.		
23.		
24.		
25.	Savings over life of investment (Table 12.2.9, Column M, line 59)	
26.		
27.	Revenue requirement over life of investment (Table 12.2.9, column J, line 59)	
28.		
29.	Net Benefit / (Cost) over life of investment	

(C)	(D)
Infrastructure Replacement Cost	
Required Investment to Lower Water Loss to 15%	$ 12,900,000
Required Rate of Return	7.87%
Required Operating Income	$ 1,015,230
Tax Multiplier	1.6286
Revenue Requirement - Return on Investment	$ 1,653,404
Depreciation Expense at 1.79%	230,910
Total Revenue Requirement	$ 1,884,314
Net Benefit / (Cost) of Reducing Water Loss	
Water Loss Reduction (MGAL) (Column B, line 22)	17,472.3
Cost per MGAL (Column B, line 10)	$ 1.10
Annual Potential Savings	$ 19,260.13
Annual Required Revenue Needed for Plant Investment (Column D, line 10)	$ 1,884,314
Annual Net Benefit / (Cost) of Reducing Water Loss	$ (1,865,053)
	$ 3,353,137
	59,084,192
	$ (55,731,055)

Please see Appendix 12.3.6 on page 67 for detailed cost for Pinewood Infrastructure Improvements

11.0 CONCLUSIONS

The Company has made a significant effort to reduce water losses for each of the seven systems that are the subject of this report, by increased monitoring of its water systems, detecting and repairing leaks, replacing infrastructure, performing meter maintenance and selecting the most appropriate meters for each application.

Additional leak surveys and repairs and increasing the rate of infrastructure replacement are necessary to reduce water losses to less than 10 percent. Water main and service line replacement projects, replacing failing radio controls, and additional leak detection surveys have helped to reduce water losses. However, increasingly water mains and services are at or nearing the end of their useful service lives. The Company has concluded that a more aggressive distribution infrastructure replacement program is needed to further reduce water losses. The Company estimates that it will cost $84 million to replace water mains and service lines that are at or nearing the end of their useful lives for these seven water systems alone. Because of the enormity of this additional level of capital expenditure, the Company is requesting that the Commission authorize the establishment of a DSIC (*See* Attachment 1) for all of its water systems. A DSIC will enable the Company to replace critical infrastructure with gradual changes in rates. Without the approval of a DSIC, the Company cannot adequately replace aging infrastructure critical to the Company's compliance with the Commission's directives in Decision No. 71845.

Additionally, not only is $84 million needed to replace infrastructure for the seven water systems that are the subject of this report, but the Company has identified the critical need to replace failing distribution infrastructure that is estimated to cost over $102 million for the Company's Eastern and Western Groups and between $25 and $30 million for the Company's Northern Group. In order to mitigate this substantial increase in investment and the resulting sharp increase in rates that would result if rates are set under the conventional method, through the filing of general rate cases, the Company has proposed the implementation of a DSIC as filed with its Western and Eastern Group general rate cases, W-0445A-10-0517 and W-01445A-11-0310 respectively. If approved, a DSIC surcharge mechanism will provide for gradual rate changes but more importantly, it will provide a means for replacing infrastructure that does not currently exist, except for the smallest of infrastructure replacement projects.

Although the sheer magnitude of the infrastructure replacement program is quite daunting, and the solutions will require a long-term commitment, the Company needs to start now in order to make additional progress towards replacing aging and failing infrastructure.

APPENDICES
12.0

12.1
Meter Replacement Schedule

METER REPLACEMENT SCHEDULE

METER SIZE/TYPE	COOLIDGE AIRPORT		PINETOP LAKES & OVERGAARD		MIAMI		BISBEE		PINEWOOD & RIMROCK	
5/8 X 3/4" METER	1M GAL.	10 YEARS	1.3M GAL.	15 YEARS	1M GAL.	10 YEARS	1M GAL.	12 YEARS	1.3M GAL.	15 YEARS
1" METER	3M GAL.	10 YEARS	4M GAL.	15 YEARS	3M GAL.	10 YEARS	3M GAL.	12 YEARS	5M GAL.	15 YEARS
2" METER	8M GAL.	4 YEARS	8M GAL.	4 YEARS	8M GAL.	4 YEARS	8M GAL.	4 YEARS	8M GAL.	4 YEARS
2" TURBO METER	15M GAL.	4 YEARS	15M GAL.	4 YEARS	15M GAL.	4 YEARS	15M GAL.	4 YEARS	15M GAL.	4 YEARS
3" TURBO METER	25M GAL.	4 YEARS	25M GAL.	4 YEARS	25M GAL.	4 YEARS	25M GAL.	4 YEARS	25M GAL.	4 YEARS
4" TURBO METER	35M GAL.	4 YEARS	35M GAL.	4 YEARS	35M GAL.	4 YEARS	35M GAL.	4 YEARS	35M GAL.	4 YEARS
6" TURBO METER	50M GAL.	4 YEARS	50M GAL.	4 YEARS	50M GAL.	4 YEARS	50M GAL.	4 YEARS	50M GAL.	4 YEARS
8" TURBO METER	70M GAL.	4 YEARS	70M GAL.	4 YEARS	70M GAL.	4 YEARS	70M GAL.	4 YEARS	70M GAL.	4 YEARS
2" COMPOUND METER	3.5M GAL.	4 YEARS	4.5M GAL.	4 YEARS	3M GAL.	4 YEARS	3.5M GAL.	4 YEARS	4.5M GAL.	4 YEARS
3" COMPOUND METER	3.5M GAL.	4 YEARS	4.5M GAL.	4 YEARS	3M GAL.	4 YEARS	3.5M GAL.	4 YEARS	4.5M GAL.	4 YEARS
4" COMPOUND METER	6M GAL.	4 YEARS	6.5M GAL.	4 YEARS	5M GAL.	4 YEARS	6M GAL.	4 YEARS	8.5M GAL.	4 YEARS
6" COMPOUND METER	8.5M GAL.	4 YEARS	10.5M GAL.	4 YEARS	6.5M GAL.	4 YEARS	8.5M GAL.	4 YEARS	11M GAL.	4 YEARS
2" OMNI COMPOUND METER	7M GAL.	5 YEARS	10M GAL.	5 YEARS	7M GAL.	5 YEARS	7M GAL.	5 YEARS	10M GAL.	5 YEARS
3" OMNI COMPOUND METER	10M GAL.	5 YEARS	15M GAL.	5 YEARS	10M GAL.	5 YEARS	10M GAL.	5 YEARS	15M GAL.	5 YEARS
4" OMNI COMPOUND METER	15M GAL.	5 YEARS	20M GAL.	5 YEARS	15M GAL.	5 YEARS	15M GAL.	5 YEARS	20M GAL.	5 YEARS
6" OMNI COMPOUND METER	20M GAL.	5 YEARS	30M GAL.	5 YEARS	20M GAL.	5 YEARS	20M GAL.	5 YEARS	30M GAL.	5 YEARS
2" OMNI TURBO METER	40M GAL.	10 YEARS	50M GAL.	10 YEARS	40M GAL.	10 YEARS	40M GAL.	10 YEARS	50M GAL.	10 YEARS
3" OMNI TURBO METER	60M GAL.	10 YEARS	70M GAL.	10 YEARS	60M GAL.	10 YEARS	60M GAL.	10 YEARS	70M GAL.	10 YEARS
4" OMNI TURBO METER	75M GAL.	10 YEARS	85M GAL.	10 YEARS	75M GAL.	10 YEARS	75M GAL.	10 YEARS	85M GAL.	10 YEARS
6" OMNI TURBO METER	200M GAL.	10 YEARS	250M GAL.	10 YEARS	200M GAL.	10 YEARS	200M GAL.	10 YEARS	250M GAL.	10 YEARS

12.2
Cost Benefit Analyses

12.2.1 Cost Benefit of Reducing Water Losses in the Pinetop Lakes Water System to 10 Percent over Life of Infrastructure Replacement

Line No.	Year	Plant in Service	Accumulated Depreciation	Net Utility Plant	Return on Rate Base	Required Operating Income	Tax Multiplier	Revenue Required Return on Investment	Depreciation Expense	Annual Revenue Requirement	Annual Cost Savings	Growth in CPI [1]	Inflation Adjusted Savings
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
1.	Year 1	4,300,000	37,590	4,262,410	7.87%	317,582	1.6186	$513,500	37,590	$571,089	$ 751	3.40%	$ 778
2.	Year 2	4,300,000	112,770	4,087,230	7.87%	321,685	1.6186	$520,064	75,180	$595,044	$ 778	3.40%	$ 805
3.	Year 3	4,300,000	187,950	4,012,050	7.87%	325,748	1.6186	$526,277	75,180	$601,457	$ 805	3.40%	$ 832
4.	Year 4	4,300,000	263,130	3,936,870	7.87%	329,832	1.6186	$532,591	75,180	$607,771	$ 831	3.40%	$ 861
5.	Year 5	4,300,000	338,310	3,861,690	7.87%	333,985	1.6186	$538,956	75,180	$614,136	$ 861	3.40%	$ 890
6.	Year 6	4,300,000	413,490	3,786,510	7.87%	337,958	1.6186	$545,310	75,180	$620,509	$ 890	3.40%	$ 920
7.	Year 7	4,300,000	488,670	3,711,330	7.87%	342,082	1.6186	$551,685	75,180	$626,885	$ 920	3.40%	$ 951
8.	Year 8	4,300,000	563,850	3,636,150	7.87%	346,185	1.6186	$558,049	75,180	$633,228	$ 951	3.40%	$ 984
9.	Year 9	4,300,000	639,030	3,560,970	7.87%	350,148	1.6186	$564,411	75,180	$639,592	$ 984	3.40%	$ 1,017
10.	Year 10	4,300,000	714,210	3,485,790	7.87%	354,331	1.6186	$570,777	75,180	$645,957	$ 1,017	3.40%	$ 1,052
11.	Year 11	4,300,000	789,390	3,410,610	7.87%	358,435	1.6186	$577,341	75,180	$652,521	$ 1,051	3.40%	$ 1,088
12.	Year 12	4,300,000	864,570	3,335,430	7.87%	362,458	1.6186	$583,904	75,180	$659,084	$ 1,088	3.40%	$ 1,125
13.	Year 13	4,300,000	939,750	3,260,250	7.87%	366,582	1.6186	$590,469	75,180	$665,649	$ 1,125	3.40%	$ 1,163
14.	Year 14	4,300,000	1,014,930	3,185,070	7.87%	370,665	1.6186	$597,033	75,180	$672,213	$ 1,163	3.40%	$ 1,202
15.	Year 15	4,300,000	1,090,110	3,109,890	7.87%	374,748	1.6186	$603,597	75,180	$678,777	$ 1,202	3.40%	$ 1,243
16.	Year 16	4,300,000	1,165,290	3,034,710	7.87%	378,832	1.6186	$610,162	75,180	$684,342	$ 1,243	3.40%	$ 1,285
17.	Year 17	4,300,000	1,240,470	2,959,530	7.87%	382,925	1.6186	$616,725	75,180	$690,905	$ 1,285	3.40%	$ 1,329
18.	Year 18	4,300,000	1,315,650	2,884,350	7.87%	386,988	1.6186	$623,289	75,180	$697,469	$ 1,329	3.40%	$ 1,374
19.	Year 19	4,300,000	1,390,830	2,809,170	7.87%	391,082	1.6186	$629,854	75,180	$704,034	$ 1,374	3.40%	$ 1,421
20.	Year 20	4,300,000	1,466,010	2,733,990	7.87%	395,185	1.6186	$636,418	75,180	$710,598	$ 1,421	3.40%	$ 1,469
21.	Year 22	4,300,000	1,541,190	2,658,810	7.87%	399,248	1.6186	$642,981	75,180	$717,161	$ 1,469	3.40%	$ 1,519
22.	Year 22	4,300,000	1,616,370	2,583,630	7.87%	403,332	1.6186	$649,546	75,180	$723,726	$ 1,519	3.40%	$ 1,571
23.	Year 23	4,300,000	1,691,550	2,508,450	7.87%	407,425	1.6186	$656,110	75,180	$730,290	$ 1,571	3.40%	$ 1,624
24.	Year 24	4,300,000	1,766,730	2,433,270	7.87%	411,498	1.6186	$662,674	75,180	$736,854	$ 1,624	3.40%	$ 1,680
25.	Year 25	4,300,000	1,841,910	2,358,090	7.87%	415,582	1.6186	$669,239	75,180	$743,419	$ 1,680	3.40%	$ 1,737
26.	Year 26	4,300,000	1,917,090	2,282,910	7.87%	419,685	1.6186	$675,802	75,180	$749,982	$ 1,737	3.40%	$ 1,796
27.	Year 27	4,300,000	1,992,270	2,207,730	7.87%	423,748	1.6186	$682,366	75,180	$756,546	$ 1,796	3.40%	$ 1,857
28.	Year 28	4,300,000	2,067,450	2,132,550	7.87%	427,831	1.6186	$688,931	75,180	$763,111	$ 1,857	3.40%	$ 1,920
29.	Year 29	4,300,000	2,142,630	2,057,370	7.87%	431,915	1.6186	$695,495	75,180	$769,675	$ 1,920	3.40%	$ 1,985
30.	Year 30	4,300,000	2,217,810	1,982,190	7.87%	435,988	1.6186	$702,058	75,180	$776,238	$ 1,985	3.40%	$ 2,053
31.	Year 31	4,300,000	2,292,990	1,907,010	7.87%	440,082	1.6186	$708,624	75,180	$782,804	$ 2,053	3.40%	$ 2,123
32.	Year 32	4,300,000	2,368,170	1,831,830	7.87%	444,185	1.6186	$715,187	75,180	$789,367	$ 2,123	3.40%	$ 2,195
33.	Year 33	4,300,000	2,443,350	1,756,650	7.87%	448,248	1.6186	$721,751	75,180	$795,931	$ 2,195	3.40%	$ 2,269
34.	Year 34	4,300,000	2,518,530	1,681,470	7.87%	452,331	1.6186	$728,316	75,180	$802,496	$ 2,269	3.40%	$ 2,347
35.	Year 35	4,300,000	2,593,710	1,606,290	7.87%	456,415	1.6186	$734,879	75,180	$809,059	$ 2,347	3.40%	$ 2,426
36.	Year 36	4,300,000	2,668,890	1,531,110	7.87%	460,498	1.6186	$741,443	75,180	$815,623	$ 2,426	3.40%	$ 2,509
37.	Year 37	4,300,000	2,744,070	1,455,930	7.87%	464,582	1.6186	$748,008	75,180	$822,188	$ 2,509	3.40%	$ 2,594
38.	Year 38	4,300,000	2,819,250	1,380,750	7.87%	468,665	1.6186	$754,572	75,180	$828,752	$ 2,594	3.40%	$ 2,682
39.	Year 39	4,300,000	2,894,430	1,305,570	7.87%	472,748	1.6186	$761,135	75,180	$835,315	$ 2,682	3.40%	$ 2,772
40.	Year 40	4,300,000	2,969,610	1,230,390	7.87%	476,831	1.6186	$767,701	75,180	$842,881	$ 2,772	3.40%	$ 2,866
41.	Year 41	4,300,000	3,044,790	1,155,210	7.87%	480,915	1.6186	$774,264	75,180	$849,444	$ 2,866	3.40%	$ 2,963
42.	Year 42	4,300,000	3,119,970	1,080,030	7.87%	484,988	1.6186	$780,828	75,180	$856,008	$ 2,963	3.40%	$ 3,063
43.	Year 43	4,300,000	3,195,150	1,004,850	7.87%	489,082	1.6186	$787,393	75,180	$862,573	$ 3,063	3.40%	$ 3,170
44.	Year 44	4,300,000	3,270,330	929,670	7.87%	493,165	1.6186	$793,957	75,180	$869,137	$ 3,170	3.40%	$ 3,278
45.	Year 45	4,300,000	3,345,510	854,490	7.87%	497,248	1.6186	$800,520	75,180	$875,700	$ 3,278	3.40%	$ 3,390
46.	Year 46	4,300,000	3,420,690	779,310	7.87%	501,332	1.6186	$807,085	75,180	$882,265	$ 3,390	3.40%	$ 3,505
47.	Year 47	4,300,000	3,495,870	704,130	7.87%	505,415	1.6186	$813,649	75,180	$888,829	$ 3,505	3.40%	$ 3,624
48.	Year 48	4,300,000	3,571,050	628,950	7.87%	509,498	1.6186	$820,213	75,180	$895,393	$ 3,624	3.40%	$ 3,747
49.	Year 49	4,300,000	3,646,230	553,770	7.87%	513,582	1.6186	$826,778	75,180	$901,958	$ 3,747	3.40%	$ 3,875
50.	Year 50	4,300,000	3,721,410	478,590	7.87%	517,665	1.6186	$833,341	75,180	$908,521	$ 3,875	3.40%	$ 4,006
51.	Year 51	4,300,000	3,796,590	403,410	7.87%	521,748	1.6186	$839,905	75,180	$915,085	$ 4,006	3.40%	$ 4,141
52.	Year 52	4,300,000	3,871,770	328,230	7.87%	525,832	1.6186	$846,470	75,180	$921,650	$ 4,141	3.40%	$ 4,281
53.	Year 53	4,300,000	3,946,950	253,050	7.87%	529,915	1.6186	$853,034	75,180	$928,214	$ 4,281	3.40%	$ 4,419
54.	Year 54	4,300,000	4,022,130	177,870	7.87%	533,998	1.6186	$859,597	75,180	$934,777	$ 4,419	3.40%	$ 4,568
55.	Year 55	4,300,000	4,097,310	102,690	7.87%	538,082	1.6186	$866,161	75,180	$941,341	$ 4,568	3.40%	$ 4,715
56.	Year 56	4,300,000	4,172,490	27,510	7.87%	542,165	1.6186	$872,726	75,180	$947,906	$ 4,715	3.40%	$ 4,870
57.	Year 57	4,300,000	4,300,000	-	7.87%	-	1.6186	-	27,510	27,510	$ 4,870	3.40%	$ 5,042
58.	Life to Date Cost and Benefit									19,236,712			133,072

[1] Annual increase in CPI based on November, 2011 data.

12.2.2 Cost Benefit of Reducing Water Losses in the Overgaard Water System to 10 Percent over Life of Infrastructure Replacement

Line No.	Year	Plant in Service	Accumulated Depreciation	Net Utility Plant	Return on Rate Base	Required Operating Income	Tax Multiplier	Revenue Required Return on Investment	Depreciation Expense	Annual Revenue Requirement	Annual Cost Savings	Growth in CPI *	Inflation Adjusted Savings
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
2.	Year 1	22,500,000	112,875	22,387,125	7.87%	974,945	1.6286	1,587,795	225,875	1,809,670	$ 2,058	2.40%	$ 2,228
3.	Year 2	22,500,000	335,625	22,164,375	7.87%	957,336	1.6286	1,558,117	223,750	1,781,867	$ 2,128	2.40%	$ 2,300
3.	Year 3	22,500,000	558,375	21,941,625	7.87%	939,727	1.6286	1,529,439	223,750	1,754,189	$ 2,200	2.40%	$ 2,375
4.	Year 4	22,500,000	781,125	21,718,875	7.87%	922,118	1.6286	1,502,761	223,750	1,726,511	$ 2,275	2.40%	$ 2,452
5.	Year 5	22,500,000	1,003,875	21,496,125	7.87%	904,509	1.6286	1,474,083	223,750	1,698,832	$ 2,352	2.40%	$ 2,532
6.	Year 6	22,500,000	1,226,625	21,273,375	7.87%	886,900	1.6286	1,444,405	223,750	1,668,155	$ 2,432	2.40%	$ 2,615
7.	Year 7	22,500,000	1,449,375	21,045,625	7.87%	869,292	1.6286	1,415,727	223,750	1,639,477	$ 2,515	2.40%	$ 2,700
8.	Year 8	22,500,000	1,672,125	20,827,875	7.87%	851,682	1.6286	1,387,049	223,750	1,610,799	$ 2,600	2.40%	$ 2,789
9.	Year 9	22,500,000	1,894,875	20,605,125	7.87%	834,072	1.6286	1,358,370	223,750	1,582,120	$ 2,689	2.40%	$ 2,880
10.	Year 10	22,500,000	2,117,625	20,374,375	7.87%	816,463	1.6286	1,329,692	223,750	1,553,442	$ 2,780	2.40%	$ 2,975
11.	Year 11	22,500,000	2,340,375	20,159,625	7.87%	798,854	1.6286	1,301,014	223,750	1,524,764	$ 2,875	2.40%	$ 3,072
12.	Year 12	22,500,000	2,572,125	9,926,875	7.87%	781,245	1.6286	1,272,336	223,750	1,496,086	$ 2,972	2.40%	$ 3,174
13.	Year 13	22,500,000	2,795,875	9,782,125	7.87%	763,636	1.6286	1,243,658	223,750	1,467,408	$ 3,074	2.40%	$ 3,278
14.	Year 14	22,500,000	3,030,625	9,479,375	7.87%	746,027	1.6286	1,214,980	223,750	1,438,730	$ 3,178	2.40%	$ 3,386
15.	Year 15	22,500,000	3,244,375	9,255,625	7.87%	728,418	1.6286	1,186,302	223,750	1,410,052	$ 3,286	2.40%	$ 3,498
16.	Year 16	22,500,000	3,468,125	9,032,875	7.87%	710,809	1.6286	1,157,624	223,750	1,382,374	$ 3,398	2.40%	$ 3,613
17.	Year 17	22,500,000	3,691,875	8,809,125	7.87%	693,199	1.6286	1,128,944	223,750	1,352,694	$ 3,513	2.40%	$ 3,732
18.	Year 18	22,500,000	3,945,625	8,584,375	7.87%	675,590	1.6286	1,100,266	223,750	1,324,016	$ 3,632	2.40%	$ 3,756
19.	Year 19	22,500,000	4,239,375	8,360,625	7.87%	657,981	1.6286	1,071,588	223,750	1,295,338	$ 3,756	2.40%	$ 3,884
20.	Year 20	22,500,000	4,363,125	8,136,875	7.87%	640,372	1.6286	1,042,910	223,750	1,266,660	$ 3,884	2.40%	$ 4,016
21.	Year 21	22,500,000	4,586,875	7,913,125	7.87%	622,762	1.6286	1,014,232	223,750	1,237,982	$ 4,016	2.40%	$ 4,152
22.	Year 22	22,500,000	4,810,625	7,689,375	7.87%	605,154	1.6286	985,554	223,750	1,209,304	$ 4,152	2.40%	$ 4,294
23.	Year 23	22,500,000	5,034,375	7,465,625	7.87%	587,545	1.6286	956,876	223,750	1,180,626	$ 4,294	2.40%	$ 4,440
24.	Year 24	22,500,000	5,258,125	7,241,875	7.87%	569,936	1.6286	928,198	223,750	1,151,948	$ 4,440	2.40%	$ 4,592
25.	Year 25	22,500,000	5,481,875	7,018,125	7.87%	552,326	1.6286	899,520	223,750	1,123,268	$ 4,592	2.40%	$ 4,747
26.	Year 26	22,500,000	5,705,625	6,794,375	7.87%	534,727	1.6286	870,840	223,750	1,094,590	$ 4,747	2.40%	$ 4,908
27.	Year 27	22,500,000	5,929,375	6,570,625	7.87%	517,108	1.6286	842,163	223,750	1,065,922	$ 4,908	2.40%	$ 5,075
28.	Year 28	22,500,000	6,153,125	6,346,875	7.87%	499,499	1.6286	813,486	223,750	1,037,234	$ 5,075	2.40%	$ 5,248
29.	Year 29	22,500,000	6,376,875	6,123,125	7.87%	481,890	1.6286	784,806	222,750	1,008,556	$ 5,248	2.40%	$ 5,426
30.	Year 30	22,500,000	6,600,625	5,899,375	7.87%	464,281	1.6286	756,128	223,750	979,878	$ 5,426	2.40%	$ 5,611
31.	Year 31	22,500,000	6,824,375	5,675,625	7.87%	446,672	1.6286	727,450	223,750	951,200	$ 5,611	2.40%	$ 5,802
32.	Year 32	22,500,000	7,048,125	5,451,875	7.87%	429,063	1.6286	698,772	222,750	922,522	$ 5,802	2.40%	$ 5,999
33.	Year 33	22,500,000	7,272,875	5,228,125	7.87%	411,453	1.6286	670,092	223,750	893,842	$ 5,999	2.40%	$ 6,203
34.	Year 34	22,500,000	7,496,625	5,004,375	7.87%	393,844	1.6286	641,414	223,750	865,164	$ 6,203	2.40%	$ 6,414
35.	Year 35	22,500,000	7,719,375	4,780,625	7.87%	376,235	1.6286	612,736	223,750	836,486	$ 6,414	2.40%	$ 6,632
36.	Year 36	22,500,000	7,943,125	4,556,875	7.87%	358,626	1.6286	584,058	223,750	807,808	$ 6,632	2.40%	$ 6,857
37.	Year 37	22,500,000	8,166,875	4,332,125	7.87%	341,017	1.6286	555,380	223,750	779,130	$ 6,857	2.40%	$ 7,090
38.	Year 38	22,500,000	8,390,625	4,109,375	7.87%	323,408	1.6286	526,702	223,750	750,452	$ 7,090	2.40%	$ 7,331
39.	Year 39	22,500,000	8,614,375	3,885,625	7.87%	305,799	1.6286	498,024	223,750	721,774	$ 7,331	2.40%	$ 7,581
40.	Year 40	22,500,000	8,838,125	3,661,875	7.87%	288,190	1.6286	469,346	223,750	693,096	$ 7,581	2.40%	$ 7,838
41.	Year 41	22,500,000	9,062,875	3,438,125	7.87%	270,580	1.6286	440,667	223,750	664,417	$ 7,838	2.40%	$ 8,105
42.	Year 42	22,500,000	9,285,625	3,214,375	7.87%	252,972	1.6286	412,989	223,750	635,739	$ 8,105	2.40%	$ 8,380
43.	Year 43	22,500,000	9,509,375	2,990,625	7.87%	235,362	1.6286	383,311	223,750	607,061	$ 8,380	2.40%	$ 8,665
44.	Year 44	22,500,000	9,733,125	2,766,875	7.87%	217,753	1.6286	354,633	223,750	578,383	$ 8,665	2.40%	$ 8,960
45.	Year 45	22,500,000	9,956,875	2,542,125	7.87%	200,144	1.6286	325,955	223,750	549,705	$ 8,960	2.40%	$ 9,265
46.	Year 46	22,500,000	10,208,625	2,329,375	7.87%	182,535	1.6286	297,277	222,750	522,027	$ 9,265	2.40%	$ 9,580
47.	Year 47	22,500,000	10,404,375	2,095,625	7.87%	164,926	1.6286	268,598	223,750	492,348	$ 9,580	2.40%	$ 9,905
48.	Year 48	22,500,000	10,628,125	1,871,875	7.87%	147,317	1.6286	239,920	223,750	463,670	$ 9,905	2.40%	$ 10,242
49.	Year 49	22,500,000	10,851,875	1,648,125	7.87%	129,707	1.6286	211,242	223,750	434,991	$ 10,242	2.40%	$ 10,590
50.	Year 50	22,500,000	22,075,625	1,424,375	7.87%	112,098	1.6286	182,563	223,750	406,313	$ 10,590	2.40%	$ 10,950
51.	Year 51	22,500,000	21,299,375	1,200,625	7.87%	94,489	1.6286	153,885	223,750	377,635	$ 10,950	2.40%	$ 11,322
52.	Year 52	22,500,000	21,523,125	976,875	7.87%	76,880	1.6286	125,207	223,750	348,957	$ 11,322	2.40%	$ 11,708
53.	Year 53	22,500,000	21,746,875	753,125	7.87%	59,272	1.6286	96,529	223,750	320,279	$ 11,708	2.40%	$ 12,106
54.	Year 54	22,500,000	21,970,625	529,375	7.87%	41,662	1.6286	67,852	223,750	291,602	$ 12,106	2.40%	$ 12,517
55.	Year 55	22,500,000	22,194,375	305,625	7.87%	24,053	1.6286	39,172	223,750	262,913	$ 12,517	2.40%	$ 12,941
56.	Year 56	22,500,000	22,420,125	82,875	7.87%	6,444	1.6286	10,495	223,750	234,245	$ 12,941	2.40%	$ 13,380
57.	Year 57	22,500,000	12,500,000	-	7.87%		1.6286		82,875	82,875	$ 13,380	2.40%	$ 13,838
58.													
59.	Life to Date Cost and Benefit									57,252,124			358,257
60.													
61.													
62.	*Annual Increase in CPI based on November, 2011 data.												
63.													
64.													

12.2.3 Cost Benefit of Reducing Water Losses in the Miami Water System to 10 Percent Over Life of Infrastructure Replacement

Line No.	Year	Plant in Service	Accumulated Depreciation	Net Utility Plant	Return on Rate Base	Required Operating Income	Tax Multiplier	Revenue Required Return on Investment	Depreciation Expense	Annual Revenue Requirement	Annual Cost Savings	Growth in CPI *	Inflation Adjusted Savings
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
1.	Year 1	18,300,000	363,785	18,136,215	7.87%	1,427,320	1.6286	2,324,513	963,785	2,488,318	$ 6,613	3.40%	$ 6,613
2.	Year 2	18,300,000	492,155	17,808,845	7.87%	1,401,540	1.6286	2,282,542	327,570	2,610,112	$ 6,851	3.40%	$ 6,857
3.	Year 3	18,300,000	818,945	17,481,055	7.87%	1,375,761	1.6286	2,240,564	327,570	2,568,134	$ 6,857	3.40%	$ 7,090
4.	Year 4	18,300,000	1,146,495	17,153,505	7.87%	1,349,981	1.6286	2,198,579	327,570	2,526,149	$ 7,090	3.40%	$ 7,333
5.	Year 5	18,300,000	1,474,085	16,825,915	7.87%	1,324,201	1.6286	2,156,594	327,570	2,484,164	$ 7,333	3.40%	$ 7,580
6.	Year 6	18,300,000	1,801,685	16,498,315	7.87%	1,298,411	1.6286	2,114,608	327,570	2,442,178	$ 7,580	3.40%	$ 7,838
7.	Year 7	18,300,000	2,129,205	16,170,795	7.87%	1,272,641	1.6286	2,072,625	327,570	2,400,195	$ 7,838	3.40%	$ 8,104
8.	Year 8	18,300,000	2,456,775	15,843,225	7.87%	1,246,862	1.6286	2,030,639	327,570	2,358,209	$ 8,104	3.40%	$ 8,380
9.	Year 9	18,300,000	2,784,345	15,515,655	7.87%	1,221,082	1.6286	1,988,654	327,570	2,316,224	$ 8,380	3.40%	$ 8,663
10.	Year 10	18,300,000	3,111,915	15,188,085	7.87%	1,195,302	1.6286	1,946,669	327,570	2,274,239	$ 8,663	3.40%	$ 8,958
11.	Year 11	18,300,000	3,439,485	14,860,515	7.87%	1,169,523	1.6286	1,904,685	327,570	2,232,255	$ 8,958	3.40%	$ 9,264
12.	Year 12	18,300,000	3,767,055	14,532,945	7.87%	1,143,743	1.6286	1,862,700	327,570	2,190,270	$ 9,264	3.40%	$ 9,579
13.	Year 13	18,300,000	4,094,615	14,205,375	7.87%	1,117,963	1.6286	1,820,715	327,570	2,148,285	$ 9,579	3.40%	$ 9,905
14.	Year 14	18,300,000	4,422,205	13,877,795	7.87%	1,092,183	1.6286	1,778,729	327,570	2,106,299	$ 9,905	3.40%	$ 10,243
15.	Year 15	18,300,000	4,749,765	13,550,235	7.87%	1,066,403	1.6286	1,736,744	327,570	2,064,314	$ 10,243	3.40%	$ 10,590
16.	Year 16	18,300,000	5,077,335	13,222,665	7.87%	1,040,624	1.6286	1,694,759	327,570	2,022,330	$ 10,590	3.40%	$ 10,950
17.	Year 17	18,300,000	5,404,905	12,895,095	7.87%	1,014,844	1.6286	1,652,775	327,570	1,980,345	$ 10,950	3.40%	$ 11,322
18.	Year 18	18,300,000	5,732,475	12,567,525	7.87%	989,064	1.6286	1,610,790	327,570	1,938,360	$ 11,322	3.40%	$ 11,707
19.	Year 19	18,300,000	6,060,045	12,239,955	7.87%	963,284	1.6286	1,568,804	327,570	1,896,374	$ 11,707	3.40%	$ 12,105
20.	Year 20	18,300,000	6,387,615	11,912,385	7.87%	937,505	1.6286	1,526,821	327,570	1,854,391	$ 12,105	3.40%	$ 12,517
21.	Year 21	18,300,000	6,715,185	11,584,815	7.87%	911,725	1.6286	1,484,835	327,570	1,812,405	$ 12,517	3.40%	$ 12,943
22.	Year 22	18,300,000	7,042,755	11,257,245	7.87%	885,945	1.6286	1,442,850	327,570	1,770,420	$ 12,943	3.40%	$ 13,383
23.	Year 23	18,300,000	7,370,315	10,929,685	7.87%	860,165	1.6286	1,400,865	327,570	1,728,435	$ 13,383	3.40%	$ 13,837
24.	Year 24	18,300,000	7,697,895	10,602,105	7.87%	834,386	1.6286	1,358,881	327,570	1,686,451	$ 13,837	3.40%	$ 14,306
25.	Year 25	18,300,000	8,025,465	10,274,535	7.87%	808,606	1.6286	1,316,896	327,570	1,644,466	$ 14,306	3.40%	$ 14,794
26.	Year 26	18,300,000	8,353,035	9,946,965	7.87%	782,826	1.6286	1,274,910	327,570	1,602,480	$ 14,794	3.40%	$ 15,297
27.	Year 27	18,300,000	8,680,605	9,619,395	7.87%	757,046	1.6286	1,232,925	327,570	1,560,495	$ 15,297	3.40%	$ 15,817
28.	Year 28	18,300,000	9,008,175	9,291,825	7.87%	731,267	1.6286	1,190,941	327,570	1,518,511	$ 15,817	3.40%	$ 16,355
29.	Year 29	18,300,000	9,335,745	8,964,255	7.87%	705,487	1.6286	1,148,956	327,570	1,476,526	$ 16,355	3.40%	$ 16,911
30.	Year 30	18,300,000	9,663,315	8,636,685	7.87%	679,707	1.6286	1,106,971	327,570	1,434,541	$ 16,911	3.40%	$ 17,486
31.	Year 31	18,300,000	9,990,885	8,309,115	7.87%	653,927	1.6286	1,064,986	327,570	1,392,556	$ 17,486	3.40%	$ 18,081
32.	Year 32	18,300,000	10,318,455	7,981,545	7.87%	628,148	1.6286	1,023,001	327,570	1,350,571	$ 18,081	3.40%	$ 18,696
33.	Year 33	18,300,000	10,646,025	7,653,975	7.87%	602,368	1.6286	981,017	327,570	1,308,587	$ 18,696	3.40%	$ 19,331
34.	Year 34	18,300,000	10,973,595	7,326,405	7.87%	576,588	1.6286	939,031	327,570	1,266,601	$ 19,331	3.40%	$ 19,988
35.	Year 35	18,300,000	11,301,165	6,998,835	7.87%	550,808	1.6286	897,046	327,570	1,224,616	$ 19,988	3.40%	$ 20,668
36.	Year 36	18,300,000	11,628,735	6,671,265	7.87%	525,029	1.6286	855,061	327,570	1,182,632	$ 20,668	3.40%	$ 21,371
37.	Year 37	18,300,000	11,956,305	6,343,695	7.87%	499,249	1.6286	813,077	327,570	1,140,647	$ 21,371	3.40%	$ 22,097
38.	Year 38	18,300,000	12,283,875	6,016,125	7.87%	473,469	1.6286	771,091	327,570	1,098,662	$ 22,097	3.40%	$ 22,848
39.	Year 39	18,300,000	12,611,445	5,688,555	7.87%	447,689	1.6286	729,106	327,570	1,056,676	$ 22,848	3.40%	$ 23,625
40.	Year 40	18,300,000	12,939,015	5,360,985	7.87%	421,910	1.6286	687,121	327,570	1,014,691	$ 23,625	3.40%	$ 24,429
41.	Year 41	18,300,000	13,266,585	5,033,415	7.87%	396,130	1.6286	645,137	327,570	972,707	$ 24,429	3.40%	$ 25,259
42.	Year 42	18,300,000	13,594,155	4,705,845	7.87%	370,350	1.6286	603,152	327,570	930,722	$ 25,259	3.40%	$ 26,118
43.	Year 43	18,300,000	13,921,725	4,378,275	7.87%	344,570	1.6286	561,167	327,570	888,737	$ 26,118	3.40%	$ 27,006
44.	Year 44	18,300,000	14,249,295	4,050,705	7.87%	318,790	1.6286	519,181	327,570	846,751	$ 27,006	3.40%	$ 27,924
45.	Year 45	18,300,000	14,576,865	3,723,135	7.87%	293,011	1.6286	477,196	327,570	804,766	$ 27,924	3.40%	$ 28,874
46.	Year 46	18,300,000	14,904,435	3,395,565	7.87%	267,231	1.6286	435,212	327,570	762,782	$ 28,874	3.40%	$ 29,856
47.	Year 47	18,300,000	15,231,985	3,067,995	7.87%	241,451	1.6286	393,227	327,570	720,797	$ 29,856	3.40%	$ 30,870
48.	Year 48	18,300,000	15,559,575	2,740,415	7.87%	215,671	1.6286	351,241	327,570	678,811	$ 30,870	3.40%	$ 31,920
49.	Year 49	18,300,000	15,887,145	2,412,855	7.87%	189,892	1.6286	309,256	327,570	636,826	$ 31,920	3.40%	$ 33,006
50.	Year 50	18,300,000	16,214,715	2,085,285	7.87%	164,112	1.6286	267,271	327,570	594,841	$ 33,006	3.40%	$ 34,127
51.	Year 51	18,300,000	16,542,285	1,757,715	7.87%	138,332	1.6286	225,287	327,570	552,857	$ 34,127	3.40%	$ 35,288
52.	Year 52	18,300,000	16,869,855	1,430,145	7.87%	112,552	1.6286	183,302	327,570	510,872	$ 35,288	3.40%	$ 36,488
53.	Year 53	18,300,000	17,197,425	1,102,575	7.87%	86,773	1.6286	141,317	327,570	468,889	$ 36,488	3.40%	$ 37,718
54.	Year 54	18,300,000	17,524,995	775,005	7.87%	60,993	1.6286	99,333	327,570	426,903	$ 37,718	3.40%	$ 39,011
55.	Year 55	18,300,000	17,852,565	647,435	7.87%	35,213	1.6286	57,348	327,570	384,918	$ 39,011	3.40%	$ 40,337
56.	Year 56	18,300,000	18,180,135	119,865	7.87%	9,433	1.6286	15,363	327,570	342,933	$ 40,337	3.40%	$ 41,709
57.	Year 57	18,300,000	18,300,000		7.87%		1.6286		119,865	119,865	$ 41,709	3.40%	$ 43,117
58.													
59.	Life to Date Cost and Benefit									33,857,107			1,186,534
60.													
61.													
62.	* Annual Increase in CPI based on November, 2011 data.												
63.													
64.													

12.2.4 Cost Benefit of Reducing Water Losses in the Rimrock Water System to 10 Percent over Life of Infrastructure Replacement

Line No.	Year	Plant in Service	Accumulated Depreciation	Net Utility Plant	Return on Rate Base	Required Operating Income	Tax Multiplier	Revenue Required Return on Investment	Depreciation Expense	Annual Revenue Requirement		Annual Cost Savings	Growth in CPI*		Inflation Adjusted Savings
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)		(K)	(L)		(M)
1.	Year 1	7,800,000	69,810	7,730,190	7.87%	608,366	1.6286	990,765	69,810	1,060,575	$	14,370	3.40%	$	14,859
2.	Year 2	7,800,000	209,430	7,590,570	7.87%	597,378	1.6286	972,890	139,620	1,112,510	$	14,859	3.40%	$	15,364
3.	Year 3	7,800,000	349,050	7,450,950	7.87%	586,390	1.6286	954,995	139,620	1,094,615	$	15,364	3.40%	$	15,886
4.	Year 4	7,800,000	488,670	7,311,330	7.87%	575,401	1.6286	937,100	139,620	1,076,720	$	15,886	3.40%	$	16,426
5.	Year 5	7,800,000	628,290	7,171,710	7.87%	564,414	1.6286	919,205	139,620	1,058,825	$	16,426	3.40%	$	16,985
6.	Year 6	7,800,000	767,910	7,032,090	7.87%	553,425	1.6286	901,308	139,620	1,040,928	$	16,985	3.40%	$	17,562
7.	Year 7	7,800,000	907,530	6,892,470	7.87%	542,437	1.6286	883,421	139,620	1,023,041	$	17,562	3.40%	$	18,159
8.	Year 8	7,800,000	1,047,150	6,752,850	7.87%	531,449	1.6286	865,518	139,620	1,005,138	$	18,159	3.40%	$	18,777
9.	Year 9	7,800,000	1,186,770	6,613,230	7.87%	520,461	1.6286	847,523	139,620	987,143	$	18,777	3.40%	$	19,415
10.	Year 10	7,800,000	1,326,390	6,473,610	7.87%	509,473	1.6286	829,728	139,620	969,348	$	19,415	3.40%	$	20,075
11.	Year 11	7,800,000	1,466,010	6,333,990	7.87%	498,485	1.6286	811,833	139,620	951,453	$	20,075	3.40%	$	20,758
12.	Year 12	7,800,000	1,605,630	6,194,370	7.87%	487,497	1.6286	793,938	139,620	933,558	$	20,758	3.40%	$	21,464
13.	Year 13	7,800,000	1,745,250	6,054,750	7.87%	476,508	1.6286	776,043	139,620	915,663	$	21,464	3.40%	$	22,193
14.	Year 14	7,800,000	1,884,870	5,915,130	7.87%	465,521	1.6286	758,148	139,620	897,768	$	22,193	3.40%	$	22,948
15.	Year 15	7,800,000	2,024,490	5,775,510	7.87%	454,533	1.6286	740,251	139,620	879,871	$	22,948	3.40%	$	23,728
16.	Year 16	7,800,000	2,164,110	5,635,890	7.87%	443,545	1.6286	722,357	139,620	861,977	$	23,728	3.40%	$	24,535
17.	Year 17	7,800,000	2,303,730	5,496,270	7.87%	432,556	1.6286	704,461	139,620	844,081	$	24,535	3.40%	$	25,369
18.	Year 18	7,800,000	2,443,350	5,356,650	7.87%	421,568	1.6286	686,566	139,620	826,186	$	25,369	3.40%	$	26,232
19.	Year 19	7,800,000	2,582,970	5,217,030	7.87%	410,580	1.6286	668,671	139,620	808,291	$	26,232	3.40%	$	27,123
20.	Year 20	7,800,000	2,722,590	5,077,410	7.87%	399,592	1.6286	650,776	139,620	790,396	$	27,123	3.40%	$	28,046
21.	Year 21	7,800,000	2,862,210	4,937,790	7.87%	388,604	1.6286	632,880	139,620	772,500	$	28,046	3.40%	$	28,999
22.	Year 22	7,800,000	3,001,830	4,798,170	7.87%	377,616	1.6286	614,985	139,620	754,605	$	28,999	3.40%	$	29,985
23.	Year 23	7,800,000	3,141,450	4,658,550	7.87%	366,628	1.6286	597,090	139,620	736,710	$	29,985	3.40%	$	31,005
24.	Year 24	7,800,000	3,281,070	4,518,930	7.87%	355,640	1.6286	579,195	139,620	718,815	$	31,005	3.40%	$	32,059
25.	Year 25	7,800,000	3,420,690	4,379,310	7.87%	344,653	1.6286	561,300	139,620	700,920	$	32,059	3.40%	$	33,149
26.	Year 26	7,800,000	3,560,310	4,239,690	7.87%	333,664	1.6286	543,405	139,620	683,025	$	33,149	3.40%	$	34,276
27.	Year 27	7,800,000	3,699,930	4,100,070	7.87%	322,676	1.6286	525,510	139,620	665,130	$	34,276	3.40%	$	35,441
28.	Year 28	7,800,000	3,839,550	3,960,450	7.87%	311,687	1.6286	507,513	139,620	647,133	$	35,441	3.40%	$	36,646
29.	Year 29	7,800,000	3,979,170	3,820,830	7.87%	300,699	1.6286	489,718	139,620	629,338	$	36,646	3.40%	$	37,891
30.	Year 30	7,800,000	4,118,790	3,681,210	7.87%	289,711	1.6286	471,823	139,620	611,443	$	37,891	3.40%	$	39,181
31.	Year 31	7,800,000	4,258,410	3,541,590	7.87%	278,723	1.6286	453,928	139,620	593,548	$	39,181	3.40%	$	40,513
32.	Year 32	7,800,000	4,398,030	3,401,970	7.87%	267,735	1.6286	436,033	139,620	575,653	$	40,513	3.40%	$	41,890
33.	Year 33	7,800,000	4,537,650	3,262,350	7.87%	256,747	1.6286	418,138	139,620	557,758	$	41,890	3.40%	$	43,314
34.	Year 34	7,800,000	4,677,270	3,122,730	7.87%	245,759	1.6286	400,243	139,620	539,863	$	43,314	3.40%	$	44,787
35.	Year 35	7,800,000	4,816,890	2,983,110	7.87%	234,771	1.6286	382,348	139,620	521,968	$	44,787	3.40%	$	46,310
36.	Year 36	7,800,000	4,956,510	2,843,490	7.87%	223,783	1.6286	364,453	139,620	504,073	$	46,310	3.40%	$	47,884
37.	Year 37	7,800,000	5,096,130	2,703,870	7.87%	212,795	1.6286	346,558	139,620	486,178	$	47,884	3.40%	$	49,512
38.	Year 38	7,800,000	5,235,750	2,564,250	7.87%	201,806	1.6286	328,662	139,620	468,281	$	49,512	3.40%	$	51,196
39.	Year 39	7,800,000	5,375,370	2,424,630	7.87%	190,818	1.6286	310,766	139,620	450,386	$	51,196	3.40%	$	52,937
40.	Year 40	7,800,000	5,514,990	2,285,010	7.87%	179,830	1.6286	292,871	139,620	432,491	$	52,937	3.40%	$	54,736
41.	Year 41	7,800,000	5,654,610	2,145,390	7.87%	168,842	1.6286	274,976	139,620	414,596	$	54,736	3.40%	$	56,597
42.	Year 42	7,800,000	5,794,230	2,005,770	7.87%	157,854	1.6286	257,081	139,620	396,701	$	56,597	3.40%	$	58,521
43.	Year 43	7,800,000	5,933,850	1,866,150	7.87%	146,866	1.6286	239,186	139,620	378,806	$	58,521	3.40%	$	60,511
44.	Year 44	7,800,000	6,073,470	1,726,530	7.87%	135,878	1.6286	221,291	139,620	360,911	$	60,511	3.40%	$	62,569
45.	Year 45	7,800,000	6,213,090	1,586,910	7.87%	124,889	1.6286	203,396	139,620	343,016	$	62,569	3.40%	$	64,696
46.	Year 46	7,800,000	6,352,710	1,447,290	7.87%	113,902	1.6286	185,501	139,620	325,121	$	64,696	3.40%	$	66,896
47.	Year 47	7,800,000	6,492,330	1,307,670	7.87%	102,914	1.6286	167,606	139,620	307,226	$	66,896	3.40%	$	69,170
48.	Year 48	7,800,000	6,631,950	1,168,050	7.87%	91,926	1.6286	149,711	139,620	289,331	$	69,170	3.40%	$	71,522
49.	Year 49	7,800,000	6,771,570	1,028,430	7.87%	80,937	1.6286	131,816	139,620	271,436	$	71,522	3.40%	$	73,954
50.	Year 50	7,800,000	6,911,190	888,810	7.87%	69,949	1.6286	113,919	139,620	253,539	$	73,954	3.40%	$	76,468
51.	Year 51	7,800,000	7,050,810	749,190	7.87%	58,961	1.6286	96,024	139,620	235,644	$	76,468	3.40%	$	79,068
52.	Year 52	7,800,000	7,190,430	609,570	7.87%	47,973	1.6286	78,129	139,620	217,749	$	79,068	3.40%	$	81,757
53.	Year 53	7,800,000	7,330,050	469,950	7.87%	36,985	1.6286	60,234	139,620	199,854	$	81,757	3.40%	$	84,536
54.	Year 54	7,800,000	7,469,670	330,330	7.87%	25,997	1.6286	42,339	139,620	181,959	$	84,536	3.40%	$	87,411
55.	Year 55	7,800,000	7,609,290	190,710	7.87%	15,009	1.6286	24,444	139,620	164,064	$	87,411	3.40%	$	90,383
56.	Year 56	7,800,000	7,748,910	51,090	7.87%	4,021	1.6286	6,549	139,620	146,169	$	90,383	3.40%	$	93,454
57.	Year 57	7,800,000	7,800,000		7.87%		1.6286		51,090	51,090	$	93,454	3.40%	$	96,632
58.															
59.	Life to Date Cost and Benefit									15,725,226					2,501,766
60.															
61.															
62.	* Annual Increase in CPI based on November, 2011 data.														
63.															
64.															

12.2.5 Cost Benefit of Reducing Water Losses in the Rimrock Water System to 15 Percent Over Life of Infrastructure Replacement

Line No.	Year	Plant in Service	Accumulated Depreciation	Net Utility Plant	Return on Rate Base	Required Operating Income	Tax Multiplier	Revenue Required Return on Investment	Depreciation Expense	Annual Revenue Requirement	Annual Cost Savings	Growth in CPI *	Inflation Adjusted Savings
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
1.	Year 1	2,700,000	24,945	2,675,055	7.87%	210,588	1.6286	342,964	24,945	367,129	$ 5,002	1.40%	$ 5,172
2.	Year 2	2,700,000	72,496	2,627,504	7.87%	206,785	1.6286	336,770	48,330	385,100	$ 5,272	1.40%	$ 5,448
3.	Year 3	2,700,000	120,825	2,579,175	7.87%	202,981	1.6286	330,575	48,330	378,905	$ 5,348	1.40%	$ 5,529
4.	Year 4	2,700,000	169,156	2,530,843	7.87%	199,178	1.6286	324,381	48,330	372,711	$ 5,529	1.40%	$ 5,718
5.	Year 5	2,700,000	217,486	2,482,526	7.87%	195,374	1.6286	318,186	48,330	366,516	$ 5,718	1.40%	$ 5,912
6.	Year 6	2,700,000	265,815	2,434,185	7.87%	191,570	1.6286	311,991	48,330	360,321	$ 5,912	1.40%	$ 6,113
7.	Year 7	2,700,000	314,145	2,385,855	7.87%	187,767	1.6286	305,797	48,330	354,127	$ 6,113	1.40%	$ 6,322
8.	Year 8	2,700,000	362,475	2,337,525	7.87%	183,963	1.6286	299,602	48,330	347,932	$ 6,322	1.40%	$ 6,536
9.	Year 9	2,700,000	410,806	2,289,195	7.87%	180,160	1.6286	293,408	48,330	341,739	$ 6,536	1.40%	$ 6,758
10.	Year 10	2,700,000	459,135	2,240,865	7.87%	176,356	1.6286	287,213	48,330	335,543	$ 6,758	1.40%	$ 6,988
11.	Year 11	2,700,000	507,466	2,192,535	7.87%	172,553	1.6286	281,020	48,330	329,350	$ 6,988	1.40%	$ 7,226
12.	Year 12	2,700,000	555,796	2,144,205	7.87%	168,749	1.6286	274,825	48,330	323,155	$ 7,226	1.40%	$ 7,472
13.	Year 13	2,700,000	604,125	2,095,875	7.87%	164,945	1.6286	268,629	48,330	316,959	$ 7,472	1.40%	$ 7,725
14.	Year 14	2,700,000	652,455	2,047,545	7.87%	161,142	1.6286	262,436	48,330	310,766	$ 7,725	1.40%	$ 7,988
15.	Year 15	2,700,000	700,785	1,999,215	7.87%	157,338	1.6286	256,241	48,330	304,571	$ 7,988	1.40%	$ 8,259
16.	Year 16	2,700,000	749,115	1,950,885	7.87%	153,535	1.6286	250,047	48,330	298,377	$ 8,259	1.40%	$ 8,540
17.	Year 17	2,700,000	797,445	1,902,555	7.87%	149,731	1.6286	243,852	48,330	292,182	$ 8,540	1.40%	$ 8,831
18.	Year 18	2,700,000	845,775	1,854,225	7.87%	145,928	1.6286	237,658	48,330	285,988	$ 8,831	1.40%	$ 9,131
19.	Year 19	2,700,000	894,105	1,805,895	7.87%	142,124	1.6286	231,462	48,330	279,793	$ 9,131	1.40%	$ 9,441
20.	Year 20	2,700,000	942,435	1,757,565	7.87%	138,320	1.6286	225,268	48,330	273,598	$ 9,441	1.40%	$ 9,762
21.	Year 21	2,700,000	990,765	1,709,235	7.87%	134,517	1.6286	219,074	48,330	267,404	$ 9,762	1.40%	$ 10,094
22.	Year 22	2,700,000	1,039,095	1,660,905	7.87%	130,713	1.6286	212,879	48,330	261,209	$ 10,094	1.40%	$ 10,437
23.	Year 23	2,700,000	1,087,425	1,612,575	7.87%	126,910	1.6286	206,686	48,330	255,016	$ 10,437	1.40%	$ 10,792
24.	Year 24	2,700,000	1,135,755	1,564,245	7.87%	123,106	1.6286	200,490	48,330	248,820	$ 10,792	1.40%	$ 11,158
25.	Year 25	2,700,000	1,184,085	1,515,915	7.87%	119,303	1.6286	194,297	48,330	242,627	$ 11,159	1.40%	$ 11,539
26.	Year 26	2,700,000	1,232,415	1,467,585	7.87%	115,499	1.6286	188,102	48,330	236,432	$ 11,539	1.40%	$ 11,931
27.	Year 27	2,700,000	1,280,745	1,419,255	7.87%	111,696	1.6286	181,906	48,330	230,236	$ 11,931	1.40%	$ 12,337
28.	Year 28	2,700,000	1,329,075	1,370,925	7.87%	107,892	1.6286	175,715	48,330	224,042	$ 12,337	1.40%	$ 12,756
29.	Year 29	2,700,000	1,377,405	1,322,595	7.87%	104,088	1.6286	169,520	48,330	217,848	$ 12,756	1.40%	$ 13,190
30.	Year 30	2,700,000	1,425,735	1,274,265	7.87%	100,285	1.6286	163,324	48,330	211,654	$ 13,190	1.40%	$ 13,638
31.	Year 31	2,700,000	1,474,065	1,225,935	7.87%	96,481	1.6286	157,129	48,330	205,459	$ 13,638	1.40%	$ 14,102
32.	Year 32	2,700,000	1,522,395	1,177,605	7.87%	92,678	1.6286	150,935	48,330	199,265	$ 14,102	1.40%	$ 14,581
33.	Year 33	2,700,000	1,570,725	1,129,275	7.87%	88,874	1.6286	144,740	48,330	193,070	$ 14,582	1.40%	$ 15,077
34.	Year 34	2,700,000	1,619,055	1,080,945	7.87%	85,070	1.6286	138,545	48,330	186,875	$ 15,077	1.40%	$ 15,590
35.	Year 35	2,700,000	1,667,385	1,032,615	7.87%	81,267	1.6286	132,351	48,330	180,681	$ 15,590	1.40%	$ 16,120
36.	Year 36	2,700,000	1,715,715	984,285	7.87%	77,463	1.6286	126,156	48,330	174,486	$ 16,120	1.40%	$ 16,668
37.	Year 37	2,700,000	1,764,045	935,955	7.87%	73,660	1.6286	119,963	48,330	168,293	$ 16,668	1.40%	$ 17,235
38.	Year 38	2,700,000	1,812,375	887,625	7.87%	69,856	1.6286	113,767	48,330	162,097	$ 17,235	1.40%	$ 17,822
39.	Year 39	2,700,000	1,860,705	839,295	7.87%	66,053	1.6286	107,574	48,330	155,904	$ 17,823	1.40%	$ 18,427
40.	Year 40	2,700,000	1,909,035	790,965	7.87%	62,249	1.6286	101,379	48,330	149,709	$ 18,427	1.40%	$ 19,054
41.	Year 41	2,700,000	1,957,365	742,635	7.87%	58,445	1.6286	95,184	48,330	143,514	$ 19,053	1.40%	$ 19,701
42.	Year 42	2,700,000	2,005,695	694,305	7.87%	54,642	1.6286	88,990	48,330	137,319	$ 19,701	1.40%	$ 20,371
43.	Year 43	2,700,000	2,054,025	645,975	7.87%	50,838	1.6286	82,795	48,330	131,125	$ 20,372	1.40%	$ 21,063
44.	Year 44	2,700,000	2,102,355	597,645	7.87%	47,035	1.6286	76,602	48,330	124,931	$ 21,063	1.40%	$ 21,779
45.	Year 45	2,700,000	2,150,685	549,315	7.87%	43,232	1.6286	70,406	48,330	118,736	$ 21,779	1.40%	$ 22,520
46.	Year 46	2,700,000	2,199,015	500,985	7.87%	39,428	1.6286	64,212	48,330	112,542	$ 22,520	1.40%	$ 23,286
47.	Year 47	2,700,000	2,247,345	452,655	7.87%	35,624	1.6286	58,017	48,330	106,347	$ 23,286	1.40%	$ 24,077
48.	Year 48	2,700,000	2,295,675	404,325	7.87%	31,820	1.6286	51,822	48,330	100,152	$ 24,077	1.40%	$ 24,896
49.	Year 49	2,700,000	2,344,005	355,995	7.87%	28,017	1.6286	45,628	48,330	93,958	$ 24,896	1.40%	$ 25,742
50.	Year 50	2,700,000	2,392,335	307,665	7.87%	24,213	1.6286	39,433	48,330	87,763	$ 25,742	1.40%	$ 26,618
51.	Year 51	2,700,000	2,440,665	259,335	7.87%	20,409	1.6286	33,240	48,330	81,570	$ 26,618	1.40%	$ 27,523
52.	Year 52	2,700,000	2,488,995	211,005	7.87%	16,606	1.6286	27,045	48,330	75,375	$ 27,523	1.40%	$ 28,458
53.	Year 53	2,700,000	2,537,325	162,675	7.87%	12,803	1.6286	20,851	48,330	69,182	$ 28,458	1.40%	$ 29,426
54.	Year 54	2,700,000	2,585,655	114,345	7.87%	8,999	1.6286	14,656	48,330	62,986	$ 29,426	1.40%	$ 30,428
55.	Year 55	2,700,000	2,633,985	66,015	7.87%	5,195	1.6286	8,462	48,330	56,793	$ 30,426	1.40%	$ 31,463
56.	Year 56	2,700,000	2,682,315	17,685	7.87%	1,392	1.6286	2,267	48,330	50,597	$ 31,461	1.40%	$ 32,531
57.	Year 57	2,700,000	2,700,000		7.87%		1.6286		37,685	37,685	$ 32,532	1.40%	$ 33,632
58.													
59.	Life on Core Cost and Benefit									17,364,464			870,232
60.													
61.													
62.	* Annual Increase in CPI based on November, 2011 data.												
63.													
64.													

12.2.6 Cost Benefit of Reducing Water Losses in the Bisbee Water System to 10 Percent over Life of Infrastructure Replacement

Line No.	Year	Plant In Service	Accumulated Depreciation	Net Utility Plant	Return on Rate Base	Required Operating Income	Tax Multiplier	Revenue Required Return on Investment	Depreciation Expense	Annual Revenue Requirement	Annual Cost Savings	Growth in CPI [1]	Inflation Adjusted Savings
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
1.	Year 1	23,500,000	710,325	23,289,675	7.87%	1,832,807	1.6286	2,985,054	710,325	3,195,381	$ 17,514	3.40%	$ 18,109
2.	Year 2	23,500,000	630,975	22,869,025	7.87%	1,799,792	1.6286	2,931,141	420,650	3,351,791	$ 18,109	3.40%	$ 18,725
3.	Year 3	23,500,000	1,051,625	22,448,375	7.87%	1,766,667	1.6286	2,877,226	420,650	3,297,876	$ 18,725	3.40%	$ 19,361
4.	Year 4	23,500,000	1,472,275	22,027,725	7.87%	1,733,542	1.6286	2,823,312	420,650	3,243,962	$ 19,361	3.40%	$ 20,020
5.	Year 5	23,500,000	1,892,925	21,607,075	7.87%	1,700,417	1.6286	2,769,397	420,650	3,190,047	$ 20,020	3.40%	$ 20,700
6.	Year 6	23,500,000	2,313,575	21,186,425	7.87%	1,667,372	1.6286	2,715,482	420,650	3,136,132	$ 20,700	3.40%	$ 21,404
7.	Year 7	23,500,000	2,734,225	20,765,775	7.87%	1,634,266	1.6286	2,661,568	420,650	3,082,216	$ 21,404	3.40%	$ 22,132
8.	Year 8	23,500,000	3,154,875	20,345,125	7.87%	1,601,161	1.6286	2,607,652	420,650	3,028,301	$ 22,132	3.40%	$ 22,884
9.	Year 9	23,500,000	3,575,525	19,924,475	7.87%	1,568,056	1.6286	2,553,736	420,650	2,974,386	$ 22,884	3.40%	$ 23,662
10.	Year 10	23,500,000	3,996,175	19,503,825	7.87%	1,534,951	1.6286	2,499,821	420,650	2,920,471	$ 23,662	3.40%	$ 24,467
11.	Year 11	23,500,000	4,416,825	19,083,175	7.87%	1,501,846	1.6286	2,445,906	420,650	2,866,556	$ 24,467	3.40%	$ 25,299
12.	Year 12	23,500,000	4,837,475	18,662,525	7.87%	1,468,741	1.6286	2,391,992	420,650	2,812,642	$ 25,299	3.40%	$ 26,159
13.	Year 13	23,500,000	5,258,125	18,241,875	7.87%	1,435,636	1.6286	2,338,077	420,650	2,758,727	$ 26,159	3.40%	$ 27,048
14.	Year 14	23,500,000	5,678,775	17,821,225	7.87%	1,402,530	1.6286	2,284,162	420,650	2,704,812	$ 27,048	3.40%	$ 27,968
15.	Year 15	23,500,000	6,099,425	17,400,575	7.87%	1,369,425	1.6286	2,230,246	420,650	2,650,896	$ 27,968	3.40%	$ 28,919
16.	Year 16	23,500,000	6,520,075	16,979,925	7.87%	1,336,320	1.6286	2,176,331	420,650	2,596,981	$ 28,919	3.40%	$ 29,902
17.	Year 17	23,500,000	6,940,725	16,559,275	7.87%	1,303,215	1.6286	2,122,416	420,650	2,543,066	$ 29,902	3.40%	$ 30,919
18.	Year 18	23,500,000	7,361,375	16,138,625	7.87%	1,270,110	1.6286	2,068,501	420,650	2,489,151	$ 30,919	3.40%	$ 31,970
19.	Year 19	23,500,000	7,782,025	15,717,975	7.87%	1,237,005	1.6286	2,014,586	420,650	2,435,236	$ 31,970	3.40%	$ 33,057
20.	Year 20	23,500,000	8,202,675	15,297,325	7.87%	1,203,899	1.6286	1,960,670	420,650	2,381,320	$ 33,057	3.40%	$ 34,181
21.	Year 21	23,500,000	8,623,325	14,876,675	7.87%	1,170,794	1.6286	1,906,755	420,650	2,327,405	$ 34,181	3.40%	$ 35,343
22.	Year 22	23,500,000	9,043,975	14,456,025	7.87%	1,137,689	1.6286	1,852,840	420,650	2,273,490	$ 35,343	3.40%	$ 36,545
23.	Year 23	23,500,000	9,464,625	14,035,375	7.87%	1,104,584	1.6286	1,798,924	420,650	2,219,574	$ 36,545	3.40%	$ 37,787
24.	Year 24	23,500,000	9,885,275	13,614,725	7.87%	1,071,479	1.6286	1,745,041	420,650	2,165,691	$ 37,787	3.40%	$ 39,072
25.	Year 25	23,500,000	10,305,925	13,194,075	7.87%	1,038,374	1.6286	1,691,086	420,650	2,111,736	$ 39,072	3.40%	$ 40,400
26.	Year 26	23,500,000	10,726,575	12,773,425	7.87%	1,005,269	1.6286	1,637,181	420,650	2,057,831	$ 40,400	3.40%	$ 41,774
27.	Year 27	23,500,000	11,147,225	12,352,775	7.87%	972,163	1.6286	1,583,265	420,650	2,003,915	$ 41,774	3.40%	$ 43,194
28.	Year 28	23,500,000	11,567,875	11,932,125	7.87%	939,058	1.6286	1,529,350	420,650	1,950,000	$ 43,194	3.40%	$ 44,663
29.	Year 29	23,500,000	11,988,525	11,511,475	7.87%	905,953	1.6286	1,475,435	420,650	1,896,085	$ 44,663	3.40%	$ 46,182
30.	Year 30	23,500,000	12,409,175	11,090,825	7.87%	872,848	1.6286	1,421,520	420,650	1,842,170	$ 46,182	3.40%	$ 47,752
31.	Year 31	23,500,000	12,829,825	10,670,175	7.87%	839,743	1.6286	1,367,605	420,650	1,788,255	$ 47,752	3.40%	$ 49,375
32.	Year 32	23,500,000	13,250,475	10,249,525	7.87%	806,638	1.6286	1,313,691	420,650	1,734,341	$ 49,375	3.40%	$ 51,054
33.	Year 33	23,500,000	13,671,125	9,828,875	7.87%	773,532	1.6286	1,259,774	420,650	1,680,424	$ 51,054	3.40%	$ 52,790
34.	Year 34	23,500,000	14,091,775	9,408,225	7.87%	740,427	1.6286	1,205,859	420,650	1,626,509	$ 52,790	3.40%	$ 54,585
35.	Year 35	23,500,000	14,512,425	8,987,575	7.87%	707,322	1.6286	1,151,945	420,650	1,572,595	$ 54,585	3.40%	$ 56,441
36.	Year 36	23,500,000	14,933,075	8,566,925	7.87%	674,217	1.6286	1,098,030	420,650	1,518,680	$ 56,441	3.40%	$ 58,360
37.	Year 37	23,500,000	15,353,725	8,146,275	7.87%	642,112	1.6286	1,044,115	420,650	1,464,765	$ 58,360	3.40%	$ 60,344
38.	Year 38	23,500,000	15,774,375	7,725,625	7.87%	608,007	1.6286	990,200	420,650	1,410,850	$ 60,344	3.40%	$ 62,394
39.	Year 39	23,500,000	16,195,025	7,304,975	7.87%	574,902	1.6286	936,285	420,650	1,356,935	$ 62,394	3.40%	$ 64,517
40.	Year 40	23,500,000	16,615,675	6,884,325	7.87%	541,796	1.6286	882,369	420,650	1,303,019	$ 64,517	3.40%	$ 66,711
41.	Year 41	23,500,000	17,036,325	6,463,675	7.87%	508,691	1.6286	828,454	420,650	1,249,104	$ 66,711	3.40%	$ 68,979
42.	Year 42	23,500,000	17,456,975	6,043,025	7.87%	475,586	1.6286	774,539	420,650	1,195,189	$ 68,979	3.40%	$ 71,324
43.	Year 43	23,500,000	17,877,625	5,622,375	7.87%	442,481	1.6286	720,625	420,650	1,141,275	$ 71,324	3.40%	$ 73,749
44.	Year 44	23,500,000	18,298,275	5,201,725	7.87%	409,376	1.6286	666,710	420,650	1,087,360	$ 73,749	3.40%	$ 76,257
45.	Year 45	23,500,000	18,718,925	4,781,075	7.87%	376,271	1.6286	612,795	420,650	1,033,445	$ 76,257	3.40%	$ 78,849
46.	Year 46	23,500,000	19,139,575	4,360,425	7.87%	343,165	1.6286	558,879	420,650	979,529	$ 78,849	3.40%	$ 81,530
47.	Year 47	23,500,000	19,560,225	3,939,775	7.87%	310,060	1.6286	504,964	420,650	925,614	$ 81,530	3.40%	$ 84,302
48.	Year 48	23,500,000	19,980,875	3,519,125	7.87%	276,955	1.6286	451,049	420,650	871,699	$ 84,302	3.40%	$ 87,168
49.	Year 49	23,500,000	20,401,525	3,098,475	7.87%	243,850	1.6286	397,134	420,650	817,784	$ 87,168	3.40%	$ 90,132
50.	Year 50	23,500,000	20,822,175	2,677,825	7.87%	210,745	1.6286	343,219	420,650	763,869	$ 90,132	3.40%	$ 93,197
51.	Year 51	23,500,000	21,242,825	2,257,175	7.87%	177,640	1.6286	289,305	420,650	709,955	$ 93,197	3.40%	$ 96,365
52.	Year 52	23,500,000	21,663,475	1,836,525	7.87%	144,535	1.6286	235,390	420,650	656,040	$ 96,365	3.40%	$ 99,642
53.	Year 53	23,500,000	22,084,125	1,415,875	7.87%	111,429	1.6286	181,475	420,650	602,125	$ 99,642	3.40%	$ 103,030
54.	Year 54	23,500,000	22,504,775	995,225	7.87%	78,324	1.6286	117,560	420,650	548,210	$ 103,030	3.40%	$ 106,532
55.	Year 55	23,500,000	22,925,425	574,575	7.87%	45,219	1.6286	73,644	420,650	494,294	$ 106,532	3.40%	$ 110,155
56.	Year 56	23,500,000	23,346,075	153,925	7.87%	12,114	1.6286	19,729	420,650	440,379	$ 110,155	3.40%	$ 113,900
57.	Year 57	23,500,000	23,500,000		7.87%		1.6286		153,925	153,925	$ 113,900	3.40%	$ 117,773
58.													
59.	Life to Date Cost and Benefit									107,633,993			3,949,864
60.													
61.													
62.	[1] Annual increase in CPI based on November, 2011 data												
63.													
64.													

12.2.7 Cost Benefit of Reducing Water Losses in the Bisbee Water System to 15 Percent Over Life of Infrastructure Replacement

Line No.	Year	Plant in Service	Accumulated Depreciation	Net Utility Plant	Return on Rate Base	Required Operating Income	Tax Multiplier	Revenue Required Return on Investment	Depreciation Expense	Annual Revenue Requirement	Annual Cost Savings	Growth in CPI[1]	Inflation Adjusted Savings
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(K)	(M)	(N)	(O)
1.	Year 1	3,300,000	29,535	3,270,465	7.87%	257,386	1.6286	419,279	29,535	448,714	$ 3,495	3.40%	$ 3,580
2.	Year 2	3,300,000	88,605	3,211,395	7.87%	252,727	1.6286	411,607	59,070	470,677	$ 3,580	3.40%	$ 3,668
3.	Year 3	3,300,000	147,675	3,152,325	7.87%	248,068	1.6286	404,036	59,070	463,106	$ 3,668	3.40%	$ 3,758
4.	Year 4	3,300,000	206,745	3,093,255	7.87%	243,409	1.6286	396,465	59,070	455,535	$ 3,758	3.40%	$ 3,852
5.	Year 5	3,300,000	265,815	3,034,185	7.87%	238,750	1.6286	388,893	59,070	447,963	$ 3,852	3.40%	$ 3,949
6.	Year 6	3,300,000	324,885	2,975,215	7.87%	234,141	1.6286	381,314	59,070	440,384	$ 3,949	3.40%	$ 4,049
7.	Year 7	3,300,000	383,955	2,916,045	7.87%	229,490	1.6286	373,752	59,070	432,822	$ 4,049	3.40%	$ 4,153
8.	Year 8	3,300,000	443,025	2,856,975	7.87%	224,804	1.6286	366,182	59,070	425,252	$ 4,153	3.40%	$ 4,260
9.	Year 9	3,300,000	502,095	2,797,905	7.87%	220,195	1.6286	358,610	59,070	417,680	$ 4,260	3.40%	$ 4,371
10.	Year 10	3,300,000	561,165	2,738,835	7.87%	215,546	1.6286	351,038	59,070	410,108	$ 4,371	3.40%	$ 4,486
11.	Year 11	3,300,000	620,235	2,679,765	7.87%	210,898	1.6286	343,466	59,070	402,536	$ 4,486	3.40%	$ 4,604
12.	Year 12	3,300,000	679,305	2,620,695	7.87%	206,249	1.6286	335,893	59,070	394,967	$ 4,604	3.40%	$ 4,727
13.	Year 13	3,300,000	738,375	2,561,625	7.87%	201,600	1.6286	328,326	59,070	387,396	$ 4,727	3.40%	$ 4,854
14.	Year 14	3,300,000	797,445	2,502,555	7.87%	196,951	1.6286	320,754	59,070	379,824	$ 4,854	3.40%	$ 4,985
15.	Year 15	3,300,000	856,515	2,443,485	7.87%	192,302	1.6286	313,183	59,070	372,253	$ 4,985	3.40%	$ 5,120
16.	Year 16	3,300,000	915,585	2,384,415	7.87%	187,653	1.6286	305,612	59,070	364,682	$ 5,120	3.40%	$ 5,259
17.	Year 17	3,300,000	974,655	2,325,345	7.87%	183,005	1.6286	298,042	59,070	357,111	$ 5,260	3.40%	$ 5,403
18.	Year 18	3,300,000	1,033,725	2,266,275	7.87%	178,356	1.6286	290,472	59,070	349,542	$ 5,405	3.40%	$ 5,552
19.	Year 19	3,300,000	1,092,795	2,207,205	7.87%	173,707	1.6286	282,899	59,070	341,969	$ 5,555	3.40%	$ 5,706
20.	Year 20	3,300,000	1,151,865	2,148,135	7.87%	169,058	1.6286	275,328	59,070	334,398	$ 5,710	3.40%	$ 5,865
21.	Year 21	3,300,000	1,210,935	2,089,065	7.87%	164,409	1.6286	267,756	59,070	326,826	$ 5,870	3.40%	$ 6,030
22.	Year 22	3,300,000	1,270,005	2,029,995	7.87%	159,761	1.6286	260,187	59,070	319,257	$ 6,035	3.40%	$ 6,200
23.	Year 23	3,300,000	1,329,075	1,970,925	7.87%	155,112	1.6286	252,615	59,070	311,685	$ 6,205	3.40%	$ 6,375
24.	Year 24	3,300,000	1,388,145	1,911,855	7.87%	150,463	1.6286	245,044	59,070	304,114	$ 6,381	3.40%	$ 6,557
25.	Year 25	3,300,000	1,447,215	1,852,785	7.87%	145,814	1.6286	237,472	59,070	296,543	$ 6,562	3.40%	$ 6,744
26.	Year 26	3,300,000	1,506,285	1,793,715	7.87%	141,165	1.6286	229,901	59,070	288,971	$ 6,744	3.40%	$ 6,931
27.	Year 27	3,300,000	1,565,355	1,734,645	7.87%	136,517	1.6286	222,332	59,070	281,402	$ 6,931	3.40%	$ 7,124
28.	Year 28	3,300,000	1,624,425	1,675,575	7.87%	131,868	1.6286	214,760	59,070	273,830	$ 7,124	3.40%	$ 7,321
29.	Year 29	3,300,000	1,683,495	1,616,505	7.87%	127,219	1.6286	207,189	59,070	266,259	$ 7,321	3.40%	$ 7,524
30.	Year 30	3,300,000	1,742,565	1,557,435	7.87%	122,570	1.6286	199,618	59,070	258,688	$ 7,524	3.40%	$ 7,732
31.	Year 32	3,300,000	1,802,635	1,498,365	7.87%	117,922	1.6286	192,046	59,070	251,116	$ 7,732	3.40%	$ 7,946
32.	Year 33	3,300,000	1,862,705	1,438,295	7.87%	113,273	1.6286	184,475	59,070	243,546	$ 7,946	3.40%	$ 8,166
33.	Year 35	3,300,000	1,922,775	1,378,225	7.87%	108,624	1.6286	176,905	59,070	235,975	$ 8,166	3.40%	$ 8,391
34.	Year 34	3,300,000	1,982,845	1,317,155	7.87%	103,975	1.6286	169,334	59,070	228,404	$ 8,391	3.40%	$ 8,622
35.	Year 35	3,300,000	2,042,915	1,257,085	7.87%	99,326	1.6286	161,761	59,070	220,832	$ 8,622	3.40%	$ 8,859
36.	Year 36	3,300,000	2,102,985	1,197,015	7.87%	94,677	1.6286	154,191	59,070	213,261	$ 8,859	3.40%	$ 9,102
37.	Year 37	3,300,000	2,163,055	1,136,945	7.87%	90,028	1.6286	146,620	59,070	205,690	$ 9,102	3.40%	$ 9,352
38.	Year 38	3,300,000	2,223,125	1,076,875	7.87%	85,380	1.6286	139,050	59,070	198,120	$ 9,352	3.40%	$ 9,609
39.	Year 39	3,300,000	2,283,195	1,016,805	7.87%	80,731	1.6286	131,479	59,070	190,548	$ 9,609	3.40%	$ 9,873
40.	Year 40	3,300,000	2,343,265	956,735	7.87%	76,082	1.6286	123,907	59,070	182,977	$ 9,873	3.40%	$ 10,144
41.	Year 41	3,300,000	2,403,335	896,665	7.87%	71,433	1.6286	116,336	59,070	175,406	$ 10,144	3.40%	$ 10,423
42.	Year 42	3,300,000	2,463,405	836,595	7.87%	66,784	1.6286	108,764	59,070	167,834	$ 10,423	3.40%	$ 10,710
43.	Year 43	3,300,000	2,523,475	776,525	7.87%	62,136	1.6286	101,195	59,070	160,265	$ 10,710	3.40%	$ 11,005
44.	Year 44	3,300,000	2,583,545	716,455	7.87%	57,487	1.6286	93,623	59,070	152,693	$ 11,005	3.40%	$ 11,308
45.	Year 45	3,300,000	2,643,615	656,385	7.87%	52,838	1.6286	86,053	59,070	145,123	$ 11,308	3.40%	$ 11,620
46.	Year 46	3,300,000	2,703,685	596,315	7.87%	48,189	1.6286	78,481	59,070	137,553	$ 11,620	3.40%	$ 11,941
47.	Year 47	3,300,000	2,763,755	536,245	7.87%	43,540	1.6286	70,909	59,070	129,979	$ 11,941	3.40%	$ 12,270
48.	Year 48	3,300,000	2,823,825	476,175	7.87%	38,892	1.6286	63,340	59,070	122,410	$ 12,270	3.40%	$ 12,608
49.	Year 49	3,300,000	2,883,895	416,105	7.87%	34,242	1.6286	55,768	59,070	114,838	$ 12,608	3.40%	$ 12,956
50.	Year 50	3,300,000	2,943,965	356,035	7.87%	29,594	1.6286	48,197	59,070	107,267	$ 12,956	3.40%	$ 13,313
51.	Year 51	3,300,000	3,003,035	296,965	7.87%	24,945	1.6286	40,625	59,070	99,695	$ 13,313	3.40%	$ 13,681
52.	Year 52	3,300,000	3,062,105	237,895	7.87%	20,296	1.6286	33,054	59,070	92,124	$ 13,681	3.40%	$ 14,059
53.	Year 53	3,300,000	3,121,175	178,825	7.87%	15,648	1.6286	25,484	59,070	84,554	$ 14,059	3.40%	$ 14,448
54.	Year 54	3,300,000	3,180,245	119,755	7.87%	10,999	1.6286	17,912	59,070	76,982	$ 14,448	3.40%	$ 14,848
55.	Year 55	3,300,000	3,239,315	60,685	7.87%	6,350	1.6286	10,341	59,070	69,412	$ 14,848	3.40%	$ 15,259
56.	Year 56	3,300,000	3,298,385	21,615	7.87%	1,701	1.6286	1,770	59,070	61,840	$ 15,259	3.40%	$ 15,681
57.	Year 57	3,300,000	3,300,000		7.87%		1.6286		21,615	21,615	$ 15,681	3.40%	$ 16,114
58.													
59.	Life to Date Cost and Benefit									15,114,547			414,390
60.													
61.													
62.	[1] Annual increase in CPI based on November, 2011 data.												
63.													
64.													

12.2.8 Cost Benefit of Reducing Water Losses in the Pinewood Water System to 10 Percent over Life of Infrastructure Replacement

Line No.	Year	Plant in Service	Accumulated Depreciation	Net Utility Plant	Return on Rate Base	Required Operating Income	Tax Multiplier	Revenue Required Return on Investment	Depreciation Expense	Annual Revenue Requirement	Annual Cost Savings	Growth in CPI*	Inflation Adjusted Savings
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
1.	Year 1	17,500,000	256,625	17,243,375	7.87%	1,364,924	1.6286	1,111,925	156,625	1,379,540	$ 16,361	1.40%	$ 17,051
2.	Year 2	17,500,000	488,875	17,030,225	7.87%	1,340,171	1.6286	1,092,765	113,250	1,406,015	$ 17,051	1.40%	$ 17,571
3.	Year 3	17,500,000	721,125	16,716,875	7.87%	1,315,418	1.6286	1,041,615	113,250	1,405,885	$ 17,571	1.40%	$ 18,121
4.	Year 4	17,500,000	1,088,375	16,402,625	7.87%	1,290,665	1.6286	1,101,466	113,250	1,415,716	$ 18,121	1.40%	$ 19,906
5.	Year 5	17,500,000	1,488,625	16,090,375	7.87%	1,266,332	1.6286	1,082,317	112,250	1,375,567	$ 19,906	1.40%	$ 20,521
6.	Year 6	17,500,000	1,722,875	15,777,125	7.87%	1,241,660	1.6286	1,021,167	113,250	1,335,417	$ 20,521	1.40%	$ 21,974
7.	Year 7	17,500,000	2,036,125	15,463,875	7.87%	1,217,007	1.6286	1,982,018	113,250	2,195,268	$ 21,974	1.40%	$ 23,061
8.	Year 8	17,500,000	2,348,375	15,150,625	7.87%	1,192,354	1.6286	1,941,868	113,250	2,195,218	$ 23,061	1.40%	$ 24,385
9.	Year 9	17,500,000	2,662,625	14,837,375	7.87%	2,167,702	1.6286	1,906,718	113,250	1,250,968	$ 24,385	1.40%	$ 25,347
10.	Year 10	17,500,000	2,975,875	14,524,125	7.87%	1,142,048	1.6286	1,861,570	113,250	2,174,820	$ 25,347	1.40%	$ 26,549
11.	Year 11	17,500,000	3,288,125	14,210,875	7.87%	1,118,395	1.6286	1,822,420	113,250	2,134,670	$ 26,549	1.40%	$ 27,791
12.	Year 12	17,500,000	3,600,375	13,897,625	7.87%	1,093,743	1.6286	1,782,270	113,250	2,094,520	$ 27,791	1.40%	$ 29,076
13.	Year 13	17,500,000	3,913,625	13,584,375	7.87%	1,069,090	1.6286	1,743,120	113,250	2,054,370	$ 29,076	1.40%	$ 30,405
14.	Year 14	17,500,000	4,226,875	13,272,125	7.87%	1,044,438	1.6286	1,700,971	113,250	2,064,221	$ 30,405	1.40%	$ 31,779
15.	Year 15	17,500,000	4,542,125	12,957,875	7.87%	1,019,785	1.6286	1,660,821	113,250	1,974,072	$ 31,779	1.40%	$ 33,199
16.	Year 16	17,500,000	4,855,375	12,644,625	7.87%	995,133	1.6286	1,620,671	113,250	1,933,921	$ 33,199	1.40%	$ 34,668
17.	Year 17	17,500,000	5,168,625	12,331,375	7.87%	970,479	1.6286	1,580,521	113,250	1,893,771	$ 34,668	1.40%	$ 36,187
18.	Year 18	17,500,000	5,480,875	12,018,125	7.87%	945,826	1.6286	1,540,371	113,250	1,853,621	$ 36,187	1.40%	$ 37,757
19.	Year 19	17,500,000	5,795,125	11,704,875	7.87%	921,174	1.6286	1,500,214	113,250	1,813,464	$ 37,757	1.40%	$ 39,381
20.	Year 20	17,500,000	6,108,375	11,391,625	7.87%	896,522	1.6286	1,460,024	113,250	1,773,314	$ 39,381	1.40%	$ 41,060
21.	Year 21	17,500,000	6,422,625	11,078,375	7.87%	871,868	1.6286	1,419,924	113,250	1,733,174	$ 41,060	1.40%	$ 42,796
22.	Year 22	17,500,000	6,734,875	10,765,125	7.87%	847,215	1.6286	1,379,774	113,250	1,693,024	$ 42,796	1.40%	$ 44,591
23.	Year 23	17,500,000	7,048,125	10,451,875	7.87%	822,563	1.6286	1,339,626	113,250	1,652,876	$ 44,591	1.40%	$ 46,447
24.	Year 24	17,500,000	7,361,375	10,138,625	7.87%	797,910	1.6286	1,299,476	113,250	1,612,726	$ 46,447	1.40%	$ 48,366
25.	Year 25	17,500,000	7,674,625	9,825,375	7.87%	773,257	1.6286	1,259,326	113,250	1,572,576	$ 48,366	1.40%	$ 50,350
26.	Year 26	17,500,000	7,987,875	9,512,125	7.87%	748,604	1.6286	1,219,176	113,250	1,532,426	$ 50,350	1.40%	$ 52,402
27.	Year 27	17,500,000	8,301,125	9,198,875	7.87%	723,953	1.6286	1,179,027	113,250	1,492,277	$ 52,402	1.40%	$ 54,524
28.	Year 28	17,500,000	8,614,375	8,885,625	7.87%	699,300	1.6286	1,138,878	113,250	1,452,128	$ 54,524	1.40%	$ 56,718
29.	Year 29	17,500,000	8,927,625	8,572,375	7.87%	674,646	1.6286	1,098,728	113,250	1,411,978	$ 56,718	1.40%	$ 58,986
30.	Year 30	17,500,000	9,240,875	8,259,125	7.87%	649,993	1.6286	1,058,579	113,250	1,372,829	$ 58,986	1.40%	$ 61,331
31.	Year 31	17,500,000	9,554,125	7,945,875	7.87%	625,340	1.6286	1,018,429	113,250	1,331,679	$ 61,331	1.40%	$ 63,757
32.	Year 32	17,500,000	9,867,375	7,632,625	7.87%	600,688	1.6286	978,280	113,250	1,291,530	$ 63,757	1.40%	$ 66,265
33.	Year 33	17,500,000	10,180,625	7,319,375	7.87%	576,035	1.6286	938,131	113,250	1,251,382	$ 66,265	1.40%	$ 68,858
34.	Year 34	17,500,000	10,493,875	7,006,125	7.87%	551,382	1.6286	897,981	113,250	1,211,231	$ 68,858	1.40%	$ 71,539
35.	Year 35	17,500,000	10,809,125	6,692,875	7.87%	526,729	1.6286	857,831	113,250	1,171,081	$ 71,539	1.40%	$ 74,321
36.	Year 36	17,500,000	11,120,375	6,379,625	7.87%	502,076	1.6286	817,681	113,250	1,130,931	$ 74,321	1.40%	$ 77,178
37.	Year 37	17,500,000	11,433,625	6,066,375	7.87%	477,424	1.6286	777,533	113,250	1,090,783	$ 77,178	1.40%	$ 80,142
38.	Year 38	17,500,000	11,746,875	5,753,125	7.87%	452,771	1.6286	737,383	113,250	1,050,633	$ 80,142	1.40%	$ 83,207
39.	Year 39	17,500,000	12,060,125	5,439,875	7.87%	428,118	1.6286	697,233	113,250	1,010,483	$ 83,207	1.40%	$ 86,376
40.	Year 40	17,500,000	12,373,375	5,126,625	7.87%	403,465	1.6286	657,083	113,250	970,333	$ 86,376	1.40%	$ 89,653
41.	Year 41	17,500,000	12,686,625	4,813,375	7.87%	378,812	1.6286	616,935	113,250	930,185	$ 89,653	1.40%	$ 93,041
42.	Year 42	17,500,000	12,999,875	4,500,125	7.87%	354,160	1.6286	576,785	113,250	890,035	$ 93,041	1.40%	$ 96,544
43.	Year 43	17,500,000	13,313,125	4,186,875	7.87%	329,507	1.6286	536,635	113,250	849,885	$ 96,544	1.40%	$ 100,167
44.	Year 44	17,500,000	13,626,375	3,873,625	7.87%	304,854	1.6286	496,485	113,250	809,735	$ 100,167	1.40%	$ 103,911
45.	Year 45	17,500,000	13,939,625	3,560,375	7.87%	280,201	1.6286	456,337	113,250	769,587	$ 103,911	1.40%	$ 107,785
46.	Year 46	17,500,000	14,253,875	3,247,125	7.87%	255,549	1.6286	416,187	113,250	729,437	$ 107,785	1.40%	$ 111,790
47.	Year 47	17,500,000	14,566,125	2,933,875	7.87%	230,896	1.6286	376,037	113,250	689,287	$ 111,790	1.40%	$ 115,931
48.	Year 48	17,500,000	14,879,375	2,620,625	7.87%	206,242	1.6286	335,887	113,250	649,137	$ 115,931	1.40%	$ 120,213
49.	Year 49	17,500,000	15,192,625	2,307,375	7.87%	181,590	1.6286	295,737	113,250	608,987	$ 120,213	1.40%	$ 124,640
50.	Year 50	17,500,000	15,505,875	2,094,125	7.87%	156,938	1.6286	255,589	113,250	568,839	$ 124,640	1.40%	$ 129,218
51.	Year 51	17,500,000	15,819,125	1,680,875	7.87%	132,285	1.6286	215,439	113,250	528,689	$ 129,218	1.40%	$ 133,951
52.	Year 52	17,500,000	16,132,375	1,367,625	7.87%	107,631	1.6286	175,289	113,250	488,539	$ 133,951	1.40%	$ 138,845
53.	Year 53	17,500,000	16,445,625	1,054,375	7.87%	82,979	1.6286	135,140	113,250	448,390	$ 138,845	1.40%	$ 143,906
54.	Year 54	17,500,000	16,758,875	741,125	7.87%	58,327	1.6286	94,991	113,250	408,241	$ 143,906	1.40%	$ 149,139
55.	Year 55	17,500,000	17,072,125	427,875	7.87%	33,674	1.6286	54,841	113,250	368,091	$ 149,139	1.40%	$ 154,550
56.	Year 56	17,500,000	17,385,375	114,625	7.87%	9,021	1.6286	14,691	113,250	127,941	$ 154,550	1.40%	$ 160,144
57.	Year 57	17,500,000	17,500,000	-	7.87%	-	1.6286	-	114,625	114,625	$ 160,144	1.40%	$ 165,919
58.													
59.	Life to Date Cost and Benefit									30,152,375			4,554,633
60.													
61.													
62.	*Annual increase in CPI based on November, 2011 data.												
63.													
64.													

12.2.9 Cost Benefit of Reducing Water Losses in the Pinewood Water System to 15 Percent Over Life of Infrastructure Replacement

Line No.	Year	Plant in Service	Accumulated Depreciation	Net Utility Plant	Return on Rate Base	Required Operating Income	Tax Multiplier	Revenue Required Return on Investment	Depreciation Expense	Annual Revenue Requirement	Annual Cost Savings	Growth in CPI[1]	Inflation Adjusted Savings
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)	(M)
1.	Year 1	12,900,000	215,456	11,784,546	7.87%	1,806,144	1.6186	1,830,646	215,455	1,754,061	$ 29,200	3.40%	$ 29,915
2.	Year 2	12,900,000	346,345	11,353,636	7.87%	987,971	1.6186	1,800,810	130,910	1,830,920	$ 29,915	3.40%	$ 30,561
3.	Year 3	12,900,000	577,375	10,912,725	7.87%	989,798	1.6186	1,570,411	130,910	1,699,323	$ 30,592	3.40%	$ 31,251
4.	Year 4	12,900,000	808,285	10,481,815	7.87%	951,616	1.6186	1,540,818	130,910	1,670,728	$ 31,251	3.40%	$ 31,916
5.	Year 5	12,900,000	1,039,095	10,050,905	7.87%	913,453	1.6186	1,510,112	130,910	1,641,132	$ 31,916	3.40%	$ 32,585
6.	Year 6	12,900,000	1,270,005	9,619,995	7.87%	875,261	1.6186	1,480,427	130,910	1,611,537	$ 32,585	3.40%	$ 33,259
7.	Year 7	12,900,000	1,500,915	9,189,085	7.87%	837,108	1.6186	1,450,830	130,910	1,581,940	$ 33,259	3.40%	$ 33,939
8.	Year 8	12,900,000	1,731,825	8,758,175	7.87%	798,935	1.6186	1,421,434	130,910	1,552,344	$ 33,939	3.40%	$ 34,629
9.	Year 9	12,900,000	1,962,735	8,327,265	7.87%	760,763	1.6186	1,392,038	130,910	1,522,749	$ 34,629	3.40%	$ 35,327
10.	Year 10	12,900,000	2,193,645	7,896,355	7.87%	722,590	1.6186	1,362,642	130,910	1,493,151	$ 35,327	3.40%	$ 36,031
11.	Year 11	12,900,000	2,424,555	7,465,445	7.87%	684,418	1.6186	1,333,247	130,910	1,463,557	$ 36,031	3.40%	$ 36,742
12.	Year 12	12,900,000	2,655,465	7,034,535	7.87%	646,245	1.6186	1,303,851	130,910	1,434,961	$ 36,742	3.40%	$ 37,460
13.	Year 13	12,900,000	2,886,375	6,603,625	7.87%	608,071	1.6186	1,274,454	130,910	1,406,364	$ 37,460	3.40%	$ 38,186
14.	Year 14	12,900,000	3,117,285	6,172,715	7.87%	569,900	1.6186	1,245,058	130,910	1,377,769	$ 38,186	3.40%	$ 38,919
15.	Year 15	12,900,000	3,348,195	5,741,805	7.87%	531,727	1.6186	1,215,663	130,910	1,349,173	$ 38,919	3.40%	$ 39,660
16.	Year 16	12,900,000	3,579,105	5,310,895	7.87%	493,554	1.6186	1,186,266	130,910	1,320,576	$ 39,660	3.40%	$ 40,408
17.	Year 17	12,900,000	3,810,015	4,879,985	7.87%	455,382	1.6186	1,156,872	130,910	1,291,982	$ 40,408	3.40%	$ 41,164
18.	Year 18	12,900,000	4,040,925	4,449,075	7.87%	417,209	1.6186	1,127,475	130,910	1,263,385	$ 41,164	3.40%	$ 41,928
19.	Year 19	12,900,000	4,271,835	4,018,165	7.87%	379,037	1.6186	1,098,080	130,910	1,234,790	$ 41,928	3.40%	$ 42,700
20.	Year 20	12,900,000	4,502,745	3,587,255	7.87%	340,864	1.6186	1,068,683	130,910	1,207,293	$ 42,700	3.40%	$ 43,480
21.	Year 21	12,900,000	4,733,655	3,156,345	7.87%	302,691	1.6186	1,040,287	130,910	1,277,197	$ 43,480	3.40%	$ 44,268
22.	Year 22	12,900,000	4,964,565	2,725,435	7.87%	264,519	1.6186	1,011,891	130,910	1,248,802	$ 44,268	3.40%	$ 45,065
23.	Year 23	12,900,000	5,195,475	2,294,525	7.87%	226,346	1.6186	983,495	130,910	1,220,405	$ 45,065	3.40%	$ 45,870
24.	Year 24	12,900,000	5,426,385	1,863,615	7.87%	188,174	1.6186	955,100	130,910	1,192,010	$ 45,870	3.40%	$ 46,684
25.	Year 25	12,900,000	5,657,295	1,432,705	7.87%	150,002	1.6186	926,704	130,910	1,163,614	$ 46,684	3.40%	$ 47,507
26.	Year 26	12,900,000	5,888,205	1,001,795	7.87%	111,829	1.6186	898,307	130,910	1,135,217	$ 47,507	3.40%	$ 48,340
27.	Year 27	12,900,000	6,119,115	570,885	7.87%	73,656	1.6186	869,912	130,910	1,106,821	$ 48,340	3.40%	$ 49,182
28.	Year 28	12,900,000	6,350,025	139,975	7.87%	35,483	1.6186	841,516	130,910	1,078,426	$ 49,182	3.40%	$ 50,034
29.	Year 29	12,900,000	6,580,935	291,065	7.87%	37,310	1.6186	813,120	130,910	1,050,029	$ 50,034	3.40%	$ 50,897
30.	Year 30	12,900,000	6,811,845	688,155	7.87%	89,138	1.6186	784,724	130,910	1,021,634	$ 50,897	3.40%	$ 51,770
31.	Year 31	12,900,000	7,042,755	1,087,245	7.87%	140,965	1.6186	756,328	130,910	993,238	$ 51,770	3.40%	$ 52,654
32.	Year 32	12,900,000	7,273,665	1,486,335	7.87%	192,792	1.6186	727,933	130,910	965,843	$ 52,654	3.40%	$ 53,550
33.	Year 33	12,900,000	7,504,575	1,885,425	7.87%	244,620	1.6186	699,536	130,910	937,446	$ 53,550	3.40%	$ 54,457
34.	Year 34	12,900,000	7,735,485	2,284,515	7.87%	296,447	1.6186	671,140	130,910	909,050	$ 54,457	3.40%	$ 55,375
35.	Year 35	12,900,000	7,966,395	2,683,605	7.87%	348,275	1.6186	642,745	130,910	880,655	$ 55,375	3.40%	$ 56,306
36.	Year 36	12,900,000	8,197,305	3,082,695	7.87%	400,102	1.6186	614,349	130,910	852,259	$ 56,306	3.40%	$ 57,249
37.	Year 37	12,900,000	8,428,215	3,481,785	7.87%	451,929	1.6186	585,954	130,910	823,864	$ 57,249	3.40%	$ 58,205
38.	Year 38	12,900,000	8,659,125	3,880,875	7.87%	503,757	1.6186	557,558	130,910	795,467	$ 58,205	3.40%	$ 59,174
39.	Year 39	12,900,000	8,890,035	4,279,965	7.87%	555,584	1.6186	529,163	130,910	767,072	$ 59,174	3.40%	$ 60,158
40.	Year 40	12,900,000	9,120,945	4,679,055	7.87%	607,412	1.6186	500,767	130,910	738,676	$ 60,158	3.40%	$ 61,155
41.	Year 41	12,900,000	9,351,855	5,078,145	7.87%	659,239	1.6186	472,372	130,910	710,281	$ 61,155	3.40%	$ 62,167
42.	Year 42	12,900,000	9,582,765	5,477,235	7.87%	711,066	1.6186	443,976	130,910	681,886	$ 62,167	3.40%	$ 63,194
43.	Year 43	12,900,000	9,813,675	5,876,325	7.87%	762,894	1.6186	415,581	130,910	653,491	$ 63,194	3.40%	$ 64,237
44.	Year 44	12,900,000	10,044,585	6,275,415	7.87%	814,721	1.6186	387,185	130,910	625,097	$ 64,237	3.40%	$ 65,296
45.	Year 45	12,900,000	10,275,495	6,674,505	7.87%	866,549	1.6186	358,790	130,910	596,701	$ 65,296	3.40%	$ 66,371
46.	Year 46	12,900,000	10,506,405	7,073,595	7.87%	918,376	1.6186	330,394	130,910	567,306	$ 66,371	3.40%	$ 67,463
47.	Year 47	12,900,000	10,737,315	7,472,685	7.87%	970,203	1.6186	301,999	130,910	537,909	$ 67,463	3.40%	$ 68,572
48.	Year 48	12,900,000	10,968,225	7,871,775	7.87%	1,022,031	1.6186	273,603	130,910	508,513	$ 68,572	3.40%	$ 69,700
49.	Year 49	12,900,000	11,199,135	8,270,865	7.87%	1,073,858	1.6186	245,208	130,910	479,118	$ 69,700	3.40%	$ 70,846
50.	Year 50	12,900,000	11,430,045	8,669,955	7.87%	1,125,685	1.6186	216,812	130,910	449,721	$ 70,846	3.40%	$ 72,011
51.	Year 51	12,900,000	11,660,955	9,069,045	7.87%	1,177,513	1.6186	188,417	130,910	420,325	$ 72,011	3.40%	$ 73,195
52.	Year 52	12,900,000	11,891,865	9,468,135	7.87%	1,229,340	1.6186	160,021	130,910	390,930	$ 73,195	3.40%	$ 74,399
53.	Year 53	12,900,000	12,122,775	9,867,225	7.87%	1,281,168	1.6186	131,626	130,910	361,534	$ 74,399	3.40%	$ 75,624
54.	Year 54	12,900,000	12,353,685	10,266,315	7.87%	1,332,995	1.6186	103,230	130,910	332,139	$ 75,624	3.40%	$ 76,870
55.	Year 55	12,900,000	12,584,595	10,665,405	7.87%	1,384,822	1.6186	74,835	130,910	302,743	$ 76,870	3.40%	$ 78,137
56.	Year 56	12,900,000	12,815,505	11,064,495	7.87%	1,436,650	1.6186	46,439	130,910	273,348	$ 78,137	3.40%	$ 79,427
57.	Year 57	12,900,000	13,046,415	11,463,585	7.87%	1,488,477	1.6186	18,044	130,910	243,952	$ 79,427	3.40%	$ 80,740
58.													
59.	Life to Date Cost and Benefit									$9,084,197			$3,353,117
60.													
61.													
62.	[1] Annual increase in CPI based on November, 2021 data.												
63.													
64.													

12.3
Infrastructure Replacement Project Cost Estimates

12.3.1 10-Year Infrastructure Replacement Preliminary Cost Estimate – Pinetop Lakes Water System

ARIZONA WATER COMPANY

PRELIMINARY COST ESTIMATE

DATE PREPARED: 12/20/2011

PREPARED BY:	APPROVED BY:	SYSTEM:	DIVISION:
AJH	FKS	PINETOP LAKES	NAVAJO

PROJECT LOCATION:	PROJECT NUMBER:	REFERENCE MAP:

PROJECT DESCRIPTION:

PINETOP LAKES WATER SYSTEM 10-YEAR INFRASTRUCTURE REPLACEMENT PLAN

MATERIALS AND LABOR

QUANTITY	UNIT	$/UNIT	DESCRIPTION	ESTIMATED ITEM COST
800	EA	$ 3,000	REPLACE PLASTIC SERVICES	$ 2,400,000
8,800	LF	90	REPLACE PROBLEMATIC MAINS W/ 6" DIP	792,000
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
(1) SUBTOTAL - MATERIALS AND LABOR				3,192,000
(2) PERFORMANCE BOND @ 1.5% OF LINE (1)				47,880
(3) SURVEY, R.O.W. PERMITTING, TESTING AND FIELD INSPECTION				223,440
(4) SUBTOTAL - LINES (1), (2) AND (3)				$ 3,463,320
(5) OVERHEAD - 15% OF LINE (4)				519,498
(6) PREPARATION OF DETAILED PLANS, SPECIFICATIONS & BIDDING DOCUMENTS				207,799
SUBTOTAL - LINES (4), (5) AND (6)				$ 4,190,617
ESTIMATED COST OF CONSTRUCTION				$ 4,190,617

AJH

12.3.2 10-Year Infrastructure Replacement Preliminary Cost Estimate - Overgaard Water System

ARIZONA WATER COMPANY

PRELIMINARY COST ESTIMATE

DATE PREPARED:			
12/20/2011			
PREPARED BY: AJH	APPROVED BY: FKS	SYSTEM: OVERGAARD	DIVISION: NAVAJO
PROJECT LOCATION:		PROJECT NUMBER:	REFERENCE MAP:

PROJECT DESCRIPTION:

OVERGAARD WATER SYSTEM 10-YEAR INFRASTRUCTURE REPLACEMENT PLAN

MATERIALS AND LABOR

QUANTITY	UNIT	$/UNIT	DESCRIPTION	ESTIMATED ITEM COST
18,200	LF	$ 60	REPLACE PROBLEMATIC MAINS W/ 6" DIP	$ 1,092,000
2,100	EA	3,000	REPLACE PLASTIC SERVICES	6,300,000
4,200	EA	500	RETROFIT METER BOXES FOR FREEZE PROTECTION	2,100,000
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
(1) SUBTOTAL - MATERIALS AND LABOR				9,492,000
(2) PERFORMANCE BOND @ 1.5% OF LINE (1)				142,380
(3) SURVEY, R.O.W. PERMITTING, TESTING AND FIELD INSPECTION				664,440
(4) SUBTOTAL - LINES (1), (2) AND (3)				$ 10,298,820
(5) OVERHEAD - 15% OF LINE (4)				1,544,823
(6) PREPARATION OF DETAILED PLANS, SPECIFICATIONS & BIDDING DOCUMENTS				617,929
SUBTOTAL - LINES (4), (5) AND (6)				$ 12,461,572
ESTIMATED COST OF CONSTRUCTION				$ 12,461,572

AJH

12.3.3 10-Year Infrastructure Replacement Preliminary Cost Estimate – Miami Water System

ARIZONA WATER COMPANY

PRELIMINARY COST ESTIMATE

DATE PREPARED: 12/21/11

PREPARED BY:	APPROVED BY:	SYSTEM:	DIVISION:
MRL	FKS	MIAMI	SUPERSTITION

PROJECT LOCATION:	PROJECT NUMBER:	REFERENCE MAP:

PROJECT DESCRIPTION:

MIAMI SYSTEM 10-YEAR INFRASTRUCTURE REPLACEMENT PLAN

MATERIALS AND LABOR

QUANTITY	UNIT	$/UNIT	DESCRIPTION	ESTIMATED ITEM COST
24,917	LF	$ 68	REPLACE 1930-1939 MAINS w/ 6" DIP	$ 1,694,356
5,903	LF	98	REPLACE 1930-1939 MAINS w/ 8" DIP	578,494
856	LF	128	REPLACE 1930-1939 MAINS w/ 12" DIP	109,568
38,387	LF	$ 68	REPLACE 1940-1949 MAINS w/ 6" DIP	2,610,316
43,319	LF	68	REPLACE PROBLEMATIC MAINS 1950&NEWER W/ 6" DIP	2,945,692
1,750	EA	3,000	REPLACE SERVICES ON MAINS 1910-1949	5,250,000
250	EA	3,000	REPLACE PLASTIC SERVICES	750,000
				-
				-
				-
				-
				-
				-
(1) SUBTOTAL - MATERIALS AND LABOR				13,938,426
(2) PERFORMANCE BOND @ 1.5% OF LINE (1)				209,076
(3) SURVEY, R.O.W. PERMITTING, TESTING AND FIELD INSPECTION				975,690
(4) SUBTOTAL - LINES (1), (2) AND (3)				$ 15,123,192
(5) OVERHEAD - 15% OF LINE (4)				2,268,479
(6) PREPARATION OF DETAILED PLANS, SPECIFICATIONS & BIDDING DOCUMENTS				907,392
SUBTOTAL - LINES (4), (5) AND (6)				$ 18,299,063
ESTIMATED COST OF CONSTRUCTION				$ 18,299,063

MRH

12.3.4 10-Year Infrastructure Replacement Preliminary Cost Estimate – Rimrock Water System

ARIZONA WATER COMPANY

PRELIMINARY COST ESTIMATE

DATE PREPARED: 12/20/2011

PREPARED BY:	APPROVED BY:	SYSTEM:	DIVISION:
AJH	FKS	RIMROCK	VERDE VALLEY

PROJECT LOCATION:	PROJECT NUMBER:	REFERENCE MAP:

PROJECT DESCRIPTION:

RIMROCK WATER SYSTEM 10-YEAR INFRASTRUCTURE REPLACEMENT PLAN

MATERIALS AND LABOR

QUANTITY	UNIT	$/UNIT	DESCRIPTION	ESTIMATED ITEM COST
40,100	LF	$ 75	REPLACE PROBLEMATIC MAINS W/ 6" DIP	$ 3,007,500
300	EA	3,000	REPLACE SERVICES ON PROBLEMATIC MAINS	1,020,000
640	EA	3,000	REPLACE PLASTIC SERVICES	1,920,000
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
(1) SUBTOTAL - MATERIALS AND LABOR				5,947,500
(2) PERFORMANCE BOND @ 1.5% OF LINE (1)				89,213
(3) SURVEY, R.O.W. PERMITTING, TESTING AND FIELD INSPECTION				416,325
(4) SUBTOTAL - LINES (1), (2) AND (3)				$ 6,453,038
(5) OVERHEAD - 15% OF LINE (4)				967,956
(6) PREPARATION OF DETAILED PLANS, SPECIFICATIONS & BIDDING DOCUMENTS				387,182
SUBTOTAL - LINES (4), (5) AND (6)				$ 7,808,176
ESTIMATED COST OF CONSTRUCTION				$ 7,808,176

AJH

12.3.5 10-Year Infrastructure Replacement Preliminary Cost Estimate – Bisbee Water System

ARIZONA WATER COMPANY

PRELIMINARY COST ESTIMATE

DATE PREPARED: 7/1/2011

PREPARED BY:	APPROVED BY:	SYSTEM:	DIVISION:
MRL	FKS	BISBEE	COCHISE

PROJECT LOCATION:	PROJECT NUMBER:	REFERENCE MAP:

PROJECT DESCRIPTION:

BISBEE WATER SYSTEM 10-YEAR INFRASTRUCTURE REPLACEMENT PLAN

MATERIALS AND LABOR

QUANTITY	UNIT	$/UNIT	DESCRIPTION	ESTIMATED ITEM COST
40,379	LF	$ 70	REPLACE 1900-1909 MAINS w/ 6" DIP	$ 2,826,530
3,153	LF	100	REPLACE 1900-1909 MAINS w/ 8" DIP	315,300
20,139	LF	130	REPLACE 1900-1909 MAINS w/ 12" DIP	2,618,070
21,701	LF	70	REPLACE 1910-1919 MAINS w/ 6" DIP	1,519,070
14,077	LF	70	REPLACE 1920-1929 MAINS w/ 6" DIP	985,390
6,731	LF	70	REPLACE 1930-1939 MAINS w/ 6" DIP	471,170
23,684	LF	70	REPLACE 1940-1949 MAINS w/ 6" DIP	1,657,880
58,551	LF	70	REPLACE PROBLEMATIC MAINS 1950&NEWER W/ 6" DIP	4,098,570
1,500	EA	2,000	REPLACE SERVICES ON MAINS 1900-1949	3,000,000
215	EA	2,000	REPLACE PLASTIC SERVICES	430,000
				-
				-
				-

(1) SUBTOTAL - MATERIALS AND LABOR	17,921,980
(2) PERFORMANCE BOND @ 1.5% OF LINE (1)	268,830
(3) SURVEY, R.O.W. PERMITTING, TESTING AND FIELD INSPECTION	1,254,539
(4) SUBTOTAL - LINES (1), (2) AND (3)	$ 19,445,349
(5) OVERHEAD - 15% OF LINE (4)	2,916,802
(6) PREPARATION OF DETAILED PLANS, SPECIFICATIONS & BIDDING DOCUMENTS	1,166,721
SUBTOTAL - LINES (4), (5) AND (6)	$ 23,528,872
ESTIMATED COST OF CONSTRUCTION	$ 23,528,872

MFH

12.3.6 10-Year Infrastructure Replacement Preliminary Cost Estimate – Pinewood Water System

ARIZONA WATER COMPANY

PRELIMINARY COST ESTIMATE

DATE PREPARED: 12/20/2011

PREPARED BY:	APPROVED BY:	SYSTEM:	DIVISION:
AJH	FKS	PINEWOOD	VERDE VALLEY

PROJECT LOCATION:	PROJECT NUMBER:	REFERENCE MAP:

PROJECT DESCRIPTION:

PINEWOOD WATER SYSTEM 10-YEAR INFRASTRUCTURE REPLACEMENT PLAN

MATERIALS AND LABOR

QUANTITY	UNIT	$/UNIT	DESCRIPTION	ESTIMATED ITEM COST
2,400	EA	$ 4,000	REPLACE PLASTIC SERVICES	$ 9,600,000
15,400	LF	240	REPLACE PROB. MAINS W/ 6" DIP (INCL. SERVICES)	3,696,000
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
				-
(1) SUBTOTAL - MATERIALS AND LABOR				13,296,000
(2) PERFORMANCE BOND @ 1.5% OF LINE (1)				199,440
(3) SURVEY, R.O.W. PERMITTING, TESTING AND FIELD INSPECTION				930,720
(4) SUBTOTAL - LINES (1), (2) AND (3)				$ 14,426,160
(5) OVERHEAD - 15% OF LINE (4)				2,163,924
(6) PREPARATION OF DETAILED PLANS, SPECIFICATIONS & BIDDING DOCUMENTS				865,570
SUBTOTAL - LINES (4), (5) AND (6)				$ 17,456,654
ESTIMATED COST OF CONSTRUCTION				$ 17,456,654

AJH

ATTACHMENT 1

DISTRIBUTION SYSTEM IMPROVEMENT CHARGES

ARIZONA WATER COMPANY
Robert W. Geake (No. 009695)
Vice President and General Counsel
3805 N. Black Canyon Highway
Phoenix, Arizona 85012-5351
Telephone: (602) 240-6860

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2011 JUL 22 A 11: 30

AZ CORP COMMISSION
DOCKET CONTROL

BEFORE THE ARIZONA CORPORATION COMMISSION

IN THE MATTER OF THE APPLICATION OF ARIZONA WATER COMPANY, AN ARIZONA CORPORATION, FOR A DETERMINATION OF THE FAIR VALUE OF ITS UTILITY PLANT AND PROPERTY, AND FOR ADJUSTMENTS TO ITS RATES AND CHARGES FOR UTILITY SERVICE AND FOR CERTAIN RELATED APPROVALS BASED THEREON.	Docket No. W-01445A-08-0440 **CERTIFICATE OF FILING COMPLIANCE ITEM**

The Arizona Corporation Commission (the "Commission"), in Decision No. 71845 (the "Decision") at page 95, lines 1-7, ordered Arizona Water Company (the "Company") to prepare a study on Distribution System Improvement Charges ("DSIC") designed to implement leak detection devices and make conservation based repairs to infrastructure. The Commission further ordered that the study should further detail costs, rate impacts and consider how to balance costs and benefits for customers and that the Company shall undertake this study and file a report detailing the findings of this study by June 30, 2011, with Docket Control, as a compliance item in this docket.

The Company filed the initial form of the DSIC study in this docket on June 29, 2011 in compliance with the Decision. The Company is now filing an update to the DSIC study in this docket, attached hereto as Attachment A.

RESPECTFULLY SUBMITTED this 22nd day of July 2011.

ARIZONA WATER COMPANY

By: Robert W. Geake

Robert W. Geake
Vice President and General Counsel
Arizona Water Company
P. O. Box 29006
Phoenix, AZ 85038
Attorney for Applicant

CERTIFICATE OF SERVICE

An original and thirteen (13) copies of the foregoing were delivered this 22nd day of July, 2011 to:

Docketing Supervisor
Docket Control Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

A copy of the foregoing was mailed this 22nd day of July, 2011 to:

Honorable Lyn Farmer
Chief Administrative Law Judge
Hearing Division
Arizona Corporation Commission
1200 West Washington Street
Phoenix, Arizona 85007

Wesley C. Van Cleve, Attorney
Legal Division
Arizona Corporation Commission
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Phoenix, Arizona 85004
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By: Robert W. Geake

EXHIBIT

A

Arizona Water Company
Distribution System Improvement Charge (DSIC) Study
Docket No. W-01445A-08-0440
July 22, 2011

ATTACHMENT A

Arizona Water Company
Distribution System Improvement Charge (DSIC) Study
Docket No. W-01445A-08-0440
July 22, 2011

Introduction and Background

In Decision No. 71845, the Arizona Corporation Commission (the "Commission") ordered Arizona Water Company (the "Company") to prepare a study on Distribution System Improvement Charges ("DSIC") designed to implement leak detection devices and make conservation-based repairs to infrastructure, and to file a report detailing the findings of this study with the Commission. The Commission stated that an infrastructure funding mechanism may be reasonable for certain of the Company's aging systems, or for systems that face other unique challenges. Further, the Commission ordered that the information contained in the study should be used by the Company to further develop this issue for future Commission consideration.

This DSIC study examines costs and effects on customer rates and takes into consideration how to balance the costs and benefits of necessary infrastructure replacements for customers. It is submitted to the Commission to provide the information discussed above, to establish the basis and need for implementing a DSIC mechanism to address aging and failing infrastructure, and to urge the Commission to approve such a mechanism in the Company's general rate cases.

The Company is a public service corporation which provides public utility water service in portions of Cochise, Coconino, Gila, Maricopa, Navajo, Pima, Pinal and Yavapai Counties in Arizona pursuant to certificates of convenience and necessity granted by the Commission. The Company operates twenty-two (22) public water systems that serve approximately 84,300 customers.

Historical Development of DSIC

The pressing need to replace aging drinking water infrastructure has been brought to the forefront of public attention by entities such as the United States Environmental Protection Agency (the "EPA") and the American Society of Civil Engineers (the "ASCE"). The ASCE's *2009 Report Card for American Infrastructure* gave the nation's aging drinking water system infrastructure a grade of D minus.[1] In addition, the EPA, in its report entitled *Drinking Water Infrastructure Needs Survey and Assessment*, projected a twenty-year capital improvement funding need of $334.8 billion.[2]

In Decision No. 71845, the Commission noted that aging infrastructure is often seen as an East Coast or Midwest phenomenon. However, according to the EPA report cited above, water providers in Arizona will need to fund nearly $7.4 billion of water system infrastructure replacements over the next twenty years, over half of which is needed for transmission and

[1] Exhibit A: *2009 Report Card for American Infrastructure – Water and Environment, Drinking Water* produced by American Society of Civil Engineers.
[2] Exhibit B: *Drinking Water Infrastructure Needs Survey and Assessment, Fourth Report to Congress* by the United States Environmental Protection Agency.

distribution system replacements. The EPA report further identified infrastructure funding needs for medium and small-sized water providers in Arizona as $2.1 billion and $889 million, respectively.

The EPA report classified medium sized community water systems as those that serve more than 3,300 but less than 100,000 persons. Community water systems serving 3,300 persons or fewer are classified as small. Based on the EPA's classification the Company's Ajo, Stanfield, Tierra Grande, Coolidge Airport and Winkelman systems are classified as small systems. All of the Company's other systems are classified as medium systems.

In recognition of this growing crisis, regulated water utilities have begun to develop ways along with their state regulatory commissions, to provide rate mechanisms to help fund the replacement and rehabilitation of failing infrastructure while, at the same time, balancing financial stability with customer affordability. In 1996, Philadelphia Suburban Water Company ("PSWC") petitioned the Pennsylvania Public Utility Commission ("PPUC") for approval of a DSIC. The PSWC DSIC was designed to recover the fixed costs (depreciation and pre-tax return) of certain non-revenue-producing infrastructure rehabilitation and replacement projects completed and placed in service between rate cases. In its petition to the PPUC, PSWC presented evidence that it was only able to replace/rehabilitate fifteen (15) miles out of a total of 3,130 miles of transmission and distribution mains or less than one-half of one percent each year, due to funding limitations. According to PSWC, at that pace, it would take approximately 212 years to complete all of the needed replacements/rehabilitations to its transmission and distribution mains. PSWC also noted that the DSIC would help it break the cycle of filing for general rate increases every fifteen (15) months, thus reducing the frequency of rate filings to the benefit of both customers and the PPUC.

The DSIC proposed by PSWC included a number of limitations. Among these were restrictions on the type of utility plant eligible for cost recovery, quarterly filing requirements, a cap on the maximum amount of revenue that could be collected by the DSIC, an eligibility earnings test, and a true-up mechanism which reset the DSIC to zero when the underlying utility plant was included in base rates in a subsequent general rate case.

In approving the DSIC in late 1996, the PPUC noted that: "PSWC and other Pennsylvania water companies had been required to make significant investments in new utility plants for projects such as the filtration of surface water supplies, the replacement of aging water distribution plant and the implementation of meter replacement programs. In addition, water companies face the daunting challenge of rehabilitating their existing distribution infrastructure before the property reaches the end of its service life to avoid serious public health and safety risks".[3]

Following its adoption by the PPUC, public utility commissions in many other jurisdictions, including Delaware, California, Connecticut, Indiana, Illinois, Missouri, New York

[3] Exhibit C: *Petition of Philadelphia Suburban Water Company for Approval to Implement a Tariff Supplement Establishing a Distribution System Improvement Charge; Doc. No. P-00961036, Opinion and Order.*

and Ohio, adopted DSIC-type mechanisms.[4] In early 1999, the National Association of Regulatory Utility Commissioners ("NARUC") endorsed the mechanism as an example of an innovative regulatory tool that other public utility commissions should consider adopting to solve infrastructure remediation challenges.[5] In 2005, NARUC adopted a resolution identifying the DSIC as a Regulatory Policy Best Practice.[6]

At the 1998 National Association of Water Companies' Pennsylvania Forum, Commissioner Norma Brownell of the PPUC reported that implementation of the DSIC created little consumer reaction and resulted in infrastructure investment that otherwise would not have occurred. In a July 2007 Public Meeting, PPUC Chairman Wendell F. Holland further praised the DSIC mechanism "as one of the most important regulatory tools of the past decade," and additionally noted the consumer safeguards that were established in conjunction with adoption of the DSIC, such as DSIC revenues capped at a percentage of general revenues, resetting the DSIC to zero at the time of the next general rate case, providing notice to customers of any change in the DSIC rate, audits conducted as needed, and an annual reconciliation audit.[7]

While the DSIC has become an important regulatory tool in other jurisdictions, it has not yet been approved in Arizona. However, in Docket No. W-01303A-05-0405, the Commission adopted a Public Safety Surcharge in Paradise Valley for Arizona American Water Company. This type of surcharge was specifically designed to provide funding for the replacement of undersized and inadequate water mains in the Town of Paradise Valley. While the Public Safety Surcharge collected funds in advance of construction, the DSIC is more like the Arsenic Cost Recovery Mechanism ("ACRM"), which was developed through the collective efforts of the Company, the Commission Staff and the Residential Utility Consumer Office ("RUCO"). The ACRM allows utilities that construct arsenic treatment plants to seek recovery of capital costs and narrowly defined components of arsenic treatment plant operating costs incurred between formal rate filings. Without this progressive recovery method, a significant number of the State's water utilities would not have had the financial ability to comply with new, more stringent, safe drinking water standards for arsenic.

Assessment of the Company's Distribution Systems

Due to the phenomenal rate of growth seen in the last decade, there is a common misconception that water distribution systems in Arizona are relatively young and that there is no aging infrastructure crisis in this state. In fact, many of the Company's water systems are comprised of a large percentage of aging water mains and service lines that are approaching or have already exceeded the end of their useful service lives, and many of those facilities are obsolete or failing. In the Bisbee system, for example, a significant portion of the water mains

[4] Exhibit D: *DSIC-type Mechanism by State.*
[5] Exhibit E: *National Association of Regulatory Utility Commissioners ("NARUC") Resolution Endorsing and Co-Sponsoring the Distribution System Improvement Charge, 1999.*
[6] Exhibit F: *National Association of Regulatory Utility Commissioners ("NARUC") Resolution. Supporting Consideration of Regulatory Policies Deemed as "Best Practices", 2005.*
[7] Exhibit G: *Motion of Chairman Wendell F. Holland, Docket No.: P-00062241, et al.*

date back to the early 1900s, and nearly thirty-five percent (35%) of that system's water mains, many of which have a history of chronic leaks, have reached the end of their useful service lives and need to be replaced. Even water systems viewed as more modern, such as the Company's Pinal Valley water system, have many water mains that were installed during the period of time from the 1920s through the 1940s.

The materials used in the manufacture of pipe and services play a significant role in determining the useful service lives of water mains, service lines and other distribution system components. For water mains constructed of ferrous pipe materials, such as cast iron, steel, galvanized steel or ductile iron, corrosion causes pitting of the pipe material. Eventually, the corrosion continues until a hole is formed in the pipe wall leading to a water leak. In advanced stages of corrosion, water mains can fail completely, resulting in water main breaks, often causing costly damage to the water facilities, the roadway and nearby property. In addition, corrosion can lead to the formation of tuberculation, which restricts the flow of water.

Water mains constructed of non-ferrous pipe materials, such as polyvinyl chloride ("PVC") and cement asbestos ("CA"), can become brittle or lose their physical integrity over time through various physical and chemical causes. Even the gasket materials made to seal the joints between pipes can degrade and fail. CA pipe, which has been used since the 1930s, loses physical strength through the leaching of cement or binding agents caused by corrosive soil conditions. This loss of physical strength or integrity leads to increased frequencies of water main leaks and breaks.

Water service lines are typically constructed of copper or polyethylene. Other materials have also been used, such as galvanized steel and PVC. Copper service lines can become pitted by internal or external corrosion leading to leaks or breaks. In the 1970s, the use of polyethylene for water service lines became commonplace however, it has been found that these materials become brittle and split longitudinally as they age, making repairs impractical and requiring complete replacement as leaks are discovered. Corrosion of galvanized steel service lines leads to similar signs of failure, including pitting and tuberculation, as seen in galvanized steel water mains.

Soil condition is an example of the factors that contribute to corrosion of water mains. When the Company first considered the use of ductile iron pipe, it conducted a number of soil surveys with help from professional engineers working for the Ductile Iron Pipe Research Association ("DIPRA"). Those soil surveys looked for certain soil attributes or conditions that could lead to corrosion. For water mains made from ferrous materials, such as ductile iron pipe, the presence of water, oxygen, conductive soils, sulfate reducing bacteria, and nearby cathodic protection systems were found to accelerate or promote corrosion. Field tests were conducted as part of these soil surveys to determine whether soils were conductive and would lead to corrosion. Because corrosion is an electrochemical process, conductive soil is likely to lead to corrosion in water mains made of ferrous or copper materials. The existence of cathodic protection systems, such as those used to protect steel gas mains against corrosion, can lead to increased rates of corrosion for water distribution systems. The DIPRA study concluded that

wrapping ductile iron pipe with a polywrap material would help protect the pipe against corrosion by providing a non-conductive barrier and by providing a barrier against the transfer of oxygen to the pipe.

As a benefit of the DIPRA study, the Company developed specifications for new installations that required the use of polywrap (or encasement of ductile iron pipe with a plastic barrier) in nearly all of its water systems. The plastic barrier limits oxygen transfer to the pipe material, thereby reducing the rates of corrosion. The Company even requires polywrap to be used on copper service lines in certain instances, based on the Company's experience with corrosive soil conditions in some of its water systems. These measures will help to prolong the life of infrastructure installed since 1986, when ductile iron was first used by the Company in its water systems. When the Company replaces aging pre-1986 infrastructure, it uses polywrap, as necessary, to maximize the useful life of the new infrastructure.

Additional environmental factors such as vegetation growth can also act to shorten the life of distribution systems. In downtown Coolidge, for example, the Company has replaced more than a mile of CA pipe due, in part, to the destructive effects of tamarack tree roots that have grown into the couplings of the mains and have caused the couplings to leak or fail. CA pipe accounts for forty-six percent (46%) of the water distribution system in the Pinal Valley water system.

Every water system has measurable system water losses. As pipes age, the frequency of water main and service line breaks and leaks increases. This observation was confirmed by an EPA research program titled "Aging Water Infrastructure Research Program" which found that the earliest sign of aging pipes is an increasing frequency of water main leaks. The condition of pipes degrades over time and, at some point, repairs alone are inadequate to reduce water losses. When reduction of system water losses through leak detection and repairs cannot reasonably keep pace with the increasing rate of leaks or breaks, the Company then needs to replace the water mains.

In Decision No. 71845, the Commission ordered the Company to reduce water loss in all of its systems to less than ten percent (10%) by July 2011. If it is not possible to comply with that standard by that date, the Company is required to submit a report demonstrating how it intends to reduce water losses to less than ten percent (10%). It is not possible for the Company to comply with that standard for all of its water systems and it will submit such a report to the Commission. The report will show that, absent a DSIC-type mechanism, it is unable to replace all of the infrastructure required to lower the water loss to meet the Commission's standard.

Economic Discussion

One of the important economic considerations that influences the Company's decision to invest in needed water distribution system improvements is the fact that replacement costs have increased dramatically over time. For example, in the Pinal Valley water system, nearly 14,000 feet of cast iron water mains were installed from 1921 to 1929. According to the Handy-

Whitman engineering cost index (an index that tracks construction costs over time), the cost factor for a cast iron water main installed in 1921 is 27, while the cost factor for a cast iron water main installed in 2010 is 587. This means that the replacement cost for such a water main in 2010 is 22 times greater than the original installation cost ninety years ago in 1921. Even though this is a significant increase, the index does not consider the full increase in construction costs over time, as water main installation in the 1920s was much less complicated than it is today. For example, modern day excavation must take into account the multitude of competing underground infrastructures such as sewer, power, and gas lines, as well as fiber optic and data networks. It should also be noted that these water mains are in service and that service to customers must be maintained during the replacement project, which complicates the process and adds significant additional cost.

As part of its efforts to monitor and identify the sources and remedies for water loss, the Company conducted a detailed analysis of its Superstition, Pinal Valley, Bisbee and Oracle service areas and concluded that, based upon water main repair logs and the age of the distribution system, approximately 521,000 feet of water mains need to be replaced. Additionally, service line repair records show that approximately 9,820 failing plastic service lines and 8,321 services on failing water mains need to be replaced.[8] The preliminary cost estimate for these much-needed utility plant replacements is over $102 million, as shown in the table below:

QUANTITY	DESCRIPTION	ESTIMATED COST
40,379	Replace Failing Water Mains 1900 - 1909	$ 2,826,530
22,712	Replace Failing Water Mains 1910 - 1919	1,587,818
29,737	Replace Failing Water Mains 1920 - 1929	1,780,750
61,590	Replace Failing Water Mains 1930 - 1939	4,019,164
324,647	Replace Failing Problematic Water Mains 1940 and later	16,545,154
41,838	Replace Failing Large Diameter Water Mains	5,221,060
8,321	Replace Services on Failing Water Mains	19,692,000
9,770	Replace Failing Plastic Services	25,287,500
Subtotal - Materials and Labor		$ 76,959,976
Performance Bonds, Surveying, Right of Way Permitting, Testing, Field Inspection and Overhead		25,068,721
Estimated Cost of Construction		$ 102,028,697

[8] The first study titled "Water Loss Reduction Program for the Pinal Valley Service Area" is attached to Mr. Schneider's direct testimony in Docket W-01445A-10-0517 as Exhibit FKS-10. The second study titled "Water Loss Reduction Program for Water Systems in the Eastern Group" is an exhibit in the Company's Eastern Group rate case.

It is significant that one of the key facts that led to the development of the ACRM was the magnitude of the approximately $30 million the Company needed to invest in water treatment systems to remove arsenic from its public drinking water supplies. But that amount is $72 million less than the estimated $102 million capital cost needed for infrastructure replacement for the Superstition, Pinal Valley, Bisbee and Oracle systems.

When a utility is faced with a large capital project, its cost and construction timeline are usually known well in advance. With that knowledge, the utility can try to time its rate case filing to coincide with completion of the facility to minimize the amount of earnings erosion. In the case of the Company's infrastructure replacement program, funding a project of this size and magnitude would be a difficult if not impossible task, given the Company's capitalization (approximately $150 million) and status as a privately-held entity. Assuming the Company was able to issue additional long-term debt to fund such a project, the traditional utility regulatory model would cause equity to erode at an unacceptable rate during the twelve to eighteen months it would take to conduct a general rate case.

The situation is further complicated by the fact that the Company's infrastructure replacement program is made up of many smaller projects that will be constructed every year for a number of years. Most of these projects would likely have a very short construction timeline, meaning that they would either not qualify for Allowance for Funds Used During Construction ("AFUDC"), or the amount of AFUDC recorded during the construction period would be nominal. Because these replacement programs do not increase sales, they will not generate additional revenues. In order to generate a financial return, the Company would be forced to file for annual general rate increases under the traditional rate case model, also resulting in erosion of earnings and equity. Such an erosion of the Company's equity balance would result in unsatisfactory financial ratios, the inability to issue short or long term debt and lead to higher costs for customers.

The DSIC discussed above was designed specifically to address this problem: it allows water providers to implement critical infrastructure replacement programs and recover the associated costs on a timely basis to ensure both the financial integrity of the utility and lower long-term average costs to customers.

DSIC Details

The Company proposes implementation of a DSIC under the following guidelines:

1. The DSIC would recover the fixed costs associated with DSIC-eligible utility plant additions, net of retirements placed in service between rate cases. Utility plant additions eligible for the DSIC would be limited to those additions net of retirements which are properly classified in the following NARUC Uniform System of Accounts for Class A and B Water Utilities (1976):

343 Transmission and Distribution Mains
344 Fire Mains
345 Services
346 Meters
347 Meter Installations
348 Hydrants
398 Miscellaneous Equipment (Leak Detection Equipment)

2. The Company would file DSIC updates with the Commission on a semi-annual basis to reflect eligible utility plant placed in service during the six-month period ending two months prior to each DSIC update, as illustrated below:

Effective Date of Update	Period in Which DSIC-Eligible Plant Additions Made
July 1	November 1 – April 30
January 1	May 1 – October 31

3. The Company would file supporting data, as described below, for each semi-annual filing with the Commission at least 30 days prior to the effective date of the update:

Schedule 1: The Company's most recent balance sheet at the time of filing for a DSIC step increase.

Schedule 2: The Company's most recent income statement, including those systems for which the Company requests a DSIC step increase.

Schedule 3: An earnings test schedule for each system where the Company is requesting a DSIC step increase. The earnings test will reflect the Company's most recent financial data.

Schedule 4: A rate review schedule for each system showing the incremental and pro forma effects of the step increase associated with the eligible DSIC capital costs on the financial data provided in Schedules 2 and 3.

Schedule 5: A revenue requirement schedule showing the calculation of the required increase related to eligible DSIC capital costs for each system. The schedule would also indicate the current incremental increase, proposed monthly fixed basic service and volumetric charges for a customer with a 5/8" x 3/4" meter. The required rate of return, gross conversion factor and depreciation rate would be the same rates approved in that system's last rate case.

Schedule 6: A schedule showing the surcharge calculation for eligible DSIC capital costs for each system. Fifty percent (50%) of recoverable capital costs would be in the form of a monthly fixed surcharge, and fifty percent (50%) would be in the form of a volumetric surcharge. The monthly fixed surcharge would be scaled to each meter size, based on the

approved 5/8" x 3/4" equivalent capacity ratio. This schedule would also provide information related to the number of customers by meter size and the number of gallons sold.

Schedule 7: A rate base schedule for each system showing the rate base determined in the most recent rate case, as well as the most recent rate base calculated as of the date of the information provided in Schedules 1 and 2, both adjusted to reflect the inclusion of completed and in-service eligible DSIC facilities.

Schedule 8: A Construction Work In Progress ledger showing monthly charges related to the construction of eligible DSIC facilities.

Schedule 9: A schedule showing the calculation of the Company's general plant allocation methodology.

Schedule 10: A typical bill analysis comparing bills for customers with a 5/8" x 3/4" meter under present and proposed rates.

4. The DSIC surcharge would be shown as a separate line item on each customer's bill. At least twice per year, the Company would be required to print a message on each customer's bill explaining the DSIC surcharge and indicating the progress made on replacing aging infrastructure.

5. The DSIC would be phased-in over time and capped at seven and one-half percent (7.5%) of the annual amount billed to customers under otherwise applicable rates and charges.

6. The DSIC would be reset to zero, as of the effective date of each new general rate case, by inclusion of the DSIC-eligible plant in rate base used to set base rates in the general rate case. Thereafter, new DSIC-eligible utility plant additions not included in the general rate case would form the basis for the new semi-annual DSIC filings. No DSIC filing would be made if, in any semi-annual period, the system for which the filing is made is earning a rate of return that exceeds the rate of return that would be used to calculate the revenue requirement under the DSIC.

Customer Benefits

Customer benefits associated with a DSIC include improved water quality, fire protection and public safety, increased water pressure, decreased water loss, reduced main breaks and fewer service interruptions. Additionally, implementation of a DSIC would help lead to rate stability, improve affordability and avoid large or sudden rate increases.

Failing distribution infrastructure often results in a number of customer service issues ranging from service interruptions for a single customer to larger problems involving service outages for hundreds of customers. Additionally, leaking water mains and service lines result in millions of gallons of treated water lost every year. While the Company's leak detection and

repair program has made progress in reducing the amount of water lost to leaks and breaks, the distribution system replacement plan and the DSIC mechanism proposed here by the Company are practical ways to make real progress towards updating and improving integrity and reliability of the distribution system, as well as reducing customer outages caused by distribution system failures.

The National Regulatory Research Institute ("NRRI"), in its publication *Effective Regulation: Guidance for Public-Interest Decision Makers*, cited infrastructure replacement as posing several challenges for utilities and regulatory commissions, including how to finance infrastructure replacements such that rates increase gradually (as opposed to sudden spikes) while maintaining the utilities financial stability.[9] Implementation of a DSIC would help meet those goals by providing the Company with the necessary financial means to invest in replacement of its aging infrastructure, and would allow it to make these investments in orderly, scheduled, incremental steps. Additionally, implementing a DSIC would mitigate the rate impact on customers by providing small, regular rate increases, rather than large, irregular increases that make customer affordability and acceptance more difficult.

Based on $2.5 million of infrastructure to be replaced, the impact on a typical residential customer's monthly bill in the Pinal Valley water system would be $0.87.[10] Even at the maximum capped amount of seven and one-half percent (7.5%), the average monthly residential bill would not increase by more than $2.58. In a recent ITT Value of Water Survey, nearly one in four American voters is "very concerned" about the state of the nation's water infrastructure and, when asked, two-thirds responded that they were willing to pay an average of $6.20 more per month to upgrade water infrastructure.[11] While each customer may hold a different view of how much they would be willing to pay to replace infrastructure, it is interesting to note that, in this survey and the comments expressed by PPUC Commissioner Brownell, customers appear to support increased water rates for necessary infrastructure replacement.

Conclusion

Water distribution systems have a limited life and must eventually be replaced. The replacement of aging water system infrastructure, however, requires the replacement of all utility plant, whether funded initially by contributions, refundable advances, or utility investments. This single issue is a primary focus of discussions at the NARUC, the American Water Works Association, the ASCE, the EPA and other organizations. The scope of this issue is so large, in fact, that the capital investments identified by the EPA in a recent national survey shows that hundreds of billions of dollars in capital investments are needed to replace aging water system infrastructure in this country.

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[9] Exhibit H: *Effective Regulation: Guidance for Public-Interest Decision Makers* produced by the National Regulatory Research Institute
[10] Exhibit I: *DSIC Revenue Requirement*
[11] Exhibit J: *ITT Corporation Value of Water Survey, Americans on the U.S. Water Crisis, 2010*

In a detailed study focusing on its Superstition, Pinal Valley, Bisbee and Oracle service areas, the Company identified over $102 million in critically needed water main and service line replacements. These replacements are needed to improve service reliability, increase pressure, decrease water losses and to enhance fire protection and public safety. The current rate structure will not allow for these critically needed investments. Battered in recent years by steep increases in debt and expenses, the Company has been unable to recover its cost of service for a number of years. In this type of financial environment, prudent management would lead the Company to slash its capital spending to the minimum, not to increase its capital spending. Yet, it is in this environment that the Company faces an order from the Commission to reduce its water losses, which requires replacement of aging water distribution infrastructure. Analyses conducted by the Company's engineering staff show that significant water main and service line replacements are immediately necessary for a number of its systems and, ultimately, for all of its systems, to ensure the integrity of the distribution system.

Even if it were possible for the Company to fund these much needed water distribution system replacements under traditional rate making, the resulting steep increases in customer rates could create a hardship for customers. A better way to achieve these goals is the adoption of the DSIC as outlined in this study. This would result in gradual increases in customers' bills without the impacts resulting from traditional ratemaking, while providing the Company a way to recover its cost of these investments in water distribution system improvements. Therefore, the Company urges the Commission to carefully consider the information presented in this study to develop a DSIC procedure as a ratemaking tool to address the urgent need for water distribution system replacements.

Report Card for American Infrastrucure *produced by American Society of Civil Engineers*

Drinking Water

America's drinking water systems face an annual shortfall of at least $11 billion to replace aging facilities that are near the end of their useful lives and to comply with existing and future federal water regulations. This does not account for growth in the demand for drinking water over the next 20 years. Leaking pipes lose an estimated 7 billion gallons of clean drinking water a day.

WATER AND ENVIRONMENT
DRINKING WATER
2009 GRADE
D-

Solutions

- Increase funding for water infrastructure system improvements and associated operations through a comprehensive federal program;
- Create a Water Infrastructure Trust Fund to finance the national shortfall in funding of infrastructure systems under the Clean Water Act and the Safe Drinking Water Act, including storm-water management and other projects designed to improve the nation's water quality;
- Employ a range of financing mechanisms, such as appropriations from general treasury funds, issuance of revenue bonds and tax exempt financing at state and local levels, public-private partnerships, state infrastructure banks, and user fees on certain consumer products as well as innovative financing mechanisms, including broad-based environmental restoration taxes to address problems associated with water pollution, wastewater management and treatment, and storm-water management.

Conditions

The nation's drinking-water systems face staggering public investment needs over the next 20 years. Although America spends billions on infrastructure each year, drinking water systems face an annual shortfall of at least $11 billion in funding needed to replace aging facilities that are near the end of their useful life and to comply with existing and future federal water regulations. The shortfall does not account for any growth in the demand for drinking water over the next 20 [tip:years.=Fix that leak!
A faucet dripping just once per second will waste as much as 2,700 gallons of water per year. Fix any leaking faucets.[

Of the nearly 53,000 community water systems, approximately 83% serve 3,300 or fewer people. These systems provide water to just 9% of the total U.S. population served by all community systems. In contrast, 8% of community water systems serve more than 10,000 people and provide water to 81% of the population served. Eighty-five percent (16,348) of nontransient, noncommunity water systems and 97% (83,351) of transient noncommunity water systems serve 500 or fewer people. These smaller systems face huge financial, technological, and managerial challenges in meeting a growing number of federal drinking-water regulations.

In 2002, the U.S. Environmental Protection Agency (EPA) issued The Clean Water and Drinking Water Infrastructure Gap Analysis, which identified potential funding gaps between projected needs and spending from 2000 through 2019. This analysis estimated a potential 20 -year funding gap for drinking water capital expenditures as well as operations and maintenance, ranging from $45 billion to $263 billion, depending on spending levels. Capital needs alone were pegged at $161 billion.

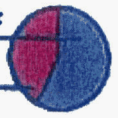
The Congressional Budget Office (CBO) concluded in 2003 that "current funding from all levels of government and current revenues generated from ratepayers will not be sufficient to meet the nation's future demand for water infrastructure." The CBO estimated the nation's needs for drinking water investments at between $10 billion and $20 billion over the next 20 years.

ESTIMATED 5-YEAR FUNDING REQUIREMENTS FOR DRINKING WATER AND WASTEWATER

Total investment needs
$255 BILLION

Estimated spending
$146.4 BILLION

Projected shortfall
$108.6 BILLION



Case Studies

LOUISVILLE, KENTUCKY
American Recovery and Reinvestment Act Funding (/case-study/american-recovery-and-reinvestment-act-funding)

PORT ANGELES, WASHINGTON
Downtown Water Main Project (/case-study/downtown-water-main-project)

ORANGE COUNTY, CALIFORNIA
Groundwater Replenishment System (/case-study/groundwater-replenishment-system)

In 1996, Congress enacted the drinking-water state revolving loan fund (SRF) program. The program authorizes the EPA to award annual capitalization grants to states. States then use their grants (plus a 20% state match) to provide loans and other assistance to public water systems. Communities repay loans into the fund, thus replenishing the fund and making resources available for projects in other communities. Eligible projects include installation and replacement of treatment facilities, distribution systems, and some storage facilities. Projects to replace aging infrastructure are eligible if they are needed to maintain compliance or to further public health protection goals.

Federal assistance has not kept pace with demand, however. Between FY 1997 and FY 2008, Congress appropriated approximately $9.6 billion for the SRF. This 11-year total is only slightly more than the annual capital investment gap for each of those years as calculated by the EPA in 2002.

Design Life of Drinking Water Systems

COMPONENTS	YEARS OF DESIGN LIFE
Reservoirs and Dams	50–80
Treatment Plants—Concrete Structures	60–70
Treatment Plants—Mechanical and Electrical	15–25
Trunk Mains	65–95
Pumping Stations—Concrete Structures	60–70
Pumping Stations—Mechanical and Electrical	25
Distribution	60–95

SOURCE US EPA Clean Water and Drinking Water Infrastructure Gap Analysis Report, September 2002

Water Usage: 1950 and 2000

	1950	2000	PERCENT CHANGE
Population (Millions)	93.4	242	159%
Usage (Billions of Gallons per Day)	14	43	207%
Per Capita Usage (Gallons per Person per Day)	149	179	20%

SOURCE US EPA Clean Water and Drinking Water Infrastructure Gap Analysis Report, September 2002

Resilience

Drinking water systems provide a critical public health function and are essential to life, economic development, and growth. Disruptions in service can hinder disaster response and recovery efforts, expose the public to water-borne contaminants, and cause damage to roadways, structures, and other infrastructure, endangering lives and resulting in billions of dollars in losses.

The nation's drinking-water systems are not highly resilient; present capabilities to prevent failure and properly maintain or reconstitute services are inadequate. Additionally, the lack of investment and the interdependence on the energy sector contribute to the lack of overall

system resilience. These shortcomings are currently being addressed through the construction of dedicated emergency power generation at key drinking water utility facilities, increased connections with adjacent utilities for emergency supply, and the development of security and criticality criteria. Investment prioritization must take into consideration system vulnerabilities, interdependencies, improved efficiencies in water usage via market incentives, system robustness, redundancy, failure consequences, and ease and cost of recovery.

Conclusion

The nation's drinking-water systems face staggering public investment needs over the next 20 years. Although America spends billions on infrastructure each year, drinking water systems face an annual shortfall of at least $11 billion in funding needed to replace aging facilities that are near the end of their useful life and to comply with existing and future federal water regulations. The shortfall does not account for any growth in the demand for drinking water over the next 20 years.

Of the nearly 53,000 community water systems, approximately 83% serve 3,300 or fewer people. These systems provide water to just 9% of the total U.S. population served by all community systems. In contrast, 8% of community water systems serve more than 10,000 people and provide water to 81% of the population served. Eighty-five percent (16,348) of nontransient, noncommunity water systems and 97% (83,351) of transient noncommunity water systems serve 500 or fewer people. These smaller systems face huge financial, technological, and managerial challenges in meeting a growing number of federal drinking-water regulations.

In 2002, the U.S. Environmental Protection Agency (EPA) issued The Clean Water and Drinking Water Infrastructure Gap Analysis, which identified potential funding gaps between projected needs and spending from 2000 through 2019. This analysis estimated a potential 20 -year funding gap for drinking water capital expenditures as well as operations and maintenance, ranging from $45 billion to $263 billion, depending on spending levels. Capital needs alone were pegged at $161 billion.

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Federal assistance has not kept pace with demand, however. Between FY 1997 and FY 2008, Congress appropriated approximately $9.5 billion for the SRF. This 11-year total is only slightly more than the annual capital investment gap for each of those years as calculated by the EPA in 2002.

Sources

1. Congressional Research Service, Safe Drinking Water Act: Selected Regulatory and Legislative Issues, April 2008.
2. U.S. Environmental Protection Agency, The Clean Water and Drinking Water Infrastructure Gap Analysis, September 2002.
3. U.S. Congressional Budget Office, Future Investment in Drinking Water and Wastewater Infrastructure, May 2002.
4. G. Tracy Mehan, Testimony before the Subcommittee on Water Resources and Environment, U.S. House Transportation and Infrastructure Committee, February 2009.

Report Card for American Infrastrucure *produced by American Society of Civil Engineers*

Arizona

Top Three Infrastructure Concerns:

1. Roads
2. Drinking Water
3. Mass Transit

Key Infrastructure Facts

Arizona Transportation Report Card - 2004
(http://www.azsce.org/downloads/AZSCE_2004_Infrastructure_Report_Card_(3.pdf)

- 12% of Arizona's bridges are structurally deficient or functionally obsolete.
- There are 98 high hazard dams in Arizona. A high hazard dam is defined as a dam whose failure would cause a loss of life and significant property damage.
- 43 of Arizona's 248 dams are in need of rehabilitation to meet applicable state dam safety standards.
- 29% of high hazard dams in Arizona have no emergency action plan (EAP). An EAP is a predetermined plan of action to be taken including roles, responsibilities and procedures for surveillance, notification and evacuation to reduce the potential for loss of life and property damage in an area affected by a failure or mis-operation of a dam.
- Arizona's drinking water infrastructure needs an investment of $9.12 billion over the next 20 years.
- Arizona ranked 33rd in the quantity of hazardous waste produced and 27th in the total number of hazardous waste producers.
- Arizona reported an unmet need of $8.6 million for its state public outdoor recreation facilities and parkland acquisition.
- 21% of Arizona's roads are in poor or mediocre condition.
- 41% of Arizona's major urban highways are congested.
- Vehicle travel on Arizona's highways increased by 78% from 1990 to 2007.
- Arizona has $4.57 billion in wastewater infrastructure needs.

Sources

*Survey of the state's ASCE members conducted in September 2008

Deficient Bridge Report, Federal Highway Administration, 2008.
National Inventory of Dams, U.S. Army Corps of Engineers, 2008.
Drinking Water Needs Survey and Assessment, Environmental Protection Agency, 2003.
National Biennial RCRA Hazardous Waste Report, Environmental Protection Agency, 2007.
The U.S. Waterway System – Transportation Facts, Navigation Data Center, U.S Army Corps of Engineers, February 2007.
2007 Annual Report, Land and Water Conservation Fund State Assistance Program, National Park Service.
TRIP Fact Sheet, March 2009.
Clean Water Needs Survey, Environmental Protection Agency, 2004.

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California (/state-page/california)
Colorado (/state-page/colorado)
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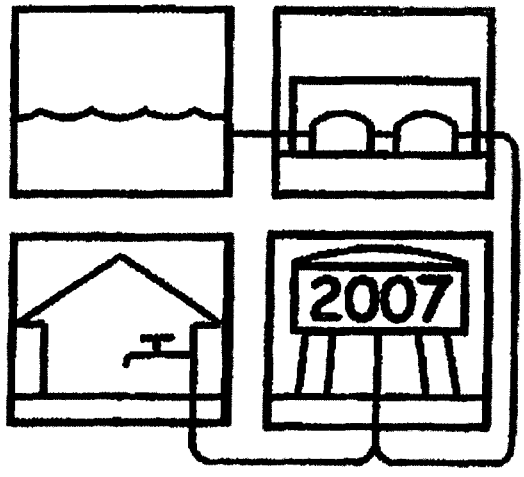
Vermont (/state-page/vermont)
Virginia (/state-page/virginia)

EXHIBIT

B

Drinking Water Infrastructure Needs Survey and Assessment

Fourth Report to Congress



U.S. Environmental Protection Agency
Office of Water
Office of Ground Water and Drinking Water
Drinking Water Protection Division
Washington, D.C. 20460

Exhibit 2.1: State 20-Year Need Reported by Project Type (in millions of January 2007 dollars)

State	Transmission/ Distribution	Source	Treatment	Storage	Other	Total
Alabama	$3,343.9	$71.6	$386.5	$285.3	$12.0	$4,099.4
Alaska	$478.2	$56.4	$121.3	$150.0	$6.5	$812.4
Arizona	$3,819.0	$460.3	$2,150.2	$900.1	$81.1	$7,410.7
Arkansas	$3,667.5	$149.3	$966.0	$478.3	$17.4	$5,278.5
California	$22,988.5	$2,515.3	$7,549.7	$5,735.6	$257.3	$39,046.3
Colorado	$3,156.7	$371.7	$2,150.2	$696.7	$24.8	$6,400.1
Connecticut	$807.1	$134.9	$280.6	$151.6	$19.7	$1,394.0
District of Columbia	$836.6	$0.0	$0.4	$35.5	$1.5	$874.2
Florida	$7,234.9	$887.3	$3,552.1	$975.4	$173.5	$12,823.1
Georgia	$6,295.6	$406.2	$1,390.5	$751.5	$93.9	$8,937.7
Illinois	$8,982.0	$1,576.3	$2,907.8	$1,386.7	$164.2	$15,017.1
Indiana	$3,814.2	$353.8	$1,096.1	$648.5	$31.8	$5,944.4
Iowa	$4,356.8	$271.9	$990.8	$467.2	$26.4	$6,113.1
Kansas	$2,784.4	$187.1	$684.1	$339.7	$35.0	$4,030.2
Kentucky	$3,643.6	$121.7	$699.0	$474.8	$38.9	$4,978.1
Louisiana	$5,100.7	$305.7	$1,024.8	$427.4	$41.3	$6,900.1
Maryland	$3,497.6	$180.6	$1,134.5	$606.0	$24.7	$5,443.4
Massachusetts	$4,456.4	$340.9	$1,130.1	$823.4	$39.1	$6,790.0
Michigan	$7,657.6	$529.6	$2,548.5	$1,035.8	$71.3	$11,842.8
Minnesota	$2,819.3	$372.0	$1,982.9	$770.3	$43.9	$5,988.4
Mississippi	$1,604.4	$284.7	$907.2	$429.8	$17.2	$3,243.3
Missouri	$4,801.6	$324.7	$1,281.2	$635.7	$42.3	$7,085.6
Nebraska	$1,017.7	$140.5	$309.2	$300.8	$8.4	$1,776.6
Nevada	$1,116.4	$892.3	$202.2	$460.6	$19.8	$2,691.3
New Jersey	$4,722.9	$307.1	$1,850.4	$1,056.7	$24.7	$7,961.6
New York	$15,417.0	$1,915.5	$6,986.2	$2,707.8	$110.9	$27,137.3
North Carolina	$6,037.1	$670.7	$2,237.7	$1,032.7	$77.1	$10,056.2
Ohio	$6,374.2	$564.2	$2,235.6	$1,330.4	$94.6	$12,599.0
Oklahoma	$2,603.5	$142.0	$858.9	$493.5	$14.1	$4,112.1
Oregon	$1,520.6	$156.3	$546.1	$536.0	$26.2	$2,785.3
Pennsylvania	$7,644.9	$567.1	$1,834.5	$1,284.2	$58.7	$11,379.3
Puerto Rico	$1,079.5	$80.6	$1,037.4	$325.2	$14.8	$2,537.5
South Carolina	$1,102.7	$75.2	$222.3	$210.2	$17.9	$1,628.3
Tennessee	$2,356.3	$109.2	$692.8	$368.0	$21.2	$3,547.6
Texas	$15,950.2	$1,600.3	$5,785.2	$2,695.8	$99.2	$26,130.8
Virginia	$3,808.3	$196.0	$1,293.3	$722.8	$43.6	$6,061.9
Washington	$5,766.5	$717.3	$1,580.0	$1,502.7	$190.6	$9,756.0
Wisconsin	$3,550.5	$386.1	$1,467.5	$758.7	$24.2	$6,186.0
Partially Surveyed States*	$10,478.1	$1,131.1	$3,347.3	$2,099.5	$136.3	$17,192.4
Subtotal	*$198,690.3*	*$19,542.3*	*$67,421.3*	*$36,091.3*	*$2,246.3*	*$323,981.4*
American Samoa	$43.7	$10.6	$15.9	$22.0	$0.6	$92.8
Guam	$223.6	$2.0	$8.8	$29.7	$0.0	$263.9
Commonwealth of the Northern Mariana Islands	$123.2	$28.7	$61.8	$65.8	$9.7	$289.3
U.S. Virgin Islands	$138.3	$7.1	$45.9	$59.8	$2.3	$253.3
Subtotal	*$528.8*	*$48.4*	*$132.2*	*$177.2*	*$12.7*	*$899.4*
Total State Need	**$199,219.1**	**$19,590.7**	**$67,553.5**	**$36,268.5**	**$2,259.0**	**$324,890.8**

* For the 2007 DWINSA the need for states that opt out of the medium system portion of the survey is presented cumulatively and not by state. The list of the 14 partially surveyed states can be seen in Exhibit 2.4.

Exhibit 2.2: State 20-Year Need Reported by System Size (in millions of January 2007 dollars)

State	Large	Medium	Small	NPR&CWS	Total
Alabama	$998.5	$2,709.8	$387.2	$3.8	$4,099.4
Alaska	$85.1	$302.3	$363.8	$61.1	$812.4
Arizona	$4,381.4	$2,121.3	$889.4	$18.5	$7,410.7
Arkansas	$443.6	$3,854.3	$973.3	$7.3	$5,278.5
California	$21,348.9	$14,098.1	$3,500.9	$101.4	$39,048.3
Colorado	$2,079.0	$3,246.6	$1,073.2	$1.3	$6,400.1
Connecticut	$288.3	$451.2	$627.0	$27.5	$1,394.0
District of Columbia	$874.2	$0.0	$0.0	$0.0	$874.2
Florida	$5,135.7	$5,769.3	$1,790.4	$127.7	$12,823.1
Georgia	$2,663.4	$4,716.0	$1,544.5	$13.8	$8,937.7
Illinois	$5,248.1	$7,006.7	$2,652.2	$110.2	$15,017.1
Indiana	$1,417.2	$3,291.0	$1,059.9	$176.3	$5,944.4
Iowa	$458.2	$4,190.3	$1,446.2	$18.4	$6,113.1
Kansas	$766.5	$2,017.8	$1,242.3	$3.5	$4,030.2
Kentucky	$757.5	$3,879.0	$340.5	$1.1	$4,978.1
Louisiana	$3,354.7	$2,249.4	$1,281.0	$14.9	$6,900.1
Maryland	$3,924.1	$853.3	$567.6	$98.2	$5,443.4
Massachusetts	$1,683.3	$4,649.7	$424.0	$32.9	$6,790.0
Michigan	$4,952.6	$4,677.0	$1,740.9	$472.2	$11,842.8
Minnesota	$672.0	$3,631.7	$1,416.5	$268.3	$5,988.4
Mississippi	$227.0	$1,432.2	$1,574.5	$9.6	$3,243.3
Missouri	$1,342.2	$3,880.3	$1,844.0	$39.1	$7,085.6
Nebraska	$379.0	$632.2	$749.4	$16.0	$1,776.6
Nevada	$2,098.2	$291.2	$287.7	$14.2	$2,691.3
New Jersey	$3,636.5	$3,502.2	$619.4	$203.6	$7,961.6
New York	$17,956.6	$5,434.9	$3,619.7	$126.2	$27,137.3
North Carolina	$3,043.9	$4,907.5	$1,734.1	$369.7	$10,055.2
Ohio	$3,172.1	$7,449.7	$1,695.0	$282.2	$12,599.0
Oklahoma	$714.8	$1,917.2	$1,457.9	$22.3	$4,112.1
Oregon	$674.2	$968.2	$1,097.3	$55.6	$2,785.3
Pennsylvania	$3,950.8	$4,542.2	$2,604.8	$281.8	$11,379.3
Puerto Rico	$823.6	$1,109.4	$603.3	$1.2	$2,537.5
South Carolina	$295.4	$806.1	$510.6	$16.2	$1,628.3
Tennessee	$555.8	$2,224.9	$738.1	$28.8	$3,547.6
Texas	$7,614.8	$13,376.3	$5,091.9	$47.7	$26,130.8
Virginia	$2,474.4	$2,216.5	$1,279.4	$91.7	$6,061.9
Washington	$2,686.7	$4,586.7	$2,366.6	$116.1	$9,756.0
Wisconsin	$1,299.2	$3,074.9	$1,328.4	$483.5	$6,186.0
Partially Surveyed States*	$1,664.1	$8,537.0	$6,686.7	$304.5	$17,192.4
Subtotal	$116,139.0	$144,574.7	$59,209.6	$4,068.2	$323,991.4
American Samoa	$0.0	$59.5	$33.3	$0.0	$92.8
Guam	[illegible]	[illegible]	[illegible]	$0.0	[illegible]
Commonwealth of the Northern Mariana Islands	$0.0	$158.6	$130.6	$0.0	$289.3
U.S. Virgin Islands	[illegible]	$187.4	$56.9	$0.0	$263.3
Subtotal	$203.1	$476.4	$219.5	$0.0	$899.4
Total State Need	$116,342.1	$145,051.1	$59,429.5	$4,068.2	$324,890.8

* For the 2007 DWINSA the need for states that opt out of the medium system portion of the survey is presented cumulatively and not by state. The list of the 14 partially surveyed states can be seen in Exhibit 2.4.

EXHIBIT

C

NOTICES

Petition of Philadelphia Suburban Water Company for Approval to Implement a Tariff Supplement Establishing a Distribution System Improvement Charge; Doc. No. P-00961036

[26 Pa.B. 4490]

Commissioners Present: John M. Quain, Chairperson; Lisa Crutchfield, Vice Chairperson; John Hanger; Robert K. Bloom

Public meeting held
August 22, 1996

Opinion and Order

By the Commission:

I. *Background*

On March 20, 1996, the Philadelphia Suburban Water Company (PSWC or company) filed the above-referenced petition with this Commission requesting regulatory approval to file and implement an automatic adjustment clause tariff that would establish a Distribution System Improvement Charge (DSIC or surcharge) under section 1307(a) of the Public Utility Code. 66 Pa.C.S. § 1307(a). Section 1307 (a) provides statutory authority for a utility to establish, subject to Commission review and approval, a tariffed automatic adjustment clause mechanism designed to provide "a just and reasonable return on the rate base" of the public utility.

As proposed by PSWC, the DSIC would operate to recover the fixed costs (depreciation and pre-tax return) of certain nonrevenue producing, nonexpense reducing infrastructure rehabilitation projects completed and placed in service between section 1308 base rate cases. The company maintains that the property additions eligible for the DSIC will be limited to revenue neutral infrastructure projects, consisting principally of replacement investments in so-called "mass property" accounts. The DSIC is designed to provide the company with the resources it needs to accelerate its investment in new utility plant to replace aging water distribution infrastructure, facilitating compliance with evolving regulatory requirements imposed by the Safe Drinking Water Act (SDWA) and the implementation of solutions to regional water supply problems.

To illustrate its point, the company states that it has 3,180 miles of mains, that it is currently rehabilitating approximately 15 miles of main each year, and that, at that pace, it would require approximately 212 years to make all of the needed improvements to existing facilities. The company also states that water service, more than any other utility service, is critical to maintaining public health as water is "a necessity of life and vital for public fire protection services." Petition at 3.

The company alleges that the DSIC may enable it to break out of a cycle, imposed on it by its capital investment needs, of filing base rate relief every 15 months. Any reduction in rate case filing frequency would generate costs savings which would inure to the benefit of customers and the Commission. In its petition, the company proposes certain accounts for recovery, time-frames and other procedures to be followed in implementing the DSIC. The details of those procedures will be discussed below.

To begin with, the company proposes that the DSIC become effective for service rendered on and after July 1, 1996. The company also proposes that the initial charge to be calculated would recover the fixed costs of eligible plant additions that have not previously been reflected in the company's rate base and will have been placed in service between January 1, 1996 and May 31, 1996. Thereafter, the company proposes to update the DSIC on a quarterly basis to reflect eligible plant additions placed in service during the 3-month periods ending 1 month prior to the effective date of each DSIC update. Petition at 3-4.

The company also proposes that the DSIC be capped at 5% of the amount billed to customers under otherwise applicable rates and charges, exclusive of amounts recovered under the State Tax Adjustment Surcharge (STAS). If the cap is reached, the company would not seek any additional increases. Petition at 4.

As with any section 1307 automatic adjustment clause, the DSIC will be subject to an annual reconciliation, whereby the revenue received under the DSIC for the reconciliation period will be compared to the Company's eligible costs for that period. The difference between such revenues and costs will be recouped or refunded to customers, as appropriate, in accordance with section 1307(e). Petition at 5.

Lastly, in terms of procedures, the company proposes that the DSIC will be reset to zero as of the effective date of new section 1308 base rates that provide for prospective recovery of the annual costs that had previously been recovered under the DSIC. Petition at 5. And to avoid over recovery of costs in the absence of a base rate case, the company also proposed that the DSIC will be reset to zero if, in any quarter, data filed with the Commission in the company's then most recent Annual or Quarterly Earnings Report shows that the company will earn a rate of return that would exceed the rate of return used to calculate its fixed costs under the DSIC. Petition at 5.

In terms of the legal issues raised by its petition, the company also states that its proposed automatic adjustment clause and procedures are lawful for a number of reasons found in statutory and case law. With regard to statutory law, PSWC states that section 1307(a) of the Public Utility Code, 66 Pa.C.S. § 1307(a), provides that a company may establish a sliding scale of rates or such other method for the automatic adjustment of the rates to recover a variety of costs. Petition at 19. Moreover, the company has cited circumstances in which the Commission has authorized the use of section 1307(a) automatic adjustment clauses to recover a wide array of expenses, depreciation and capital costs. See *Pennsylvania Industrial Energy Coalition v. Pa. P.U.C.*, 653 A.2d 1336 (Pa. Cmwlth. 1995) (PIEC) (recovery of electric utilities' demand-side management costs); 52 Pa. Code § 69.181 (recovery of gas utilities' take or pay liabilities to pipeline suppliers); 52 Pa. Code § 69.341(b) (recovery of gas utilities' gas supply realignment costs and stranded costs resulting from Federal Energy Regulatory Commission Order 636); and 52 Pa. Code § 69.353 (recovery of water utilities' principal and interest due on PennVEST obligations). Petition at 20-21.

Answers were filed by the Office of Trial Staff (OTS) (Answer filed April 9, 1996), the Office of Small Business Advocate (OSBA) (Answer filed May 3, 1996) and the Office of Consumer Advocate (OCA) (Comments and testimony filed May 6, 1996). Protests to the petition were also filed by many individual customers.

In its answer, the OTS requests that the Commission deny the company's petition based on legal and technical grounds. With regard to the legal objections, the OTS argues that, since the facilities are "new" facilities, the company is attempting to circumvent a base rate review through the use of a surcharge, in violation of the Court's decision in *PIEC*.

The OSBA's answer did not submit legal arguments opposing the implementation of the DSIC. Rather, the OSBA has requested that the Commission conduct a thorough investigation regarding the reasonableness and lawfulness of the proposed tariff supplement as they affect the company's various customer classes.

In its comments, the OCA argues against the implementation of the DSIC alleging that the company

does not need the DSIC mechanism and that implementation of a DSIC mechanism would provide in excess of a fair return to the company. With regard to legal arguments, OCA challenges the legality of the surcharge based upon the same arguments outlined in OTS' answer based on its interpretation of section 1307(a) and the *PIEC* decision.

On May 30, 1996, the company filed a reply with the Commission addressing the comments raised in the answers filed by OTS, OSBA and OCA. The OCA then filed a response to this reply on June 19, 1996. In PSWC's reply to the various parties concerning the legality of the DSIC, the company continued to support the legality of a surcharge under section 1307(a) of the Public Utility Code and the Commonwealth Court decision in *PIEC*, and supplied rebuttal arguments in support of its need for the DSIC and the legality of its proposal.

II. *Discussion*

At the outset of this discussion regarding the PSWC petition, we believe it necessary to clarify the Commission's view of the scope of this proceeding and the nature of the PSWC proposal. Because the PSWC petition requests regulatory approval to file and implement a certain type of automatic adjustment clause, we will not address, in this order, the specific factual issues that may be raised by the proposed tariff supplement submitted as Exhibit A to the petition. The Commission views the tariff supplement in Exhibit A as no more than the company's proposal as to how such an automatic adjustment clause should be structured. Indeed, as explained below, the specific tariff supplement proposed by PSWC will not be approved by this order.

Therefore, to the extent that parties have objections and/or complaints to the rates to be charged by means of an automatic adjustment clause that provides for the recovery of a water company's infrastructure improvement costs, those objections and/or complaints would be appropriately addressed to an actual PSWC tariff filing that contains specific rates to be charged to consumers based on specific distribution system improvement expenditures. A section 701 complaint would be the appropriate procedural vehicle to challenge such a tariff filing and, provided that factual issues are raised, the filing of such a complaint will entitle the complainant to a hearing before an administrative law judge and an adjudication of the complaint.

Thus, the key issues raised by the PSWC petition, and to be resolved in this order, are generic threshold issues regarding (1) the legality of the type of automatic adjustment clause proposed by the company and (2) the appropriate general structure of such an automatic adjustment clause that conforms to the requirement of the statute and Pennsylvania case law. In other words, this proceeding will address the legal issue concerning the adoption of the surcharge under section 1307(a) of the Code. In addition, the Commission will outline the general parameters of a surcharge mechanism that meets the requirement of the statute, that is consistent with the case law, that has adequate safeguards to protect consumers' interests and, therefore, constitutes a surcharge that is likely to receive regulatory approval when filed.

To begin with, we applaud companies who present this Commission with innovative ideas to address recurring problems for their respective industries. In the water industry, companies are faced with the dual tasks of improving the quality of the water delivered to customers due to the new mandates of the SDWA and other governmental requirements and, at the same time, maintaining an aging water utility infrastructure. We recognize that, in recent years, PSWC and other Pennsylvania water companies have been required to make significant investments in new utility plant for projects such as the filtration of surface water supplies, the replacement of aging water distribution plant and the implementation of meter replacement programs. In addition, water companies face the daunting challenge of rehabilitating their existing distribution infrastructure before the property reaches the end of its service life to avoid serious public health and safety risks

In the Commission's judgment, the establishment of a DSIC along the lines proposed by PSWC can substantially aid the water company in meeting these challenges on behalf of the water consuming public. We agree with the company that the establishment of a DSIC would enable the company to address, in an orderly and comprehensive manner, the problems presented by its aging water distribution

system, and would have a direct and positive effect upon water quality, water pressure and service reliability For these reasons, we endorse the concept of using an automatic adjustment clause to address this regulatory problem for the water industry in Pennsylvania and, in particular, the type of DSIC proposed by PSWC.

A. *Legal Issues*

In Pennsylvania, utility costs are recovered from customers through section 1308 base rates and through section 1307 automatic adjustment clauses. The purpose of a section 1307 automatic adjustment clause is to provide an automatic mechanism enabling utilities to recover specific costs not covered by general rates. *Allegheny Ludlum Steel Corporation v. Pa. P.U.C.* 501 Pa. 71, 75 n.3, 459 A.2d 1218, 1220 n.3 (1983). Moreover, section 1307(e), 66 Pa.C.S. § 1307(e), provides that the automatic adjustment clause procedures shall include an annual report detailing the revenues collected and the expenses incurred under the automatic adjustment clause, followed by a public hearing to reconcile the amounts and to determine any refunds owed to customers or additional recovery due from customers.

Until recently, an automatic adjustment clause has usually been applied only to gas and electric companies. However, the Commission has provided for the recovery of capital costs in at least one instance to date, i.e., for PECO Energy's costs to convert oil-fired units to units which burn natural gas. *Philadelphia Electric Co. ECR No. 3*, Docket No. M-00920312 (Order adopted April 1, 1993). The Commission has also adopted a policy statement which encourages water companies to seek section 1307(a) cost recovery for their PENNVEST debt costs, 52 Pa. Code § 69.361, and policy statements approving section 1307 cost recovery for certain FERC Order 636 stranded costs, 52 Pa. Code § 69.341 (b)(4), and electric utility coal uprating costs, 52 Pa. Code § 57.124(a). Moreover, since 1970, the Commission has authorized all utilities to use an automatic adjustment clause mechanism to recover certain incremental changes in State tax rates. 52 Pa. Code § 69.44.

Pennsylvania case law regarding the permissible scope of section 1307 cost recovery, while not extensive, supports a broad interpretation of that section. In *National Fuel Gas Distribution Corp. v Pa. P.U.C.*, 473 A.2d 1109, 1121 (Pa. Cmwlth. 1984), the Commonwealth Court held that the purpose of section 1307 of the code is to permit reflection in customer charges of changes in one component of a utility's cost of providing public service without the necessity of the "broad, costly and time-consuming inquiry" required in a section 1308 base rate case. Moreover, under the 1995 *PIEC* decision, the Commonwealth Court adopted the Commission's legal position that its use of section 1307 was not limited to fuel and purchased power costs. At the same time, the Commonwealth Court cautioned that section 1307 should have limited application and should not override the traditional ratemaking process. *PIEC* at 1349. In determining whether DSM costs could be recovered through the section 1307 mechanism, the Court wrote:

> Although we agree that Section 1307 should have limited application and the PUC should not use it to disassemble the traditional rate-making process, *the General Assembly did not limit the allowance of automatic adjustment to only fuel costs and taxes which are generally beyond the control of the utility. Instead, the General Assembly specifically allowed the recovery of fuel costs and also allowed the PUC or the utilities to initiate the automatic adjustment of costs within specific procedures* . . . In this case, Section 1319 of the Code specifically states that all prudent and reasonable costs should be recovered and sets forth requirements that the proposed programs be determined to be "prudent and cost-effective" by the PUC (or the Bureau of Conservation, Economics and Energy Planning as designated by the PUC), before any costs may be recovered through the surcharge mechanism.

PIEC at 1349 (emphasis added). The Court then concluded that the recovery of DSM costs under section 1307 was lawful because the language of section 1307 gives the Commission discretion to establish automatic adjustment clauses for the recovery of prudently incurred costs, and because in section 1319 the legislature specifically identified and provided for the recovery of prudent and reasonable costs for developing DSM programs.

Clearly, the Court in *PIEC* recognized the importance of the statute (section 1319) in providing for the

recovery of development costs of the DSM programs via section 1307. However, the Court also recognized that the language of section 1307 is not limited to a narrow set of costs (as advocated by the industrials), that whether the costs at issue should be recovered via an automatic adjustment clause is a matter of Commission discretion, and that the court "is not free to substitute its discretion for the discretion properly exercised by the PUC in establishing the surcharge method." *PIEC* at 1349.

Turning to the PSWC proposal to file and implement an automatic adjustment clause to recover its distribution system improvement costs, we find that the proposal is appropriately limited and narrowly tailored to recover a specific category of utility costs--the incremental fixed costs (depreciation and pre-tax return) associated with nonrevenue producing, nonexpense reducing distribution system improvement projects completed and placed in service between base rate cases. Recovery of this narrow set of costs is clearly permitted under section 1307(a) (which has no cost category limitation in its language) and Pennsylvania case law; and, in the Commission's judgment, this proposal is in no way a mechanism to "disassemble" the traditional ratemaking process for several reasons: first, the DSIC is designed to identify and recover the distribution system improvement costs incurred between rate cases; second, the costs to be recovered represent a narrow subset of the company's total cost of service; and third, the DSIC amount will be capped at a relatively low level to prevent any long-term evasion of a base rate review of these plant costs. Indeed, the company's proposal recognizes that there will be a full review of these costs in a subsequent section 1308 base rate proceeding. We also note that the DSIC is designed to reflect only the costs of the eligible plant additions that are actually placed in service during the 3-month periods ending 1 month prior to the effective date of each surcharge update; this key provision serves to avoid any potential violation of section 1315 and this State's long-standing "used and useful" rule.

Additionally, we find that sections 1307(d) and (e) provide broad auditing powers to the Commission and a formal reconciliation mechanism to carefully monitor the operation of such a surcharge. While admittedly section 1307(d) is addressed to fuel cost adjustment audits, we do not view the Commission's auditing power over automatic adjustment clauses as limited to only fuel costs, given the broad auditing and investigative powers granted to the Commission via sections 504, 505, 506, and 516 of the Public Utility Code. 66 Pa.C.S. §§ 504, 505, 506, 516. Nor would we be likely to approve a utility's request for approval of an automatic adjustment clause in the absence of its complete agreement that the Commission has such auditing powers. Moreover, section 1307(e) provides for a mandatory annual reconciliation report regarding the revenues and expenses recovered via an automatic adjustment clause and a "public hearing on the substance of the report and any matters pertaining to the use by such public utility" of the automatic adjustment clause. As such, the costs to be recovered via the company's DSIC proposal will be subject to the Commission's auditing powers, an annual reconciliation report and public hearings.

B. *General Tariff Parameters*

The basic elements of a tariff supplement to implement a lawful DSIC mechanism include a statement of purpose and description of eligible property, a specification of its effective date and the dates of its subsequent quarterly updates, details regarding the computation methodology and appropriate consumer safeguards. The proposed tariff supplement included with the PSWC petition, as Exhibit A, includes most of these elements but, in the Commission's judgment, certain elements should be modified in order to adequately protect consumer interests and to comply with section 1307. In order to provide guidance to PSWC and any other water utility that may need to implement a DSIC, the Commission has developed sample tariff language that, if used in a water utility's section 1307 proposed tariff supplement, is likely to receive the Commission's approval. The sample tariff language is contained in Appendix A to this order.

The major differences between the tariff supplement proposed by PSWC and the sample tariff language in Appendix A can be summarized as follows:

--specification of the eligible plant accounts by type and account number;

--provision to include recovery of main extensions installed to implement solutions to regional water

supply problems that have been documented as presenting a significant public health and safety concern to existing customers;

--specification that the costs of projects funded by PENNVEST loans are not eligible;

--provision of a prospective January 1, 1997 effective date for the tariff supplement and the property eligible for the initial filing;

--if more than 2 years have elapsed since the utility's last base rate case, use of the equity return rate determined by staff and specified in the latest Quarterly Earnings Report released by the Commission;

--greater specification of the depreciation and pretax return elements in the formula to calculate the DSIC;

--added provision to provide interest to consumers for any over recoveries during operation of the DSIC; and

--provision for customer notice of any DSIC changes.

Thus, use of the sample tariff language will fully explain the DSIC computation, including a listing of DSIC eligible property and related account numbers, so that in future years the purpose and intent of the DSIC surcharge will be apparent from reading only the tariff supplement. Additionally, the inclusion of plant account numbers and descriptions of property eligible for DSIC cost recovery parallels the format used for other section 1307 surcharges, such as the ECR for electric utilities, the GCR for gas distribution utilities and the SCR for steam heat companies.

With these changes to PSWC's proposal, the eligible property, filing dates, parameters, and consumer safeguards have been significantly strengthened. In particular, we note here that the provisions (1) for resetting the DSIC to zero if the company's rate of return exceeds its allowable rate of return, and (2) for resetting the DSIC to zero as of the effective date of new section 1308 base rates that provide for prospective recovery of the eligible plant costs both serve as effective and reliable rate mechanisms to insure that the DSIC automatic adjustment clause will not produce rates in excess of a fair return to the utility, as required by section 1307(a). We also note that the provision of a 5% of billed revenues cap on the maximum amount of any DSIC insures that the surcharge mechanism will not evade the section 1308 base rate process and its intensive top-to-bottom review of all company revenue, expense, rate base and return claims. See Appendix A. In other words, the 5% cap will insure that the surcharge will not allow the company to avoid a base rate review of the eligible property in perpetuity.

Accordingly, although we are denying the PSWC petition to the extent that it requests permission to file and implement a section 1307(a) tariff supplement to implement a surcharge as set forth in its Exhibit A, we invite the company to file a new tariff supplement consistent with the parameters outlined in the sample tariff language set forth in Appendix A to this order. The sample tariff language in Appendix A is identical to that recommended for the Pennsylvania-American Water Company at Docket No. P-00961031 which has also requested permission to file a DSIC surcharge.

As with other section 1307 tariff filings, the new tariff supplement would provide for a notice period of no less than 60 days to allow sufficient time for staff review of the proposed tariff supplement and its initial rates for consistency with the sample tariff language and for accuracy of the plant account, depreciation, pre-tax return and other elements of the DSIC calculation. If recommended for approval by staff and formally approved by the Commission, the tariff supplement and initial rates to implement the DSIC will be permitted to go into effect, subject to the outcome of any timely filed complaints. Subsequent quarterly updates, however, may be filed on 10 days notice as originally proposed by the company. *Therefore,*

It Is Ordered That:

1. The petition filed by the Philadelphia Suburban Water Company (PSWC) to file and implement a

section 1307(a) automatic adjustment clause tariff that would establish a Distribution System Improvement Charge (DSIC) is hereby approved in part and denied in part consistent with this order.

2. All protests, answers and other objections filed with respect to the PSWC petition are hereby granted in part and denied in part consistent with this order.

3. Any complaints regarding the rates to be charged pursuant to a DSIC tariff supplement may be filed if and when PSWC files a tariff supplement with specific rates in accordance with the tariff parameters outlined by this order.

4. The parameters set forth in the Appendix A are hereby adopted to serve as sample tariff language to be implemented for tariff supplements to establish a DSIC.

5. The normal auditing, reconciliation, reporting and public hearing procedures applicable to all 1307 (e) filings will likewise apply to all DSIC tariff supplements.

6. This order be published in the *Pennsylvania Bulletin*.

7. This order be served upon Philadelphia Suburban Water Company, the Office of Consumer Advocate, the Office of Small Business Advocate, the Office of Trial Staff and the National Association of Water Companies.

JOHN G. ALFORD,
Secretary

APPENDIX A

Sample Tariff Language

Distribution System Improvement Charge (DSIC)

I. *General Description*

Purpose: To recover the fixed costs (depreciation and pre-tax return) of certain nonrevenue producing, nonexpense reducing distribution system improvement projects completed and placed in service and to be recorded in the individual accounts, as noted below, between base rate cases and to provide the Company with the resources to accelerate the replacement of aging water distribution infrastructure, to comply with evolving regulatory requirements imposed by the Safe Drinking Water Act and to develop and implement solutions to regional water supply problems. The costs of extending facilities to serve new customers are not recoverable through the DSIC. Also, Company projects receiving PENNVEST funding are not DSIC-eligible property.

Eligible Property: The DSIC-eligible property will consist of the following:

--services (account 323), meters (account 324) and hydrants (account 325) installed as in-kind replacements for customers;

--mains and valves (account 322) installed as replacements for existing facilities that have worn out, are in deteriorated condition, or upgraded to meet Chapter 65 regulations of Title 52;

--main extensions (account 322) installed to eliminate dead ends and to implement solutions to regional water supply problems that have been documented as presenting a significant health and safety concern for customers currently receiving service from the company or the acquired Company;

--main cleaning and relining (account 322) projects; and

--unreimbursed funds related to capital projects to relocate Company facilities due to highway relocations.

Effective Date: The DSIC will become effective for bills rendered on and after January 1, 1997.

II. *Computation of the DSIC*

Calculation: The initial charge, effective January 1, 1997, shall be calculated to recover the fixed costs of eligible plant additions that have not previously been reflected in the Company's rate base and will have been placed in service between September 1, 1996, and November 30, 1996. Thereafter, the DSIC will be updated on a quarterly basis to reflect eligible plant additions placed in service during the 3-month periods ending 1 month prior to the effective date of each DSIC update. Thus, changes in the DSIC rate will occur as follows:

Effective Date of Change	Date To Which DSIC-Eligible Plant Addition Reflected
April 1	February 28
July 1	May 30
October 1	August 31
January 1	November 30

The fixed costs of eligible distribution system improvement projects will consist of depreciation and pre-tax return, calculated as follows:

Depreciation: The depreciation expense will be calculated by applying to the original cost of DSIC-eligible property the annual accrual rates employed in the Company's last base rate case for the plant accounts in which each retirement unit of DSIC-eligible property is recorded.

Pre-tax return: The pre-tax return will be calculated using the State and Federal income tax rates, the Company's actual capital structure and actual cost rates for long-term debt and preferred stock as of the last day of the 3-month period ending 1 month prior to the effective date of the DSIC and subsequent updates. The cost of equity will be the equity return rate approved in the Company's last fully-litigated base rate proceeding for which a final order was entered not more than 2 years prior to the effective date of the DSIC. If more than 2 years shall have elapsed between the entry of such a final order and the effective date of the DSIC, then the equity return rate used in the calculation will be the equity return rate calculated by the Commission Staff in the latest Quarterly Report on the Earnings of Jurisdictional Utilities released by the Commission.

DISC Surcharge Amount: The charge will be expressed as a percentage carried to two decimal places and will be applied to the total amount billed to each customer under the Company's otherwise applicable rates and charges, excluding amounts billed for public fire protection service and the State Tax Adjustment Surcharge (STAS). To calculate the DSIC, one-fourth of the annual fixed costs associated with all property eligible for cost recovery under the DSIC will be divided by the Company's projected revenue for sales of water for the quarterly period during which the charge will be collected, exclusive of revenues from public fire protection service and the STAS.

Formula: The formula for calculation of the DISC surcharge is as follows:

$$DSIC = \frac{(DSI \times PTRR) + Dep + c}{PQR}$$

Where:

DSI = the original cost of eligible distribution system improvement projects.

PTRR = the pre-tax return rate applicable to eligible distribution system improvement projects.

Dep = Depreciation expense related to eligible distribution system improvement projects.

e = the amount calculated under the annual reconciliation feature as described below.

PQR = Projected quarterly revenue including any revenue from acquired companies that are now being charged the rates of the acquiring company.

Quarterly updates: Supporting data for each quarterly update will be filed with the Commission and served upon the Office of Trial Staff, the Office of Consumer Advocate and the Office of Small Business Advocate at least 10 days prior to the effective date of the update.

III. *Safeguards*

Cap: The DSIC will be capped at 5% of the amount billed to customers under otherwise applicable rates and charges.

Audit/Reconciliation: The DSIC will be subject to audit at intervals determined by the Commission. It will also be subject to annual reconciliation based on a reconciliation period consisting of the 12 months ending December 31 of each year. The revenue received under the DSIC for the reconciliation period will be compared to the Company's eligible costs for that period. The difference between revenue and costs will be recouped or refunded, as appropriate, in accordance with section 1307(e), over a 1 year period commencing on April 1 of each year. If DSIC revenues exceed DSIC-eligible costs, such overcollections will be refunded with interest. Interest on the overcollections will be calculated at the residential mortgage lending specified by the Secretary of Banking in accordance with the Loan Interest and Protection Law (41 P. S. § 101, et seq.) and will be refunded in the same manner as an overcollection.

New Base Rates: The charge will be reset at zero as of the effective date of new base rates that provide for prospective recovery of the annual costs that had theretofore been recovered under the DSIC. Thereafter, only the fixed costs of new eligible plant additions, that have not previously been reflected in the Company's rate base, would be reflected in the quarterly updates of the DSIC.

Earning Reports: The charge will also be reset at zero if, in any quarter, data filed with the Commission in the Company's then most recent Annual or Quarterly Earnings reports show that the Company will earn a rate of return that would exceed the allowable rate of return used to calculate its fixed costs under the DSIC as described in the Pre-tax return section.

Customer Notice: Customers shall be notified of changes in the DSIC by including appropriate information on the first bill they receive following any change. An explanatory bill insert shall also be included with the first billing.

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EXHIBIT

D

ARIZONA WATER COMPANY
DSIC-type Mechanisms by State

Line No.	State	Program	Frequency	Surcharge Cap	Included Plant
1					
2	Indiana	Distribution System Improvement Charge (DSIC)	Annually	5.0%	Mains, hydrants, services, meters
3					
4	Illinois	Qualifying Infrastructure Plant Surcharge (QIPS)	Annually	5.0%	Mains, hydrants, services, meters
5					
6	Missouri	Infrastructure System Replacement Surcharge (ISRS)	Semi-Annually	10.0%	Mains (includes relining), valves, hydrants, facility relocations
7					
8	Ohio	System Infrastructure Charge	Annually	3.0%	Mains (includes cleaning, relining, & extensions), valves, hydrants, services, landfand rights, rek
9					
10	Pennsylvania	Distribution System Improvement Charge (DSIC)	Quarterly	7.5%	Mains, valves, services, meters
11					
12	California	Distribution System Improvement Charge (DSIC)	Quarterly	7.0%	Wells, pumps, mains, hydrants, services, meters, tools & equipment
13					
14	Delaware	Distribution System Improvement Charge (DSIC)	Semi-Annually	7.5%	Mains, valves, hydrants, services, meters
15					
16	Connecticut	Water Infrastructure Conservation Adjustment (WICA)	Semi-Annually	5.0%	Mains (includes cleaning & relining), valves, services, hydrants, meters, leak detection equipmen
17					
18					
19					
20					
21					
22					

EXHIBIT

E

Resolution Endorsing and Co-Sponsoring "The Distribution System Improvement Charge"

WHEREAS, The Pennsylvania Public Utility Commission and the Pennsylvania Legislature have adopted a promising and unique regulatory approach that encourages the acceleration of the needed remediation of aging water utility infrastructures; *and*

WHEREAS, The Distribution System Improvement Charge is an automatic adjustment charge that enables recovery of infrastructure improvement costs on a quarterly basis in between rate cases for projects that are non-revenue producing and non-expense reducing such as main cleaning and relining, fire hydrant replacement and main extensions to eliminate dead ends; *and*

WHEREAS, A videotape which explains this unique approach is being prepared by the National Association of Water Companies to help educate and inform other regulatory agencies and legislatures about the benefits of this unique approach; *and*

WHEREAS, The U.S. EPA within its Drinking Water Infrastructure Needs Survey has identified a magnitude of national infrastructure needs of $77.2 billion in pending expenditures; *and*

WHEREAS, As the magnitude of need may be too great to be accomplished under traditional ratemaking methodologies; *and*

WHEREAS, The Distribution System Improvement Charge provides benefits to ratepayers such as improved water quality, increased pressure, fewer main breaks, fewer service interruptions, lower levels of unaccounted for water, and more time between rate cases which leads to greater rate stability; *and*

WHEREAS, Ratepayer protections are incorporated in the Pennsylvania approach: the surcharge is limited to a maximum of 5% of the water bill, annual reconciliation audits are conducted where overcollections will be refunded with interest and undercollections will be billed into future rates without interest recovery, the surcharge is reset to zero at the time of the next rate case, the charge is reset to zero if the company is over-earning, customer notice is provided, and all charges reflect used and useful plant; *now, therefore, be it*

RESOLVED, That the Board of Directors of the National Association of Regulatory Utility Commissioners (NARUC), convened at its 1999 Winter Meetings in Washington, D.C, agrees to endorse the mechanism as an example of an innovative regulatory tool that other Public Utility Commissions may consider to solve infrastructure remediation challenges in their States; *now be it further*

RESOLVED, That NARUC agrees to co-sponsor with the National Association of Water Companies the videotape of the Distribution System Improvement Charge as an educational tool to inform other regulatory agencies and legislatures about this promising new mechanism.

Sponsored by the Committee on Water
Adopted February 24, 1999

EXHIBIT

F

Resolution Supporting Consideration of Regulatory Policies Deemed as "Best Practices"

WHEREAS, A number of innovative regulatory policies and mechanisms have been implemented by public utility commissions throughout the United States which have contributed to the ability of the water industry to effectively meet water quality and infrastructure challenges; *and*

WHEREAS, The capacity of such policies and mechanism to facilitate resolution of these challenges in appropriate circumstances supports identification of such policies and mechanisms as "best practices"; *and*

WHEREAS, During a recent educational dialogue, the "2005 NAWC Water Policy Forum," held among representatives from the water industry, State economic regulators, and State and federal drinking water program administrators, participants discussed (consensus was not sought nor determined) and identified over 30 innovative policies and mechanisms that have been summarized in a report of the Forum to be available on the website of the Committee on Water at www.naruc.org; *and*

WHEREAS, As public utility commissions continue to grapple with finding solutions to meet the myriad water and wastewater industry challenges, the Committee on Water hereby acknowledges the Forum's *Summary Report* as a starting point in a commission's review of available and proven regulatory mechanisms whenever additional regulatory policies and mechanisms are being considered; *and*

WHEREAS, To meet the challenges of the water and wastewater industry which may face a combined capital investment requirement nearing one trillion dollars over a 20-year period, the following policies and mechanisms were identified to help ensure sustainable practices in promoting needed capital investment and cost-effective rates: a) the use of prospectively relevant test years; b) the distribution system improvement charge; c) construction work in progress; d) pass-through adjustments; e) staff-assisted rate cases; f) consolidation to achieve economies of scale; g) acquisition adjustment policies to promote consolidation and elimination of non-viable systems; h) a streamlined rate case process; i) mediation and settlement procedures; j) defined timeframes for rate cases; k) integrated water resource management; l) a fair return on capital investment; *and* m) improved communications with ratepayers and stakeholders; *and*

WHEREAS, Due to the massive capital investment required to meet current and future water quality and infrastructure requirements, adequately adjusting allowed equity returns to recognize industry risk in order to provide a fair return on invested capital was recognized as crucial; *and*

WHEREAS, In light of the possibility that rate increases necessary to remediate aging infrastructure to comply with increasing water quality standards could aversely affect the affordability of water service to some customers, the following were identified as best practices to address these concerns: a) rate case phase-ins; b) innovative payment arrangements; c) allowing the consolidation of rates ("Single Tariff Pricing") of a multi-divisional water utility to spread capital costs over a larger base of customers; *and* d) targeted customer assistance programs; *and*

WHEREAS, Small water company viability issues continue to be a challenge for regulators, drinking water program administrators and the water industry; best practices identified by Forum participants include: a) stakeholder collaboration; b) a memoranda of understanding among relevant

State agencies and health departments; c) condemnation and receivership authority; and d) capacity development planning; *and*

WHEREAS, The U.S. Environmental Protection Agency's "Four-Pillar Approach" was discussed as yet another best practice essential for water and wastewater systems to sustain a robust and sustainable infrastructure to comprehensively ensure safe drinking water and clean wastewater, including: a) better management at the local or facility level; b) full-cost pricing; c) water efficiency or water conservation; *and* d) adopting the watershed approach, all of which economic regulators can help promote; *and*

WHEREAS, State drinking water program administrators emphasized the following mechanisms which Forum participants identified as best practices: a) active and effective security programs; b) interagency coordination to assist with new water quality regulation development and implementation, such as a memorandum of understanding; c) expanded technical assistance for small water systems; d) data system modernization to improve data reliability; e) effective administration and oversight of the Drinking Water State Revolving Fund to maximize infrastructure remediation, along with permitting investor owned water companies access in all States; f) the move from source water assessment to actual protection; *and* g) providing State drinking water programs with adequate resources to carry out their mandates; *now therefore be it*

RESOLVED, That the National Association of Regulatory Utility Commissioners (NARUC), convened in its July 2005 Summer Meetings in Austin, Texas, conceptually supports review and consideration of the innovative regulatory policies and practices identified herein as "best practices;" *and be it further*

RESOLVED, That NARUC recommends that economic regulators consider and adopt as many as appropriate of the regulatory mechanisms identified herein as best practices; *and be it further*

RESOLVED, That the Committee on Water stands ready to assist economic regulators with implementation of any of the best practices set forth within this Resolution.

Sponsored by the Committee on Water
Adopted by the NARUC Board of Directors July 27, 2005

EXHIBIT

G

PENNSYLVANIA PUBLIC UTILITY COMMISSION
HARRISBURG, PENNSYLVANIA 17105-3265

Petition of Pennsylvania-American Water Company for Approval to Implement a Tariff Supplement...Revising the Distribution Distribution System Improvement Charge	**Public Meeting held July 11, 2007** **JUL-2007-OSA-0161*** **Docket No.: P-00062241, *et al.***

MOTION OF CHAIRMAN WENDELL F. HOLLAND

Before us for consideration is the Petition filed by the Pennsylvania American Water Company for approval to implement a tariff supplement revising the distribution system improvement charge ("DSIC"). The revision being sought is a request to raise the DSIC cap from 5% of billed revenues to 7.5% on DSIC eligible infrastructure.[1] Administrative Law Judge Wayne L. Weismandel issued a Recommended Decision which denied the Petition. I disagree with the Recommended Decision and instead will move to grant Pennsylvania-American's Exceptions which succinctly clarify the Petition's consistency with the purpose of DSIC, along with providing ample support as to the benefits expected to accrue to ratepayers with a 7.5% DSIC cap.

If there were ever a regulatory tool literally created right here in Pennsylvania that is recognized as a best practice around the country it is the DSIC. Its main features are that it is:

- Pro-environmental as it significantly decreases line loss of one of our most precious resources;
- Promotes a major objective of this Administration and this Legislature which is to fix Pennsylvania's aging infrastructure; and
- Promotes economic development as it creates hundreds of jobs.

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[1] Revenue neutral projects allowed under DSIC include: main and valve replacement, main cleaning and relining, fire hydrant replacement, main extensions to eliminate dead ends, solutions to regionalization projects and meter change outs.

Background

1. National View

The DSIC mechanism is one of the most important regulatory tools of the past decade. It has been cited by the National Association of Regulatory Utility Commissioners as a "Best Practice"[2] and it has been designated by the Council of State Governments as "Model Legislation."[3] Nationwide, it is common knowledge that infrastructure is deteriorating throughout the country and this dilemma must be addressed in a timely, cost-effective manner.[4] The U.S. Environmental Protection Agency cites a $276.8 billion need to upgrade or replace drinking water infrastructure over the next 20 years.[5] Here in the Commonwealth, the state's portion of drinking water infrastructure needs over 20 years totals $10.8 billion.[6]

Many utilities were built more than a century ago and much of today's plant in service requires expensive upgrading. The unprecedented magnitude of the extent of needed infrastructure upgrades, along with the high cost, call for innovative solutions. Mains that were first placed into the ground a century ago cost approximately $1 a foot. Today, the remediation or replacement costs range from $61 to $100 per foot. Under traditional ratemaking, the pace of remediation ranged from a few hundred years to 900 years, or not in any way nearing a realistic timeframe to match the actual service lives of mains (approximately 75-125 years, with exceptions based on materials and soils). Legislatures in six other states recognized that a new regulatory mechanism was needed to accelerate the pace of infrastructure upgrades at a reasonable cost. DSIC has been a key response toward resolving this challenge.

2. Pennsylvania Perspective

Prior to DSIC's implementation in 1997, Pennsylvania-American's timeframe to upgrade its existing, aging infrastructure was 225 years.[7] Following DSIC's implementation, the timeframe was reduced by nearly 25% to 170 years. A critical factor is that with its current increased investments in DSIC eligible projects over the 5% cap (the most recent[8] quarterly filing reached 6.36%), the Company estimates a 33%

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[2] NARUC Board of Directors, "Resolution Supporting Consideration of Regulatory Policies Deemed as Best Practices," July 27, 2005.

[3] Council of State Governments, "Suggested State Legislation," 2000 Volume 59, pages 44-45.

[4] Innumerable articles have documented this situation, among the most well known is the American Society of Civil Engineers, "Report Card for America's Infrastructure," 2005; water and wastewater infrastructure received grades of "D minus; the grade for American's infrastructure overall was a "D."

[5] U.S. Environmental Protection Agency, "Drinking Water Infrastructure Needs Survey and Assessment," 2003.

[6] *Ibid.*

[7] Other jurisdictional water companies faced similar or worse timeframes.

[8] As of January 1, 2007.

reduction to 112 years, which more realistically reflects actual service lives.[9] Matching replacement with service life substantially improves service reliability.

Infrastructure remediation and improved service and service reliability directly benefits customers. Upgrades of deteriorated mains are essential to reduce main breaks, service interruptions and unaccounted for water; and improve water quality, improve pressure, enhance fire protection, and achieve rate stability. Additional ratepayer benefits include these essential goals; DSIC:

- Promoted the acquisition of small and non-viable water systems, consistent with Commission policy (see 52 Pa. Code §§ 69.711 (relating to small and nonviable systems));
- Promoted the regionalization of water systems, consistent with Commission policy (see 52 Pa. Code §69.721 (relating to acquisitions));
- Reduced rate case expense by decreasing the frequency of base rate case filings;
- Allowed water utilities to afford remediation projects that would have otherwise been cost-prohibitive; and
- Decreased main breaks, service interruptions, low pressure problems, and discolored water.[10]

When DSIC's implementation was approved by the Commission, several critical safeguards were established, including a cap of 5% of billed revenues.[11] Additional safeguards include: resetting the DSIC to zero at the time of the next base rate case or if the utility is over-earning; providing notice to customers of any change in the DSIC rate; audits are conducted as needed, and an annual reconciliation audit is conducted to ascertain any over or under-collections, with any over-collections being refunded with interest at the time of the next DSIC calculation. All mains or other DSIC eligible projects have been placed into service prior to DSIC charges being issued to customers and meet used and useful parameters, which are among the foundations of utility ratemaking principles. These safeguards remain untouched by the Company's requested higher cap.

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[9] Pennsylvania-American Main Brief, page 9.

[10] Aqua Pennsylvania, Inc. Correction to Amicus Curiae Brief, Docket Nos. P-00062241 and P-00062241C-0001, p. 4.

[11] Petition of Pennsylvania-American Water Company for Approval to Implement a Tariff Supplement Establishing a Distribution System Improvement Charge, Docket No. P-00961031, Order entered August 16, 1996, see Attachment A, "Sample Tariff Language," p. 4. The Petition was undergoing an appeal in Commonwealth Court when an amendment was enacted by the Legislature to add a section to the Public Utility Code to expressly provide for the allowance of an automatic adjustment charge for infrastructure remediation at 66 Pa. C.S. §1307 (g). The new section of the Statute was signed into law on December 18, 1996.

The Company points out that:

> . . . under the ALJ's criteria, there would not be a need for a DSIC at all, so long as a minimal level of adequate service was being rendered. Fortunately, the General Assembly had a broader vision and has provided the Commission with the tools to replace aging infrastructure in the Commonwealth. PAWC simply requests that the Commission use this tool and permit the Company to increase its DSIC percentage so that the purpose of the law can be realized.[12]

Goal of An Increased Cap

Pennsylvania-American recognized that its ideal spending level for infrastructure remediation "should be adequate to keep pace with the anticipated remaining useful life of the distribution system infrastructure."[13] The Company explained that in 2006 it accelerated its infrastructure upgrade program by over 50% and replaced 82 miles of mains. This can be compared with the pre-DSIC figure of replacing 25 miles per year. From DSIC's inception in1997 until 2005, the Company replaced 47 miles of main, or 0.56%. The 2006 increased rate of 0.90% has been maintained in 2007 at a DSIC level of 6.36% for all of 2007, although it is only allowed to collect at 5%. As previously stated, the current accelerated rate should enable the Company to significantly reduce by 34% the amount of time it would take to make all of the needed improvements, from approximately170 years to 112 years.[14]

The Company also noted its current focus on replacing smaller diameter mains due to its discovery that they were found to be a more frequent source of main breaks than larger diameter mains.[15] The Company states that an increased DSIC cap to 7.5% will support its efforts to accelerate the systematic replacement of its older small diameter mains. The company estimates it can reduce by about 20 years the time in which it will be able to make the needed improvements to this segment of its distribution system. The Company points out that in comparison, "an under-funded DSIC is more likely to result in more significant costs associated with unplanned or more extensive system repairs in the future (e.g., more main breaks and service interruptions, higher levels of unaccounted for water, etc.).[16]

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12 Pennsylvania-American Water Company Exceptions, Docket No. P-00062241, p. 11.
13 Pennsylvania-American Water Company Main Brief, p. 9.
14 *Ibid.*, pp. 8-9.
15 *Ibid.*, p. 11.
16 *Ibid.*, p. 12.

The Company has determined that a higher investment level is essential for it to keep pace with the anticipated remaining useful life of the distribution system infrastructure.[17] In fact, the Company summarizes the evidence presented in the instant case as revealing a choice between:

> . . . (1) providing the Company with adequate resources (a 7.5% DSIC cap) to support a three-year or more base rate case filing cycle, or (2) providing the Company with more limited resources (a 5% DSIC cap) that would encourage a more frequent base rate case cycle – every year or two.[18]

The Company summarizes further that:

> . . . the current DSIC cap of 5% will still be inadequate to provide the Company with resources adequate to achieve the Commission's long term objective – to accelerate the replacement of PAWC's efforts to accelerate its distribution system improvement program and encouraging the Company to make reasonable frequent base rate case filings.[19]

A higher DSIC rate today is consistent with the legislative intent to economically accelerate infrastructure remediation:

> The DSIC more accurately reflects the ongoing investments and improvements that are made in the water distribution system versus the less frequent but larger step increases that would result from base rate increases without an appropriately funded DSIC. The timely recovery of the fixed costs of infrastructure replacement through the DSIC provides an incentive for increased and continued levels of capital infusion. This results in a stronger and more reliable water distribution system for both current and future customers.[20]

Moreover, I note that Pennsylvania-American's customers' rates at the 5% DSIC rate average $1.75 a month. With a 7.5% DSIC, that rate will increase by $1.00 a month. It should be kept in mind that this rate will be reset to zero following the next base rate case (or at any time that the Company is over-earning) and it takes a number of billing cycles of progressive increases over a few years to rise to the allowed level of the cap.

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17 *Ibid.*, p. 9

18 Pennsylvania-American Exceptions, p. 12.

19 *Ibid.*

20 Pennsylvania-American Main Brief, p. 13.

Most importantly, DSIC represents a dollar-for-dollar recovery of prudent expenses incurred for improving reliability to customers.

In addition, a response is necessary to the argument put forth by the Office of Consumer Advocate ("OCA") that simple presentation of expenses virtually guarantees recovery.[21] Expense recovery is granted only for those DSIC eligible projects that are prudently incurred, in service and used and useful. In raising the level of DSIC expense recovery, we clearly intend to continue its cautious use. Contrary to the OCA's reference to the reasoning of the Commonwealth Court in the recent Collection System Improvement Charge Appeal,[22] the DSIC review and audit process includes a determination of compliance and prudency. Hence, the Court's reference to recovery of projects being relatively automatic (using the example of a solid gold manhole cover being allowed, provided the expense was made and submitted) is simply not accurate nor reflective of the extensive and thorough DSIC review process.

Finally, I am mindful of the value of DSIC: "its success cannot be denied. It is now time to improve upon that success by allowing an incremental increase in the cap."[23] I wholeheartedly agree.

THEREFORE, I MOVE:

1. That the Recommended Decision of Administrative Law Judge Wayne L. Weismandel is rejected, consistent with this Motion;

2. That the Exceptions of the Pennsylvania-American Water Company are granted;

3. That the Petition of Pennsylvania-American Water Company to implement a tariff supplement revising the distribution system improvement charge is granted.

4. That the Office of Special Assistants shall prepare the appropriate order consistent with this Motion.

DATE **WENDELL F. HOLLAND, CHAIRMAN**

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21 Office of Consumer Advocate Main Brief, p. 12.
22 *Popowsky v. Pa. PUC*, 869 A.2d 1144, 1156 (2005).
23 Aqua Pennsylvania Amicus Curiae Brief, p. 3.

EXHIBIT

H

INFRASTRUCTURE REPLACEMENT AND ASSET MANAGEMENT[16]

Surveys conducted by the EPA suggest that the need for water and wastewater infrastructure improvement and replacement (both privately and publicly owned) over the next 20 years is between $500 billion and $1 trillion. This dollar level reflects a growing need across the nation to replace water and sewer pipes and other water and wastewater facilities as they approach the end of their useful lives.

The reason for this surge in infrastructure needs stems from the population boom and economic growth at the end of World War II. During those post-war years, there was unprecedented industrial, business, commercial and residential development, along with the water and wastewater infrastructure to support it. That infrastructure is now reaching the age when it is beginning to wear out and needs to be upgraded or replaced. Water and wastewater utilities need to manage those assets actively or risk adverse economic consequences, such as unplanned system failures, increased maintenance costs, and unbudgeted repair and replacement costs. Depending on the length of the useful life of various components, the need to replace this infrastructure will continue over the next several decades.

Many utilities have conducted plans consisting of a complete assessment of utility facilities and assets, including a determination of the condition and remaining useful life of each component of the system, right down to each segment of buried pipe. Components of the system are also rated in terms of criticality for operation of the system. A model is often developed based on asset condition, criticality, and other relevant factors to prioritize the infrastructure replacement and improvement needs over time. Costs are then applied to determine reinvestment needs over time.

The goal of these plans is to determine a reinvestment timeline that will allow continued operation of critical infrastructure throughout its useful life, but will ensure replacement before it fails and before maintenance costs increase dramatically. Planners then can prepare infrastructure replacement schedules and budgets that will spread out the costs of improvements over a pre-established planning horizon. This scheduling and budgeting will avoid unplanned maintenance and capital costs to the utility while maintaining efficient operation of the system.

This situation poses several challenges for utilities and regulatory commissions. One challenge is how to finance the necessary infrastructure replacements such that (a) rates increase gradually (as opposed to sudden spikes in rates) while (b) maintaining the utilities' financial stability. A second challenge is ensuring that the large expenditures are made prudently, so as to win and sustain customer trust and political credibility. Adding to the challenge is the absence, for most utilities, of a designated fund available to replace aging infrastructure—an absence attributable to ratemaking practices which have kept depreciation rates low and have disallowed or discouraged rate recovery of contributions in aid of construction.

EXHIBIT

I

ARIZONA WATER COMPANY
DSIC Revenue Requirement
As of December 31, 2010

Line No.		[A] Pinal Valley	[B]	[C]	[D]
1	TEST YEAR DATA				
2					
3	Eligible DSIC Plant in Service				
4	Accumulated Depreciation	$ 2,500,000			
5	(Sch. B, p. 1)	-			
6	Eligible DSIC Plant Rate Base	$ 2,500,000			
7	Required Rate of Return	9.51%			
8	(Proposed)				
9	Required Operating Income	$ 237,750			
10	(Ln. 6 x Ln. 7)				
11	Revenue Conversion Factor	1.8569			
12	(Decision No. 71845)				
13	Revenue Requirement - Return on Eligible DSIC Plant	$ 383,927			
14	(Ln. 9 x Ln. 11)				
15					
16	Depreciation on Eligible DSIC Plant	$ 45,249			
17	(Sch. B, p. 1)				
18					
19	Total Revenue Requirement	$ 429,175			
20	(Ln. 13 + Ln. 16)				
21					
22	Total Operating Revenue	17,358,501			
23					
24	Maximum increase cap	7.5%			
25					
26	Total Operating Revenue Limited by cap	$ 1,301,888			
27	(Ln. 22 X Ln. 24)				
28					
29	Total Revenue Requirement lesser of L 19 or 26	$ 429,175			
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	PINAL VALLEY (CASA GRANDE/COOLIDGE)		
	Current Rates	Proposed Rates	
	Decision No. 71845	DSIC	Total (B + C)
5/8 X 3/4-INCH RESIDENTIAL METER			
Basic Service Charge	$ 15.79	$ 0.50	$ 16.29
Commodity Rate (Per M Gallon)			
0 - 3,000 Gallons	$ 1.3700	$ 0.0437	1.4137
3,001 - 10,000 Gallons	$ 1.7123	$ 0.0437	1.7560
Over 10,000 Gallons	$ 2.1406	$ 0.0437	2.1843

	PINAL VALLEY (STANFIELD)		
	Current Rates	Proposed Rates	
	Decision No. 71845	DSIC	Total (B + C)
5/8 X 3/4-INCH RESIDENTIAL METER			
Basic Service Charge	$ 15.79	$ 0.50	$ 16.29
Commodity Rate (Per M Gallon)			
0 - 3,000 Gallons	$ 2.4379	$ 0.0437	2.4816
3,001 - 10,000 Gallons	$ 3.0476	$ 0.0437	3.0913
Over 10,000 Gallons	$ 3.8097	$ 0.0437	3.8534
Average Residential Bill (5/8 x 3/4 meter) - Casa Grande / Coolidge (8,622 gallons of usage)	$ 29.36	$ 0.87	$ 30.23
Average Residential Bill (5/8 x 3/4 meter) - Stanfield (8,622 gallons of usage)	$ 39.93	$ 0.87	$ 40.81

Supporting Schedules:

N:\2011_Rate_Case\Work Papers\DSIC ACRM Support\DSIC calculation example.xlsx\5-Revenue Req
Processing Date: 7/22/2011 8:58 AM

Recap Schedules:

EXHIBIT

J

VALUE OF WATER CAMPAIGN

AMERICANS ON THE U.S. WATER CRISIS

650
WATER MAIN BREAKS PER DAY

$2.6
BILLION IN LOST WATER EVERY YEAR

AT RISK
OUR NATION'S CLEAN WATER

BACKGROUND

Water has for too long been absent from the national debate on infrastructure. Hidden underground, the deterioration of our nation's water pipes and treatment systems has become an unseen crisis. In an era of water scarcity and tight budgets, we can no longer afford to lose nearly two trillion gallons of clean water, at an annual cost of $2.6 billion, to broken and leaking pipes every year.

Americans agree.

ITT's nationwide survey on the value of water details what Americans think should be done about this crisis—and who should pay for it.

EXECUTIVE SUMMARY

95% of American voters value water over any other service they receive, including heat and electricity

Our nation's industrial and agricultural businesses—among the heaviest water users—rank it second, after only electricity

About three out of four American voters and businesses* say disruptions in the water system would have direct and personal consequences

Too many take clean water for granted: 69% of voters, 72% of businesses*

When asked, U.S. voters and businesses* do express concern about our nation's water.

- Nearly one in four American voters is "very concerned" about the state of the nation's water infrastructure
- 29% percent of voters agree that water pipes and systems in America are crumbling and approaching a state of crisis
- 80% of voters say water infrastructure needs reform; about 40% say major reform

*INDUSTRIAL AND AGRICULTURAL BUSINESSES ONLY

FKS-RB9

November 28, 2011

Mr. Bobby Beeman
Beeman Pump Inc.
P.O. Box 5607
Apache Junction, AZ 85178

Re: Request for Proposal/Contract

Dear Mr. Beeman:

You are hereby invited to submit a formal written bid for the Bandy Heights Well No. 17, in accordance with Arizona Water Company's *General Conditions of Contract, Construction Specifications* and *Standard Specification Drawings*, and with specific plans and related construction drawings for this project.

All bids must be submitted on the enclosed Proposal form. Sealed bids will be received at the above address until December 2, 2011. There will be no formal bid opening.

A current Certificate of Insurance from the bidder must be on file with Arizona Water Company before the bidder's proposal will be considered. A **bid bond** is not required for this project.

Before a bidder is awarded a contract, the bidder may be required to demonstrate to Arizona Water Company's satisfaction that the bidder has the necessary facilities, ability, and financial resources to perform the work in a satisfactory manner within the time stipulated, and that the bidder has experience in the same or similar construction work. The bidder may also be required to furnish references concerning the bidder's qualifications.

Arizona Water Company reserves the right to reject or accept any bid.

A discussion of this project and a tour of the construction site may be scheduled by calling me at the above number.

Very truly yours,

Mike Loggins
Engineer
engineering@azwater.com

afh
Enclosures

November 28, 2011

Mr. Jeff McCray
Copperstate & Supply Inc.
P.O. Box 190
Snowflake, AZ 85937

Re: Request for Proposal/Contract

Dear Mr. McCray:

You are hereby invited to submit a formal written bid for the Bandy Heights Well No. 17, in accordance with Arizona Water Company's *General Conditions of Contract, Construction Specifications* and *Standard Specification Drawings*, and with specific plans and related construction drawings for this project.

All bids must be submitted on the enclosed Proposal form. Sealed bids will be received at the above address until December 2, 2011. There will be no formal bid opening.

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Arizona Water Company reserves the right to reject or accept any bid.

A discussion of this project and a tour of the construction site may be scheduled by calling me at the above number.

Very truly yours,

ML

Mike Loggins
Engineer
engineering@azwater.com

afh
Enclosures

November 28, 2011

Mr. Dan Wadell
Navajo Pump & Supply Company
P.O. Box 798
Tolleson, AZ 85353

Re: Request for Proposal/Contract

Dear Mr. Wadell:

You are hereby invited to submit a formal written bid for the Bandy Heights Well No. 17, in accordance with Arizona Water Company's *General Conditions of Contract, Construction Specifications* and *Standard Specification Drawings*, and with specific plans and related construction drawings for this project.

All bids must be submitted on the enclosed Proposal form. Sealed bids will be received at the above address until December 2, 2011. There will be no formal bid opening.

A current Certificate of Insurance from the bidder must be on file with Arizona Water Company before the bidder's proposal will be considered. A **bid bond** is not required for this project.

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Arizona Water Company reserves the right to reject or accept any bid.

A discussion of this project and a tour of the construction site may be scheduled by calling me at the above number.

Very truly yours,

ML

Mike Loggins
Engineer
engineering@azwater.com

afh
Enclosures

November 28, 2011

Mr. Fred Tregaskes
Weber Group, LC
16825 S. Weber Drive
Chandler, AZ 85226-4112

Re: Request for Proposal/Contract

Dear Mr. Tregaskes:

You are hereby invited to submit a formal written bid for the Bandy Heights Well No. 17, in accordance with Arizona Water Company's *General Conditions of Contract, Construction Specifications* and *Standard Specification Drawings*, and with specific plans and related construction drawings for this project.

All bids must be submitted on the enclosed Proposal form. Sealed bids will be received at the above address until December 2, 2011. There will be no formal bid opening.

A current Certificate of Insurance from the bidder must be on file with Arizona Water Company before the bidder's proposal will be considered. A **bid bond** is not required for this project.

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Arizona Water Company reserves the right to reject or accept any bid.

A discussion of this project and a tour of the construction site may be scheduled by calling me at the above number.

Very truly yours,

ML

Mike Loggins
Engineer
engineering@azwater.com

afh
Enclosures

November 28, 2011

Mr. Chris Willis
Willis Drilling & Pump Company
1351 S. Main Street
Snowflake, AZ 85937

Re: Request for Proposal/Contract

Dear Mr. Willis:

You are hereby invited to submit a formal written bid for the Bandy Heights Well No. 17, in accordance with Arizona Water Company's *General Conditions of Contract, Construction Specifications* and *Standard Specification Drawings*, and with specific plans and related construction drawings for this project.

All bids must be submitted on the enclosed Proposal form. Sealed bids will be received at the above address until December 2, 2011. There will be no formal bid opening.

A current Certificate of Insurance from the bidder must be on file with Arizona Water Company before the bidder's proposal will be considered. A **bid bond** is not required for this project.

Before a bidder is awarded a contract, the bidder may be required to demonstrate to Arizona Water Company's satisfaction that the bidder has the necessary facilities, ability, and financial resources to perform the work in a satisfactory manner within the time stipulated, and that the bidder has experience in the same or similar construction work. The bidder may also be required to furnish references concerning the bidder's qualifications.

Arizona Water Company reserves the right to reject or accept any bid.

A discussion of this project and a tour of the construction site may be scheduled by calling me at the above number.

Very truly yours,

MC

Mike Loggins
Engineer
engineering@azwater.com

afh
Enclosures

ARIZONA ATER COMPANY

SUPERSTITION - MIAMI
422 W. SULLIVAN STREET
MIAMI, AZ PH: 928-473-4433 FX: 928-473-2271

PROPOSAL/CONTRACT

CONTRACTOR: BEEMAN PUMP, INC	SYSTEM: SUPERSTITION
ADDRESS: P. O. BOX 5607	W.A. No(s):
CITY ST ZIP: APACHE JUNCTION, ARIZONA 85178	BID DUE DATE: December 2, 2011

CONTRACTOR SUBMITS this PROPOSAL/CONTRACT to ARIZONA WATER COMPANY, an Arizona corporation (the "Company"), to perform the work and complete the project described on Page 2 (the "Project"), as an independent prime contractor.

1. Contractor certifies that it has a complete copy of, and has read, understands and accepts, the Company's General Conditions of Contract, and the Company's Construction Specifications and Standard Specification Drawings, (the "Specifications"), all of which are attached hereto. Contractor has examined the specific plans and related construction drawings for the Project (the "Drawings"), copies of which are also attached hereto. The General Conditions of Contract, Specifications and Drawings are incorporated into this Proposal/Contract. Contractor affirms that all work and materials to be furnished or purchased for the Project will be in strict conformance with the General Conditions of Contract, Specifications and Drawings.

2. Contractor represents and warrants that it has satisfied and complied with the provisions of Section 6, Contractor Understands Work and Working Conditions, of the General Conditions of Contract prior to submitting this Proposal/Contract.

3. Contractor represents that this Proposal/Contract is fair and honest in all respects, is submitted in good faith and is not submitted in collusion with any other company, entity or person.

4. Contractor acknowledges that one hundred percent (100%) Performance and Payment Bonds are required and must be provided to the Company prior to the commencement of work.

5. Prior to the commencement of work, Contractor will submit to the Company a list of all materials to be used in the Project. The materials list will include the manufacturer, part number, price and quantity included in this Proposal/Contract.

6. Contractor will furnish all labor, tools, equipment and materials required to complete the Project according to the General Conditions of Contract, Specifications and Drawings. No materials purchased by Contractor to be incorporated into the Project are subject to tax at the time of purchase and Contractor will not charge the Company for any such tax. Contractor will pay the applicable transaction privilege tax (the "Contracting Tax") on the Project after Contractor receives payment of the final Project invoice from the Company. The cost of materials incorporated into the Project which are exempt by Arizona Revised State Statues ("A.R.S.") from the Contracting Tax, for example, pipes or valves having a diameter of four (4) inches or larger, including equipment, fittings and any other related part that is used in operating the pipes or valves (A.R.S. §42-5061 B.6.), will not be included in the total cost of the labor and materials upon which the Contracting Tax is computed. Contractor retains full liability and obligation to pay the Contracting Tax and will defend and indemnify the Company against any demand or obligation to pay the Contracting Tax.

7. Contractor will maintain detailed accounting records of all materials purchased and incorporated into the Project. Such records will include all supporting original vendor invoices for all materials purchased. Following completion of the Project, Contractor will submit an itemized accounting to the Company which will include all supporting original vendor invoices and satisfactory evidence of payment thereof. The Company will not pay Contractor for materials not actually incorporated into the Project, and the disposition of such materials will remain Contractor's responsibility.

8. The Estimated Total Cost of the Project, shown on Page 2, is based on estimated labor and material quantities to be furnished. It includes an estimate of the Contracting Tax and the cost of the required Performance and Payment Bonds. Contractor will not cancel, modify or withdraw this Proposal/Contract during a ninety-day (90) period commencing on the Bid Due Date. The Company may accept this Proposal/Contract by signing and mailing, or otherwise delivering, a copy hereof to Contractor during such ninety-day (90) period. If the Company does not accept this Proposal/Contract during such ninety-day (90) period, Contractor may cancel this Proposal/Contract by giving written notice of cancellation to the Company.

9. Prior to the commencement of work, Contractor will provide the Company with a detailed construction schedule, in either Gantt or CPM form, identifying all tasks to be performed from the date of the written Commencement Notice through completion of the Project, including testing, training of Company Personnel and final Project invoicing. Contractor will provide the Company with a copy of such construction schedule documenting the progress of work on the Project at least monthly.

10. Contractor will not commence work on the Project until the Company gives Contractor a written Commencement Notice. Contractor will complete the Project within _____ calendar days after the Commencement Notice is issued.

11. Following the Company's written notice of satisfactory completion of the Project, and upon receipt of the final Project invoice from Contractor, the Company shall pay Contractor the actual total cost of the Project, which will be calculated as shown on Page 2, except that actual labor and material quantities installed/constructed will be substituted for the estimated labor and materials quantities and the Contracting Tax will be recalculated based on such actual labor and materials quantities.

12. The amount of applicable liquidated damages for Contractor's failure to deliver or perform within the time limit shown in Paragraph 10 may be deducted from the Company's payment of the final Project invoice. This provision shall not limit the Company's ability to terminate this Proposal/Contract for Contractor's unsatisfactory performance or failure to perform as provided in the General Conditions of Contract, Specifications or Drawings, or in this Proposal/Contract.

SPECIAL CONDITIONS:

CONTRACTOR	PROPOSAL/CONTRACT ACCEPTED:
BEEMAN PUMP, INC.	***ARIZONA WATER COMPANY***
By:	By:
Print Name:	Print Name: Fredrick K. Schneider, PE
Title:	Title: Vice President - Engineering
Date:	Date:

AFH

ARIZONA WATER COMPANY

SUPERSTITION - MIAMI
422 W. SULLIVAN STREET
MIAMI, AZ PH: 928-473-4433 FX: 928-473-2271

PROPOSAL/CONTRACT

CONTRACTOR: BEEMAN PUMP, INC	SYSTEM: SUPERSTITION
AZ CONTRACTOR LICENSE NO: CLASSIFICATION:	W.A. No(s):
ADDRESS: P. O. BOX 5607	BID DUE DATE: December 2, 2011
CITY ST ZIP APACHE JUNCTION, ARIZONA 85178	BID BOND REQUIRED ☐ Yes ☑ No

DESCRIPTION OF PROJECT: PULL AND REPLACE SUBMERSIBLE PUMP AND MOTOR AT BANDY HEIGHTS WELL NO. 17 IN MIAMI, ARIZONA.

1-2. MATERIALS EXEMPT FROM CONTRACTING TAX (per Paragraph 6)	QUANTITY	UNIT PRICE LABOR	UNIT PRICE MATERIALS		TOTAL COST LABOR		TOTAL COST MATERIALS
				1		2	
3. Total Labor to Install Exempt Materials (add the amounts in column 1)				3			
4. Total Exempt Materials (add the amounts in column 2)						4	

5-6. NON-EXEMPT MATERIALS	QUANTITY	LABOR	MATERIALS		LABOR		MATERIALS
Pull & replace submersible pump and motor	1 ea						
Purchase and install Gould 90L25 pump & motor	1 ea						
Video well w/side scan, video log and DVD copy	1 ea						
Misc SS buckles, bandits, and tape	Lot						
MEG submersible cable	1 ea						
3/4" SCH 40 PVC couplings	35 ea						
2 1/2" x 20' column pipe (price only)	1 ea			5		6	
1/4" Stainless Steel airline (price only)	700 ft						
2 1/2" Flowmatic DIX check valve w/knock out plug (price only)	1 ea						
#4 - 3 wire submersible cable (price only)	750 ft						
1" SCH 40 PVC (price only)	700 ft						
2" SCH 40 PVC (price only)	200 ft						
Brush and bail cable tool only (price only)	1 hr						
7. Total Labor to Install Non-Exempt Materials (add the amounts in column 5)				7			
8. Total Non-Exempt Materials (add the amounts in column 6)						8	
9. Subtotal A (add lines 3, 7 and 8)						9	
10. Contracting Tax Base (multiply the amount on line 9 by 0.65)				10			
11. Applicable Contracting Tax Rate				11			
12. Contracting Tax (multiply the amount on line 10 by line 11)						12	
13. Subtotal B (add lines 4, 9 and 12)						13	
14. 100% Performance and Payment Bonds Cost						14	
15. Estimated Total Cost (add lines 13 and 14)						15	

NOTE: The Estimated Total Cost includes all labor and materials for backfill, pavement replacement, chip seal, and traffic control necessary for the Project.

FKS-RB10

ARIZONA WATER COMPANY

CONSTRUCTION PLACED IN SERVICE NOTICE

WORK AUTHORIZATION NO.: 1-4942

DIVISION: Miami

DATE PLACED IN SERVICE: 03 | 22 | 2012

CONTRACT NO: Special #3

FOR PURPOSES OF *MODIFIED ACCELERATED COST RECOVERY SYSTEM*, AN ASSET IS "PLACED IN SERVICE" WHEN IT IS IN A CONDITION OR STATE OF READINESS AND AVAILABILITY FOR A SPECIFICALLY ASSIGNED FUNCTION, WHETHER IT BE FOR USE IN A TRADE OR BUSINESS, OR FOR THE PRODUCTION OF INCOME.

I CERTIFY THAT THE ASSET(S) CONSTRUCTED PURSUANT TO THE PROVISIONS OF THE ABOVE-REFERENCED WORK AUTHORIZATION ARE READY FOR SERVICE AS OF THE DATE SHOWN ABOVE.

Division Manager or Operations Superintendent
(signature)

03/22/2012
Date

SUBMIT ORIGINAL TO ACCOUNTING DEPARTMENT

A-1-3-1
FKS 11/24/11

ARIZONA WATER COMPANY

Docket No. W-01445A-11--310

2011 RATE HEARING

For Test Year Ending 12/31/10

PREPARED

REBUTTAL TESTIMONY & EXHIBITS

OF

THOMAS M. ZEPP

TABLE OF CONTENTS

I. INTRODUCTION, PURPOSE OF TESTIMONY AND SUMMARY 3

II. RESPONSES TO MR. RIGSBY'S DCF ESTIMATES 5

III. RESPONSES TO MR. RIGSBY'S CAPM ESTIMATES AND OTHER ISSUES 14

IV. RESPONSES TO MR. CASSIDY'S DCF ESTIMATES 23

V. RESPONSES TO MR. CASSIDY'S CAPM ESTIMATES AND OTHER ISSUES 30

VI. QUANTITATIVE EVIDENCE SHOWING ANALYSTS' FORECASTS ARE NOT BIASED 32

VII. ARITHMETIC VERSUS GEOMETRIC ANNUAL AVERAGES 39

EXHIBITS

ROGER A. MORIN, NEW REGULATORY FINANCE, PUBLIC UTILITIES REPORTS INC., 2006 ..... TMZ-1

REBUTTAL TABLES 1-13 ..... TABLES

MATT KRANTZ, INVESTORS FINALLY SEE PICTURE OF PROFIT, USA TODAY, 2005 ..... TMZ-3

THE VALUE LINE INVESTMENT SURVEY, SELECTION & OPINION, PART 2, JUNE 29, 2001 ..... TMZ-4

ARIZONA WATER COMPANY

Rebuttal Testimony of

THOMAS M. ZEPP

I. Introduction, Purpose of Testimony and Summary

Q. PLEASE STATE YOUR NAME AND ADDRESS.

A. My name is Thomas M. Zepp. My business address is 1500 Liberty Street, S.E., Suite 250, Salem, Oregon 97032.

Q. ARE YOU THE SAME THOMAS M. ZEPP THAT PREVIOUSLY PROVIDED DIRECT TESTIMONY IN THIS MATTER?

A. Yes. I previously filed direct testimony on the appropriate cost of equity. My professional background and experience are described in that testimony.

Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS CASE?

A. On behalf of the applicant, Arizona Water Company ("Arizona Water" or "the Company").

Q. WHAT IS THE PURPOSE OF YOUR REBUTTAL TESTIMONY?

A. The purpose of this rebuttal testimony is to review and respond to the direct testimonies of John A. Cassidy who testifies on behalf of the Arizona Corporation Commission ("Commission"), Utilities Division ("Staff") and William A. Rigsby who testifies on behalf of the Residential Utility Consumer Office ("RUCO") which address Arizona Water's cost of equity in this proceeding.

Q. HAS YOUR RECOMMENDED COST OF EQUITY FOR ARIZONA WATER CHANGED AFTER REVIEWING THE TESTIMONIES PRESENTED BY MR. CASSIDY AND MR. RIGSBY?

A. No. It is my opinion that the Company should be authorized a return on equity of 12.5%. I fully explain the basis for that recommendation in my direct testimony. While expected interest rates have decreased since March 2011 when I prepared

that cost of equity estimate, other indicators of the cost of equity indicate the 12.5% cost of equity still falls within a reasonable range of equity cost estimates for Arizona Water, and thus my recommendation is still appropriate at this time.

Q. HOW IS YOUR REBUTTAL TESTIMONY ORGANIZED?

A. In Section II, I respond to Mr. Rigsby's DCF equity cost estimates. I discuss the samples he adopts for his analysis and point out how choices he makes bias his DCF cost of equity estimates downward.

In Section III, I reply to Mr. Rigsby's CAPM cost of equity estimates. His CAPM estimates are not reasonable and should be rejected because they are below the expected cost of low risk investment grade bonds. This occurs, in part, because he ignored the work of William Sharpe who was one of the developers of the CAPM.

In Section IV, I respond to Mr. Cassidy's DCF analyses. American Water Works satisfies the criteria he adopted to establish his sample, yet he excludes it from his sample. His decision to exclude this utility biases his DCF cost of equity estimates downward. His DCF estimates are also flawed because he fails to consider analysts' estimates of EPS growth made by Zacks, Yahoo! Finance and Reuters.

In Section V, I respond to Mr. Cassidy's CAPM estimates and mis-statements he makes about my CAPM estimates. I revisit the importance of basing CAPM cost of equity estimates on Treasury rates expected during the period new prices for Arizona Water services will be in place and why long-term Treasury rates should be used as the risk-free rate to compute estimates under both Staff CAPM approaches.

In Section VI, I offer evidence, in the form of quantitative studies, that analysts' forecasts of EPS growth for utilities are not "overly optimistic" as claimed by Mr. Cassidy and Mr. Rigsby. These studies show that analysts' forecasts of future EPS growth for utilities are very reliable once unexpected

inflation is taken into account. Also, statistical analyses of data for two of the studies show that, once the variability in the data is recognized, the analysts' forecasts of EPS for utilities are statistically no different than perfect forecasts. Mr. Cassidy relied upon a quotation from a book by Professor Malkiel to conclude limited weight should be given to analysts' forecasts for utilities. The four quantitative studies I present put the Malkiel quotation in perspective and show analysts' forecasts for utilities are quite accurate predictors.

In Section VII, I explain why it is appropriate to rely on arithmetic annual averages instead of geometric annual averages when determining future growth rates and required ROEs from historical data. Mr. Rigsby ignores the thoughtful discussion by scholars about this issue and biases his cost of equity estimates by relying on estimates of market returns based on conceptually inappropriate geometric annual averages.

II. Responses to Mr. Rigsby's and Mr. Cassidy's DCF Cost of Equity Estimates

Q. WHAT SAMPLES OF UTILITIES DOES MR. RIGSBY RELY UPON TO PREPARE HIS COST OF EQUITY ESTIMATES FOR ARIZONA WATER?

A. He relies on a sample of five water utilities and separately a sample of nine natural gas local distribution companies ("LDCs") to conduct his analyses.

Q. DO YOU RESPOND TO HIS COST OF EQUITY ESTIMATES FOR THE GAS LDCs?

A. No. I limit my response to his estimates for the sample of five water utilities. He does not include either American Water Works or Connecticut Water Service in his sample of water utilities. I address the exclusion of American Water Works in my response to Mr. Cassidy and address my response to Mr. Rigsby based on the sample of five water utilities he adopts.

Q. ARE YOU AWARE OF ANY PRIOR ATTEMPTS TO USE GAS UTILITIES TO ESTIMATE THE COST OF EQUITY IN A WATER UTILITY RATE CASE?

A. Yes. In Arizona Water's 2002 rate case for its Eastern Group, I proposed the

use of a sample of gas utilities to estimate the cost of equity. Because of differences in risk and estimated required ROEs for the two groups of utilities, the Commission rejected the use of the gas utilities.[1]

Company witness Pauline M. Ahern provides additional testimony on the differences in the risks between water utilities and gas utilities in her rebuttal testimony that is filed concurrently.

Q. ARE THERE OTHER REASONS NOT TO CONSIDER MR. RIGSBY'S ANALYSIS BASED ON GAS LDCs?

A. Yes. A thorough response to the estimates made with his gas proxy group must necessarily consider whether his sample is truly representative of the gas LDCs, as well as the cost of equity estimates.

Q. ARE YOU MAKING SUCH A THOROUGH ANALYSIS IN THIS CASE?

A. No. Instead I note that Mr. Rigsby does not justify why the nine gas companies he includes in his gas LDC sample were chosen for such an analysis while other gas companies were excluded. In *Value Line's* Issue 3, dated December 9, 2011, *Value Line* lists 21 companies in a category it calls "Natural Gas (Diversified) Industry and lists 12 companies in a category it calls "Natural Gas Utility Industry." Mr. Rigsby does not explain why he considers only 9 of these 33 companies in his analysis.

For example, he excludes NiSource, Inc. from his LDC sample without justification even though it supplies gas to 3.3 million gas customers in Indiana, Ohio, Pennsylvania, Kentucky, Virginia, Maryland and Massachusetts. *Value Line* includes NiSource in the group of companies it calls the Natural Gas Utility Industry. Additionally, the March 2012 AUS Utility Reports states 65% of NiSources' revenues come from regulated gas utility operations.

Q. WHY DO YOU FOCUS ON NISOURCE?

[1] Decision No. 66849 at 21.

A. I focus on this one company to show by example why the gas proxy group adopted by Mr. Rigsby appears to be results-oriented. By excluding NiSource from his analysis, he biases downward his DCF cost of equity and CAPM cost of equity estimates for the gas LDC sample and ultimately for Arizona Water. Based on Value Line's report for NiSource dated December 9, 2011, the company had a dividend yield of 4.2% and expected EPS growth of 9.0%. Even if we assume no growth in dividends during the first year (as is done by Mr. Rigsby in his estimates for water utilities) the indicated cost of equity for NiSource is 13.2% — much greater than the 9.32% he reports for his gas LDC sample. That cost of equity is estimated as follows:

Equity cost = 4.2% + 9.0% = 13.2%

In regard to the CAPM estimate, the beta for NiSource is 0.85 — higher than any of the betas he reports for his selected group of gas companies. As a result, had Mr. Rigsby included NiSource in his sample, he would have determined the DCF cost of equity and the CAPM cost of equity for his gas proxy group (and correspondingly for Arizona Water) were higher than 9.32%.

Q. PLEASE TURN TO YOUR COMMENTS ABOUT MR. RIGSBY'S DCF COST OF EQUITY ESTIMATES FOR THE WATER UTILITIES SAMPLE. HOW DOES MR. RIGSBY DETERMINE THE GROWTH RATES HE USES IN HIS DCF MODEL?

A. Mr. Rigsby relies on his estimates of sustainable growth for each of the five water utilities included in his water utilities sample. He determines sustainable growth by adding together his estimates of expected growth from retained earnings ("br growth") and his estimates of growth from future sales of stock above book value ("sv growth"). Though he compares his estimates of br + sv growth to forecasts

of growth made by Value Line and Zacks and considers past growth in EPS, DPS and BVPS, he ignores forecasts of growth and gives no explicit weights to any forecasted data when he determines his growth rate estimates.

Q. AS A THRESHOLD MATTER, DO YOU HAVE CONCERNS WITH DETERMINING DCF COST OF EQUITY ESTIMATES FOR UTILITIES WHICH ARE BASED ON MR. RIGSBY'S BR GROWTH RATE ESTIMATES?

A. Yes. I have two threshold concerns with relying on Mr. Rigsby's br growth rates to determine DCF cost of equity estimates for regulated utilities.

First, Mr. Rigsby understates and biases downward his br growth rate estimates by not making the standard adjustment usually attributed to FERC. This adjustment has also been routinely made by Staff, so RUCO should be familiar with this standard adjustment. Value Line reports ROEs by computing the ROE on year-end equity. For a regulated utility, the ROE should be adjusted to a mid-period basis. Rebuttal Table 1 combines the Value Line book value per share forecasts reported by Mr. Rigsby in Schedule WAR-6 with the FERC formula to adjust the Value Line ROEs to a mid-period basis. After making this correction, the average estimate of br growth increases. Compare Rebuttal Table 1 with Mr. Rigsby's Schedule WAR-4, page 1 of 2.

Second, scholars recognize estimates of "br" growth for utilities are based on circular reasoning and thus should not be considered or should, at most, be given less weight. See, for example, Roger Morin, New Regulatory Finance, pages 303-307. Morin points out one of the practical problems with applying Mr. Rigsby's approach is potential circularity in the approach. Mr. Rigsby relies on Value Line estimates of future returns on equity (the "r" in "br" growth) to make his estimates. The circularity occurs because Value Line's estimates of the expected future ROEs depend to a large extent upon what Value Line expects regulators will set as the authorized ROEs. Thus, to the extent that regulators rely on Value Line's forecasts of ROEs to determine growth for the DCF equity

cost estimates, they are relying to a large extent on the ROEs Value Line predicts will be established by the regulators. This reliance on the Value Line forecasts makes br growth rate estimates circular.

Q. ARE THERE REASONS OTHER THAN THE CIRCULARITY PROBLEM WHICH INDICATE LIMITED WEIGHT SHOULD BE GIVEN TO DCF ESTIMATES BASED ON BR + SV GROWTH RATE ESTIMATES?

A. Yes. Mr. Rigsby overlooks an obvious inconsistency between his equity cost estimates and the ROEs projected by Value Line. Rebuttal Table 1 shows that the average ROE Value Line forecasts will be earned by the water utilities is 10.7%, once it is corrected to a mid-period basis. If these utilities are authorized to earn 10.7% ROE, the regulators should adopt rates and rate-adjustment mechanisms which allow them, on average, a reasonable opportunity to earn a 10.7% ROE. But when Mr. Rigsby uses br + sv growth rate estimates to calculate DCF costs of equity, the resulting ROE is more than 200 basis points lower than what Value Line forecasts for water utilities. This inconsistency raises serious questions about the reliability of Mr. Rigsby's methods, model and the br + sv growth rates he uses in the model.

Q. DO YOU HAVE ANY CONCERNS WITH HIS ESTIMATES OF "SV" GROWTH?

A. Yes. Rebuttal Table 2 revises Mr. Rigsby's estimates of sv growth to be consistent with assumptions underlying the DCF model. Rebuttal Table 3 combines the adjusted estimates of br growth with the corrected estimates of sv growth. Mr. Rigsby biases his estimates of "sv" growth downward by basing his calculations on assumptions that are inconsistent with the DCF model. His estimates are also unsupportable and arbitrary because he provides no basis for his assumed values of "v."

Q. WHAT IS THE PROBLEM WITH THE FORMULA HE USES TO COMPUTE "V" IN "SV" GROWTH?

A. In estimating the "v" in "sv" growth, Mr. Rigsby chooses a formula that reduces

the estimates of sv growth to values that are only one-half as large as is revealed in market data. He opines that, ultimately, investors would expect stock prices for regulated utilities to drop to book value (*See* Mr. Rigsby's direct testimony, Pg. 16). Thus, instead of using the market prices to determine "v", Mr. Rigsby substitutes an average of the observed market-to-book ratio and a hypothetical market-to-book ratio of 1.0 to compute his estimate of "v" in "sv" growth. This method of calculating sv growth is both arbitrary and ignores important concepts underlying the DCF model.

When the market-to-book ratio is 1.0, "v" is estimated to be zero and "sv" growth is also estimated to be zero. If one adopts the concept Mr. Rigsby espouses, it has the effect of assuming investors expect one-half as much "sv" growth as is revealed by market data. The issue is not whether investors do or do not expect prices for utility stocks to drop to book values at some point in the future. The issue is that the DCF model assumes market prices for utility stocks would already reflect potential movements, if any, back to book values. Therefore, Mr. Rigsby's adjustment is inconsistent with concepts underlying the DCF model. By adopting the formula he uses to compute sv growth, he cuts the sv growth rate estimates in half, ultimately causing understated DCF cost of equity estimates.

The adjustment is also arbitrary because Mr. Rigsby cuts the estimate of sv growth to one-half the value indicated by market prices but provides no evidence or support for such reductions in sv growth.

Q. SHOULD MARKET PRICES MOVE TOWARD BOOK VALUES IF A UTILITY'S AUTHORIZED RETURN IS EQUAL TO THE COST OF EQUITY?

A. Not necessarily. There are a number of reasons investors price utility stocks above book values. These reasons include the fact if a utility is condemned, investors can expect courts to award prices for utility assets that reflect market, not book, prices. As a result, average market-to-book ratios for water utilities

followed by AUS Utilities Reports have been consistently above 1.0 since at least 1991. Past history does not support the arbitrary adjustment made by Mr. Rigsby.

Q. WHAT IS SHOWN IN REBUTTAL TABLE 3?

A. Rebuttal Table 3 places Mr. Rigsby's growth rate estimates in perspective. It reports values of br + sv growth that incorporate correct estimates of external (sv) growth and other indicators of growth reported by Mr. Rigsby.

Q. ARE THESE GROWTH RATES THE ONLY INDICATORS OF FUTURE GROWTH AVAILABLE TO INVESTORS?

A. No. Mr. Rigsby presented a basic model at page 10 of his testimony that shows EPS, BVPS and DPS are all expected to grow at the same rate in equilibrium. He fails to mention that in equilibrium, market prices per share ("MPPS") will also grow at the same rate as BVPS, DPS and EPS if the market-to-book ratio is constant during the period considered.

Q. DOES VALUE LINE PROVIDE FORECASTS OF MPPS GROWTH AS WELL AS GROWTH IN BVPS, EPS AND DPS IN THE REPORTS MR. RIGSBY INCLUDED IN ATTACHMENT A TO HIS TESTIMMONY?

A. Yes.

Q. DID MR. RIGSBY INCLUDE MPPS GROWTH IN HIS LIST OF GROWTH RATES THAT MIGHT BE CONSIDERED BY INVESTORS?

A. No, he did not.

Q. WHAT IS THE IMPACT OF MR. RIGSBY NOT CONSIDERING MPPS GROWTH IN HIS ANALYSIS?

A. It understates the indicators of growth he considers as a check on the growth rates he adopts, thereby invalidating such check. Rebuttal Table 3 provides the Value Line forecasts of future increases in MPPS for each of the water utilities in Mr. Rigsby's sample.

Q. WOULD INVESTORS BE INTERESTED IN FORECASTS OF MPPS INCREASES?

A. Yes. Obviously investors would be interested in potential capital gains from owning water utility stocks. Except for projected increases in EPS, investors would likely be more interested in projected MPPS increases than either projected DPS or projected BVPS. I explain in my direct testimony why investors would be more interested in EPS growth than DPS or BVPS growth.

Q. DO YOU ALSO PROVIDE ESTIMATES OF PAST GROWTH IN MPPS?

A. Yes. Past growth in MPPS is also provided in Rebuttal Table 3. To the extent that investors give weight to past growth in BVPS, EPS or DPS, they would also be interested in past growth in MPPS.

Q. ARE THERE OTHER DATA AVAILABLE TO INVESTORS THAT MR. RIGSBY DID NOT INCLUDE IN HIS PRESENTATION OF GROWTH RATES?

A. Yes. There are analysts' forecasts reported by Reuters and Yahoo! Finance that are readily available to investors that Mr. Rigsby excluded from his analysis. I report those other analysts' forecasts in Rebuttal Table 3.

Q. HAVE YOU DETERMINED AN AVERAGE OF THESE VARIOUS INDICATORS OF GROWTH?

A. Yes. Rebuttal Table 3 reports averages of (a) br + sv growth (as corrected), (b) an average of the four Value Line forecasts, (c) an average of the three analysts' forecasts and (d) an average of the four historic growth rates. Each of these averages is higher than the 5.17% estimate of growth relied upon by Mr. Rigsby. Mr. Rigsby states that he considers all of these indicators of growth but then he disregards these indicators and relies solely on his estimate of br + sv growth to conduct his DCF analysis. Above, I explained why the circularity in br growth rate estimates reduces the usefulness of such calculations. As a result, it is appropriate to give estimates of br + sv growth less weight and to give analysts' forecasts of EPS growth more weight.

Q. WHAT ARE THE AVERAGES YOU REPORT IN REBUTTAL TABLE 3?

A. Rebuttal Table 3 reports averages of all of the growth rates presented in Rebuttal Table 3, as well as averages of the conceptually most appropriate estimates of growth for DCF estimate, analysts' forecasts of EPS growth. In Schedule WAR-4, page 1 of 2, Mr. Rigsby reports the average growth rate he has used in his analysis is 5.17%. For perspective, an average of all of the growth rates reported in Rebuttal Table 3 is 6.7% and an average of the conceptually correct analysts' estimates of growth is 7.9%. Mr. Rigsby has chosen lower estimates of growth for his analysis which, ultimately, understate DCF cost of equity estimates.

Q. ARE COMBINED AVERAGES OF THESE VARIOUS ESTIMATES OF GROWTH BETTER ESTIMATES OF GROWTH FOR THE WATER UTILITIES THAN ANALYSTS' FORECASTS?

A. No. I explain in my direct testimony why averages of analysts' forecasts of EPS growth provide the best indicator of growth expected by investors. I report an average of Value Line EPS forecasts and consensus estimates of analysts' forecasts reported by Zacks, Yahoo! Finance and Reuters in Rebuttal Table 3.

Q. HOW DOES MR. RIGSBY DETERMINE HIS ESTIMATES OF DIVIDEND YIELDS USED IN HIS DCF ESTIMATES?

A. The DCF model requires estimates of growth for the next period (D_1) to be used in the calculation of the dividend yield (D_1/P_0). Mr. Rigsby has not done that. Instead, he inappropriately computes the dividend yields for California Water and SJW Corp. using <u>last year's</u> dividend as the measure of the future dividend and assumes the future dividends for the other three utilities will be the same as they are today. Rebuttal Table 4 shows part of the impact this defective choice of data causes[2]. If current dividends had been increased by the near-term

[2] The full impact would recognize the time value of money as well as appropriate forecasts of next year's dividends.

growth rate assumed by Staff of 5.2%, the dividend yield he used in his DCF analysis would be higher.

Q. SHOULD THE DIVIDEND YIELDS ADOPTED IN DCF ANALYSES RECOGNIZE THE TIME VALUE OF MONEY?

A. Yes. I explained this point at page 18 of my direct testimony. When Mr. Rigsby computed his dividend yields, he did not recognize the time value of money.

Q. DO YOU HAVE A RESPONSE TO HIS COMMENTS ABOUT DIFFERENCES IN YOUR DCF ESTIMATES AND HIS?

A. Yes. At page 59, Mr. Rigsby states he believes the main reason for differences in our growth rate estimates is that I rely primarily on EPS forecasts and he relies on forecasts of future growth in EPS, DPS and BVPS. I do not agree. His focus was on determining estimates of br growth and sv growth and he limited his reliance on the other indicators of growth. Also, if past growth in MPPS and Value Line's projected estimates of MPPS were taken into account, his indicators of DCF growth would increase substantially. Mr. Rigsby fails to acknowledge that in equilibrium, investors would anticipate MPPS would grow at the same rate as DPS, EPS and BVPS and thus should be considered in his analysis. He never rebuts the fact that EPS forecasts from numerous sources are readily available to investors and are the best indicators of growth expected by investors.

III. <u>Responses to Mr. Rigsby's CAPM Estimates and Other Issues</u>

Q. DO YOU HAVE ANY PRELIMINARY COMMENTS ABOUT RUCO'S CAPM ESTIMATES?

A. Yes. Without even considering how RUCO's CAPM results were derived, it is clear that Mr. Rigsby's estimates are too low to satisfy the attraction of capital standard required by the U.S. Supreme Court. Mr. Rigsby's CAPM estimates range from 4.03% to 5.38% for the water utilities sample and average only

4.71%.[3] By contrast, the yield on expected investment-grade corporate bonds (i.e., low risk) is 6.30%.[4] The results produced by RUCO's method are unreasonable under any test and would be confiscatory if actually used to set rates. They are well below the alternative expected cost of lower risk investment grade debt.

Q. TURN TO YOUR SPECIFIC COMMENTS ABOUT MR. RIGSBY'S CAPM ESTIMATES. HAS HE USED A CORRECT CONCEPT TO DETERMINE THE VALUE FOR RF?

A. No. Mr. Rigsby uses a 5-year Treasury security rate in his CAPM approach. It is inappropriate to use either a short-term or intermediate-term Treasury security to determine the value for RF, the risk-free rate of return, for two reasons.

First, at page 31, Mr. Rigsby points to William Sharpe as an authority on the CAPM. Sharpe was one of the scholars who developed the model. In his book *Investments*, Professor Sharpe advised readers that empirical analyses have shown the estimated value for RF (the rate for a risk free zero-beta asset) in tests of the Sharpe-Lintner CAPM show the required zero-beta return averaged 7.32% during the period of an empirical study, while the return for short-term Treasury rates averaged only 1.56%.[5] Also, during the period of the study, the average return on intermediate term Treasury rates was 2.56% — only 35% as large as the estimated required return for the zero-beta asset. This empirical evidence indicates the required value for RF is almost three times larger than the return Mr. Rigsby used in his analysis. Though Mr. Rigsby attempts to rely on Professor Sharpe as an authority on CAPM he ignores empirical studies Professor Sharpe relies upon in his textbook that show expected returns for intermediate-term Treasury rates understate the value of RF.

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[3] Rigsby Schedule WAR 7, pages 1 and 2.
[4] See Rebuttal Table 8.
[5] William Sharpe, Investments, Third Edition (1985) page 401. The period of the study was 1938 to 1968.

Second, intermediate-term Treasury rates understate the appropriate RF to use when analyzing long-lived assets such as common stocks. Morningstar explains that the appropriate choice for the zero-beta asset is a return that is no less than the expected return for long-term Treasury securities.

> The horizon of the chosen Treasury security should match the horizon of whatever is being valued. When valuing a business that is being treated as a going concern, the appropriate Treasury security should be that of a long-term Treasury bond. Note that the horizon is a function of the investment, not the investor. If the investor plans to hold a stock in a company for only five years, the yield on a five-year Treasury note would not be appropriate since the company will continue to exist beyond those five years. . . .
>
> Companies are entities that generally have no defined life span; when determining a company's value, it is important to use a long-term discount rate because the life of the company is assumed to be infinite.[6]

Mr. Rigsby's use of intermediate-term Treasury rates is clearly a mismatch. He argues that the shorter-term Treasury rate he uses is appropriate because it matches the timing of rate cases filings. As explained by Morningstar, it is the life of the asset, not the frequency of rate case filings or the expected holding period of a typical investor that is relevant to the choice of the horizon for the risk-free asset.

The rate for long-term Treasury securities is often adopted as a proxy for that RF. Based on the results of empirical studies, such as the ones reported by Professor Sharpe, it is possible that long-term Treasury rates may also understate the return investors require for the zero-beta asset, but such long-term Treasury rates are clearly a more appropriate proxy for RF than are intermediate-term Treasury rates.

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[6] Morningstar, *Ibbotson SBBI 2011 Valuation Yearbook*, at 44, 55.

Q. DOES MR. RIGSBY AGREE THAT FORECASTED VALUES FOR THE RF SHOULD BE ADOPTED IN A CAPM ANALYSIS?

A. No. At page 60, Mr. Rigsby offers his opinion that forecasted rates tend to be overly "optimistic". As a threshold issue, there is a problem with determining what is meant when someone says "analysts tend to make optimistic interest rate forecasts". Does it mean the analysts are expected to forecast interest rates that are lower or higher than what subsequently happens? Obviously, some investors would be interested in lower future rates (if they planned on borrowing) while others would be interested in higher rates (if they wanted to buy bonds). Mr. Rigsby provides no evidence or support for his opinion that analysts make "optimistic" interest rate forecasts or even what he means by "optimistic". Data presented by Staff in the 2002 Arizona Water Eastern Group case (Docket No. W-01445A-02-0619) showed precisely the opposite; there was no bias in forecasts — either up or down — during the period 1999 to 2003. That data showed one forecast for AAA bonds was very close to the actual rate for AAA bonds, two forecasts were below the subsequent rates and two forecasts were above subsequent rates. In effect, analysts' forecasts were neither biased upward nor biased downward.

Additionally, Mr. Rigsby does not challenge the fact that it is more appropriate to rely on the best estimate of interest rates expected during the period of time when Arizona Water's new rates will be in place. If interest rate forecasts are not expected to be higher than rates that actually occur in future periods, it is obviously more appropriate to adopt forecasts of rates expected when Arizona Water's new rates are in place than to use out-dated information. For example, Mr. Rigsby reported the current rate for long-term Treasuries was 3.02% and Mr. Cassidy reported that the current rate was 3.01%. Such "current" rates are already well below the rate on long-term Treasuries of 3.46% which was reported on March 20, 2012.

Q. ARE THERE PROBLEMS WITH MR. RIGSBY'S CHOICE OF A VALUE FOR THE MARKET RISK PREMIUM?

A. Yes. Mr. Rigsby relies on two flawed concepts to determine his market risk premiums; the use of geometric annual average returns, and the use of total returns for Treasury securities instead of conceptually correct income returns. Mr. Rigsby also relies solely on historical data, and does not consider current market risk. In this struggling stock market, an analyst should give weight to both long-term and current estimates of the MRP as has been the Staff's practice. I discuss the issue of the use of geometric annual averages in Section VII below and do not repeat that discussion here. A long-horizon MRP should be determined as an arithmetic annual average using long-term averages of the expected income from those Treasury securities. Morningstar reports that long-horizon average is 6.72%. (Morningstar, Ibbotson SBBI 2011 Valuation Yearbook, Table 5-1).

Estimates of the current MRP are higher than this long-horizon average. I determined that a reasonable value for the current MRP is 9.4%. (*See* my Direct Testimony Table 14.) An update of the Staff method of determining the current MRP, as presented in Mr. Cassidy's testimony in this case, indicates the current MRP is 11.2%. It is based on Value Line's projected appreciation potential of 65% and dividend yields of 2.3% for 1700 stocks as of March 16, 2012 and the projected long-term Treasury rate of 4.42% reported in Rebuttal Table 6.[7] The MRP falls slightly below the middle of the range of MRPs I estimated with the Staff method in Table 13 of my direct testimony. Use of an understated MRP shows the huge magnitude of the bias in the calculation of Mr. Rigsby's CAPM estimates.

[7] The MRP estimate based on a current long-term Treasury rate of 3.46% is 12.2%.

Q. HAS THE METHOD USED BY STAFF TO CALCULATE THE CURRENT MARKET RISK PREMIUM BEEN ADOPTED BY THE COMMISSION IN WATER AND WASTEWATER UTILITY RATE CASES?

A. Yes. In a prior Arizona Water Western Group rate case, for example, the Commission adopted Staff's CAPM estimate, explaining:

> [W]hile interest rates have gone up, the cost of equity for the market as a whole has decreased, while the cost of equity for utilities has remained relatively stable. Staff states that while its witness in [Arizona Water's prior rate case] estimated an overall market risk premium at 13.1%, its current estimate is 7.8% ...[8]

A similar discussion appears in Decision No. 69164, which involved a request for rate increases by an Arizona wastewater utility.[9] In that case, Staff's cost of capital witness testified that changes in interest rates do not mean that the cost of equity will also change or even move in the same direction as interest rates. Thus, "while interest rates increased between the filing of [the Staff witness'] direct and surrebuttal testimonies, from 3.3% to 4.7%, Staff's current MRP declined from 13.1% to 5.7%, thereby offsetting the interest rate increase (Tr. 719-722)."[10]

Q. WHAT ARE THE CRUCIAL DIFFERENCES IN RUCO'S CAPM APPROACH AND YOURS?

A. The biggest difference is the choice of the security used to estimate the risk-free rate. As discussed above, empirical tests of the CAPM have shown application of the basic Sharpe-Lintner version of CAPM requires a risk free rate of return for a zero-beta asset that is higher than intermediate-term Treasury rates. The value for RF used by Mr. Rigsby is expected to be roughly one-third as large as the empirical tests indicated is required for the zero-beta asset. While forecasts of long-term Treasury rates are currently 4.42%, a value still far below the 7.32%

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[8] Decision No. 68302 at 38.
[9] *Black Mountain Sewer Corp.*, Decision No. 69164 (Dec. 5, 2006).
[10] Decision No. 69164 at 25.

found to be required by the zero-beta asset during the period of the empirical study reported by Sharpe, these forecasts certainly provide a better proxy for RF than 0.83%. The quotation from Morningstar I provided above also explains the use of a long-term Treasury return to determine required returns is required for an asset that has a long life. Utility stocks have lives that are longer than long-term Treasuries, and certainly much longer than the time between rate cases.

A second difference is Mr. Rigsby's reliance on recent Treasury rates instead of Treasury rates expected during the period new rates will be in place for Arizona Water's Eastern Group. Long-term Treasury rates are currently 3.46%,[11] whereas long-term Treasury rates expected during the period new rates will be in place average 4.42%. (*See* Rebuttal Table 8)

Another difference is that Mr. Rigsby computed his market risk premium from conceptually incorrect data that relies on geometric annual averages as well as total returns for Treasury rates. I discuss that issue in Section VII.

Q. DOES MR. RIGSBY JUSTIFY EXCLUSION OF THE 90 BASIS POINT RISK PREMIUM YOU RECOMMENDED FOR ARIZONA WATER'S EASTERN GROUP?

A. No. At page 63 of his testimony, Mr. Rigsby argues the water utilities in his sample are essentially collections of water systems such as those that make up Arizona Water. He does not address the fact that, while the Company's common stock is owned by a parent, Arizona Water operates on a stand-alone basis. All of the utilities in his sample operate in multiple states and thus gain risk-reducing benefits of diversification. They are also larger than Arizona Water. The lower risk of the utilities in Mr. Rigsby's sample was discussed by a Staff consultant in prior dockets. He noted the following:

[11] As reported by the Federal Reserve for March 20, 2012. This value is over 40 basis points higher than rates reported by both Staff at page 42 of Mr. Cassidy's testimony and Mr. Rigsby at page 36 of his testimony.

> [Arizona-American] is the largest publicly-traded water system in the U.S. As a result, it generally faces lower risk than smaller water systems. In addition, the fact that AWW operates in a large number of states, with multiple divisions in many states, indicates that it has less risk than less diversified water systems.[12]

Arizona Water, in contrast, does not have operations in states other than Arizona. Arizona Water raises capital on its own and issues its own debt. Moreover, as other Company witnesses have testified, many of Arizona Water's systems are very small, with limited numbers of customers and high capital investment per customer.

Q. HAS MR. RIGSBY PROVIDED ANY EVIDENCE SHOWING OTHER COMPANY-SPECIFIC RISKS YOU IDENTIFIED IN YOUR DIRECT TESTIMONY ARE THE SAME AS RISK OF THE WATER UTILTIES IN HIS SAMPLE?

A. No. He did not respond to the fact that Arizona Water is smaller than the companies in his sample and thus is more risky. (*See* Zepp Direct, pages 31 to 37.) He also fails to respond to my application of a relative risk study advocated by a California Division of Ratepayer Advocates witness which clearly showed Arizona Water to be more risky than companies in his sample. (*See* my direct testimony, pages 37 - 41.)

Additionally, he states he believes my recommended risk premium of 90 basis points is not required because he has recommended an ROE that exceeds his DCF cost of equity estimates for his sample of water utilities. But by making that statement, in effect, Mr. Rigsby recommends a risk premium of 80 basis points. His implied risk premium can be computed as the difference between his recommended ROE of 9.3% and his DCF cost of equity estimate for the water utilities sample of 8.5%.

[12] Surrebuttal Testimony of David C. Parcell, Docket Nos. W-01303A-08-0227 and SW-01303A-08-0227 (March 3, 2009) at 6.

Q. PLEASE SUMMARIZE THE FLAWS IN MR. RIGSBY'S DCF ANALYSIS.

A. I have pointed out several obvious flaws in Mr. Rigsby's DCF estimates. His estimates of dividend yields are flawed and biased downward because the data he used for dividends expected next year (D_1) were actually dividends paid last year or today. He does not adjust those estimates of dividends for the time value of money. His estimates of br growth are understated because he fails to make the standard adjustment routinely made by the FERC and ACC Staff which puts projected ROEs on a mid-period basis. His estimates of sv growth are arbitrary and inconsistent with assumptions underlying the DCF model. His unsupported approach cuts estimates of sv growth in half. He focuses on estimates of br + sv growth which he compares to some other indicators of growth but fails to give weight to other readily available indicators of growth, such as analysts' forecasts of EPS growth reported by Yahoo! Finance and Reuters and forecasts of MPPS reported by Value Line. The Value Line forecasts of potential capital gains are clearly as important to investors as DPS and BVPS growth. He does not acknowledge that estimates of br + sv growth for utilities are probably based on circular logic. Each of these shortcomings in his analysis biases his cost of equity estimates downward. If those issues were addressed, his cost of equity estimate for the sample of water utilities would be substantially higher than 9.3%.

Q. PLEASE SUMMARIZE THE FLAWS IN HIS CAPM APPROACH.

A. One flaw in his CAPM analysis stems from an inconsistency between the interest rates he adopts to implement the CAPM and empirical studies which support the proxy for the RF in the model to be no less than the expected return on long-term Treasury rates. At page 31, Mr. Rigsby points to William Sharpe as an authority on the CAPM, but, in Professor Sharpe's textbook, Sharpe reports that empirical studies indicate the proxy for RF must be larger than the low, shorter-term Treasury rates Mr. Rigsby uses to implement the model. Mr. Rigsby's inappropriate choice for RF leads him to estimate CAPM costs of equity that are

lower than the cost of investment grade debt and thus would be confiscatory.

IV. Responses to Mr. Cassidy's DCF Cost of Equity Estimates

Q. SHOULD AMERICAN WATER WORKS BE INCLUDED IN THE STAFF SAMPLE OF WATER UTILITIES?

A. Yes. At page 13 of his direct, Mr. Cassidy lists the criteria he considered when he determined his sample of six water utilities. American Water Works is publicly-traded and receives the majority of its earnings from regulated operations. American Water Works not only satisfies Mr. Cassidy's criteria, but based on its market capitalization, more investors have an interest in it than have an interest in any of the other water utilities in his sample. *See* Rebuttal Table 5. Also, Rebuttal Table 6 shows more analysts follow American Water Works than any of the utilities in his sample. Thus, investors have a larger group of technical analysts providing information about American Water Works than about any of the other stocks in his sample.

Mr. Cassidy says Staff uses averages for a representative sample group to reduce sample error resulting from random fluctuations in the market. Adding American Water Works to his sample would provide greater breadth to that average. While empirical evidence I provided in my direct testimony shows larger utilities such as American Water Works and Aqua America are expected to be less risky than the typical water utility and less risky than Arizona Water, American Water Works should be included in the sample of utilities used to calculate benchmark cost of equity estimates.

Q. DOES THE EXCLUSION OF AMERICAN WATER WORKS BIAS MR. CASSIDY'S DCF COST OF EQUITY ESTIMATES DOWNWARD?

A. Yes. Mr. Cassidy relies on Value Line estimates of EPS growth and DPS growth to conduct his DCF analyses. Rebuttal Table 7 shows the averages of Value Line forecasts of both EPS growth and DPS growth would be higher if American Water Works were included in the sample. This increase in the estimates of

1 projected growth would more than offset the small drop in the average dividend
2 yield that would occur if American Water Works were in the sample.
3 **Q. DOES MR. CASSIDY RELY ON FORECASTS OF GROWTH MADE BY**
4 **FINANCIAL INSTITUTIONS OTHER THAN VALUE LINE TO CONDUCT HIS**
5 **ANALYSES?**
6 A. No. Rebuttal Table 6 shows there are analysts' forecasts for his sample and
7 American Water Works which are provided by Zacks, Yahoo! Finance and
8 Reuters. These sources of information are free to investors and logically would
9 be and are considered by investors.
10 **Q. WHAT WOULD HAPPEN TO STAFF'S ESTIMATE OF EPS GROWTH IF MR.**
11 **CASSIDY HAD CONSIDERED DATA FROM THE THREE READILY**
12 **AVAILABLE SOURCES ON THE INTERNET?**
13 A. Rebuttal Table 6 answers that question. The average of analysts' EPS forecasts
14 without American Water Works in the average, would increase from 6.8% to
15 7.9%. Mr. Cassidy's decision to exclude this readily available information in his
16 analysis produces a significant downward bias in his forecasts of EPS growth.
17 **Q. WHAT WOULD HAPPEN TO MR. CASSIDY'S ESTIMATE OF EPS GROWTH**
18 **IF HE HAD CONSIDERED ALL FOUR SOURCES OF INFORMATION AND**
19 **INCLUDED AMERICAN WATER WORKS IN THE ANALYSIS?**
20 A. His estimate of average EPS growth would increase from 6.8% to 9.6%. Mr.
21 Cassidy's choices produce a serious negative bias in his estimates of the
22 average of analysts' forecasts of EPS growth. As I explain in my direct
23 testimony, the best available estimates of growth are analysts' estimates of EPS
24 growth. Section VI of my rebuttal testimony provides quantitative studies which
25 provide additional support that analysts' forecasts of future EPS growth for
26 utilities are not biased.
27 **Q. MR. CASSIDY GIVES ONLY A 17% WEIGHT TO ANALYSTS' FORECASTS**
28 **OF EPS GROWTH WHEN HE DETERMINED HIS ESTIMATES OF GROWTH.**

WHY DOES HE GIVE THE EVIDENCE SUCH A SMALL WEIGHT?

A. At page 35 of his testimony, Mr. Cassidy argues that "analysts' forecasts are known to be overly optimistic" and thus he states that sole reliance on such forecasts serves to inflate the growth rate estimate and thus DCF cost of equity estimates. He also opines that investors would look at other information such as historical growth and questions whether EPS growth rates projected by analysts are expected by investors. Additionally, Mr. Cassidy offers quotations from several sources as evidence that analysts EPS forecasts for stocks in general and for utilities in particular, are optimistic. In Section VI, I provide four studies and a discussion of the Gordon, Gordon and Gould article I presented in my direct testimony that put the quotations he offers in perspective. The studies I present below show (a) one cannot conclude with any degree of confidence normally accepted in a statistical study that analysts' forecasts of EPS for utilities are biased and (b) that once unexpected inflation is recognized, analysts' have done a remarkably good job of forecasting EPS for utilities. This quantitative evidence refutes Mr. Cassidy's 17% weight given to analysts' EPS forecasts, and shows that a much larger weight than 17% is warranted.

Q. MR. CASSIDY GIVES A 33% WEIGHT TO PAST AND FORECASTED DPS GROWTH. DO YOU HAVE A RESPONSE TO HIS CHOICE OF WEIGHTS?

A. Yes. I provide a thorough discussion of this issue at pages 18 to 20 and pages 21 to 22 of my direct testimony and do not repeat those points. For the reasons stated in my direct testimony, I give no weight to past and projected DPS growth. For those same reasons, if the Commission determines some weight should be given to past and projected DPS growth, it should be much smaller than 33%.

Q. AT PAGES 36 AND 37, MR. CASSIDY CITES STUDIES HE CONTENDS PROVIDE EVIDENCE THAT EXCLUSIVE RELIANCE ON ANALYSTS' FORECASTS OF EPS GROWTH RESULT IN INFLATED DCF COST

OF EQUITY ESTIMATES. DOES THIS EVIDENCE APPLY TO THE USEFULNESS OF ANALYSTS' FORECASTS OF EPS GROWTH FOR UTILITIES?

A. No. The Dreman and Seigel studies were for stocks in general, not for utilities. The study by Malkiel was also for stocks in general, but Malkiel does make a specific statement about utilities.

In Footnote 14, Mr. Cassidy also cites testimony by Gordon and Gould, but Mike Gordon and Lawrence Gould were two of the authors who wrote the article I discuss at page 18 of my direct testimony. Gordon, Gordon and Gould compared the usefulness of four indicators of growth to prepare DCF estimates and found that analysts' forecasts of EPS growth outperformed growth indicated by past EPS growth, past DPS growth and past br growth for a sample of 75 utilities. Gordon, Gordon and Gould also looked at data for industrial stocks but found none of the indicators of growth provided very useful indications of growth.

The differences between results for industrial stocks and utilities are especially important for two reasons. First, a consideration of the quality of analysts' forecasts for stocks in general does <u>not</u> address the issue of whether analysts' forecasts of EPS growth for utilities, the issue of importance in this case, are useful. The results of the Gordon, Gordon and Gould study indicate analyses of the usefulness of analysts' forecasts for industrial stocks does not tell us if any of the four indicators of growth are useful in the utility context. Second, Gordon, Gordon and Gould found that analysts' forecasts of EPS for utilities outperformed growth indicated by past br growth, past EPS and past DPS growth.

Q. **DID MR. CASSIDY RESPOND TO THE IMPORTANT FINDINGS IN THE GORDON, GORDON AND GOULD STUDY?**

A. No.

Q. IN THE QUOTATION MR. CASSIDY PROVIDES AT PAGE 37, PROFESSOR MALKIEL REPORTS HE FOUND ANALYSTS' FORECASTS FOR UTILITIES WERE "FAR OFF THE MARK". DO THE QUANTITATIVE STUDIES YOU PRESENT IN SECTION VI RESPOND TO THIS QUOTATION FROM MALKIEL?

A. Yes. I present four analyses. Two of the analyses are based on extensive data compiled by Professor J. Randall Woolridge, a consumer advocate witness in a number of cases in which I have participated. I use the results of the two studies I conducted and the data compiled by Dr. Woolridge to put Professor Malkiel's quotation in perspective. Those studies show the following:

(1) Though averages of analysts' forecasts of EPS for utilities are slightly higher than the averages of EPS that subsequently occurred, there is so much variability in the data that anyone conducting a statistically valid test could not conclude with any degree of confidence that analysts do not make perfect forecasts. See Section VI and Rebuttal Tables 12 and 13.

(2) During the periods of all of the studies, anticipated inflation turned out to be higher than what actually occurred. Once the unexpected inflation is accounted for and the test of the quality of analysts' forecasts becomes a test of whether analysts provide good real (inflation adjusted) forecasts for utilities, it is found that the analysts provide excellent unbiased forecasts for utilities. (*See* Section VI and Rebuttal Tables 10, 11, 12 and 13.) Professor Malkiel obviously did not consider this possibility and thus his quotation does not apply during a period in which expected inflation is minimal as it is today.

Q. MR. CASSIDY GIVES A 33% WEIGHT TO HIS PAST AND PROJECTED ESTIMATES OF SUSTAINABLE GROWTH. IS SUCH A LARGE WEIGHT JUSTIFIED?

A. No. First, as discussed above, Gordon, Gordon and Gould found that analysts' EPS forecasts for utilities outperformed future growth suggested by past br

growth. At a minimum, this result supports giving analysts EPS forecasts a greater weight than is given to past sustainable growth.

Second, in my responses to Mr. Rigsby, I explain that Professor Morin and other scholars now recognize that estimates of growth that are based on Value Line forecasts of future earned returns on equity (the "r" in br growth) are likely to be circular. As a result, one should be skeptical of such growth forecasts and give them minimal weight. In no case, should past data on sustainable growth and forecasts be given twice a much weight (33%) as Mr. Cassidy gives to the best forecasts of growth, analysts' forecasts of EPS growth. Mr. Cassidy gives analysts' forecasts of growth only a 17% weight when he determines his average growth rate of 5.2% in Schedule JAC-8.

Q. GIVEN YOUR STUDIES AND YOUR DIRECT TESTIMONY, SHOULD MR. CASSIDY GIVE MORE THAN A 17% WEIGHT TO ANALYSTS' FORECASTS WHEN HE CONDUCTS HIS DCF ANALYSES?

A. Yes. In my direct testimony, I determine two DCF cost of equity estimates. One was computed by giving analysts' forecasts of EPS growth a 100% weight. The other approach determined growth by giving analysts' forecasts of EPS growth a 50% weight and a 50% weight to past growth. Either approach is preferable to giving only a 17% weight to the best forecasts of growth. Any weighting that gives a greater weight than 17% to the best indicator of future growth would produce higher DCF cost of equity estimates than the weighting scheme adopted by Mr. Cassidy.

Q. MR. CASSIDY ARGUES THE CONCEPTS UNDERLYING THE DCF MODEL REQUIRE THAT SPOT PRICES BE USED IN DCF ANALYSES. DO YOU AGREE?

A. No. The issue with spot prices is not one of being conceptually correct, as Mr. Cassidy suggests at page 16, but what is an appropriate method for implementing the DCF model when it is applied to determine cost of equity

estimates for regulated utilities. Arizona Water filed its direct testimony in this case on August 5, 2011. Staff had more than 140 days between August 5, 2011 and early March 2012 to choose a date for the spot prices used in its analysis. Rebuttal Table 9 compares spot prices (and the associated dividend yields) chosen by Mr. Cassidy to the highest average of spot prices reported for closing days in each of the seven months from August 2011 to February 2012. Whether it was by accident or a deliberate choice by Mr. Cassidy, his choice of February 1, 2012 to determine spot prices produces the same dividend yield as would be the case if he had chosen the highest closing prices (February 29, 2012). Based on my check of the data, there are few dates that would produce a higher average of prices (and thus lower average DCF yield) than the date Mr. Cassidy chose for his analysis. Had he chosen a date with lower prices, his estimated dividend yield would have been higher.

As a practical matter, because regulatory proceedings take a while to process, cost of equity estimates should be based on a reasonable average of dividend yields — not spot prices which a witness cherry-picks to support his result. Such an approach avoids the problem of either accidentally or deliberately adopting a dividend yield that is too low or too high and out of line with prices investors were willing to pay for the utility stocks at the time the growth rate information became known in the market. Mr. Cassidy's dividend yield should be given no weight and the Commission should base its determination of DCF costs of equity on an average of dividend yields known to investors at the time other data were being considered.

Q. AT PAGE 39, LINE 19, MR. CASSIDY STATES YOU ADOPTED HISTORICAL AVERAGES OF DIVIDEND YIELDS TO COMPENSATE FOR THE TIME VALUE OF MONEY. IS MR. CASSIDY CORRECT?

A. No. Mr. Cassidy's testimony is incorrect . I adopt averages of dividend yields to avoid the problem of bias — such as the negative bias that resulted from Mr.

Cassidy adopting spot prices on February 1, 2012 — that might result from choosing spot prices.

Q. AT PAGE 39, LINE 26, MR. CASSIDY STATES "INVESTORS ARE ASSUMED TO BE RATIONAL, AND WOULD THUS HAVE BEEN AWARE THAT DIVIDEND DISTRIBUTIONS WOULD BE MADE ON A QUARTERLY BASIS PRIOR TO HAVING MADE AN INVESTMENT DECISION." DO YOU AGREE?

A. Yes. This is the precise reason dividend yields must be adjusted for the time value of money. As indicated by Mr. Cassidy, the prices investors pay for stocks anticipate quarterly payments of dividends and thus an investor's ability to reinvest those dividends. But, the dividend in the DCF model is stated on an annual basis (four times the quarterly dividend). Unless the time value of money is recognized, there will be a mismatch of the numerator and the denominator of the dividend yield. The denominator (price) anticipates being able to reinvest dividends, but the numerator of the yield (dividend) does not. The numerator is the simple annualized value of the quarterly dividend. Unless the time value of money is recognized and the dividend adjusted to reflect such anticipated compounding, there will be a mismatch. I explain why the time value of money must be recognized at page 17 of my direct testimony. Mr. Cassidy failed to respond to this simple explanation. Instead, at page 39, line 25, Mr. Cassidy testifies that I made the adjustment because average historical stock prices are used to determine the price in the denominator. This is not true.

V. <u>Responses to Mr. Cassidy's CAPM Estimates and Other Issues</u>

Q. DO YOU AGREE WITH MR. CASSIDY'S DECISION TO GIVE FULL WEIGHT TO CURRENT RATES ON TREASURY SECURITIES AND ZERO WEIGHT TO FORECASTS OF TREASURY RATES EXPECTED DURING THE PERIOD NEW RATES FOR ARIZONA WATER'S SERVICES WILL BE IN PLACE?

A. No. I addressed this issue in my response to Mr. Rigsby and do not repeat that testimony here.

Q. MR. CASSIDY BASES ONE OF HIS CAPM ESTIMATES ON RATES FOR INTERMEDIATE-TERM TREASURY SECURITIES AND ONE ON RATES FOR LONG-TERM TREASURY SECURITIES. SHOULD RATES FOR INTERMEDIATE-TERM TREASURY SECURITIES BE USED IN A CAPM ANALYSIS?

A. No. I addressed this issue in my response to Mr. Rigsby. Because empirical evidence suggests that even long-term Treasury rates may understate the required return on the zero-beta asset, analysts should never use a proxy for the risk free rate in a CAPM analysis that is lower. Some scholars, such as Professor Morin, have adopted what he calls the "empirical CAPM" to address this concern. Morin proposes estimating the empirical CAPM ("ECAPM") with the following model:

$$\text{Cost of equity} = RF + .25\ MRP + .75 * \beta * MRP.$$ [13]

With this model the risk-return relationship is flatter than the risk-return relationship in the traditional CAPM and estimated costs of equity for stocks with betas less than 1.0 will be higher than is estimated with the model adopted by Mr. Cassidy and Mr. Rigsby.

Q. AT PAGE 41, LINE 19, MR. CASSIDY STATES YOU CALCULATED YOUR FORECASTED RISK FREE RATE OF 5.17 PERCENT "AS THE AVERAGE OF THE BAA BOND RATE AND THE 30-YEAR LONG-TERM TREASURY YIELD". IS HE CORRECT?

A. No. Mr. Cassidy's testimony is not correct. Table 10 of my direct testimony shows how the 5.17 percent value for the risk free rate was computed. It is an average of Blue Chip and Value Line forecasts of long-term Treasury security rates. Table 10 does not report any values for Baa rates.

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[13] Roger Morin, New Regulatory Finance, pages 189-191.

Q. AT PAGE 43, MR. CASSIDY SUGGESTS ARIZONA WATER AND OTHER SMALL FIRMS DO NOT REQUIRE A RISK PREMIUM BECAUSE SUCH RISKS ARE "UNSYSTEMATIC" AND THUS COULD BE DIVERSIFIED AWAY. IS HE CORRECT?

A. No. Based on the work of Fama and French and the studies of Morningstar I discuss on page 34 of my direct testimony, appropriate CAPM models should include size as a second explanatory variable, i.e.,

$$\text{Cost of Equity} = \alpha + \beta_1 * \text{MRP} + \beta_2 * \text{size factor.}$$

Such a size effect is a second "systematic" risk factor. Mr. Cassidy appears to misunderstand this issue. Based on these alternative versions of CAPM, diversification cannot eliminate the risk of a company being smaller than average. A well-diversified portfolio of small firms would still be more risky than a well-diversified portfolio of larger firms. Morin shows the impact of this size effect graphically at page 182, and discusses the issue on pages 181 to 183, of his book, New Regulatory Finance[14]. Mr. Cassidy's testimony does not justify ignoring the expected additional risk of Arizona Water that stems from it being much smaller than the utilities in the water utilities sample.

Q. DOES MR. CASSIDY RESPOND TO THE OTHER COMPANY-SPECIFIC RISK FACTORS YOU IDENTIFIED IN YOUR DIRECT TESTIMONY?

A. No. He does not comment about those other company-specific risks. Arizona Water's small size and those other risks should be recognized by authorizing a risk premium of 90 basis points in the authorized ROE for Arizona Water's Eastern Group.

VI. Analysts' Estimates of EPS Growth Are Superior to Other Measures of Growth

Q. WHAT IS THE PURPOSE OF THIS SECTION OF YOUR TESTIMONY?

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[14] Morin, New Regulatory Finance, pages 181-183.

A. The most significant difference between my DCF estimates and those of RUCO and Staff results from their unsupported contention that analysts' forecasts of long-term EPS growth are upwardly biased and should be given limited weight. Given the importance of this issue, I respond to it in this separate section. Attachment TMZ-3, Attachment TMZ-4, and Rebuttal Tables 10, 11, 12 and 13 support this section of my testimony.

Q. WHAT IS SHOWN IN ATTACHMENT TMZ-3?

A. Attachment TMZ-3 provides an August 3, 2009 Wall Street Journal study and a study reported by USA Today that show, contrary to Mr. Cassidy's and Mr. Rigsby's contention, that analysts' forecasts are not biased upward. These studies found that analysts' forecasts of EPS have historically been lower than actual EPS. The Wall Street Journal study presents data showing the percentage of companies in the S&P 500 whose actual earnings results came in above analysts' EPS forecasts for the period 1994 through 2009. The WSJ concludes "company results are trumping analyst expectations." In an article posted 4/23/2004, *USA Today* stated that more than half of the S&P 500 companies had reported earnings at that point in time and 78% of those companies beat analysts' estimates. The article also pointed out that "typically, only 58% of companies beat forecasts". If more than half of the companies <u>typically</u> beat earnings forecasts, the optimistic bias suggested by Mr. Cassidy and Mr. Rigsby does not exist.

Q. WHAT IS SHOWN IN ATTACHMENT TMZ-4?

A. *Value Line* is in the business of selling information to investors. It has the incentive to provide accurate, not upwardly biased, forecasts so that investors will continue to buy subscriptions. Attachment TMZ-4 is an open letter from *Value Line's* Chairman and CEO to its subscribers describing its goal to provide "the most accurate information and independent advice anywhere." *Value Line* does not sell stock and thus does not have an incentive to bias upward its

estimates of future growth that Mr. Cassidy and Mr. Rigsby attribute to analysts.

Q. WHAT IS CONTAINED IN REBUTTAL TABLES 10 AND 11?

A. Rebuttal Tables 10 and 11 report two studies I conducted that show *Value Line* forecasts for utilities are right on target once errors in expected inflation are recognized.

Rebuttal Table 10 compared *Value Line* forecasts of returns for a sample of gas distribution utilities to realized returns for the same sample of gas distribution utilities during the 21 year period 1977 to 1998. In that study I found that once unexpected inflation was taken into account, Value Line forecasts of returns were actually slightly below earned returns.

In Rebuttal Table 11, I present a study based on data from 1982 through 2009 to determine how well *Value Line* forecast growth from retained earnings (br-growth) for the electric utility (central) industry. *Value Line* reports both its forecasts of average br-growth and average realized br-growth for this industry. The br-growth rate is the portion of sustainable growth that comes from retained earnings and is relied upon by both Mr. Cassidy and Mr. Rigsby in their DCF analyses. As was found in the study reported in Rebuttal Table 10, this analysis also shows that once unexpected inflation is taken into account, Value Line should be commended for its accurate growth forecasts.

In both studies, I took into account differences in expected and realized rates of inflation and thus compared real forecasts of returns and real forecasts of br-growth with realized real returns and real br-growth. Rebuttal Tables 10 and 11 show that after recognizing differences in actual and realized inflation, the average of *Value Line* forecasts of ROEs and br-growth were very close to the values which subsequently occurred and, if anything, the real forecasts (forecasts adjusted for unexpected inflation) were slightly below the real ROEs and br-growth that occurred. In the study of electric utilities, I also found that not only were average real (inflation-adjusted) br-growth rates accurately projected

but also that *Value Line*'s forecasts for 2006, 2007 and 2008 were right on the money. The studies in Rebuttal Tables 10 and 11 show *Value Line's* projected growth rate estimates provide reliable and accurate forecasts for utilities.

Q. WHAT EVIDENCE IS CONTAINED IN REBUTTAL TABLES 12 AND 13?

A. Rebuttal Tables 12 and 13 provide other analyses of the usefulness of analysts' forecasts for utilities that are based on data compiled by a consumer advocate (Professor J. Randall Woolridge) in other cases in which I have participated.

If, on average, analysts made perfect forecasts of future EPS, the average difference between the forecasts and actual EPS would be zero. Panel A of Rebuttal Table 12 shows that there is no statistically significant difference between average analysts' forecasts and actual EPS for the gas distribution companies reported by Professor Woolridge for the period 1990 to 2007. I examined the data he relied on and found the forecasts were not perfect. In some periods (quarters), analysts' forecasts of EPS were higher than what subsequently occurred; and, in other periods, the forecasted returns were lower than what subsequently occurred. This, of course, is not unexpected. Data underlying his analysis indicated a standard deviation of 2.81% for the reported differences between forecasted and actual EPS, while the average difference between forecasted and actual EPS was only 0.62%. In such a case, a standard statistical t-test shows the average of differences between predicted and earned EPS is not different from zero at any generally accepted level of confidence. Thus, this study does not support the conclusion that analysts provide poor forecasts for gas utilities with any degree of confidence normally required in a statistical analysis.

Also, as I did in the studies reported in Rebuttal Tables 10 and 11, I considered whether unexpected inflation explained the difference between forecasted and actual EPS. Panel B of Rebuttal Table 12 shows that is the case. At the time analysts made their forecasts, on average, expected inflation was

greater than inflation that subsequently occurred. Once forecasts and actual EPS are restated in real (inflation-adjusted) terms the difference between forecasted and actual returns is very close to zero (-0.05%).

This study for gas distribution utilities corroborates the results I reported in Rebuttal Tables 10 and 11. On average the difference between analysts' forecasts and actual EPS is not statistically different than zero and, once unexpected inflation is recognized, Professor Woolridge's study supports a conclusion that analysts provide reliable forecasts of EPS for utilities.

Q. WHAT IS SHOWN IN REBUTTAL TABLE 13?

A. Rebuttal Table 13 applies data Professor Woolridge compiled for electric utilities to put Mr. Cassidy's reliance on a quotation from Professor Malkiel's book in perspective. For this analysis, I used data for the period ending in 2003 when Professor Malkiel's book was published. I found that while the average of analysts' forecasts of EPS was greater than the average of actual EPS — as reported by Malkiel — the difference between the forecasted and actual EPS for electric utilities was not significantly different from zero. Based on the Malkiel quotation reported by Staff, it appears Malkiel conducted no such statistical test. Additionally, as was found in Rebuttal Tables 10, 11 and 12, once unexpected inflation during the period considered by Malkiel is recognized, the difference between analysts' forecast in real (inflation-adjusted) and subsequent earnings (in real terms) is close to zero and not positive. Apparently Malkiel did not consider if unexpected inflation was the culprit when he criticized the quality of analysts' forecasts for utilities

Q. DO YOU HAVE OTHER OBSERVATIONS ABOUT REBUTTAL TABLE 13?

A. Yes. This study is based on data limited to the period ending in 2003. I limited the data to this period to provide data that can be used to put in perspective the quotation in Professor Malkiel's 2003 book. Staff relies solely on this quotation from Malkiel to support the usefulness of analysts' forecasts for utilities. All of the

other evidence and quotations provided by Staff are for companies in general and, thus, do not reflect the fact that it is far easier for analysts to forecasts earnings for utilities than for companies in high tech businesses or cyclical companies.

In Section IV, I responded to pages 36 and 37 of Mr. Cassidy's testimony and revisit my discussion of the Gordon, Gordon and Gould article presented in my direct testimony. One of the findings in the Gordon, Gordon and Gould paper was that analysts' forecasts of EPS growth provided more useful indicators of growth for utilities than three other indicators of growth, but Gordon, Gordon and Gould were unable to show that any of the four indicators of growth studied provided useful indicators of future growth for industrial companies. This result from the Gordon, Gordon and Gould paper casts doubt on Mr. Cassidy's suggestion that studies of the quality of analysts' forecasts for stocks in general provides "evidence" that analysts provide poor forecast of EPS growth for utilities. Mr. Cassidy offers no support for the position that studies of a large basket of stocks provide evidence that backs his contention that analysts' forecasts of EPS for utilities are overly optimistic.

Q. WHAT DO YOU CONCLUDE FROM THE STUDIES IN REBUTTAL TABLES 10, 11, 12 AND 13?

A. I conclude that the available empirical evidence shows analysts' forecasts of EPS growth for utilities are not upwardly biased once differences in expected and realized inflation are taken into account. Moreover, contentions by Mr. Cassidy and Mr. Rigsby's that analysts' projected EPS growth rate forecasts are upwardly-biased for utility companies is inconsistent with the data in all four studies for utilities. Rebuttal Tables 12 and 13 show analysts cannot make such a claim with a degree of confidence normally adopted in a statistical study. Mr. Cassidy's and Mr. Rigsby's claims of consistent upward bias in analysts' forecasts of growth for utilities are simply not supported.

Q. DID YOU EXPLAIN WHY YOU RELY PRIMARILY ON ANALYSTS' FORECASTS IN YOUR DIRECT TESTIMONY?

A. Yes. At pages 18 to 21, I offered five reasons that analysts' forecasts of EPS growth provide the best forecasts for the DCF model.

Q. DID YOU EXPLAIN WHY YOU DID NOT RELY ON VALUE LINE FORECASTS OF FUTURE DPS GROWTH IN YOUR DIRECT TESTIMONY?

A. Yes. Value Line is the only major financial institution that provides forecasts of dividends. Investors know that EPS is what permits DPS to be paid. If historical DPS and DPS forecasts were of major importance to investors, it would be DPS forecasts — not EPS forecasts — that would be demanded by investors and the financial institutions would provide those forecasts.

Q. MR. CASSIDY AND MR. RIGSBY CLAIMED "IT IS WELL-KNOWN THAT THE LONG-TERM EPS GROWTH RATE FORECASTS OF WALL STREET SECURITIES ANALYSTS ARE OVERLY OPTIMISTIC AND UPWARDLY BIASED". DO YOU HAVE ANY FINAL OBSERVATIONS ABOUT THE ISSUE IN THIS SECTION OF YOUR TESTIMONY?

A. Yes. I have three final observations. One is that the empirical studies in Rebuttal Tables 10, 11, 12 and 13 show that when unexpected inflation is taken into account, analysts have done a good job of forecasting EPS for utilities. That aside, neither Mr. Cassidy nor Mr. Rigsby dispute the fact that thousands of dollars are being spent by Wall Street firms to make EPS forecasts and there is no question that these forecasts are being relied upon by investors. If that is the case, such forecasts lead to prices investors are willing to pay for utility stocks and should, therefore, be incorporated into the DCF cost of equity estimates. Putting both points aside, Mr. Cassidy and Mr. Rigsby finally provide no solid evidence showing any other growth rate indicator is superior to analysts' forecasts.

VII. Arithmetic and Geometric Annual Averages

Q. WHAT IS THE MAIN POINT YOU MAKE IN THIS SECTION OF YOUR REBUTTAL TESTIMONY?

A. To the extent that one believes historical data provide useful information for the determination of future growth rates and required returns on equity, the analyst should rely on arithmetic annual averages to make such growth projections and required ROE determinations. Geometric annual averages routinely produce negatively biased estimates of future growth and negatively biased estimates of ROEs required by investors and should, therefore, *not* be given any weight in cost of capital analyses. No weight should be given to any growth rate or ROE estimate that is based in whole or in part on geometric annual averages of past data.

Q. WHEN SHOULD GEOMETRIC ANNUAL AVERAGES BE CONSIDERED BY INVESTORS?

A. Geometric annual averages provide a useful way to compare past performance of different assets during different periods of time. For example, T. Rowe Price offers investors an Emerging Markets Bond Fund and an International Bond Fund. During recent 5-year and 10-year periods, the International Bond Fund provided total returns of 23.2% and 53.7%. But such returns are difficult for investors to understand and compare. Once those total returns are converted to annual average geometric returns, the returns are 4.26% and 4.39%, respectively, and investors would know that that fund provided similar returns over 5-year and 10-year periods. Geometric annual average returns are also useful for comparing past performances of different funds. During the same five year period, the Emerging Markets Bond Fund had a total return of 30.6% which would be difficult for investors to compare to the range of total returns of 23.2% to 53.7% for the International Bond Fund. If, however, the five-year returns for the Emerging Markets Bond Fund are restated as annual average geometric

return of 5.49%, the investor can easily make a comparison of past performances of the different funds.

But although the geometric annual average can be a useful way to examine what has happened in the past, it should not be used to determine estimates of expected future returns or future growth rates. Even if one believes that future growth for water utilities will be similar to growth in the past, it is conceptually incorrect to use past geometric annual average growth rates to determine future growth or anticipated returns in the future.

Q. WHY IS THAT THE CASE?

A. Average annual geometric averages do not account for the expected variance in past and future returns, while annual arithmetic averages do. The relationship between arithmetic annual average returns (A) and geometric annual average returns (G) is approximately:

$$A \approx G + Var(A)/2,$$

where the arithmetic average annual return ("A") is approximately equal to the geometric annual average return ("G") plus the variance in the arithmetic return (Var(A)) divided by 2.[15]

In the special case where a return or growth rate is exactly the same in every period, the variance would be zero and the two returns would be the same. However, this is not the case for risky assets. Thus, if one believes future growth (or future returns) and variance in future growth (returns) will be similar to what has occurred in the past, the arithmetic annual average growth rate must be used to determine equity costs or the utility will be unable to achieve the past geometric annual average growth. Mr. Rigsby's proposal to consider past geometric annual average growth and past geometric annual averages of returns is a results-driven way to make sure a utility will not attain the forecasted growth

[15] Morningstar, *Ibbotson SBBI 2011 Valuation Yearbook*, p. 66.

or earn returns in the future that have occurred in the past.

Q. DO YOU HAVE A SIMPLE EXAMPLE WHICH ADDRESSES THE ISSUE?

A. Yes. I have attached Attachment TMZ-1 to my testimony which is a copy of Appendix 4-A of Roger Morin's 2006 book *New Regulatory Finance.* Morin provides a thorough discussion of this issue and cites several academic studies which explain why the arithmetic annual average is the appropriate concept to adopt when relying on past data to forecast future growth or required ROEs. One of the examples he provides is from Brealey, Myers and Allen's 2006 graduate textbook in corporate finance. Brealey, Myers and Allen provide an excellent example showing that with a possibility of annual returns of -10%, +10% and +30% for a fictional entity "Big Oil" that does not pay dividends, the expected return is 10% (an average of the three potential returns) and with an initial investment of $100 in that stock, the expected end-of period value of the stock is $110. Brealey, Myers and Allen show that this 10% return must be the discount rate used to determine the present value of the stock of $100. They also show that the compound average return of 8.8% ($100 x 1.1 x .9 x 1.3) = $108.77, (the geometric annual average return), is less than the opportunity cost of capital. Thus, if this were a utility stock (instead of "Big Oil") and a regulator set the return at only 8.8%, investors would not be willing to invest in that utility stock because the opportunity cost of investing elsewhere is 10%. Mr. Rigsby recommends that the equivalent of this 8.8% ROE be included in the average of ROEs they suggest are acceptable to investors when that is not the case. The 8.8% ROE is less than the opportunity cost of capital of 10%. Thus if the 8.8% is given <u>*any*</u> weight, even a 25% weight, the authorized ROE would be 9.7% which is less than the cost of capital, which is 10% in this example.

Q. IS THERE A HIDDEN FLAW IN APPROACHES THAT RELY ON GEOMETRIC ANNUAL AVERAGE RETURNS ON EQUITY AS A MEASURE OF FUTURE REQUIRED ROES?

A. Yes. The hidden flaw is that the approach assumes investors already know what will happen in the future when they do not. In effect, it assumes investors will know the final outcome when that is never the case with investments in common stocks. If an investor actually expected he/she would only get an 8.8% return when a 10% return is required, the investor would be better off investing in assets other than the regulated utility.

Q. DOES THE SAME CONCEPT APPLY TO ESTIMATED GROWTH RATES?

A. Yes. A geometric annual average of past EPS growth can be computed by comparing EPS at the beginning and end of a period. But by comparing EPS at the start and the end of a long period, the metric totally ignores the variance in EPS experienced by the company being considered. If past EPS growth is a harbinger of future growth, each of the annual changes in EPS growth during the entire period should be considered.

Q. DOES THIS COMPLETE YOUR REBUTTAL TESTIMONY?

A. Yes.

TMZ-1

NEW
REGULATORY
FINANCE

Roger A. Morin, PhD

2006
PUBLIC UTILITIES REPORTS, INC.
Vienna, Virginia

Appendix 4-A
Arithmetic versus Geometric Means in Estimating the Cost of Capital

The use of the arithmetic mean appears counter-intuitive at first glance, because we commonly use the geometric mean return to measure the average annual achieved return over some time period. For example, the long-term performance of a portfolio is frequently assessed using the geometric mean return.

But performance appraisal is one thing, and cost of capital estimation is another matter entirely. In estimating the cost of capital, the goal is to obtain the rate of return that investors expect, that is, a target rate of return. On average, investors expect to achieve their target return. This target expected return is in effect an arithmetic average. The achieved or retrospective return is the geometric average. In statistical parlance, the arithmetic average is the unbiased measure of the expected value of repeated observations of a random variable, not the geometric mean. This appendix formally illustrates that only arithmetic averages can be used as estimates of cost of capital, and that the geometric mean is not an appropriate measure of cost of capital.

The geometric mean answers the question of what constant return you would have had to achieve in each year to have your investment growth match the return achieved by the stock market. The arithmetic mean answers the question of what growth rate is the best estimate of the future amount of money that will be produced by continually reinvesting in the stock market. It is the rate of return which, compounded over multiple periods, gives the mean of the probability distribution of ending wealth.

While the geometric mean is the best estimate of performance over a long period of time, this does not contradict the statement that the arithmetic mean compounded over the number of years that an investment is held provides the best estimate of the ending wealth value of the investment. The reason is that an investment with uncertain returns will have a higher ending wealth value than an investment which simply earns (with certainty) its compound or geometric rate of return every year. In other words, more money, or terminal wealth, is gained by the occurrence of higher than expected returns than is lost by lower than expected returns.

In capital markets, where returns are a probability distribution, the answer that takes account of uncertainty, the arithmetic mean, is the correct one for estimating discount rates and the cost of capital.

While the geometric mean is appropriate when measuring performance over a long time period, it is incorrect when estimating a risk premium to compute the cost of capital.

TABLE 4A-1
GEOMETRIC VS. ARITHMETIC RETURNS

	Stock A	Stock B
1996	50.0%	11.61%
1997	−54.7%	11.61%
1998	98.5%	11.61%
1999	42.2%	11.61%
2000	−32.3%	11.61%
2001	−39.2%	11.61%
2002	153.2%	11.61%
2003	−10.0%	11.61%
2004	38.9%	11.61%
2005	20.0%	11.61%
Standard Deviation	64.9%	0.0%
Arithmetic Mean	26.7%	11.6%
Geometric Mean	11.6%	11.6%

Theory

The geometric mean measures the magnitude of the returns, as the investor starts with one portfolio and ends with another. It does not measure the variability of the journey, as does the arithmetic mean. The geometric mean is backward looking. There is no difference in the geometric mean of two stocks or portfolios, one of which is highly volatile and the other of which is absolutely stable. The arithmetic mean, on the other hand, is forward-looking in that it does impound the volatility of the stocks.

To illustrate, Table 4A-1 shows the historical returns of two stocks, the first one is highly volatile with a standard deviation of returns of 65% while the second one has a zero standard deviation. It makes no sense intuitively that the geometric mean is the correct measure of return, one that implies that both stocks are equally risky since they have the same geometric mean. No rational investor would consider the first stock equally as risky as the second stock. Every financial model to calculate the cost of capital recognizes that investors are risk-averse and avoid risk unless they are adequately compensated for undertaking it. It is more consistent to use the mean that fully impounds risk (arithmetic mean) than the one from which risk has been removed (geometric mean). In short, the arithmetic mean recognizes the uncertainty in the stock market while the geometric mean removes the uncertainty by smoothing over annual differences.

Empirical Evidence

If both the geometric and arithmetic mean returns over the 1926–2004 data are regressed against the standard deviation of returns for the firms in the

deciles, the arithmetic mean outperforms the geometric mean in this statistical regression. Moreover, the constant of arithmetic mean regression matches the average Treasury bond rate and therefore makes economic sense while the constant for the geometric mean matches nothing in particular. This is simply because the geometric mean is stripped of volatility information and, as a result, does a poor job of forecasting returns based on volatility.

The following illustration is frequently invoked in defense of the geometric mean. Suppose that a stock's performance over a two-year period is representative of the probability distribution, doubling in one year ($r_1 = 100\%$) and halving in the next ($r_2 = -50\%$). The stock's price ends up exactly where it started, and the geometric average annual return over the two-year period, r_g, is zero:

$$
\begin{aligned}
1 + r_g &= [(1 + r_1)(1 + r_2)]^{1/2} \\
&= [(1 + 1)(1 - .50)]^{1/2} = 1 \\
r_g &= 0
\end{aligned}
$$

confirming that a zero year-by-year return would have replicated the total return earned on the stock. The expected annual future rate of return on the stock is not zero, however. It is the arithmetic average of 100% and −50%, $(100-50)/2 = 25\%$. There are two equally likely outcomes per dollar invested: either a gain of \$1 when $r = 100\%$ or a loss of \$0.50 when $r = -50\%$. The expected profit is $(\$1-\$.50)/2 = \$.25$ for a 25% expected rate of return. The profit in the good year more than offsets the loss in the bad year, despite the fact that the geometric return is zero. The arithmetic average return thus provides the best guide to expected future returns.

What Academics Have to Say

Bodie, Kane, and Marcus (2005) cite:

> Which is the superior measure of investment performance, the arithmetic average or the geometric average? The geometric average has considerable appeal because it represents the constant rate of return we would have needed to earn in each year to match actual performance over some past investment period. It is an excellent measure of *past* performance. However, if our focus is on future performance, then the arithmetic average is the statistic of interest because it is an unbiased estimate of the portfolio's expected future return (assuming, of course, that the expected return does not change over time). In contrast, because the geometric return over a sample period is always less than the arithmetic mean,

> it constitutes a downward-biased estimator of the stock's expected return in any future year.
>
> Again, the arithmetic average is the better guide to future performance.

Another way of stating the Bodie, Kane, Marcus argument in favor of the arithmetic mean is that it is the best estimate of the future value of the return distribution because it represents the expected value of the distribution. It is most useful for determining the central tendency of a distribution at a particular time, that is, for cross-sectional analysis. The geometric mean, on the other hand, is best suited for measuring an investment's compound rate of return over time, that is, for time-series analysis. This is the same argument made by Ibbotson Associates (2005) where it is shown, using probability theory, that future terminal wealth is given by compounding the arithmetic mean, and not the geometric mean. In other words, if we accept the past as prologue, the best estimate of a future year's return based on a random distribution of the prior years' returns is the arithmetic average. Statistically, it is our best guess for the holding-period return in a given year.

Brigham and Ehrhardt (2005) in their widely used corporate finance text point out that the arithmetic average is more consistent with CAPM theory, as one of its key underpinning assumptions is that investors are supposed to focus, in their portfolio decisions, upon returns in the next period and the standard deviation of this return. To the extent that this next period is one year, the preference for the arithmetic mean, which derives from a set of single one year period returns, follows. It is also noteworthy that one of the crucial assumptions inherent in the CAPM is that investors are single-period expected utility of terminal wealth maximizers who choose among alternative portfolios on the basis of each portfolio's expected return and standard deviation.

Brealey, Myers, and Allen (2006) in their leading graduate textbook in corporate finance opt strongly for the arithmetic mean. The authors illustrate the distinction between arithmetic and geometric averages and conclude that arithmetic averages are appropriate when estimating the cost of capital:

> The proper uses of arithmetic and compound rates of return from past investments are often misunderstood. Therefore, we call a brief time-out for a clarifying example.
>
> Suppose that the price of Big Oil's common stock is \$100. There is an equal chance that at the end of the year the stock will be worth \$90, \$110, or \$130. Therefore, the return could be -10 percent, $+10$ percent or $+30$ percent (we assume that Big Oil does not pay a dividend). The expected return is $1/3(-10+10+30) = +10$ percent.

If we run the process in reverse and discount the expected cash flow by the expected rate of return, we obtain the value of Big Oil's stock:

$$PV = \frac{110}{1.10} = \$100$$

The expected return of 10 percent is therefore the correct rate at which to discount the expected cash flow from Big Oil's stock. It is also the opportunity cost of capital for investments which have the same degree of risk as Big Oil.

Now suppose that we observe the returns on Big Oil stock over a large number of years. If the odds are unchanged, the return will be −10 percent in a third of the years, +10 percent in a further third, and +30 percent in the remaining years. The arithmetic average of these yearly returns is

$$\frac{-10 + 10 + 30}{3} = +10\%$$

Thus the arithmetic average of the returns correctly measures the opportunity cost of capital for investments of similar risk to Big Oil stock.

The average compound annual return on Big Oil stock would be

$$(.9 \times 1.1 \times 1.3)^{1/3} - 1 = .088, \text{ or } 8.8\%$$

less than the opportunity cost of capital. Investors would not be willing to invest in a project that offered an 8.8 percent expected return if they could get an expected return of 10 percent in the capital markets. The net present value of such a project would be

$$NPV = -100 + \frac{108.8}{1.1} = -1.1$$

Moral: If the cost of capital is estimated from historical returns or risk premiums, use arithmetic averages, not compound annual rates of return (geometric averages).

(Richard A. Brealey, Stewart C. Myers, and Paul Allen, *Principles of Corporate Finance*, 8th Edition, Irwin McGraw-Hill, 2006, page 156–7.)

The widely cited Ibbotson Associates publication also contains a detailed and rigorous discussion of the impropriety of using geometric averages in estimating the cost of capital.[12]

[12] Ibbotson Associates, *Stocks, Bonds, Bills, and Inflation, 2005 Yearbook, Valuation Edition*, page 75.

> The arithmetic average equity risk premium can be demonstrated to be most appropriate when discounting future cash flows. For use as the expected equity risk premium in either the CAPM or the building block approach, the arithmetic mean or the simple difference of the arithmetic means of stock market returns and riskless rates is the relevant number. This is because both the CAPM and the building block approach are additive models, in which the cost of capital is the sum of its parts. The geometric average is more appropriate for reporting past performance, since it represents the compound average return.
>
> The argument for using the arithmetic average is quite straightforward. In looking at projected cash flows, the equity risk premium that should be employed is the equity risk premium that is expected to actually be incurred over the future time periods.
>
> The best estimate of the expected value of a variable that has behaved randomly in the past is the average (or arithmetic mean) of its past values.

In their widely publicized research on the market risk premium, Dimson, Marsh and Staunton (2002) state

> The arithmetic mean of a sequence of different returns is always larger than the geometric mean. To see this, consider equally likely returns of +25 and −20 percent. Their arithmetic mean is 2½ percent, since (25 − 20)/2 = 2½. Their geometric mean is zero, since (1 + 25/100) × (1 − 20/100) − 1 = 0. But which mean is the right one for discounting risky expected future cash flows? For forward-looking decisions, the arithmetic mean is the appropriate measure.
>
> To verify that the arithmetic mean is the correct choice, we can use the 2½ percent required return to value the investment we just described. A $1 stake would offer equal probabilities of receiving back $1.25 or $0.80. To value this, we discount the cash flows at the arithmetic mean rate of 2½ percent. The present values are respectively $1.25/1.015 = $1.22 and $0.80/1.025 = $0.78, each with equal probability, so the value is $1.22 × ½ + $0.80 × ½ = $1.00. If there were a sequence of equally likely returns of +25 and −20 percent, the geometric mean return will eventually converge on zero. The 2½ percent forward-looking arithmetic mean is required to compensate for the year-to-year volatility of returns.

Lastly, on the practical side, Bruner, Eades, Harris, and Higgins (1998) found that 71% of the texts and tradebooks in their extensive survey of practice supported use of an arithmetic mean for estimation of the cost of equity.

Mean Reversion Argument

Some academics have argued that if stock returns were expected to revert to a trend, this would suggest the use of a geometric mean since the geometric mean is, by definition, an estimate of a smoothed long-run trend increment. These same academics have argued that the historical estimate of the market risk premium ("MRP") is upward-biased by the buoyant performance of the stock market prior to 2002, and because of the extraordinary and unusually high realized MRPs in those years, investors expect a return to lower MRPs in the future, bringing the average MPR to a more "normal" level.

The presence or absence of mean reversion is an empirical issue. The empirical findings are weak and highly contradictory; the empirical evidence is inconclusive and unconvincing, certainly not enough to support the "mean reversion" hypothesis. The weight of the empirical evidence on this issue is that the more sophisticated tests of mean reversion in the MRP demonstrate that the realized MRP over the last 75 years or so was almost perfectly free of mean reversion, and had no statistically identifiable time trend. It is also noteworthy that most of these studies were performed prior to the stock market's debacle in 2000–2002, years of extraordinary and unusually low realized MRPs. The stock market's dismal performance of 2000–2002 has certainly taken the wind out of the mean reversion school's sails.

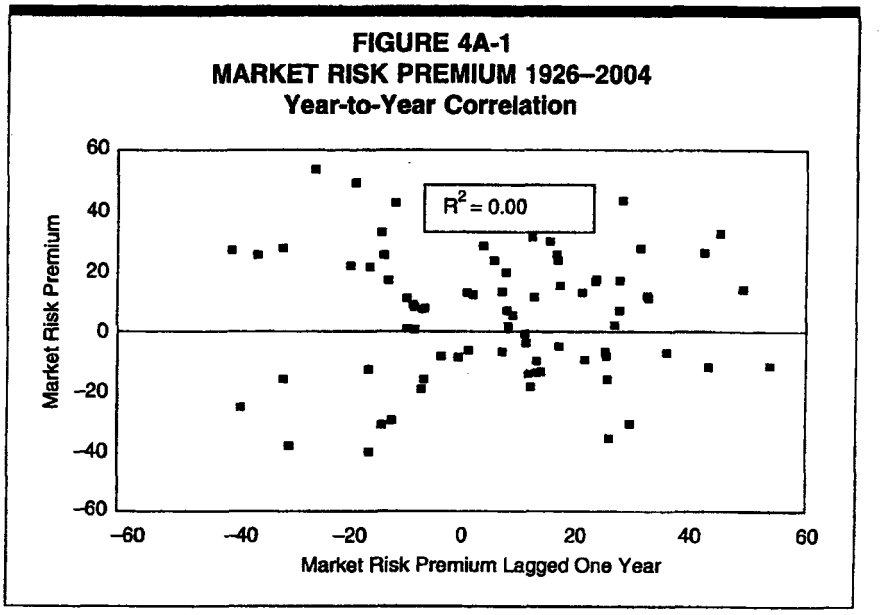
An examination of historical MRPs reveals that the MRP is random with no observable pattern. To the extent that the estimated historical equity risk premium follows what is known in statistics as a random walk, one should expect the equity risk premium to remain at its historical mean. Therefore, the best estimate of the future risk premium is the historical mean.

Ibbotson Associates (2005) find no evidence that the market price of risk or the amount of risk in common stocks has changed over time:

> Our own empirical evidence suggests that the yearly difference between the stock market total return and the U.S. Treasury bond income return in any particular year is random . . . there is no discernable pattern in the realized equity risk premium. (Ibbotson Associates, *Stocks, Bonds, Bills, and Inflation, 2005 Yearbook, Valuation Edition,* pages 74–75)

In statistical parlance, there is no significant serial correlation in successive annual market risk premiums, that is, no trend. Ibbotson Associates go on to state that it is reasonable to assume that these quantities will remain stable in the future (*Id.*):

> The best estimate of the expected value of a variable that has behaved randomly in the past is the average (or arithmetic mean)



of its past values. (Ibbotson Associates, *Stocks, Bonds, Bills, and Inflation, 2004 Yearbook, Valuation Edition*, page 75)

Nowhere is it suggested by Ibbotson Associates that the market risk premium has declined over time.

Because there is little evidence that the MRP has changed over time, it is reasonable to assume that these quantities will remain stable in the future. Figure 4A-1 shows the relationship, or the lack of relationship, between year-to-year MRPs reported in the Ibbotson Associates Valuation Yearbook, 2005 edition, for the 1926–2004 period. The relationship is virtually absent, as indicated by the low R^2 of zero between successive MRPs. In other words, there is no history in successive MRPs as indicated by the zero serial correlation coefficient.

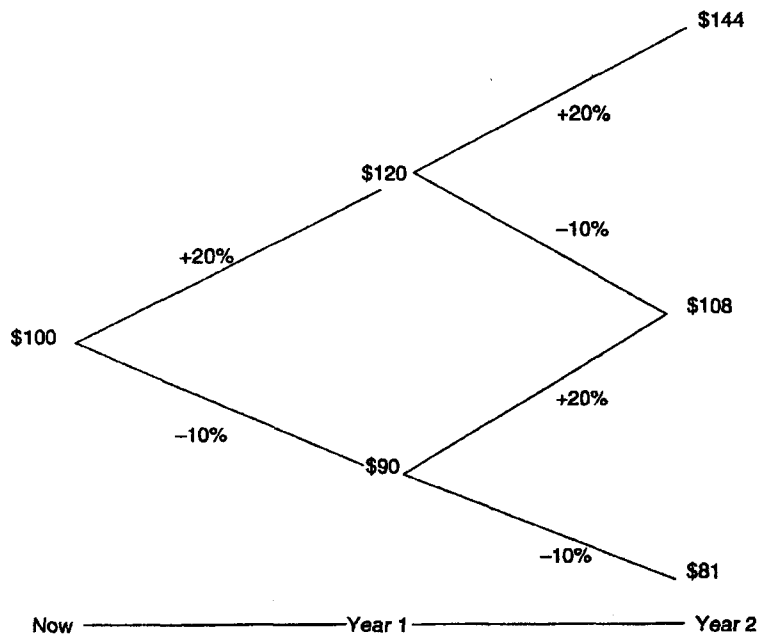
In short, the determination of the cost of capital with the CAPM requires an unbiased estimate of the expected annual return. The expected arithmetic return provides the appropriate measure for this purpose.

Formal Demonstration

This section shows why arithmetic rather than geometric means should be used for forecasting, discounting, and estimating the cost of capital.[13] By

[13] This section is adapted from a similar treatments and demonstration in Brealey, Myers, and Allen (2006) and Ibbotson Associates (2005).

FIGURE 4A-2
POSSIBLE STOCK PRICES



definition, the cost of equity capital is the annual discount rate that equates the discounted value of expected future cash flows (from dividends and the sale of the stock at the end of the investor's investment horizon) to the current market price of a share in the firm. The discount rate that equates the discounted value of future expected dividends and the end of period expected stock price to the current stock price is a prospective arithmetic, rather than a prospective geometric, mean rate of return. Since future dividends and stock prices cannot be predicted with certainty, the "expected" annual rate of return that investors require is an average "target" percentage rate around which the actual, year-by-year returns will vary. This target rate is, in effect, an arithmetic average.

A numerical illustration will clarify this important point. Consider a non-dividend paying stock trading for $100 which has, in every year, an equal chance of appreciating by 20% or declining by 10%. Thus, after one year, there is an equal chance that the stock's price will be $120 and an equal chance the price will be $90. Figure 4A-2 presents all possible eventualities after two periods have elapsed (the rates of return are presented at the end of the lines in the diagram).

The possible stock prices are shown in the following table.

TABLE 4A-2
STOCK PRICES AFTER TWO PERIODS

Price	Chance
$144	1 chance in 4
$108	2 chances in 4
$ 81	1 chance in 4

The expected future stock price after two periods is then:

$$1/4\ (\$144) + 2/4\ (\$108) + 1/4\ (\$81) = \$110.25$$

The cost of equity capital is calculated as the discount rate that equates the present value of the future expected cash flows to the current stock price. In the present simple example, the only cash flow is the gain from selling the stock after two periods have elapsed. Thus, using the expected stock price of $110.25 calculated above, the expected rate of return is that r, which solves the following equation:

$$\text{Current Stock Price} = \frac{\text{Expected Stock Price}}{(1 + r)^2}$$

The factor $(1 + r)^2$ discounts the expected stock price to the present. Substituting the numerical values, we have:

$$\$100 = \frac{\$110.25}{(1+r)^2}$$

$$r = 5\%$$

Thus, the cost of equity capital is 5%. This 5% cost of equity capital is equal to the prospective arithmetic mean rate of return, which is the probability-weighted average single period rate of return on equity. Since in every period there is an equal chance that the stock's return will be 20% or −10%, the probability-weighted average is:

$$1/2\ (20\%) + 1/2\ (-10\%) = 5\%$$

However, the 5% cost of equity capital is not equal to the prospective geometric mean rate of return, which is a probability-weighted average of the possible compounded rates of return over the two periods. Now consider the prospective geometric mean rate of return. Table 4A-3 shows the possible compounded rates of return over two periods, and the probability of each.

Thus, the prospective geometric mean rate of return is:

$$1/4\ (20\%) + 2/4\ (3.92\%) + 1/4\ (-10\%) = 4.46\%$$

TABLE 4A-3
STOCK PRICES AND RETURNS AFTER TWO PERIODS

Price	Chance	Compounded Return
$144	1 chance in 4	20.00%
$108	2 chances in 4	3.92%
$ 81	1 chance in 4	−10.00%

This return is not equal to the 5% cost of equity capital.

The example can easily be extended to include the case of a dividend-paying company and will reach the same conclusion: the implied discount rate calculated in the DCF model is an expected arithmetic rather than an expected geometric mean rate of return.

The foregoing analysis shows that it is erroneous to use a prospective multi-year geometric mean rate of return as a "target" rate of return for each year of the period. If, for example, investors currently require an expected future rate of return on an investment of 13% each year, then 13% is the appropriate annual rate of return on equity for ratemaking purposes. Consequently, in using a risk premium approach for the purposes of rate of return regulation, the single-year annual required rate of return should be estimated using arithmetic mean risk premiums.

It should be pointed out that the use of the arithmetic mean does not imply an investment holding period of one year. Rather, it is premised on the uncertainty with respect to each year's return during the holding period, however many years that may be. When computing the arithmetic average of historic annual returns in order to calculate the average return (expected value of the return), every achieved return outcome is one possible future outcome for each year the security will be held. Each historic return has an equal probability of occurring during each year of the holding period. The resulting expected value of the risk premium is the arithmetic average of all of the past premiums considered, regardless of the length of the expected holding period.

TABLES

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 1

Calculate br Growth on Mid-Period Basis

Line		American States Water	California Water	Middlesex Water MSEX	SJW Corp	Aqua America	Average
1	Projected ROE Reported by Value Line	11.50%	10.50%	11.00%	7.50%	12.50%	10.6%
2	Value Line Forecast of BVPS Growth	0.50%	3.50%	1.00%	3.50%	5.00%	2.7%
3	FERC formula correction of ROE[a/]	11.53%	10.68%	11.05%	7.63%	12.80%	10.7%
4	Forecasted DPS	$1.32	$0.72	$0.80	$0.82	$0.78	88.8%
5	Forecasted EPS	$2.50	$1.30	$1.20	$1.40	$1.40	156.0%
6	Forecasted Retenion Ratio	47.20%	44.62%	33.33%	41.43%	44.29%	42.2%
7	br Growth on mid-period equity	5.44%	4.77%	3.68%	3.16%	5.67%	4.5%

Notes and Sources:

a/ FERC formula is adjusted ROE = ROE^{VL} * 2 ((1+BVPSg))/(2+BVPSg), where ROE^{VL} is the ROE reported by Value Line.

b/ Other data reported by RUCO or Value Line.

3/24/2012

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 2

Correct Mr. Rigsby's Determination of sv Growth
To Be Consistent with Assumptions of the DCF Model

COMPANY	Share Growth[a/]	RUCO External Growth[b/]	Corrected External Growth[c/]
American States Water	1.00%	0.31%	0.63%
California Water	2.70%	0.89%	1.78%
Middlesex Water	1.80%	0.67%	1.33%
SJW Corp.	4.00%	1.38%	2.76%
Aqua America	0.70%	0.50%	1.01%
		0.75%	1.50%

Notes and Sources
a/ Mr. Rigsby's Schedule WAR- 4, page 2 of 2.
b/ Mr. Rigsby's Schedule WAR -4, page 1 of 2.
c/ Computed with Mr. Rigsby's formula but assuming market prices for stocks are consistent with DCF model assumptions.

3/24/2012

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 3

Corrected br+sv Growth Reported by RUCO and Various Growth Rates Reported by RUCO and Indicated Sources

		VALUE LINE PROJECTED				ANALYSTS' FORECASTS			HISTORIC GROWTH			
COMPANY	br + sv-a/	EPS-b/	DPS-b/	PRICE-c/	BVPS-b/	Zacks-b/	Reuters	Yahoo!-d/	EPS-b/	DPS-b/	PRICE-e/	BVPS-b/
AWR	6.1%	6.5%	4.5%	9.9%	0.5%	12.00%	7.57%	5.70%	11.50%	2.50%	7.0%	5.00%
CWT	6.5%	5.5%	3.5%	8.8%	3.5%	10.00%	9.80%	9.93%	6.50%	1.00%	7.1%	5.50%
MSEX	5.0%	6.0%	2.0%	3.0%	1.0%	na	na	2.70%	4.50%	1.50%	5.6%	5.50%
SJW	5.9%	6.0%	4.5%	8.4%	3.5%	na	na	14.00%	NMF-f/	5.50%	14.4%	6.50%
WTR	6.7%	10.0%	6.0%	9.1%	5.0%	8.30%	7.85%	7.53%	4.50%	8.00%	16.7%	7.00%
AVERAGES		6.8%	4.1%	7.8%	2.7%	10.1%	8.4%	8.0%	6.75%	3.70%	10.2%	5.90%
AVERAGES	6.0%			5.36%			8.83%				6.63%	

COMPANY	OVERALL AVERAGE	ANALYSTS' EPS FORECASTS
AWR	6.6%	7.9%
CWT	6.7%	8.8%
MSEX	3.7%	4.4%
SJW	8.6%	10.0%
WTR	7.8%	8.4%
AVERAGES	6.7%	7.9%

Notes and Sources:
a/ br + sv growth calculated as sum of data in Rebuttal Tables 1 and 2.
b/ As reported by RUCO.
c/ MPPS increases projected by Value Line at January 20, 2012.
d/ Reported on the Internet March 7, 2012.
e/ Growth during the last 15 years.
f/ Not meaningful if negative. Also, negative growth reflects SJW Corp having abnormally high earnings at start of period.

3/24/2012

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 4: RUCO and Alternative Methods Used to Estimate Dividend Yields

A. RUCO Method: RUCO used incorrect data shown below

COMPANY	REPORTED-c/ AVG STOCK PRICE (PER SHARE)	ESTIMATED DIVIDEND (PER SHARE)	DIVIDEND YIELD
AWR	$35.53	$1.12 -a/	3.15%
CWT	$18.15	$0.62 -b/	3.39%
MSEX	$18.76	$0.74 -a/	3.94%
SJW	$23.63	$0.69 -b/	2.93%
WTR	$21.85	$0.66 -a/	3.02%
		AVERAGE DIVIDEND YIELD:	**3.29%**

B. Alternative Method: assumes next year's dividend is 5.2% grearter than current dividend -d/

COMPANY	REPORTED-c/ AVG STOCK PRICE (PER SHARE)	ESTIMATED DIVIDEND (PER SHARE)	DIVIDEND YIELD-a/
AWR	$35.53	$1.18	3.32%
CWT	$18.15	$0.66	3.66%
MSEX	$18.76	$0.78	4.15%
SJW	$23.63	$0.75	3.17%
WTR	$21.85	$0.69	3.18%
		AVERAGE DIVIDEND YIELD:	**3.50%**

Notes and Sources:

a/ Dividend adopted by RUCO is current dividend instead of forecast of next year's dividend.
b/ Dividend adopted by RUCO is last year's dividend instead of forecast of next year's dividend.
c/ Prices and growth rates from RUCO Schedules except where indicated.
d/ 5.2% growth is computed by ACC Staff in Schedule JAC-8.B9.

3/24/2012

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 5

Selected Data for the Water Utilities Sample

		Measures of Firm Size						
	Companies in Sample	Number of Customers (000)-b/	Operating Revenues-a/ ($ millions)	Net Plant-a/ ($ millions)	Market Capitalization-d/ ($ millions)	Spot Price 2/1/20112-d/	Dividend-d/	Yield D_1/P_0-d/
1	American States Water	279	$428	$891	$685	$36.87	$1.16	3.1%
2	Aqua America	900	$736	$3,513	$3,062	$22.31	$0.67	3.0%
3	California Water Service	500	$504	$1,347	$771	$18.90	$0.65	3.4%
4	Connecticut Water Service	90	$73	$355	$265	$32.03	$0.98	3.1%
5	Middlesex Water	99	$103	$417	$291	$19.18	$0.75	3.9%
6	SJW Corporation	236	$227	$727	$440	$23.96	$0.73	3.0%
	Sample average	350	$345	$1,208	$1,632	$25.54	$0.82	3.2%
7	American Water Works Co.	3101	$2,716	$10,647	$5,909	$33.68	$1.01	3.0%

Notes and Sources:
_a/ Source: AUS Utility Reports, March 2012.
_b/ From SEC 10-K Reports or Annual Reports for the various utilties.
_c/ Market capitalization as of February 15, 2012 per AUS Utiltiy Reports.
_d/ Data from Mr. Cassidy other than for American Water Works. Price for American Water Works from Internet. Dividend and yield for American Water Works are equal to 1.052 times current indicated yield to be consistent with approach Schedules JAC-3 and JAC-9.

03/24/12

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 6

Analysts' Forecasts of Growth for DCF Model

		Zack's[a/]	Yahoo! Finance[a/]	Reuters[a/]	Value Line[b/]	Average	Number of Analysts[d/]
1	American States	12.0%	5.7%	7.6%	6.5%	7.9%	3
2	Aqua America	8.3%	7.5%	7.9%	10.0%	8.4%	6
3	California Water	10.0%	9.9%	9.8%	5.5%	8.8%	1
4	Connecticut Water Service	na	10.2%	5.7%	na	7.9%	3
5	Middlesex Water	na	2.7%	na	6.0%	4.4%	2
6	SJW Corporation	na	14.0%	na	6.0%	10.0%	2
	Simple average	10.1%	8.3%	7.7%	6.8% [e/]	7.9%	17
7	American Water Works	8.1%	9.2%	11.2%	10.0%	9.6%	9

Sources and Notes:
a/ Reported on the Internet, March 7, 2012.
b/ Reported by Value Line January 20, 2012.
c/ If "na", analysts' consenus forecast is not available at this time.
d/ Number of analysts reported by Reuters.
e/ Mr. Cassidy uses a different method to compute EPS growth projected by Value Line which produces an average without American Water Works of 6.7%.

3/24/2012

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 7

Estimates of Projected Growth

		EPS-[a/]	DPS-[b/]
1	American States	7.9%	4.9%
2	Aqua America	8.4%	5.7%
3	California Water	8.8%	3.9%
4	Connecticut Water Service	7.9%	na
5	Middlesex Water	4.4%	2.1%
6	SJW Corporation	10.0%	4.8%
	Simple average	7.9%	4.3%
7	American Water Works -[c/]	9.6%	10.0%

Notes and Sources
a/ From Rebuttal Table 6.
b/ From Value Line and Schedule JAC-5.
c/ From Value Line and Schedule JAC-6.

3/24/2012

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 8

Forecasts of Treasury and Baa Bond Rates
2013 - 2015

	2013	2014	2015	Average
30-Year Treassury Rates				
Blue Chip Consensus Forecasts[a/]	4.2%	4.8%	5.3%	
Value Line[b/]	3.7%	4.0%	4.5%	
Average				4.42%
Corporate Baa Bond Rates				
Blue Chip Consensus Forecasts[a/]	5.7%	6.4%	6.8%	
Value Line[b/]	na	na	na	
Average				6.30%

Sources and Notes:
a/ December 2011 Blue Chip long-term consensus forecasts.
b/ Value Line Quarterly forecasts dated February 24, 2012.

3/24/2012

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 9

Staff's Choice for Spot Prices Compared to Highest Closing Prices

	Dividend-[a/]	Staff-[a/] Choice for Spot Price 2/1/12	Yield D_1/P_0-[d/]	Highest-[b/] Closing Spot Price 2/29/12	Yield D_1/P_0-[d/]
American States Water	$1.16	$36.87	3.1%	36.86	3.1%
Aqua America	$0.67	$22.31	3.0%	22.21	3.0%
California Water Service	$0.65	$18.90	3.4%	19.21	3.4%
Connecticut Water Service	$0.98	$32.03	3.1%	28.82	3.4%
Middlesex Water	$0.75	$19.18	3.9%	18.42	4.1%
SJW Corporation	$0.73	$23.96	3.0%	23.89	3.1%
	$0.82	$25.54	3.3%	24.90	3.3%

Notes and Sources

a/ Data uudes by Mr. Cassidy.

b/ Data from the Internet. Highest average of monthly closing prices during the period August 2011 to February 2012.

3/24/2012

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 10

Examination of Bias in Real and Nominal Value Line ROE Forecasts for 8 Natural Gas Utilities
1977 to 1998

		Nominal Returns			Inflation_c/			Real Returns		
	Date of Value Line Issues	Average Value Line Forecasted ROE (1977-1994)	Average Actual Earned ROE 4 Years Later (1981-1998)	Difference Between Forecasted and Actual Nominal ROEs	Expected Inflation	Actual Inflation	Difference Between Forecasted and Actual Inflation	Average Value Line Forecasted ROE (1977-1994)	Actual Earned ROE 4 Years Later (1981-1998)	Difference Between Forecasted and Actual Real ROEs
1	Oct-77	13.00%	11.32%	1.68%	5.50%	9.70%	-4.20%	7.50%	1.62%	5.88%
2	Jan-79	12.81%	11.91%	0.90%	5.50%	3.90%	1.60%	7.31%	8.01%	-0.70%
3	Oct-80	14.13%	15.86%	-1.73%	8.25%	3.70%	4.55%	5.88%	12.16%	-6.28%
4	Oct-81	15.06%	13.81%	1.25%	7.50%	3.20%	4.30%	7.56%	10.61%	-3.05%
5	Oct-82	14.00%	12.07%	1.93%	5.20%	2.60%	2.60%	8.80%	9.47%	-0.67%
6	Oct-83	13.94%	12.28%	1.66%	5.00%	3.00%	2.00%	8.94%	9.28%	-0.34%
7	Oct-84	15.13%	14.67%	0.46%	5.50%	3.70%	1.80%	9.63%	10.97%	-1.34%
8	Oct-85	15.56%	13.12%	2.44%	4.50%	4.20%	0.30%	11.06%	8.92%	2.14%
9	Oct-86	13.63%	12.41%	1.21%	3.80%	4.40%	-0.60%	9.83%	8.01%	1.81%
10	Oct-87	13.19%	11.62%	1.56%	4.50%	4.00%	0.50%	8.69%	7.62%	1.06%
11	Oct-88	13.13%	10.88%	2.24%	4.60%	2.70%	1.90%	8.53%	8.18%	0.34%
12	Oct-89	13.50%	12.58%	0.92%	4.60%	2.60%	2.00%	8.90%	9.98%	-1.08%
13	Oct-90	14.00%	11.71%	2.29%	4.30%	2.30%	2.00%	9.70%	9.41%	0.29%
14	Oct-91	14.13%	11.34%	2.78%	3.70%	2.50%	1.20%	10.43%	8.84%	1.58%
15	Oct-92	14.38%	13.08%	1.29%	3.90%	2.10%	1.80%	10.48%	10.98%	-0.51%
16	Dec-93	12.56%	12.62%	-0.06%	2.40%	2.00%	0.40%	10.16%	10.62%	-0.46%
17	Dec-94	12.19%	11.20%	0.99%	2.80%	1.30%	1.50%	9.39%	9.90%	-0.51%
	Average	13.78%	12.50%	1.28%	4.80%	3.41%	1.39%			-0.11%

Notes and Source:
a/ Source of Study: Testimony of Thomas M. Zepp in Oregon PUC Docket UG-132, Exhibit UG-132/NWN/5000.
b/ ROEs are annual averages for 8 natural gas distribution companies for each year.
c/ Based on forecasted and realized values for the GNP deflator.

3/24/2012

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 11: Comparison of Forecasted and Realized Value Line Forecasts of br-growth for Electric Utility (Central) Industry
1982 to 2009

				Nominal - br growth-b/			Consumer Price Index-a/			Real - br growth		
Line	Year-end Date of Forecast	Future period	Future Mid-Year	Value Line Forecast of br Growth	Actual br Growth	Difference Between Forecasted and Actual	Forecast	Actual	Difference Between Forecasted and Actual	Forecast	Actual	Difference Between Forecasted and Actual
1	1982	1985 -1987	1986	3.00%	4.60%	-1.60%	5.00%	1.90%	3.10%	-2.00%	2.70%	-4.70%
2	1983	1986 -1988	1987	4.00%	4.40%	-0.40%	5.30%	3.70%	1.60%	-1.30%	0.70%	-2.00%
3	1984	1987 -1989	1988	4.50%	3.30%	1.20%	5.50%	4.10%	1.40%	-1.00%	-0.80%	-0.20%
4	1985	1988 -1990	1989	5.00%	2.90%	2.10%	5.00%	4.80%	0.20%	0.00%	-1.90%	1.90%
5	1986	1989 -1991	1990	5.00%	2.50%	2.50%	4.50%	5.40%	-0.90%	0.50%	-2.90%	3.40%
6	1987	1990 -1992	1991	4.70%	2.40%	2.30%	5.00%	4.20%	0.80%	-0.30%	-1.80%	1.50%
7	1988	1991 -1993	1992	4.00%	3.30%	0.70%	4.50%	3.00%	1.50%	-0.50%	0.30%	-0.80%
8	1989	1992 -1994	1993	3.70%	2.90%	0.80%	4.90%	3.00%	1.90%	-1.20%	-0.10%	-1.10%
9	1990	1993 -1995	1994	3.80%	2.50%	1.30%	4.70%	2.60%	2.10%	-0.90%	-0.10%	-0.80%
10	1991	1995 -1997	1996	3.70%	3.00%	0.70%	4.50%	2.90%	1.60%	-0.80%	0.10%	-0.90%
11	1992	1995 -1997	1996	3.50%	3.00%	0.50%	4.10%	2.90%	1.20%	-0.60%	0.10%	-0.70%
12	1993	1996 -1998	1997	3.10%	2.60%	0.50%	3.40%	2.30%	1.10%	-0.30%	0.30%	-0.60%
13	1994	1997 -1999	1998	3.00%	2.80%	0.20%	3.50%	1.60%	1.90%	-0.50%	1.20%	-1.70%
14	1995	1998 -2000	1999	3.20%	4.20%	-1.00%	3.30%	2.20%	1.10%	-0.10%	2.00%	-2.10%
15	1996	1999 -2001	2000	3.60%	0.10%	3.50%	3.30%	3.40%	-0.10%	0.30%	-3.30%	3.60%
16	1997	2000 -2002	2001	4.00%	5.40%	-1.40%	2.80%	2.80%	0.00%	1.20%	2.60%	-1.40%
17	1998	2001 -2003	2002	4.50%	2.50%	2.00%	2.80%	1.60%	1.20%	1.70%	0.90%	0.80%
18	1999	2002 -2004	2003	5.20%	4.80%	0.40%	2.80%	2.30%	0.50%	2.40%	2.50%	-0.10%
19	2000	2003 -2005	2004	6.00%	4.80%	1.20%	2.70%	2.70%	0.00%	3.30%	2.10%	1.20%
20	2001	2004 -2006	2005	6.00%	4.90%	1.10%	2.80%	3.40%	-0.60%	3.20%	1.50%	1.70%
21	2002	2005 -2007	2006	5.50%	5.50%	0.00%	2.80%	3.20%	-0.40%	2.70%	2.30%	0.40%
22	2003	2006 -2008	2007	5.50%	5.50%	0.00%	2.50%	2.90%	-0.40%	3.00%	2.60%	0.40%
23	2004	2007 -2009	2008	5.00%	5.00%	0.00%	2.50%	3.80%	-1.30%	2.50%	1.20%	1.30%
24	2005	2008 -2010	2009	5.00%	4.30%	0.70%	2.70%	-0.30%	3.00%	2.30%	4.60%	-2.30%
		Column average		4.35%	3.63%	0.72%	3.79%	2.93%	0.85%	0.57%	0.70%	-0.13%

Notes and Sources:

a/ Forecasted and actual Consumer Price Index values which were correlated with Value Line estimates for the Electric Utility (Central) Industry.

b/ Actual br-growth and forecasted br-growth as reported by Value Line in various year-end issues of Issue 5, Ratings & Reports for the Electric Utility (Central) Industry.

3/24/2012

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 12

Restatement of Dr. Woolridge's Analysis Comparing Analysts' Forecasts To Actual EPS Growth Rates for Gas Distribution Utilities[a,d/]
Average of Quarterly Forecasts: 1990 to 2007

A. Statistical significance of Dr. Woolridge's study	Average Forecast	Average Actual	Difference
Data from Dr. Woolridge[b/]	5.15%	4.53%	0.62%
Standard deviation			2.81%
t-statistic[c/]			0.22

B. Dr. Woolridge's Analysis in Real Terms[d/]	Average Forecast	Average Actual	Difference
Data from Dr. Woolridge[b/]	5.15%	4.53%	0.62%
Average inflation during period[e/]	3.29%	2.61%	0.67%
Analysis based on differences in real growth rates	1.86%	1.92%	-0.05%

Notes and Sources
a/ Source is Dr. Woolridge's work papers.
b/ Means reported by Dr. Woolridge in work papers.
c/ Mean difference not significantly different than zero.
d/ Period is 1990 to 2007.
e/ *Value Line* forecasts of CPI and actual CPI.

ARIZONA WATER EASTERN GROUP
DOCKET NO. W-01445A-11-0310

Rebuttal Table 13

Restatement of Dr. Woolridge's Analysis Comparing Analysts' Forecasts to Actual EPS Growth Rates for Electric Utilities Average of Quarterly Forecasts: 1990 to 2003[a,d/]

	Average Forecast	Average Actual	Average of Differences
A. Statistical significance of Dr. Woolridge's study			
Data from Dr. Woolridge[b,d/]	4.08%	3.41%	0.68%
Standard deviation			2.10%
t-statistic[c/]			0.32

	Average Forecast	Average Actual	Average of Difference
B. Put Dr. Woolridge's Analysis in Real Terms[d/]			
Data from Dr. Woolridge[b,d/]	4.08%	3.41%	0.68%
Average inflation during period[e/]	3.52%	2.46%	1.06%
Analysis based on differences in real growth rates	0.56%	0.95%	-0.38%

Notes and Sources
a/ Source is Dr. Woolridge's work papers.
b/ Means computed from work papers provided by Dr. Woolridge.
c/ Mean difference not significantly different than zero.
d/ Analysis based on Dr. Woolridge's data for 1990 to 2003. Period chosen to match publication of Professor Malkiel's book A Random Walk Down Wallstreet which Staff reports was published in 2003.
e/ *Value Line* forecasts of CPI and actual CPI for 1990 to 2003.

3/24/2012

TMZ-3

Posted 4/23/2004 12:20 AM

Investors finally see picture of profit

By Matt Krantz, USA TODAY

After ignoring Corporate America's boffo earnings season all week, investors are finally waking up.

Stocks soared in a broad rally Thursday that traders mostly attributed to the sudden realization the stream of first-quarter earnings reports has been better than already-lofty expectations.

The Dow Jones industrial average rose 144 points to 10,461 for its best gain in a month.

With blowout earnings pouring in from companies ranging from American International Group to Caterpillar, earnings season has stolen investors' attention from the recent fixation over the threat of higher interest rates. "I hate to be an overwhelming bull, but (the earnings season) is amazing," says Scott Pape, portfolio manager at CastleArk Management.

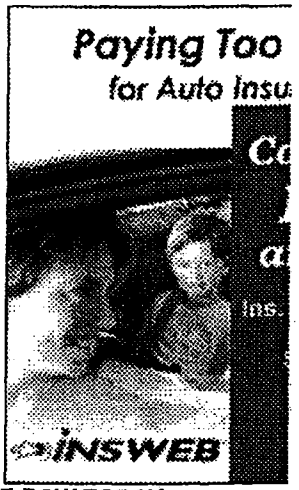
It's not like the strong earnings just started landing Thursday. More than half the companies in the Standard & Poor's 500 have reported, and 78% of them have beat estimates, Thomson First Call says. Typically, only 58% of companies beat forecasts.

So far, operating earnings have been nearly 22% higher than the first quarter last year, says Howard Silverblatt at S&P. While that's down slightly from the 24.6% growth in the fourth quarter of 2003, if companies deliver what's expected, S&P 500 earnings will be a record this quarter, he says.

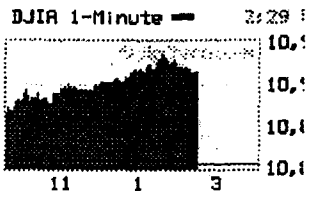
With the abundance of good earnings news, the question is why has it taken investors so long to notice. Some explanations:

•**Reduced fears of skyrocketing interest rates.** Federal Reserve Chairman Alan Greenspan, in his comments to Congress Wednesday, quieted fears of a massive and sudden spike in short-term interest rates. "People realized that an aggressive hiking of short-term rates is probably not likely," says Gary Tapp at SunTrust Robinson Humphrey.

•**Acknowledgment stocks can move higher, even when rates rise.** Though investors have initially panicked, the Dow has actually gained an average of 8% in the year following



THE DOW TODAY



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•**Companies are bullish about the future.** Not only are companies such as Caterpillar, Qualcomm and Starbucks beating estimates, but they're raising their forecasts for future earnings. "The guidance has really started to come in awfully strong," Tapp says.

•**Pressure on bonds receding.** The yield on the widely followed 10-year Treasury note — which moves in the opposite direction of its price — fell to 4.39% from 4.43% Wednesday as rate fears eased.

Some, like Rod Smyth, a strategist at Wachovia, are skeptical, thinking the reality of higher interest rates will derail all this happiness. "This is a relief rally," he says. "Something has got to give."

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THE WALL STREET JOURNAL.

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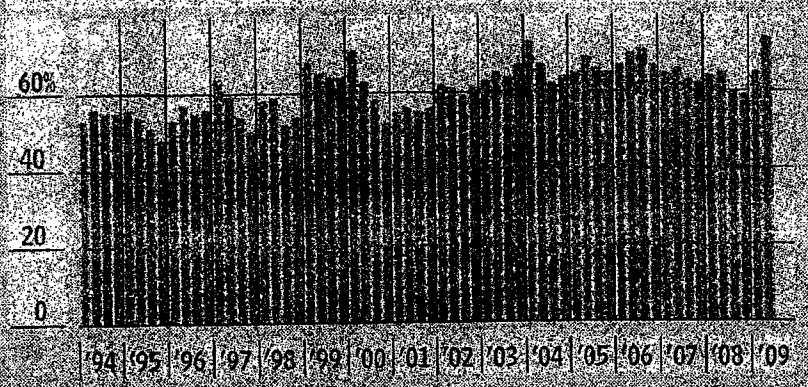
Vital Signs

Percentage of companies in the S&P 500 whose results came in above analyst estimates



Source: Thomson Reuters

Company results are trumping analyst expectations. Three-quarters of the companies in the S&P 500 index that have reported second quarter results so far have topped analyst estimates—the most ever in data going back to 1994. That is less a sign of an improving economy than of how deeply businesses have cut costs in response to the downturn.

TMZ-4

THE VALUE LINE Investment Survey®

PAGES 4179-4190
File in page order in the *Selection & Opinion* binder

PART 2 — *Selection & Opinion* — JUNE 29, 2001

A Letter from Our Chairman

In This Issue

A Letter from Our Chairman	4179
Stock Highlight	4180
Dow Jones Industrials: Earnings and Dividends	4181
Dow Jones Industrials Forecast: An Update	4181
The Value Line View	4182
Stocks for Long-Term Gains	4182
Investors' Datebook: July, 2001	4183
Model Portfolios: Recent Developments	4184
Timely Stocks with Healthy Price Appreciation Potential	4186
Selected Yields	4187
Federal Reserve Data	4187
Tracking the Economy	4188
Major Insider Transactions	4188
Market Monitor	4189
Industry Price Performance	4189
Changes in Financial Strength Ratings	4189
Stock Market Averages	4190

The *Selection & Opinion* Index appears on page 4218 (June 8, 2001).

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Jean B. Buttner
Chairman & CEO

CLOSING STOCK MARKET AVERAGES AS OF PRESS TIME

	6/14/2001	6/21/2001	%Change 1 week	%Change 12 months
Dow Jones Industrial Average	10690.13	10715.43	+0.2%	+2.1%
Standard & Poor's 500	1219.87	1237.04	+1.4%	-16.4%
N.Y. Stock Exchange Composite	623.96	631.08	+1.1%	-2.8%
NASDAQ OTC Composite	2044.07	2058.76	+0.7%	-49.3%
American Stock Exchange Index	921.88	906.97	-1.6%	-3.3%
Value Line (Geometric)	392.95	390.46	-0.6%	-6.0%
Value Line (Arithmetic)	1224.44	1220.60	-0.3%	+13.4%
London (FT-SE 100)	5752.5	5641.4	-1.9%	-12.9%
Tokyo (Nikkei)	12846.66	12962.43	+0.9%	-24.7%
Russell 2000	495.38	497.82	+0.5%	-5.6%