OCA STATEMENT NO. 1

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Spring Township v. Pennsylvania American Water Company	: : :	Docket No. C-20054746
Neil R Rahn and David Singerling, et al. v. Pennsylvania-American Water Company	: : :	Docket No. C-20054919
Wilson School District v. Pennsylvania American Water Company	: : :	Docket No. C-20055371

DIRECT TESTIMONY

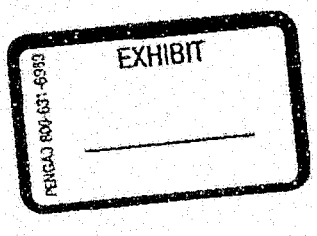
OF

TERRY L. FOUGHT, P.E.

ON BEHALF OF

PENNSYLVANIA OFFICE OF CONSUMER ADVOCATE

MAY 17, 2006



Q. **PLEASE STATE YOUR NAME AND BUSINESS ADDRESS FOR THE RECORD.**

A. Terry L. Fought, 780 Cardinal Drive, Harrisburg, Pennsylvania, 17111.

Q **BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?**

A. I am a self-employed consulting engineer retained by the Office of Consumer Advocate (OCA) for the purposes of providing testimony in this proceeding.

Q. **PLEASE DESCRIBE YOUR BACKGROUND AND QUALIFICATIONS.**

A. Appendix A, which is attached to this testimony, describes my educational background and applicable experience.

Q. **HAVE YOU BEEN ASKED TO INVESTIGATE COMPLAINTS FROM CUSTOMERS OF THE PENNSYLVANIA-AMERICAN WATER COMPANY (PAWC OR COMPANY) REGARDING A WATER MAIN BREAK ON IROQUOIS AVENUE, SINKING SPRINGS, SPRING TOWNSHIP, BERKS COUNTY, PA?**

A. Yes. The OCA requested that I investigate customer complaints regarding a water main break that occurred on or about February 5, 2005 on Iroquois Avenue near its intersection with South Wagner Circle, in Sinking Springs, PA.

Q. **WHAT DID YOUR INVESTIGATION CONSIST OF?**

A. My investigation included (1) reviewing the Formal Complaint forms submitted to the Public Utility Commission (PUC); (2) inspecting, on December 20, 2005, the broken pieces of pipe that were removed from the water main break site; (3) meeting with some

Complainants and inspecting the site of the water main break and adjacent area on December 20, 2005 and April 24, 2006; (4) reviewing two reports concerning the water main break, one prepared for PAWC by American Geotech Incorporated (AGI) dated February 22, 2005 (Rev. 3/8/05), and the other prepared for USAA by Enviroscan, Inc. (ENVIROSCAN) dated March 20, 2005; (5) viewing the Company's 3-minute video of excavation at and around the water main break site; (6) reviewing photographs taken by others after the water main break, (7) attending the April 24, 2006 meeting with the Wagner Farms Home Owners Association (WFHOA); (8) conversing with OCA witness Dr. Donald M. Hoskins; (9) reviewing the Companies' responses to interrogatories; and (10) reviewing the depositions of Mr. John A. Rothwell, PAWC Network Supervisor, taken on May 9, 2006.

Q. WHAT ARE THE FACTS CONCERNING THE WATER MAIN BREAK?

A. At approximately 10:45 p.m. on February 5, 2005, Mr. Rothwell, PAWC Network Supervisor was notified that some customers were complaining about low water pressure and water outages. Mr. Rothwell telephonically checked the water level in the tanks via the water system instrumentation devices (SCADA).

At approximately 11:15 p.m. on February 5, 2005, Mr. Rothwell arrived at the tanks and verified that the tanks were empty. Mr. Rothwell called other PAWC employees to work to locate a water main break.

Around midnight on February 5, 2005, PAWC employees started looking for the water main break by shutting valves to isolate (shut off service to) various portions of the distribution system. The approximate location of the leak can be found by this trial and error method because once the area containing the leak is isolated, the tanks will start refilling with water. However, the approximate location of the leak was not found by this procedure.

Sometime after 7:30 a.m February 6, 2005, PAWC received call from a customer on Shelly Drive who had water in basement. PAWC employees arrived at Shelly Drive in daylight and noticed sump pumps from 2 houses discharging muddy water into the street. The employees listened for leaks at valves at the intersection of Shelly Drive and Nash Road and drilled holes in Shelly Drive to listen at the water main. The employees hear sounds that indicated that the leak may be nearby.

Around noon on February 6, 2005, a PAWC employee noticed that a sump pump from the Creveling House (located at the corner of Iroquois Avenue and South Wagner Circle) was discharging muddy water to the street. The basement floor of the Creveling House had started to crack. Also, collapsed sinkholes and a sunken tree were noted on the Creveling property. The pipeline in Iroquois Avenue in front of the Creveling property was isolated by shutting valves and the water level in the tanks eventually started rising.

There is no evidence that water had surfaced at the location of the water main break without being pumped by the sump pumps. Also, there is no evidence that Iroquois Avenue road pavement sagged at the water main break location.

At approximately 1:00 p.m. on February 6, 2005, PAWC was satisfied that leak was found and called the Company's emergency contractor.

It was still daylight out when contractor arrived at site and uncovered the water main break. Where the water main broke, Mr. Rothwell noted that one piece of pipe was approximately 12" to 18" below the other piece pipe.

The water main break was repaired by removing and replacing approximately 125 feet of 8-inch cast iron pipe installed around 1970 with 8-inch ductile iron pipe.

Following the water main repair, collapsed sinkholes were noted at the Wilson School parking lot, along Iroquois Avenue, along South Wagner Circle, and in some nearby residential properties. PAWC made repairs to the collapsed sinkhole in the Wilson School parking lot and provided temporary housing for the Creveling family.

In June 2006, PAWC started operation of Palmer Data Loggers installed to automatically listen for water main leaks at 30 locations in the distribution system.

Q. **HAVE YOU DESIGNED WATER MAINS IN AREAS HAVING A KARST OR LIMESTONE GEOLOGY?**

A. Yes. In 1990, I designed approximately 4,000 feet of 12-inch and 16-inch ductile iron pipe along U.S. Route 11 in Carlisle, Pennsylvania. Also, in 1982, I designed approximately 15,600 feet of 8-inch and 10-inch ductile-iron or pvc pipe near Mifflintown, Pennsylvania.

Q. **HAVE YOU DESIGNED OTHER FACILITIES IN AREAS HAVING A KARST OR LIMESTONE GEOLOGY?**

A. Yes. I have designed many stormwater management and drainage facilities in limestone areas around Carlisle, in Cumberland County, Pennsylvania.

Q. **PLEASE EXPLAIN THE TERM "KARST".**

A. Karst is soluble bedrock. Karst areas and aquifers form when water dissolves limestone and other rocks causing sinkholes, sinking streams and springs.

Q. **HAVE YOU ENCOUNTERED SINKHOLES IN YOUR DESIGN WORK?**

A. Yes.

Q. **WHAT IS A SINKHOLE?**

A. A sinkhole is a cavity in the underground karst (limestone or dolomite) bedrock. When the soil overlying the bedrock is washed down into the cavities, a collapse occurs. In this

testimony, I will refer to an uncollapsed sinkhole as "sinkhole" and a collapsed sinkhole as "collapsed sinkhole."

Q. IN YOUR DESIGN WORK, WHAT HAVE YOU DONE TO PREVENT DAMAGES RESULTING FROM SINKHOLES?

A. I have tried to avoid installing utilities over naturally formed sump areas (depressed areas where water from precipitation must percolate into the ground because it can not outlet overland). Where utilities must be installed in a sump area, I have recommended that an attempt be made to seal any underground openings in the bedrock and the ground be graded to direct surface water away from the sump area.

Q. WERE YOUR RECOMMENDATIONS ACCEPTED?

A. Over the past 30 years, I have been involved with over 100 stormwater management and drainage projects in limestone areas. Sometimes my clients have accepted my recommendations and sometimes they have not.

Q. WHAT WAS THE RESULT?

A. To the best of my knowledge, none of the facilities that I have designed have failed due to sinkhole activities.

Q. TURNING TO THE PAWC MAIN BREAK, WHEN WAS THE PIPELINE THAT FAILED INSTALLED?

A. According to PAWC's response to OCA Set I-6, the pipeline was installed approximately in the year 1970. See Exhibit TLF-1.

Q. PLEASE DESCRIBE THE CHARACTERISTICS OF THE PIPE THAT BROKE.

A. According to PAWC's response to OCA Set I–6, the broken pipe was 8-inch cast-iron pipe manufactured by U S. Pipe in 18-foot lengths. See Exhibit TLF-1. Cast-iron pipe is also known as gray iron pipe or gray cast-iron pipe.

Q. WHAT WAS IS THE NORMAL OPERATING PRESSURE IN THE WATER MAIN WHERE THE BREAK OCCURRED?

A. According to PAWC's response to OCA Set I–6, the normal operating pressure is 95 pounds per square inch (psi). See Exhibit TLF-1. According to the AGI Report, John Rothwell of PAWC provided the information that the pressure varies from 95 to 105 psi in that main. See Exhibit TLF-2, page 1.

Q. WHAT IS THE TOTAL LENGTH OF PIPELINE THAT WAS REPLACED AS A RESULT OF THE MAIN BREAK?

A. According to PAWC's response to OCA Set I–6, approximately 125 feet of pipeline was replaced. See Exhibit TLF-1.

Q. HOW ARE THE 18-FOOT PIPE LENGTHS JOINED TOGETHER TO FORM A PIPELINE?

A. The broken pipe had a push-on joint, the purpose of which is to connect two pipes, consisting of a rubber gasket placed in a groove inside the bell end of the pipe. When the plain end of the pipe is pushed through the lubricated gasket, the gasket is compressed making the joint pressure tight. A push-on joint for ductile iron pipe is shown on Exhibit TLF-3.

Q. HOW ARE SINKHOLES FORMED?

A. Briefly, sinkholes are formed in karst (limestone or dolomite) areas by water dissolving, over long periods of time, the carbonate bedrock and opening solution channels and cavities in the underground bedrock. A collapsed sinkhole occurs when water percolates through the soil overlying the bedrock and washes the overlying soil down into the cavity. A solution channel is an opening in the bedrock that can transport water from one location to another.

Q. IS THE LOCATION OF THE WATER MAIN BREAK SUBJECT TO WATER FROM PRECIPITATION?

A. No. The water main break was located underneath pavement on Iroquois Avenue. The roadway pavement directs precipitation away from the water main. Also, there is no storm sewer located in Iroquois Avenue that would allow leakage from storm sewers to flow to the water main break site

Q. **IS THERE A SOURCE OF WATER THAT COULD CAUSE OR WORSEN SINKHOLE DEVELOPMENT AT THE LOCATION OF THE WATER MAIN BREAK?**

A. Yes. Water leaking from the water main would cause or worsen sinkhole development.

Q. **CAN WATER LEAK FROM PUSH-ON JOINTS?**

A. Yes, water leaks from push-on joints for several reasons. Water leaks at a push-on joint if the joint is improperly formed during installation or the joint becomes overly deflected.

Q. **WHAT IS MEANT BY A DEFLECTED PUSH-ON JOINT?**

A. A. deflection occurs at a pipe joint when the joined pipes are not laid in a straight line. Deliberately reflecting a pipe joint allows for slight changes in the pipeline alignment and grade without installing a special pipe fitting.

Q. **WHEN IS A PUSH-ON PIPE JOINT OVERLY DEFLECTED?**

A. The maximum allowable deflection for push-on type joints is 5 degrees for pipe sizes 12-inch in diameter and smaller.

Q. **HOW CAN THE JOINT BE IMPROPERLY FORMED DURING INSTALLATION?**

A. An improperly formed joint can occur during construction in the following ways: (1) by using an incorrect gasket, (2) by not thoroughly cleaning the groove and hub socket; (3) by not properly lubricating the gasket and making sure the gasket is properly seated; (4)

by not using a beveled plain end of pipe; and (5) by not keeping the joint straight while pushing and then making any desired deflection after the joint is assembled. Any one of these problems could have caused the main break at issue.

Q. IN LIGHT OF THESE ISSUES, IS THERE AN ACCEPTABLE LEAKAGE IN CAST-IRON WATER MAINS?

A. Yes. Specifications for installation of pipelines, including cast-iron pipe, allow for some leakage upon completion of construction. The generally accepted allowable leakage based on AWWA standards is 0.60 gallons per hour per 1,000 feet for 8-inch pipe with 18-foot nominal lengths subject to 100 psi water pressure.

Q. WHAT WOULD BE THE ALLOWABLE LEAKAGE UPON THE COMPLETION OF CONSTRUCTION FOR 125 FEET OF 8-INCH PIPE HAVING A PRESSURE OF 100 PSI?

A. The allowable leakage would be 0.075 gallons per hour which is equivalent to 1.8 gallons per day, or 657 gallons per year, or 22,995 gallons per 35 years.

Q. WOULD THE AMOUNT OF ALLOWABLE LEAKAGE THAT OCCURRED AT THE WATER MAIN BREAK LOCATION BE LIMITED TO THE 125 FEET OF PIPE THAT WAS REPLACED?

A. No. Since the roadway is relatively flat around to the water main break, any pipe leakage could follow the pipe for a considerable distance to a point where it can percolate into the ground.

Q. IS IT UNUSUAL FOR WATER MAINS TO BE SUBJECT TO LEAKAGE IN EXCESS OF THE ALLOWABLE LEAKAGE?

A. No. Water companies are constantly finding and repairing water main leaks. In response to OCA Set I-8, PAWC has submitted information regarding the repair of leaks, including an estimated amount of water leaked at each location. See Exhibit TLF-4 for the information submitted regarding unaccounted water, leak repair, and leak detection. Water main pipes, including cast-iron pipes, can fail by leaking at pipe joints, corrosion pitting, or breaking. Water leaks will occur once the pipe wall has been penetrated by a pit or crack. Leaks can occur where the main is tapped for connecting house service lines. Pipe leakage is often found when water surfaces, customers lose their water supply, or by leak detection procedures that use acoustic monitoring technology.

Q. DID PAWC PERFORM ANY LEAK DETECTION TESTS WITHIN 500 FEET OF THE WATER MAIN BREAK SITE PRIOR TO THE WATER MAIN BREAK?

A. The relevant portions of PAWC's response to OCA Set I-8 included some leak detection data for fire hydrants, some undated, and some shortly dated prior to the water main break, but the submitted data does not identify any fire hydrants located on Iroquois Avenue, South Wagner Circle, North Wagner Circle, Nash Road, or Shelly Drive. See Exhibit TLF-4.

Q. SINCE THE WATER MAIN BREAK, HAS PAWC PERFORMED ANY LEAK DETECTION TESTS WITHIN 500 FEET OF THE WATER MAIN BREAK?

A. Yes, During his deposition, Mr. Rothwell stated that PAWC has installed 30 Permalog units in its system since the water main break and has purchased 40 more units to install. For 15 minutes in the middle of the night, the Permalog units listen for noise that would indicate leaks. According to documents submitted by the Company, PAWC has installed Permalog equipment to detect leaks on Iroquois Avenue at its intersections with North Wagner Circle and South Wagner Circle.

Q. HOW MUCH WATER WAS RELEASED AT THE LOCATION OF THE FEBRUARY 5, 2005 WATER MAIN BREAK?

A. Approximately 1,000,000 gallons was quickly released at the water main break location from the two 500,000 gallon storage tanks and water stored in the mains. PAWC has estimated that a total of 1,500,000 gallons was released at the site prior to the break being repaired. The additional 500,000 gallons came from water stored in the distribution system pipes and the continued pumping from the water supply sources prior to the break being found.

Q. PLEASE DESCRIBE WHAT VOLUME 1,000,000 GALLONS OCCUPY.

A. One million gallons occupies approximately 133,680 cubic feet. For example, an empty trench 125 feet long and 4 foot wide would have to be over 267 feet deep to contain 1,000,000 gallons of water

Q. IS THERE ANY EVIDENCE THAT ANY OF THIS WATER SURFACED AT THE SITE OF THE WATER MAIN BREAK?

A. No. Company representatives and some Complainants have stated that they did not find any sign of water surfacing at the site of the water main break. Approximately 350 to 400 feet from the water main break site, sump pumps located in houses at 303 and 305 Shelly Drive discharged water to the street.

Q. WHERE DID ALL OF THIS WATER GO?

A. Since the water did not surface, most of the water entered solution channels and openings in the bedrock. I did notice an indication that some of the water followed a portion of the water main installed in South Wagner Circle. In other words, I observed that a fire hydrant had sunk into the ground a few inches, indicating that the water had flowed along the main to the fire hydrant and caused the fire hydrant and part of its connecting pipeline to sink.

Q. WHAT TYPE OF PIPE WAS USED TO REPLACE THE PIPE REMOVED AT THE WATER MAIN BREAK?

A. According to PAWC's response to OCA Set I–6, ductile iron pipe was used to replace the pipe removed at the water main break. See Exhibit TLF-1.

Q. IS DUCTILE IRON PIPE SUPERIOR TO CAST-IRON PIPE FOR WATER MAINS?

A. Yes. In fact, because ductile iron pipe is superior to cast-iron pipe, cast-iron pipe has not been manufactured for use as water mains since the mid 1970's. According to the Ductile Iron Pipe Research Association, "Ductile Iron has approximately twice the strength of

Cast Iron as determined by tensile, beam, ring bending, and bursting tests. Its impact strength and elongation are many times greater than Cast Iron's". See Exhibit TLF-5.

Q. IN THE YEAR 1970, WAS THE ORIGINALLY INSTALLED CAST-IRON PIPE THE BEST AVAILABLE PIPE FOR INSTALLATION IN A KARST AREA?

A. No. Ductile iron pipe has been available and acceptable for use as water main pipe in Pennsylvania since 1965 when the American National Standards Institute and the American Water Works Association published *ANSI/AWWA C151, American National Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.*

Q. DID YOU INSPECT THE PIPE THAT WAS REMOVED FROM THE WATER MAIN BREAK?

A. Yes. I inspected and photographed the pipe on December 20, 2005 where PAWC has it stored. See Exhibit TLF-6 for photographs.

Q. DURING THAT INSPECTION DID YOU NOTICE ANYTHING THAT COULD INDICATE HOW THE PIPE BROKE?

A. As shown on the attached photographs, it appears that the pipe experienced failure due to "wedge splitting" where a wedge of the pipe at the bell is split off to relieve bending stresses. I also noticed another length of pipe that could have failed by wedge splitting. Cast iron has allowable bending stress. The deflection of the pipe that broke exceeded the allowable bending stress of the cast iron material. See Exhibit TLF-7, Page 1.

Q. HOW WOULD WEDGE SPLITTING BE APPLICABLE TO THE WATER MAIN BREAK?

A. Due to lack of support, the pipe deflected to the extent that the bending stress in the pipe exceeded its design bending stress. The excessive bending stress, or corrosion pitting or manufacturing defects on the pipe could cause wedge splitting to occur.

Q. DOES DUCTILE IRON PIPE HAVE A GREATER RESISTANCE TO WEDGE SPLITTING THAN CAST IRON PIPE?

A. Yes. As mentioned above, ductile iron pipe has approximately twice the strength as cast-iron pipe in tensile, beam, and ring bending tests and many times the strength of cast iron pipe in elongation. Tensile, beam, ring bending and strength in elongation are all factors that could be applicable during a wedge splitting failure. See Exhibit TLF-5. Ductile iron pipe should be less susceptible to failing due to wedge splitting.

Q. DO YOU HAVE ANY COMMENTS CONCERNING THE AGI REPORT?

A. Yes. I have the following comments concerning the findings and recommendations listed in Section D of the AGI Report prepared for PAWC (See Exhibit TLF-2, Pages 4 through 6):

The AGI Report states "that the broken water main location was apparently located above a sinkhole ....". It would be more accurate to say that the broken water main location was apparently above or adjacent to a sinkhole and that the collapse of the sinkhole resulted

from water leaking from the water main and washing the material supporting the pipe into the sinkhole.

I agree with the statement in the AGI Report that the 8" diameter water main with high water pressure had not been designed for large differential settlement in this sinkhole area. I also generally agree with the conclusion that the broken water main was caused by a sinkhole underneath or immediately adjacent to the water main; however, I would add that the failure of the water main had to have been associated with water leaking from the main.

Q. DO YOU HAVE ANY COMMENTS CONCERNING THE ENVIROSCAN REPORT?

A. Yes. I have concluded that a water source must have been associated with break in the water main, washing the material supporting the pipe into an existing sinkhole. Since the break occurred underneath the paved roadway and there are not any storm sewers nearby, the only available water source is water leaking from the water main. My conclusion is supported by the author of the ENVIROSCAN Report. See TLF Exhibit 8, Page 10.

Conclusions

Q. BASED ON YOUR INVESTIGATION OF THE WATER MAIN BREAK, DO YOU HAVE ANY CONCLUSION AND RECOMMENDATIONS?

A. Yes.

Q. WHAT ARE YOUR CONCLUSIONS AND RECOMMENDATIONS?

A First, it is my opinion that the water main break was caused by the pipeline settling at or adjacent to an uncollapsed sinkhole. The pipeline settling was probably caused by water percolating through and removing some of the pipeline bedding and soil to a buried sinkhole cavity. Since the pipeline settling occurred underneath a paved road, leakage from the water main is the only available source of water for removing the material from underneath the pipeline. It should be noted that most normal settling under a pipeline occurs during the first couple of years after installation.

Second, since the water released at the water main break did not surface, the water entered existing solution channels in the limestone and also traveled for some distance along the water main in South Wagner Circle Subsequent sinkholes and collapsed sinkholes located along South Wagner Circle at House No. 3128, at the fire hydrant in front of House No. 3119, and in the roadway in front of House No. 3117 indicate that some of the water released from the main break followed the path of the water main in South Wagner Circle.

Third, the amount of water released from the water main break and its initial high pressure caused the collapsing of nearby sinkholes and enhances the occurrence of additional collapse of sinkholes throughout the area.

Therefore, I recommend that additional geophysical studies should be done by PAWC to determine the locations and extent of other uncollapsed sinkholes in the area.

Q. **DOES THIS COMPLETE YOUR WRITTEN DIRECT TESTIMONY?**

A Yes, at this time. PAWC has not responded to all of the interrogatories, however I reserve the right to supplement this testimony either in writing or orally if additional information is received.

EXHIBIT TLF-1

6. Please provide information on all of the following regarding the water main that broke. If exact information is not available, provide estimated information and indicate that it is estimated:

a. Date the water main was installed;
b. Material of pipe used;
c. Manufacturer's name;
d. Pipe size;
e. Pipe class;
f. Type of pipe joints;
g. Whether the pipe was and is laid with joints northerly or southerly;
h. Laying length of each pipe (i.e. 16, 18, 20 foot lengths);
i. Type and depth of pipe bedding material;
j. Normal operating pressure at the location of the break;
k. Did the pipe break at a joint or at the barrel?

l. How many lengths of pipe were removed and replaced?
m. Specifications of the pipe used to replace the pipe removed.

ANSWER:
a. Approximately 1970.
b. Cast Iron.
c. US Pipe
d. 8"
e. Unknown.
f. Gasket.
g. Unknown.
h. 18 foot length.
i. Dirt and rock.
j. 95 P.S.I.
k. Unknown. Pipe broke between bell and spigot.
l. Approximately 125 feet.
m. Ductile Iron Pipe Class 53.

7. Please discuss the Company's procedure(s) for locating leaks in its Sinking Spring distribution system. What were the procedures when the broken water main was installed? What are the procedures now? Please explain if the procedures have changed from the time the broken water main was installed to date, and describe those changes and why they were implemented. Include data on the type of equipment used to locate leaks

ANSWER: Without waiver of PAWC's previous objections, on the date of the accident, total gallons of consumption were calculated daily by PAWC. A marked change in total gallons of daily consumption will prompt PAWC to begin checking the system for leaks. Additionally, PAWC utilized S.C.A.D.A. System which sends alarms on low pressure and/or low tank levels. Currently, PAWC not only monitors the total gallons of daily consumption and utilizes the S.C.A D.A. System but has also installed 30 Palmer Data Loggers in the area for leak detection purposes. Additionally, the S.C.A.D.A. System has been upgraded with the Verbatim program that gives conditions through the system via telephone access. See total consumption figures for January, 2005 attached hereto. See Penn Water District Permanent Logger data sheets and leak location reports 6/16/05 through 1/17/06 and leak detection for fire hydrants attached hereto. See Section 15000 Piping General Provisions for Installation for piping provided to contractors attached hereto.

8. Please provide the copies of all leak detection tests and information on all leak detection tests that the Company has performed on Iroquois Avenue from the time the broken water main was installed to date. Include all notes, memorandums, studies, and reports regarding leak detection on Iroquois Avenue.

ANSWER: Without waiver of previous objections, see Permanent Logger Data Sheets dated 6/16/05 to 1/17/06 attached hereto. Additionally, see leak detection for fire hydrants attached hereto.

9. Please provide on an annual basis from the date the broken water main was installed to date, in gallons and percentage of production, the unaccounted water or water loss of the Sinking Spring system.

EXHIBIT TLF-2

SINKHOLE INVESTIGATION
WATER MAIN BREAK
AT IROQUOIS AVENUE
SPRING TOWNSHIP,
BERKS COUNTY, PA

Prepared For
Travelers
P.O. Box 4370
Reading, PA 19606

Prepared By:

Kin Y. C. Chung, Ph.D., P.E.
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February 22, 2005 (Rev. 3/8/05)

AMERICAN GEOTECH, INC.

SINKHOLE INVESTIGATION
WATER MAIN BREAK
AT IROQUOIS AVENUE
IN FRONT OF
WILSON SOUTHERN JUNIOR HIGH SCHOOL/
CORNWALL TERRACE ELEMENTARY COMPLEX,
SPRING TOWNSHIP,
BERKS COUNTY, PA

A. INTRODUCTION

American Geotech Incorporated (AGI) has completed a study and investigation for a Pennsylvania American Water Company pressurized water main break happened on late Saturday (February 5, 2005) at Iroquois Avenue in front of the Wilson Southern Junior High School/Cornwall Terrace Elementary Complex (See **Figure 1** - Site Plan). Near the break location, several sinkholes around a house (3123 Wagner Circle), at the roadside opposite to the break location and in the School parking area collapsed. Two large water tanks located at south of the Old Fritztown Road and west of Grings Hill Road drained through the break and lost more than 1 million gallons of water.

The Information provided by John Rothwell of PA American Water Company lists blow:

- The cast iron water main at the break section was 8" diameter.
- The 8" diameter water pipe starts from the intersection of Iroquois Ave and the South Wagner Circle. The water pipe size becomes 12" diameter to the Water Tanks in the high ground in the south.
- The normal water pressure varies from 95 to 105 lbs per square inch.
- The break section of the water pipe was buried at 5 ft below grade.
- Water loss on February 5, 2005 was 1 million to 1.5 million gallons
- Occurrence sequence from 12:00 AM, Sunday, on February 6, 2005 by Pa American Water Company.

- A video tape records the excavation of the broken water main location (3 minutes) and the excavation of the sinkhole opposite to broken water main location.

The study consists of geophysical investigation, sinkhole identification, and topographic survey to obtain a contour drawing and to map the existing and susceptible sinkholes around the area. The scope of work can be summarized below:

- Reviewed site location, geology and hydrogeology.
- Set up grid-point system for geophysical investigation.
- Performed electromagnetic survey (EM31) and Ground Penetration Radar (GPR) geophysical survey at the location of previously collapsed sinkholes and the surrounding areas.
- Due to the extent of the sinkholes, performed a topographic survey for the sinkhole surrounding area. The surveying service also mapped the geophysical findings into drawing.
- Inspected the sinkhole damaged house and surrounding areas.
- Evaluated and analyzed the results
- Prepared a report including the cause of the water main damages and sinkhole and recommendation for sinkhole remediation.

B. GEOPHYSICAL SURVEYS

Geophysical survey consists of Electromagnetic survey and Ground Penetration Radar (GPR) survey. Three sets of grids were established at the school parking lot, around the collapsed sinkholes on the curb of the road, and at the back yard of the residential houses.

AGI conducted this geophysical survey on February 13th to 16th, 2005.

Electromagnetic Survey was performed using an EM-31, manufacured by Geonics Limited of Canada. The EM-31 device measures terrain conductivity by inducing an electromagnetic field into

the ground, using a battery operated transmitter. The electromagnetic field induces in any conductive materials, a secondary magnetic field, or "eddy currents," which are detected by a receiver unit. The secondary magnetic field is wholly dependent on the conductive properties of the terrain in which it is induced. This electromagnetic survey was performed along the grid lines at a spacing of 10 ft. Terrain conductivities were recorded on each line at every 5 feet. This method with this equipment is limited to a depth of up to 20 feet with an effective depth of 15 feet below ground level. The electromagnetic survey was performed in accordance with current Geonics Ltd's EM-31 Operating Manual. Due to the urgency of the survey, the suspected underground objects measured by EM-31 were immediately marked in field and confirmed with GPR. EM-31data was processed using TDS computer program and EM-31 contour map was created as shown in **Figure 2**.

The Ground Penetrating Radar (GPR) is based on radar reflections and velocity of radar pulse propagation, associated with changes in dielectric permittivity of subsurface materials. The receiving antenna detects pulses that are reflected from interfaces where the dielectric constant of the materials change. The receiver converts these electromagnetic signals, only a few nanoseconds in duration, to analog signals tens of milliseconds in duration by a time-domain sampling technique. These signals are transmitted to the Control Unit for amplification and processing. The data, displayed as travel time, is printed on the Graphic Recorder. As the transducer is pulled along a transect line, the computer screen indicates a continuous profile record corresponding to the interfaces found in the subsurface. The GPR survey was used as a non-destructive tool to locate underground objects. The GPR used for this survey was a cart-mounted Ramac/GPR with a 250 MHz antenna manufactured by Mala GeoScience. The GPR was used to verify all susceptible locations selected from the results by EM-31. Most of the susceptible sinkhole and soft overburden areas and possible sinkhole routing were detected and plotted on **Figure 2**.

C. GEOLOGY

According to the geological maps of "Sinking Spring and Womelsdolf" from Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania, 1981, published by Pennsylvania Geological Survey, fourth series, Harrisburg, PA, the site investigated is underlain by Millbach Formation (Geologic Symbol: Cm included in Crms)

According to the Pennsylvania Geological Survey, Engineering Characteristics of The Rocks of Pennsylvania, Fourth (4th) Series, Revised 1982, the Millbach Formation consists of Pinkish –gray and medium gray, laminated limestone, interbeds of light to medium gray dolomite that weather buff to yellowish gray, approximately maximum thickness is 1,500 ft. Bedding within Millbach is well bedded and thick to massive. Joints have a blocky pattern; well developed; moderately abundant; regularly spaced, having a moderate distance between fractures; open and nearly vertical. Millbach Formation is moderately resistant and slightly weathered to a shallow depth. Sinkholes are numerous. Solution channels provided a secondary porosity of moderate to high magnitude, high permeability. Rock pinnacles are also common in this Formation.

D. FINDINGS AND RECOMMENDATIONS

Based on the information obtained from geophysical surveys, site topographic survey and engineering evaluation, we have the following findings and recommendations:

- A detailed topographic and sinkhole map has been prepared in accordance with the results obtained from the geophysical surveys using EM-31 and GPR. A total of 6 current open-up sinkholes and 8 susceptible sinkholes were identified and sinkhole routings were estimated as shown in Fig. 1.
- The current broken water main location was apparently located above a sinkhole which connects to the previous mended sinkhole underneath the Iroquois Ave and may extend

to numerous sinkholes at the west and one current sinkhole in the slope of the School parking lot at the east

- One test pit next to the current open-up sinkhole opposite to the broken pipe location inside the School parking lot, was dug by EKI, the remedial Contractor. According to Don Kuser of EKI, no solution channel was found inside the test pit.
- The 8" diameter cast iron water main with high water pressured had not been designed for large different settlement in this sinkhole area. It is reasonably concluded that the broken main was caused by the sinkhole underneath or immediately next to the water main.
- The recent open-up sinkholes were caused by the excessive water drained through the existing solution channels and existing sinkholes injected from the broken main location toward to the west to the residential areas and to the northeast to the School area.
- Although the house at 3123 Wagner Circle had previous minor sinkhole problem, the large quantity of water with pressure did worsen and enlarge extensively the sinkholes and voids underneath the house to dangerous condition. It is close to the level if it can be saved by grouting or un-remediable condition.
- For the house at 3123 Wagner Circle, AGI Geotechnical personnel did EM31 and GPR testing and found extensive voids underneath the basement slab Additional investigation such as engineering borings outside the house and drilling holes through the basement slab and development of an economical remedial method to save the house are highly recommended. The additional investigation, development of an economical method and remedial work should be initiated immediately.
- It is recommended that special consideration and foundation consultation by an experience geotechnical engineer should be included in design of a pressured water main embedded in carbonate geological areas. Also, an automatic warning system be

considered in each large water tank to ensure the early cutoff excessive water drainis recommended.

- It is a concern about the loss of the 1 million gallons of water that seeped into the ground at this broken water main location. Based on our findings, as shown in Figure 1, water was drained through the existing sinkholes or underground solution channels to the west and to the northeast according to our estimated routings. Information indicates that portion of water came out to the west street, two blocks away from the Iroquois Ave. But, the destination of most of the lost water is still unknown.
- By experience, this large quantity of water will worsen the existing sinkhole conditions underneath the existing houses in the path of our estimated sinkhole routing as shown in Figure 1. Because of this accidence, chance of future sinkhole activity has greatly increased in this area. It is, therefore, recommended that additional investigation by an experience geotechnical engineer using additional geophysical investigation, engineering borings and small drill holes through the basement slabs for several residential houses immediately west of the broken main location be performed. The sinkhole investigation for the safety of the school building and the parking lot is also recommended.

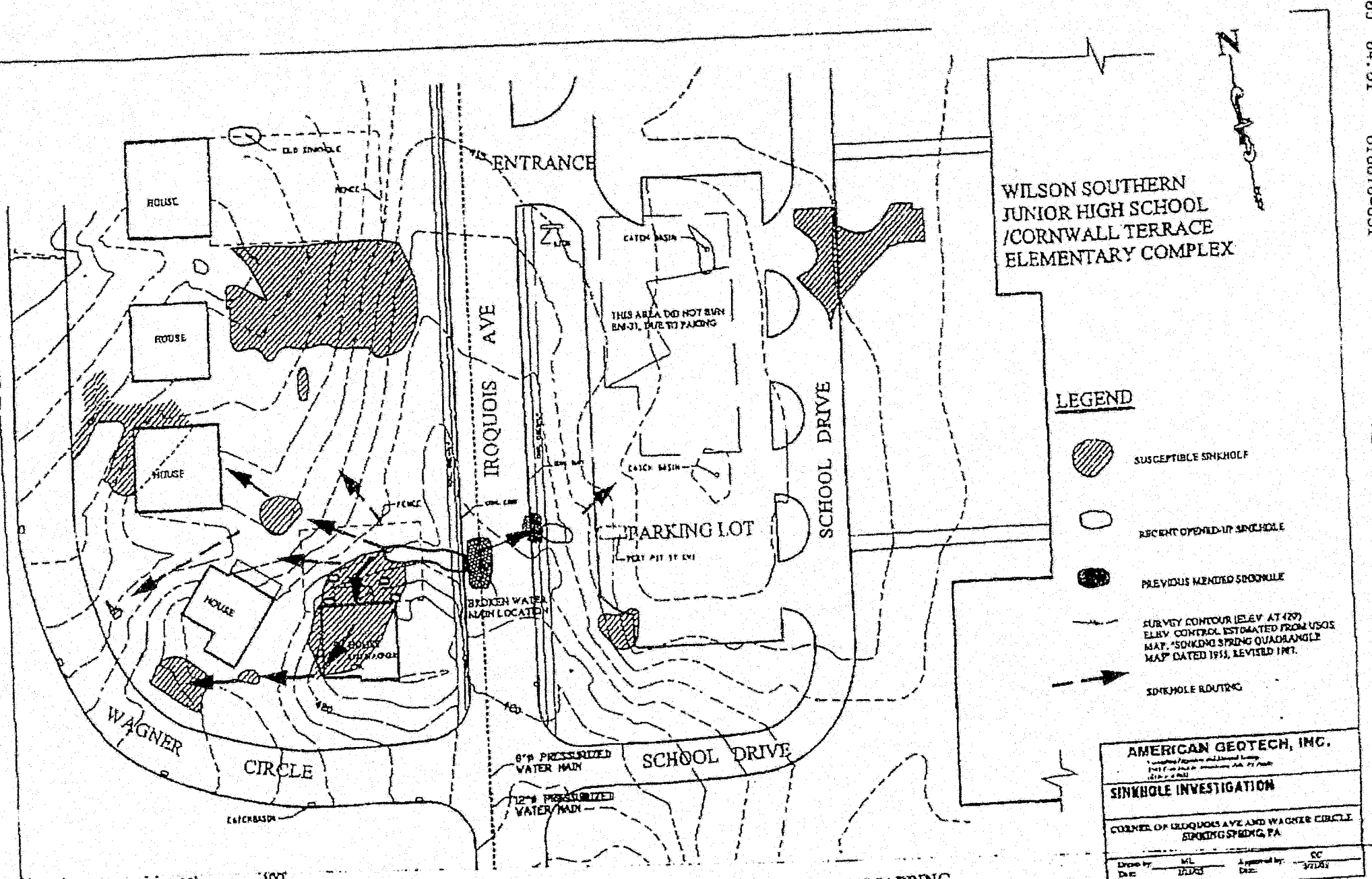


FIG. 1 - SITE PLAN AND SINKHOLE MAPPING

12/13/2005 04:01 6106704851 HETRANEM2HNENG PAGE 10

12/13/2005 04:01 6106704951

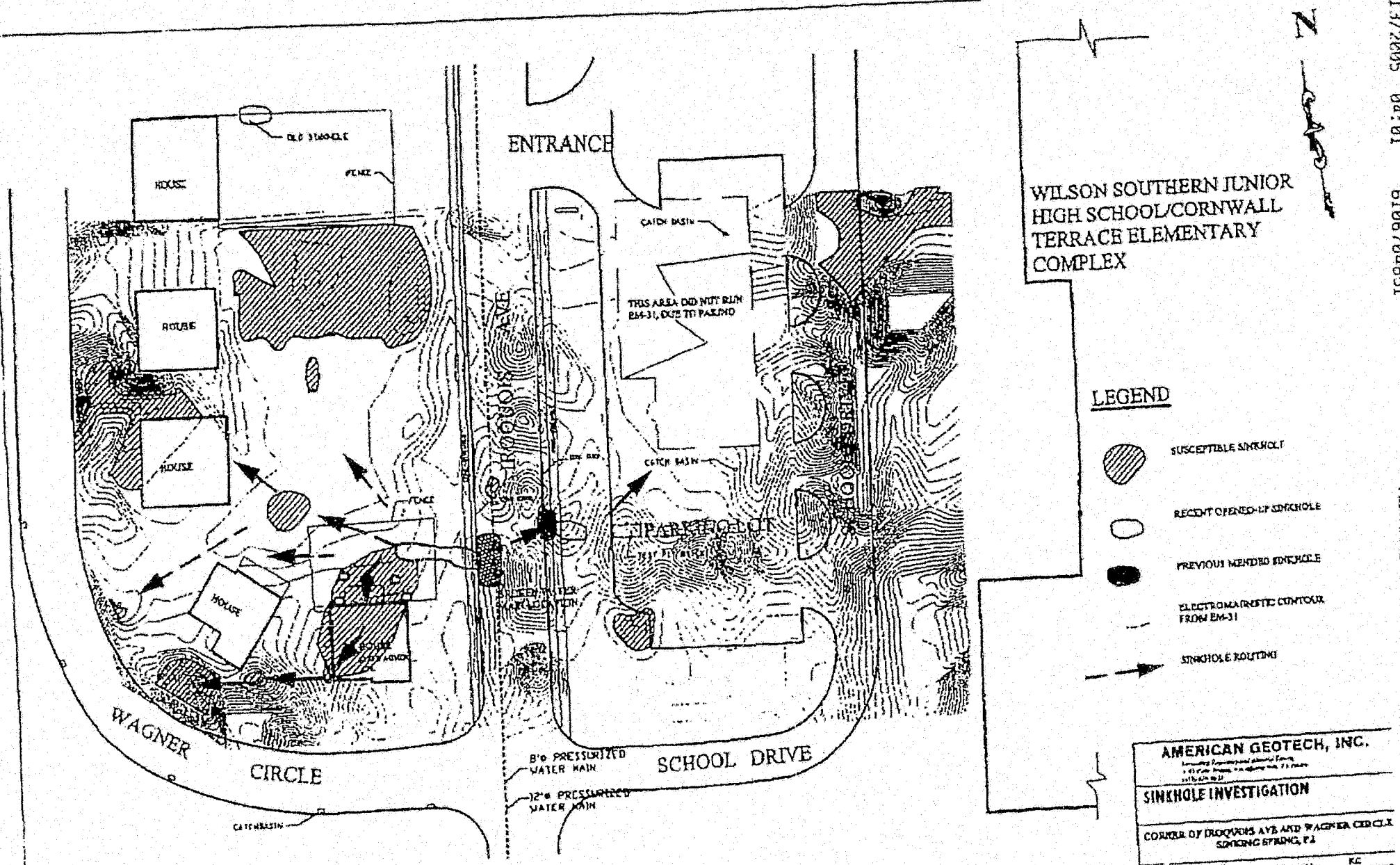
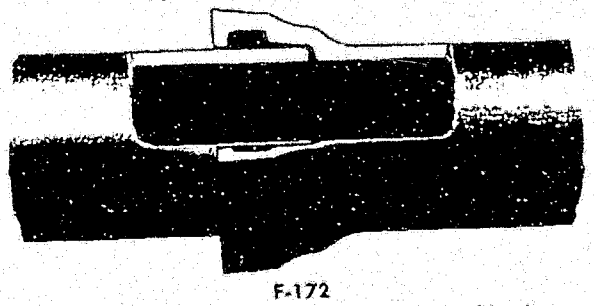


FIG. 2 - GEOPHYSICAL MAPPING BY EM-31 AND GPR

EXHIBIT TLF-3

SUPER BELL-TITE® PUSH-ON JOINT DUCTILE IRON PIPE

For Water and Other Liquids



F-172

The Super Bell-Tite Push-On Joint is a compression type joint, whose only accessory is a molded rubber gasket. Fitted into the gasket recess of the bell, the gasket forms a pressure-tight seal with ample deflection when compressed in position by the entering plain end of pipe. Super Bell-Tite Joint pipe is recommended for hydraulic pressures only, and can be provided with copper cable bonds for electrical thawing when required.

Assembly of the joint is easy and fast. Pipe can be laid as fast as a shallow trench can be opened. The speed of installation contributes greatly to a lowest possible installed cost.

Plain ends of this pipe must be beveled to facilitate assembly.

The joint meets all applicable requirements of ANSI/AWWA-C111/A21.11 standard. The joint also meets the requirements of the Underwriters Laboratories, Inc. and Associated Factory Mutual Companies for 350 psi water working pressure.

Super Bell-Tite pipe and fittings are shipped complete with gaskets and joint lubricant in quantities indicated on page 15. For joint assembly instructions, see pages 15 and 16.

THE GASKET

A single rubber gasket is the only accessory required to assemble a Super Bell-Tite joint. The gasket is of heavy section and has recesses in one side as pictured here.

The F-173 gaskets regularly furnished are synthetic rubber suitable for use with water and sanitary sewage at operating temperatures not exceeding 150° F.

F-169 high temperature gaskets are available for operating temperatures up to 230° F. F-169 gaskets are identified by a green stripe.

F-173
Super Bell-Tite Push-On Gasket

LUBRICANT

Super Bell-Tite lubricant used to facilitate assembly is non-toxic, odorless, tasteless and will not support bacteria. *Do not substitute other material for this use.*

See the table on page 15 for approximate lubricant usage by pipe size.

F-174
Super Bell-Tite Push-On Lubricant

THE STRIPE

Cutaway of the joint completely assembled, showing the stripe within the bell.

Each length of Super Bell-Tite Push-On pipe has painted on the plain end a circular stripe. This stripe serves as a guide line in making up the joint, to provide a fast, positive visual check as to when the joint is assembled. The joint is made up and pressure tight when the stripe is no longer visible.

WHEN ORDERING

The actual laying lengths of Super Bell-Tite Push-On pipe vary depending upon the pipe size. We compute footage based on actual lengths and *our invoice will cover the actual footage shipped.* See page 48 for Ordering Information.

Note: See page 226 for Super Bell-Tite joint deflection.

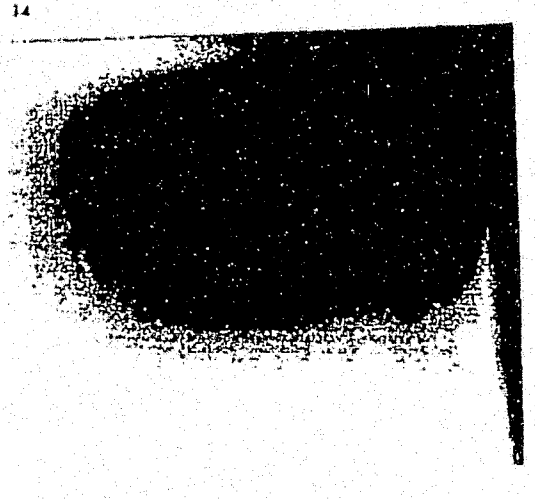


EXHIBIT TLF-4

PENN DISTRICT
UNACCOUNTED WATER

Period: October 2002

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: _____

Service Line Leaks: 69,840 gals

Water Used at Sources (metered): 16,050 gals

Hydrant Flushing: _____

Loading/Flushing Mains: 45,000 gals

Water Used by Municipalities: 13,000 gals (fire companies)

Storage: _____

Meter Testing: 3635 gals

General Use: Warehouse: 330 gals

New Text Document
November Unaccountable 2002

	Old	New		
Well 16 -	0089180	0090000 =	820gals	
Well 18 -	0068480	0068710 =	230gals	
Well 19 -	992200	998390 =	6190gals	
Well 20 -	096520	094590 =	340gals	
Well 21 -	822230	827210 =	4980gals	
Well 23 -	0029680	0029840 =	160gals	
Blanton -	0021470	0021650 =	180gals	
Shiloh -	0021090	0021180 =	675gals	(7.5)
Wyo. H. -	366900	367080 =	180gals	
		Totals =	13755gals	

Mtr. Shop #1 -	6975590	6977770 =	2180gals	
Mtr. Shop #2 -	0031760	0032220 =	3450gals	(7.5)
Mtr. Shop #3 -	0017130	0017220 =	675gals	(7.5)
		Total =	6305gals	
Warehouse -	796340	796670 =	330gals	

Nov. 13 -	Loaded main Shelly Dr.	- 5,000gals
Nov. 18 -	Service leak 505 Albert Dr.	- 10,000gals
Nov. 26 -	Loaded Ph6 Heid. Run East	- 30,000gals

Grand Total - 65,390gals

PENN DISTRICT
UNACCOUNTED WATER

Period: November 2002

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: _____

Service Line Leaks: 10,000 gals

Water Used at Sources (metered) 13,755 gals

Hydrant Flushing: _____

Loading/Flushing Mains: 35,000 gals

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 6305 gals

General Use: Warehouse: 330 gals

~~November~~ Dec. New Text Document
Unaccountable 2002

	Old	New		
Well 16 -	0090000	0090550 =	550gals	
Well 18 -	0068710	0071390 =	2680gals	
Well 19 -	998390	998970 =	580gals	
Well 20 -	094590	094880 =	290gals	
Well 21 -	827210	827580 =	370gals	
Well 23 -	0029840	0029980 =	140gals	
Blanton -	0021650	0021900 =	250gals	
Shiloh -	0021180	0021260 =	600gals	(7.5)
Wyo. H. -	367080	367240 =	160gals	
		Totals =	5620gals	

Mtr. Shop #1 -	6977770	6978520 =	750gals	
Mtr. Shop #2 -	0032220	0032270 =	375gals	(7.5)
Mtr. Shop #3 -	0017220	0017250 =	225gals	(7.5)
		Total =	1350gals	
Warehouse -	796670	797000 =	330gals	

Dec. 6 -	Flush Storm Sewer B. Square	- 3,500gals
Dec. 15 -	Mainbreak 3120 Octagon	- 45,000gals
Dec. 18 -	Service leak 41 Park Rd.	- 3,000gals
Dec. 19 -	Mainbreak Garfield	- 50,000gals
Dec. 30 -	Meter Pit Leak Alum. Alloys	- 44,640gals

Grand Total - 153,440gals

PENN DISTRICT
UNACCOUNTED WATER

Period: December 2002

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 95,000gals

Service Line Leaks: 47,640gals

Water Used at Sources (metered): 5620gals

Hydrant Flushing: 3,500gals

Loading/Flushing Mains: _____

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 1350gals

General Use: Warehouse: 330gals

New Text Document

January Unaccountable 2003

	Old	New			
Well 16 -	0090550	0091100	=	550gals	
Well 18 -	0071390	0071730	=	340gals	
Well 19 -	998970	999690	=	720gals	
Well 20 -	094880	095360	=	480gals	
Well 21 -	827580	828060	=	480gals	
Well 23 -	0029980	0030120	=	140gals	
Blanton -	0021900	0022110	=	210gals	
Shiloh -	0021260	0021390	=	975gals	(7.5)
Wyo. H. -	367240	367510	=	270gals	
		Totals	=	4165gals	

Mtr. Shop #1 -	6978520	6980110	=	1590gals	
Mtr. Shop #2 -	0032270	0032390	=	900gals	(7.5)
Mtr. Shop #3 -	0017250	0017330	=	600gals	(7.5)
		Total	=	3090gals	
Warehouse -	797000	798270	=	1270gals	

Jan. 18 -	Mainbreak 108 Rosemeade Ave.	- 50,000gals
Jan. 20 -	Mainbreak Blanton Station	- 100,000gals
Jan. 22 -	Blew off Sell Ave.	- 675gals
Jan. 24 -	Fire service leak Chilis	- 43,200gals
Jan. 31 -	Mainbreak 2118 Reading Ave.	- 50,000gals

Grand Total - 252,400gals

PENN DISTRICT
UNACCOUNTED WATER

Period: January 2003

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 200,000 gals

Service Line Leaks: 43,200 gals

Water Used at Sources (metered): 4,165 gals

Hydrant Flushing: 675 gals

Loading/Flushing Mains: _____

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 3090 gals

General Use: Warehouse: 1270 gals

New Text Document
February Unaccountable 2003

	Old	New		
Well 16 -	0091100	0091440 =	340gals	
Well 18 -	0071730	0075970 =	4240gals	
Well 19 -	999690	004880 =	520gals	
Well 20 -	095360	095590 =	230gals	
Well 21 -	828060	828290 =	230gals	
Well 23 -	0030120	0030250 =	130gals	
Blanton -	0022110	0022260 =	150gals	
Shiloh -	0021390	0021450 =	450gals	(7.5)
Wyo. H. -	367510	367620 =	110gals	
		Totals =	6400gals	

Mtr. Shop #1 -	6980110	6981070 =	960gals	
Mtr. Shop #2 -	0032390	0032420 =	225gals	(7.5)
Mtr. Shop #3 -	0017330	0017380 =	375gals	(7.5)
		Total =	1560gals	

Warehouse -	798270	798640 =	370gals	

Feb. 5 -	Mainbreak 207 Woodside	- 50,000gals
Feb. 11 -	2" Srevice leak Barnes & Noble	- 50,000gals
Feb. 12 -	2" Service leak Fam. Footwear	- 55,000gals
Feb. 14 -	Leaking fire service Chilis	- 30,000gals
Feb. 19 -	Service leak Body Zone	- 13,500gals
Feb. 21 -	Leaking hydrant Woodside & Noble	- 40,000gals
Feb. 23 -	Mainbreak 1745 York	- 500,000gals
Feb. 26 -	Bell joint leak 1945 Cleveland	- 75,000gals
		813,500gals

Grand Total- 821,830gals

PENN DISTRICT
UNACCOUNTED WATER

Period: February 2003

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 625,000 gals

Service Line Leaks: 148,500 gals

Water Used at Sources (metered): 6400 gals

Hydrant Flushing: 40,000 gals

Loading/Flushing Mains: _____

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 1560 gals

General Use: Warehouse: 370 gals

New Text Document

March Unaccountable 2003

	Old	New		
Well 16 -	0091440	0091900 =	460gals	
Well 18 -	0075970	0076140 =	170gals	
Well 19 -	004880	005330 =	450gals	
Well 20 -	095590	095640 =	50gals	
Well 21 -	828290	828520 =	230gals	
Well 23 -	0030250	0030410 =	160gals	
Blanton -	0022260	0028270 =	6010gals	
Shiloh -	0021450	0021540 =	675gals	(7.5)
Wyo. H. -	367620	367690 =	70gals	
		Totals =	8275gals	

Mtr. Shop #1 -	6981070	6982430 =	1360gals	
Mtr. Shop #2 -	0032420	0032450 =	225gals	(7.5)
Mtr. Shop #3 -	0017380	0017470 =	675gals	(7.5)
		Total =	2260gals	
Warehouse -	798640	799190 =	550gals	

March 1 -	3/4" service leak 2129 Spring St. -	5,000gals
March 3 -	4" mainbreak 2521 Garfield Ave -	30,000gals
March 10-	3/4" service leak 2611 Reading Blvd.	60,000gals
March -	Leaking hydrant Woodside & Noble -	40,000gals
		135,000gals

Grand Total- 146,085gals

PENN DISTRICT
UNACCOUNTED WATER

Period: March 2003

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 30,000 gals

Service Line Leaks: 105,000 gals

Water Used at Sources (metered): 8275 gals

Hydrant Flushing: _____

Loading/Flushing Mains: _____

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 2260 gals

General Use: Warehouse: 550 gals

New Text Document
March Unaccountable 2003

	Old	New		
Well 16 -	0091440	0091900 =	460gals	
Well 18 -	0075970	0076140 =	170gals	
Well 19 -	004880	005330 =	450gals	
Well 20 -	095590	095640 =	50gals	
Well 21 -	828290	828520 =	230gals	
Well 23 -	0030250	0030410 =	160gals	
Blanton -	0022260	0028270 =	6010gals	
Shiloh -	0021450	0021540 =	675gals	(7.5)
Wyo. H. -	367620	367690 =	70gals	
		Totals =	8275gals	

Mtr. Shop #1 -	6981070	6982430 =	1360gals	
Mtr. Shop #2 -	0032420	0032450 =	225gals	(7.5)
Mtr. Shop #3 -	0017380	0017470 =	675gals	(7.5)
		Total =	2260gals	
Warehouse -	798640	799190 =	550gals	

March 1 -	3/4" service leak 2129 Spring St. -	5,000gals
March 3 -	4" mainbreak 2521 Garfield Ave -	30,000gals
March 10-	3/4" service leak 2611 Reading Blvd.	60,000gals
March -	Leaking hydrant Woodside & Noble -	40,000gals
		135,000gals

Grand Total- 146,085gals

April

16 - 009258[0]

18 - 007641[0]

19 - 01011[0]

20 - 09022[0]

23 - 003081[0]

Blanton - 002852[0]

Shiloh - 002162

Wyo Hills - 367850

21 - 828850

Meter Shop

#1 - 6983990

#2 - 0032450

#3 - 0017520

Warehouse

799750

PENN DISTRICT
UNACCOUNTED WATER

Period: April 2003

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction. _____

Water Main Breaks: 325,000 gals

Service Line Leaks: _____

Water Used at Sources (metered): 7430 gals

Hydrant Flushing: 1,015,000 gals

Loading/Flushing Mains: 40,000 gals

Water Used by Municipalities: 480 gals Spring Twp.

Storage: _____

Meter Testing: 1660 gals

General Use. Warehouse: 560 gals

April Unaccountable 2003

Well 16	680 gals	Meter Shop	
Well 18	270 gals	Meter # 1	1560 gals
Well 19	4.780 gals	Meter # 2	0 gals
Well 20	580 gals	Meter # 3	100 gals
Well 21	230 gals		1660 gals
Well 23	400 gals		
Blawtan	250 gals	Warehouse	560 gals
Shiloh	80 gals		
Wyc. Hills	100 gals		
	7430 gals		

11 Month	Flushed Hydrants	1,000,000 gals
30	Flushed Penn Ave for shut down	15,000 gals
1	Blew off Woodson	15,000 gals
28	Spring Twp from hydrant	780 gals
6	Mainbreak 114 Woodside	75,000 gals
16	Mainbreak 38 Devonshire	300,000 gals
29	Mainbreak Papermill Rd	50,000 gals
19/4-21	Loaded Lilyfield	25,000 gals
		1,380,480 gals

Total - 1,390,130

PENN DISTRICT
UNACCOUNTED WATER

Period: May 2003

Total Pumpage:

Purchased Water:

Total:

Metered Sales:

Unmetered Sales-Construction:

Water Main Breaks:

Service Line Leaks: 96,400 gals

Water Used at Sources (metered): 9350 gals

Hydrant Flushing: 5 000 gals

Loading/Flushing Mains:

Water Used by Municipalities:

Storage:

Meter Testing: 2710 gals

General Use: Warehouse: 300 gals

New Text Document

May Unaccountable 2003

	Old	New		
Well 16 -	0092580	0093020 =	440gals	
Well 18 -	0076410	0076670 =	260gals	
Well 19 -	010110	010500 =	390gals	
Well 20 -	096220	096350 =	130gals	
Well 21 -	828850	829300 =	450gals	
Well 23 -	0030810	0030940 =	130gals	
Blanton -	0028520	0034760 =	6240gals	
Shiloh -	0021620	0021780 =	1200gals	(7.5)
Wyo. H. -	367850	367960 =	110gals	
		Totals =	9350gals	

Mtr. Shop #1 -	6983990	6985800 =	1810gals	
Mtr. Shop #2 -	0032450	0032490 =	300gals	(7.5)
Mtr. Shop #3 -	0017570	0017650 =	600gals	(7.5)
		Total =	2710gals	
Warehouse -	799750	800050 =	300gals	

May 8 -	Leak in Body Zone meterpit	- 86,400gals
May 12 -	Service leak Heidelberg Run W.	- 5,000gals
May 14 -	Flushed Hydrant Krick Rd.	- 2,000gals
May 23 -	Service hit on Woodrow Ave Kuser	- 5,000gals
May 27 -	Blew off Belmont	- 1,000gals
May 29 -	Blew off Green Valley Heights	- 2,000gals
		~~135,000~~gals
		101,400gals

Grand Total- ~~147,360gals~~
113,760gals

PENN DISTRICT
UNACCOUNTED WATER

Period: June 2003

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 75,000gals

Service Line Leaks: 40,000gals

Water Used at Sources (metered): 5780gals

Hydrant Flushing: 45,500gals

Loading/Flushing Mains: 88,000gals

Water Used by Municipalities: 87,640gals (Sinkhole Morgan Dr.)

Storage: _____

Meter Testing: 2205gals

General Use: Warehouse: 450gals

New Text Document

June Unaccountable 2003

	Old	New		
Well 16 -	0093020	0096100	= 3080gals	
Well 18 -	0076670	0077270	= 600gals	
Well 19 -	010500	011120	= 620gals	
Well 20 -	096350	096630	= 280gals	
Well 21 -	829300	829620	= 320gals	
Well 23 -	0030940	0031210	= 270gals	
Blanton -	0034760	0034840	= 80gals	
Shiloh -	0021780	0021840	= 450gals	(7.5)
Wyo. H. -	367960	368040	= 80gals	
		Totals	= 5780gals	

Mtr. Shop #1 -	6985800	6987330	= 1530gals	
Mtr. Shop #2 -	0032490	0032520	= 225gals	(7.5)
Mtr. Shop #3 -	0017650	0017710	= 450gals	(7.5)
		Total	= 2205gals	
Warehouse -	800050	800500	= 450gals	

June	3-	Flushed hydrant Evans & Woodrow	- 10,000gals
June	4-	Blew off Lilyfield ph.1	- 10,000gals
June	6-	Cut in valve Morgan Dr.	- 16,000gals
June	6-	Sinkhole Morgan Dr. FD/Schlouch	- 30,000gals
June	6-	Blow off Conestoga Dr.	- 2,000gals
June	9-	Blew off Belmont Ave.	- 18,500gals
June	9-	Sinkhole Morgan Dr. FD/Schlouch	- 30,000gals
June	10-	Leows Temp service	- 12,000gals
June	13-	Mainbreak Noble St.	- 75,000gals
June	20-	Blew off O. Fritztown Rd.	- 25,000gals
June	21-	Service leak 414 Fredrick Blvd.	- 80,000gals
June	26-	Blew off O. Fritztown Rd.	- 25,000gals
June	27-	Service leak 528 Arrowhead Tr.	- 80,000gals
June	30-	Flushed Commerce Dr.	- 15,000gals
			428,500gals

Grand Total- 436,935gals

* Note - Spring Twp Fire Co - 25,000gals
Spring Twp. 2,640gals

New Grand Total - 464,575gals

PENN DISTRICT
UNACCOUNTED WATER

Period: July 2003

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: _____

Service Line Leaks: 47,000 gals

Water Used at Sources (metered): 10,910 gals

Hydrant Flushing: 51,000 gals

Loading/Flushing Mains: 30,000 gals

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 2650 gals

General Use: Warehouse: 425 gals

New Text Document

July Unaccountable 2003

	Old	New		
Well 16 -	0096100	0096960 =	860gals	
Well 18 -	0077270	0078150 =	880gals	
Well 19 -	011120	018450 =	7330gals	
Well 20 -	096630	096870 =	240gals	
Well 21 -	829620	830230 =	610gals	
Well 23 -	0031210	0031380 =	170gals	
Blanton -	0034840	0034940 =	100gals	
Shiloh -	0021840	0021920 =	600gals	(7.5)
Wyo. H. -	368040	368160 =	120gals	
		Totals =	10910gals	

Mtr. Shop #1 -	6987330	6989180 =	1850gals	
Mtr. Shop #2 -	0032520	0032570 =	125gals	(7.5)
Mtr. Shop #3 -	0017710	0017800 =	675gals	(7.5)
		Total =	2650gals	
Warehouse -	800500	800925 =	425gals	

July 1-	Spring Ridge pit leak	- 45,000gals
July 14-	Loaded main Green Valley Ph. 10	- 15,000gals
July 15-	Service leak 10 Lawndale	- 1,000gals
July 18-	Service leak 18 Eagles Ln.	- 1,000gals
July 24-	Flow test for Wyo. Borough	- 7,000gals
July 30-	Flow test for Wyo. Borough	- 14,000gals
July 12-	Flushed Columbia Ave.	- 30,000gals
July 25-	Loaded main Werner Est. ph. 7&8	- 15,000gals

128,000gals

Grand Total- 141,985gals

PENN DISTRICT
UNACCOUNTED WATER

Period: August 2003

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 45,000 gals

Service Line Leaks: 47,500 gals

Water Used at Sources (metered): 8135 gals

Hydrant Flushing: 66,300 gals

Loading/Flushing Mains: 60,000 gals

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 1620 gals

General Use: Warehouse: 245 gals

August Unacccuntable 2003

	Old	New		
Well 16 -	0096960	0097370 =	410gals	
Well 18 -	0078150	0078340 =	190gals	
Well 19 -	018450	024180 =	5730gals	
Well 20 -	096870	097100 =	230gals	
Well 21 -	830230	830600 =	370gals	
Well 23 -	0031380	0031530 =	150gals	
Blanton -	0034940	0035040 =	100gals	
Shiloh -	0021920	0022010 =	675gals	(7.5)
Wyo. H. -	368160	368440 =	280gals	
		Totals =	8135gals	

Mtr. Shop #1 -	6989180	6990050 =	870gals	
Mtr. Shop #2 -	0032570	0032620 =	375gals	(7.5)
Mtr. Shop #3 -	0017800	0017850 =	375gals	(7.5)
		Total =	~~2625gals~~ 1620gals	
Warehouse -	800925	801170 =	245gals	

Aug. 1-	Flushed Wilshire	- 40,000gals
Aug. 1-	Spring Ridge Pit	- 45,000gals
Aug. 5-	Flushed Buckingham Flow Test	- 4,600gals
Aug. 8-	Flushed Cleveland	- 500gals
Aug. 12-	Flushed Hawthorne Flow Test	- 1,000gals
Aug. 19-	Blew off Leows	- 30,000gals
Aug. 20-	Blew off Corp. Campus	- 5,000gals
Aug. 21-	Flushed Downing Flow Test	- 2,800gals
Aug. 21-	Blew off Broadcasting Ridge	- 25,000gals
Aug. 22-	Flushed Canaberra Ct.	- 9,000gals
Aug. 25-	Bell Joint Leak Overhill	- 45,000gals

Aug. 26 -	Flushed Deborah Dr. Flow Test	- 2,400gals
Aug. 28 -	Flushed Morgan Dr.	- 6,000gals
Aug. 29 -	Service Leak Primrose Dr.	- 2,500gals

Totals - 218,800gals

Grand Total - 228,800gals

August Unaccountable 2003

	Old	New		
Well 16 -	0096960	0097370	= 410gals	
Well 18 -	0078150	0078340	= 190gals	
Well 19 -	018450	024180	= 5730gals	
Well 20 -	096870	097100	= 230gals	
Well 21 -	830230	830600	= 370gals	
Well 23 -	0031380	0031530	= 150gals	
Blanton -	0034940	0035040	= 100gals	
Shiloh -	0021920	0022010	= 675gals	(7.5)
Wyo. H. -	368160	368440	= 280gals	
		Totals	= 8135gals	

Mtr. Shop #1 -	6989180	6990050	= 870gals	
Mtr. Shop #2 -	0032570	0032620	= 375gals	(7.5)
Mtr. Shop #3 -	0017800	0017850	= 375gals	(7.5)
		Total	= ~~8135gals~~ 1620gals	
Warehouse -	800925	801170	= 245gals	

Aug. 1-	Flushed Wilshire	- 40,000gals
Aug. 1-	Spring Ridge Pit	- 45,000gals
Aug. 5-	Flushed Buckingham Flow Test	- 4,600gals
Aug. 8-	Flushed Cleveland	- 500gals
Aug. 12-	Flushed Hawthorne Flow Test	- 1,000gals
Aug. 19-	Blew off Leows	- 30,000gals
Aug. 20-	Blew off Corp. Campus	- 5,000gals
Aug. 21-	Flushed Downing Flow Test	- 2,800gals
Aug. 21-	Blew off Broadcasting Ridge	- 25,000gals
Aug. 22-	Flushed Canaberra Ct.	- 9,000gals
Aug. 25-	Bell Joint Leak Overhill	- 45,000gals

Aug. 26 -	Flushed Deborah Dr. Flow Test	- 2,400gals
Aug. 28 -	Flushed Morgan Dr.	- 6,000gals
Aug. 29 -	Service Leak Primrose Dr.	- 2,500gals

Totals - 218,800gals

Gnand Total - 228,800gals

PENN DISTRICT
UNACCOUNTED WATER

Period: _____

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 45,000 gals

Service Line Leaks: 47,500 gals

Water Used at Sources (metered): 8135 gals

Hydrant Flushing: 66,300 gals

Loading/Flushing Mains: 40,000 gals

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 1620 gals

General Use: Warehouse: 245 gals

PENN DISTRICT
UNACCOUNTED WATER

Period: Sept. 2003

Total Pumpage: _____

Purchased Water. _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: _____

Service Line Leaks: 15,000 gals

Water Used at Sources (metered): 7650 gals

Hydrant Flushing: 2,300 gals

Loading/Flushing Mains: 200,000 gals

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 1575 gals

General Use: Warehouse: 620 gals

September Unaccountable 2003

	Old	New		
Well 16	- 0097370	0097800	=	430gals
Well 18	- 0078340	0078540	=	200gals
Well 19	- 024180	024690	=	510gals
Well 20	- 097100	097330	=	230gals
Well 21	- 830600	831040	=	440gals
Well 23	- 0031530	0036330	=	4800gals
Blanton	- 0035040	0035270	=	230gals
Shiloh	- 0022010	0022090	=	600gals (7.5)
Wyo. Hills	- 368440	368650	=	210gals
		Total	=	7650gals
Meter Shop #1	- 6990050	6991100	=	1050gals
Meter Shop #2	- 0032620	0032620	=	0gals (7.5)
Meter Shop #3	- 0017850	0017920	=	525gals (7.5)
		Total	=	1575gals
Warehouse	- 801170	801790	=	620gals

Sept. 2	- Kinsley blew off Broadcasting Ridge	= 30,000 gals.
Sept. 5	- Hit service 209 Woodrow Ave.	= 15,000 gals.
Sept. 9	- Blew off Green Valley Ph. 10	= 50,000gals
Sept. 9	- Loaded main Lilyfield Ph. 2	= 10,000gals
Sept. 10	- Flow tests Wyomissing	= 7,300gals
Sept. 11	- Blew off Green Valley Ph. 10	= 25,000gals
Sept. 12	- Blew off Werner Estates Ph 7,8,9	= 75,000gals
Sept. 22	- Blew off Corp. Campus	= 10,000gals
	Total	= 222,300gals
	Grand Total	= 232,145gals

PENN DISTRICT
UNACCOUNTED WATER

Period: October 2003

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: _____

Service Line Leaks: 129,600 gals

Water Used at Sources (metered): 12,870 gals

Hydrant Flushing: 1,003,500 gals

Loading/Flushing Mains: 35,000 gals

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 3210 gals

General Use: Warehouse: 830 gals

October Unaccountable 2003

	Old	New		
Well 16	- 0097800	0098760	=	960gals
Well 18	- 0078540	0078730	=	190gals
Well 19	- 024690	029820	=	5130gals
Well 20	- 097330	098420	=	1090gals
Well 21	- 831040	831390	=	350gals
Well 23	- 0036330	0040440	=	4110gals
Blanton	- 0035270	0035610	=	340gals
Shiloh	- 0022090	0022170	=	600gals (7.5)
Wyo. Hills	- 368650	368750	=	100gals
		Total	=	12870gals
Meter Shop #1	- 6991100	6993410	=	2310gals
Meter Shop #2	- 0032620	0032670	=	375gals (7.5)
Meter Shop #3	- 0017920	0017990	=	525gals (7.5)
		Total	=	3210gals
Warehouse	- 801790	802620	=	830gals

Oct. 7	- Flow test Darlin Dr. Wyomissing	= 3,500gals
Oct. 18	- Leak Spring Ridge pit	= 129,600gals
Oct. 13-24	- Flush Hydrants	= 1,000,000gals
Oct. 15	- Loaded & Blew off Reedy Estates	= 35,000gals

Total = 1,168,100gals

Grand Total = 1,185,010gals

November Unaccountable 2003

	Old	New		
Well 16	- 0098760	0103910	=	5150gals
Well 18	- 0078730	0080200	=	1470gals
Well 19	- 029820	030200	=	380gals
Well 20	- 098420	102680	=	4260gals
Well 21	- 831390	831570	=	180gals
Well 23	- 0040440	0045500	=	5060gals
Blanton	- 0035610	0035820	=	210gals
Shiloh	- 0022170	0022260	=	675gals (7.5)
Wyo. Hills	- 368750	368960	=	210gals
		Total	=	17595gals
Meter Shop #1	- 6993410	6997970	=	4560gals
Meter Shop #2	- 0032670	0032840	=	1275gals (7.5)
Meter Shop #3	- 0017990	0018060	=	525gals (7.5)
		Total	=	6360gals
Warehouse	- 801790	802920	=	1130gals

Nov. 10	- Mainbreak Vester Place	= 25,000gals
Nov. 11	- Mainbreak Oberlin Ave.	= 100,000gals
Nov. 11	- Loaded Reedy Estates	= 30,000gals
Nov. 14	- Flushed Hydrant on Lincoln Ave.	= 10,000gals
Nov. 20	- Blew off Broadcasting Ridge	= 25,000gals
Nov. 17	- Drained Low Tank for Inspection	= 300,000gals

Total = 490,000gals

Grand Total = 515,085gals

PENN DISTRICT
UNACCOUNTED WATER

Period: November 2003

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 125,000 gals

Service Line Leaks: _____

Water Used at Sources (metered): 17545 gals

Hydrant Flushing: 10,000 gals

Loading/Flushing Mains: 55,000 gals

Water Used by Municipalities: _____

Storage: (DRAINED LOW TANK) 300,000

Meter Testing: 6360 gals

General Use: Warehouse: 1130 gals

PENN DISTRICT
UNACCOUNTED WATER

Period: December 2003

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 75,000 gals

Service Line Leaks: 55,000 gals

Water Used at Sources (metered): 17485 gals

Hydrant Flushing: _____

Loading/Flushing Mains: 53,000 gals

Water Used by Municipalities: Fire - 20,000 gals

Storage: _____

Meter Testing: 5805 gals

General Use: Warehouse: 1440 gals

Penn Water

December Unaccountable 2003

	Old	New		
Well 16	- 0103910	0109220	=	5310gals
Well 18	- 0080200	0081890	=	1690gals
Well 19	- 030200	030630	=	430gals
Well 20	- 102680	106950	=	4270gals
Well 21	- 831570	831650	=	80gals
Well 23	- 0045500	0050650	=	5150gals
Blanton	- 0035820	0035850	=	30gals
Shiloh	- 0022260	0022310	=	375gals (7.5)
Wyo. Hills	- 368960	369110	=	150gals
		Total	=	17485gals
Meter Shop #1	- 6997970	7002650	=	4680gals
Meter Shop #2	- 0032840	0032920	=	600gals (7.5)
Meter Shop #3	- 0018060	0018130	=	525gals (7.5)
		Total	=	5805gals
Warehouse	- 801790	803230	=	1440 gals

Dec. 8	- Mainbreak 18 Laird St.	=	75,000gals
Dec. 9	- Fire Wilson Townhouses	=	20,000gals
Dec. 18	- Blew off Reedy Estates	=	50,000gals
Dec. 24	- Blew off Mt. Home Rd.	=	3,000gals
Dec. 29	- Service leak 4720 Penn Ave	=	55,000gals

Total = 203,000gals

Grand Total = 227,730 ~~224,730~~gals

PENN DISTRICT
UNACCOUNTED WATER

Period: February 2004

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 90,000 gals

Service Line Leaks: _____

Water Used at Sources (metered): 19,125 gals

Hydrant Flushing: 10,000 gals

Loading/Flushing Mains: _____

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 4240 gals

General Use: Warehouse: 410 gals

February Unaccountable 2004

	Old	New		
Well 16	- 0116880	0121150	=	4270gals
Well 18	- 0086900	0090610	=	3710gals
Well 19	- 031150	031660	=	510gals
Well 20	- 111350	116610	=	5260gals
Well 21	- 835200	835230	=	30gals
Well 23	- 0056130	0060620	=	4490gals
Blanton	- 0035850	0035950	=	100gals
Shiloh	- 0022330	0022420	=	675gals (7.5)
Wyo. Hills	- 369210	369290	=	80gals
		Total	=	19125gals
Meter Shop #1	- 7009310	7012650	=	3340gals
Meter Shop #2	- 0032950	0032990	=	300gals (7.5)
Meter Shop #3	- 0018210	0018290	=	600gals (7.5)
		Total	=	4240gals
Warehouse	- 805170	805580	=	410gals

Feb. 8	- Mainbreak 2641 Girard Ave	=	50,000gals
Feb. 12	- Flushed Shillington Rd.	=	10,000gals
Feb. 14	- Mainbreak 1 Bristol Ct.	=	25,000gals
Feb. 16	- Valve replacement Wassner & Berks Pl.	=	15,000gals

Total = 100,000gals

Grand Total = 123,775gals

PENN DISTRICT
UNACCOUNTED WATER

Period: March 2004

Total Pumpage: _____

Purchased Water. _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: 10,000 gals

Service Line Leaks: 35,000 gals

Water Used at Sources (metered): 35,650 gals

Hydrant Flushing: _____

Loading/Flushing Mains: 35,000 gals

Water Used by Municipalities: _____

Tank Maintenance - 515,000 gals

Storage: _____

Meter Testing: 4090 gals

General Use: Warehouse: 690 gals

Penn Water March Unaccountable 2004

	Old	New		
• Well 16	- 0121150	0126240	=	5090gals
• Well 18	- 0090610	0095370	=	4760gals
• Well 19	- 031660	032310	=	650gals
• Well 20	- 116610	120140	=	3530gals
• Well 21	- 835230	850610	=	15380gals
• Well 23	- 0060620	0065940	=	5320gals
• Blanton	- 0035950	0035980	=	30gals
• Shiloh	- 0022420	0022420	=	0gals (7.5)
• Wyo. Hills	- 369290	370180	=	890gals

Total = 35650gals

Meter Shop #1	- 7012650	7014490	=	1840gals
Meter Shop #2	- 0032990	0033150	=	1200gals (7.5)
Meter Shop #3	- 0018290	0018430	=	1050gals (7.5)

Total = 4090gals

Warehouse	- 805580	806270	=	690gals

March 1- Service leak 2930 Penn Ave.	= 20,000gals
March 9- Blew off Calvary Church	= 25,000gals
March 9- Blanton Tank overflowed	= 15,000gals
March 13- Service leak 2020 Penn Ave.	= 15,000gals
March 15- Drained low tank	= 500,000gals
March 15- Flow test Calvary Church	= 10,000gals
March 25- Gambone Bros. Hit blow off	= 10,000gals

Total = 595,000gals

Grand Total = 635,430gals

PENN DISTRICT
UNACCOUNTED WATER

Period: April 2004

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: _____

Service Line Leaks: 35,000 gals

Water Used at Sources (metered): 6853 gals

Hydrant Flushing: 200,000 gals

Loading/Flushing Mains: 35,000 gals

Water Used by Municipalities: 720 gals

Storage: _____

Meter Testing: 2154 gals

General Use: Warehouse: 585 gals

Penn Water April Unaccountable 2004

	Old	New		
• Well 16	- 0126240	0126995	=	755gals
• Well 18	- 0095370	0096001	=	631gals
• Well 19	- 032310	032713	=	403gals
• Well 20	- 120140	120846	=	706gals
• Well 21	- 850610	853266	=	2656gals
• Well 23	- 0065940	0066755	=	815gals
• Blanton	- 0035980	0036025	=	45gals
• Shiloh	- 0022420	0022420	=	0gals (7.5)
• Wyo. Hills	- 370180	371022	=	842gals

Total = 6853gals

Meter Shop #1	- 7014490	7015369	=	879gals
Meter Shop #2	- 0033150	0033250	=	750gals (7.5)
Meter Shop #3	- 0018430	0018500	=	525gals (7.5)

Total = 2154gals

Warehouse	- 806270	806855	=	585gals

April 14- Loaded Brookfield Manor	=	25,000gals
April 20- Service leak Green Valley	=	35,000gals
April 30- Loaded Spring Meadows	=	10,000gals
April 30- Spring Twp. Hydrant	=	720gals
April 12-16 High Tank out	=	200,000gals

Total = 270,720gals

Grand Total = 280,312gals

PENN DISTRICT
UNACCOUNTED WATER

Period: May 2004

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: _____

Service Line Leaks: 35,000 gals

Water Used at Sources (metered): 52,997 gals

Hydrant Flushing: 1,002,000 gals

Loading/Flushing Mains: 277,000 gals

Water Used by Municipalities: 10,000 gals

Storage: _____

Meter Testing: 4276 gals

General Use: Warehouse: 2295 gals

Penn Water May Unaccountable 2004

	Old	New		
• Well 16	- 0126995	0139770	=	12775gals
• Well 18	- 0096001	0106270	=	10269gals
• Well 19	- 032713	042700	=	9987gals
• Well 20	- 120846	125600	=	4754gals
• Well 21	- 853266	858810	=	5544gals
• Well 23	- 0066755	0076370	=	9615gals
• Blanton	- 0036025	0036050	=	25gals
• Shiloh	- 0022420	0022420	=	0gals (7.5)
• Wyo. Hills	- 371022	371050	=	28gals

Total = 52997gals

Meter Shop #1	- 7015369	7016720	=	1351gals
Meter Shop #2	- 0033250	0033550	=	2250gals (7.5)
Meter Shop #3	- 0018500	0018590	=	675gals (7.5)

Total = 4276gals

Warehouse	- 806855	809150	=	2295gals

May 2 – Service leak 3105 Wyoming Dr.	- 15,000gals
May 4 – Test fire hoses	- 10,000gals
May 5 – Loaded and Flushed Spring Meadows	- 40,000gals
May 7 – Loaded part of Heidelberg Run West Ph. 2	- 15,000gals
May 10-21 – Flushed Hydrants	- 1,000,000gals
May 11 – Loaded Brookfield	- 60,000gals
May 11 – Flushed sinkhole for Grande	- 2,000gals
May 12 – Blew off Green Valley Ph.9b	- 25,000gals
May 13 – Blew off Corp. Campus Ph.4	- 40,000gals
May 14 – Blew off Brookfield	- 80,000gals
May 21 – Loaded Heidelberg West second part	- 12,000gals
May 24 – Corp hit on State Hill Rd.	- 10,000gals
May 25 – Service leak 510 Martins Rd.	- 10,000gals
May 27 – Loaded Wagner Farm Ph. 4	- 5,000gals

Total = 1,324,000gals

Grand Total = ~~[illegible]~~gals

1,383,568gals

Inventory needs - Penn Water May 2004

2 - curbstops Mueller 3/4"
6 - 3/4 Comp Couplings Mueller
6 - 3/4 flare nipples
2 - runs of 1 1/4 nipples/curb box risers to 8" - Galvinized
3 - runs of 2" nipples up to 4" > Brass
3 - runs of 1 1/2 nipples up to 4"
12 - valve box lids
10 - 1" risers
6 - 1/4" wood lids
Speed Wrench mainwalks

PENN DISTRICT
UNACCOUNTED WATER

Period: June 2004

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: _____

Service Line Leaks: _____

Water Used at Sources (metered): 15,740 gals

Hydrant Flushing: 70,000 gals

Loading/Flushing Mains: 226,500 gals

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 1680 gals

General Use: Warehouse: 630 gals

Penn Inventory Needs - June

3/4" Comp Couplings - we have none
3/4" Comp Caps - need 10
Street valve boxes w/lids - we have none
Nipples for changeouts of 2" + 1½ meters (Wilson Townhouse
¼" wood bits
3/4" Comp Curbstops need 10
4 - 3/4 - flare repairs
12 valve box lids
10 - 1" risers
Speed Wrench maintenance

PENN DISTRICT
UNACCOUNTED WATER

Period: July 2004

Total Pumpage: _____

Purchased Water: _____

Total: _____

Metered Sales: _____

Unmetered Sales-Construction: _____

Water Main Breaks: _____

Service Line Leaks: 10,000 gals

Water Used at Sources (metered): 23,255 gals

Hydrant Flushing: _____

Loading/Flushing Mains: 42,000 gals

Water Used by Municipalities: _____

Storage: _____

Meter Testing: 1595 gals

General Use: Warehouse: 90 gals

Penn Water July Unaccountable 2004

	Old	New		
• Well 16	- 0144410	0149410	=	5000gals
• Well 18	- 0110270	0114820	=	4550gals
• Well 19	- 043430	043820	=	390gals
• Well 20	- 126750	127630	=	880gals
• Well 21	- 858990	859240	=	250gals
• Well 23	- 0081130	0090360	=	9230gals
• Blanton	- 0036060	0036090	=	30gals
• Shiloh	- 0022420	0022810	=	2925gals (7.5)
• Wyo. Hills	- 371320	371320	=	0gals

Total = 23255gals

Meter Shop #1	- 7017500	7018420	=	920gals
Meter Shop #2	- 0033600	0033620	=	150gals (7.5)
Meter Shop #3	- 0018660	0018730	=	525gals (7.5)

Total = 1595gals

Warehouse	- 809780	809870	=	90gals

July 2	- Loaded Wheatfield Run	- 10,000gals
July 7	- Service leak 2611 Girard Ave.	- 10,000gals
July 7	- Blew off Wheatfield Run	- 25,000gals
July 16	- Blew off Bittner Rd.	- 2,000gals
July 22	- Blew off Green Valley Rd.	- 5,000gals

Total = 52,000gals

Grand Total = 76940gals

Penn District
Unaccounted Water

Period : January 2005

Water Main Breaks: 1,900,000 gals
Service Line Leaks: 400,000 gals
Estimated NRW loss: _____
Usage of Hydrants & Blowoffs: _____
Usage of fixed Blowoffs : _____
Water Used at Sources: 33890 gals
Water Used for Meter Testing: 1425 gals
Water Used at Warehouse: 6 gals
Water Used by Municipalities: _____

TOTAL: 2,335,377

Number of Unmetered Fire Services Checked: _____
1)_____ 2)_____ 3)_____
4)_____
Number of Right of Ways Checked: _____
1)_____ 2)_____ 3)_____
4)_____ 5)_____
Number of River Crossings Checked: _____
1)_____ 2)_____ 3)_____
Number of Leaks Repaired: 5
Number of Services Replaced: _____
Number of Identified Leaks Running: 1 (Mowroe Ave. customer side)
Number of Unmetered Flat Rate Accounts: _____
Number of Water Theft Investigations: _____

Retirement of Parallel Mains: _____
Small Diameter Main Replacement: _____

Penn Water Unaccountable

Well#	Dec	Jan-05	Usage	
12			0	
13			0	
16	172410	191280	18870	
18	135710	140220	4510	
19	48670	49380	710	
20	135000	137270	2270	
21	859500	859610	110	
23	114230	119320	5090	
28			0	
Blanton	36220	37050	830	
Cushion Peak			0	
Wyo Hills	372540	372540	0	
Shiloh	177970	179470	1500	7.5
Well Total			33890	
Meter Shop 1	7025320	7026070	750	
Meter Shop 2	254475	254550	75	7.5
Meter Shop 3	142725	143325	600	7 5
Shop Total			1425	
Warehouse	227	289	62	
Total			35377	
Events			2300000	
Grand Total			2335377	

Date	Description	Usage
01/11/05	Grings Hill Station Leak	100,000
01/26/05	Mainbreak Reading Ave@West Lawn Ave	700,000
01/01/05	Mainbreak Durwood	500,000
01/28/05	3/4" Service Leak Cotswald	150,000
01/31/05	Mainbreak Warwick	700,000
01/24/05	3/4" service leak Monroe	150,000
	Total	2,300,000

Penn District
Unaccounted Water

Period : Feb. 2005

Water Main Breaks: 3,550,000 gals
Service Line Leaks: 205,400 gals
Estimated NRW loss:
Usage of Hydrants & Blowoffs: 30 000 gals
Usage of fixed Blowoffs :
Water Used at Sources: 66,370 gals
Water Used for Meter Testing: 2020 gals
Water Used at Warehouse: 64 gals
Water Used by Municipalities:

TOTAL: 3 853 454

//

Number of Unmetered Fire Services Checked:
1) 2) 3)
4)
Number of Right of Ways Checked: 4
1) Lowes 2) Weaver Farm 3) Hunnewood
4) Green Valley 5)
Number of River Crossings Checked: 3
1) Mt. Horse Rd. 2) Lilyfield 3) Reedy Rd
Number of Leaks Repaired: 6 mainlacuks
Number of Services Replaced:
Number of Identified Leaks Running: 2 - 4216 Penn Ave (Customers) 2308 Monroe Ave (Customers)
Number of Unmetered Flat Rate Accounts:
Number of Water Theft Investigations:

//

Retirement of Parallel Mains:
Small Diameter Main Replacement: 110' 8 DIP Iroquois Ave

5,250,000
185

Penn Water Unaccountable

	Jan-05	Feb-05	Usage	
Well#				
12			0	
13			0	
16	191280	194770	3490	
18	140220	143300	3080	
19	49380	52060	2680	
20	137270	137800	530	
21	859610	911710	52100	
23	119320	122770	3450	
28			0	
Blanton	37050	37160	110	
Cushion Peak			0	
Wyo Hills	372540	373320	780	
Shiloh	179470	179620	150	7.5
Well Total			66370	
Meter Shop 1	7026070	7027040	970	
Meter Shop 2	254550	255150	600	7.5
Meter Shop 3	143325	143775	450	7.5
Shop Total			2020	
Warehouse	289	353	64	
Total			68454	
Events			3785000	
Grand Total			3853454	

Date	Description	Usage
02\01\05	Mainbreak Ruth & Elwyn	500,000
02\03\05	Mainbreak Sherwood & Gage	500,000
02\06\05	Iroquois Mainbreak & Sinkhole	1,600,000
02\07\05	Mainbreak 1 Vista Rd.	300,000
02\07\05	Mainbreak Wilson School Lane	400,000
02\08\05	Mainbreak 52 Warwick Dr.	250,000
02\18\05	Blew off Iroquois Ave.	20,000
All Month	Customer Service Leak 4216 Penn Ave	95,000
02\22\05	Loaded Main Wheatfield Run	10,000
All Month	Customer Service Leak 2308 Monroe	110,900
	Total	3,785,900

Penn District
Unaccounted Water

Period : March 2005

Water Main Breaks: 750.000 gals
Service Line Leaks: _____
Estimated NRW loss: _____
Usage of Hydrants & Blowoffs: 125.000 gals
Usage of fixed Blowoffs : _____
Water Used at Sources: 24.017 gals
Water Used for Meter Testing: 3065 gals
Water Used at Warehouse: 99 gals
Water Used by Municipalities: _____

TOTAL: _____

Number of Unmetered Fire Services Checked: _____
1)_____ 2)_____ 3)_____
4)_____
Number of Right of Ways Checked: 4
1) Clemens Farm 2) Hymenwood 3) Lewis
4) Green Valley 5)_____
Number of River Crossings Checked: 3
1) Reedy Rd 2) Montello 3) Lilyfield
Number of Leaks Repaired: 3 main breaks
Number of Services Replaced: _____
Number of Identified Leaks Running: _____
Number of Unmetered Flat Rate Accounts: _____
Number of Water Theft Investigations: _____

Retirement of Parallel Mains: _____
Small Diameter Main Replacement: _____

Penn Water Unaccountable March 2005

Well 16	194770	0202590	7820 gals
18	143300	Building under construction	
19	052060	057010	4950 gals
20	137800	142040	4240 gals
21	911710	911930	220 gals
23	122770	128090	5320 gals
Blaston	37160	38150	990 gals
Wyo. Hills	373320	373490	170 gals
Shiloh	179620	181922	307 gals
Well Totals			24.017 gals
Meter Shop #1	7027040	7028530	1490 gals
#2	255150	256125	975 gals
#3	143775	144975	1200 gals
Shop Totals			3665 gals
Warehouse	353	452	99 gals
		Total	27.781 gals

1-5-05 Mainbreak Kevin Ct - 100,000 gals
1-16-05 12" main hit by contractor 250,000 gals
1-18-05 Flushed Hydrant on Celco - 5,000 gals
1-19-05 Mainbreak old Fritztown Rd - 100,000 gals
1-21-05 Flushed Hydrant O. Fritztown Rd - 20,000 gals
1-22-05 Blew off Wheatfield Run - 100,000 gals Total - 575,000 gals

Penn District
Unaccounted Water

Period : April 2005

Water Main Breaks: _____
Service Line Leaks: _____
Estimated NRW loss: _____
Usage of Hydrants & Blowoffs: 118,000 gals
Usage of fixed Blowoffs : _____
Water Used at Sources: 8,898 gals
Water Used for Meter Testing: 2,765 gals
Water Used at Warehouse: 82 gals
Water Used by Municipalities. _____

TOTAL: _____

Number of Unmetered Fire Services Checked: _____
1)_____ 2)_____ 3)_____
4)_____
Number of Right of Ways Checked: 4
1) Jones 2) Wynnewood 3) Wenger Farm
4) Green Valley 5)_____
Number of River Crossings Checked: 3
1) Mantello 2) Lilyfield 3) Reedy Rd.
Number of Leaks Repaired: _____
Number of Services Replaced: _____
Number of Identified Leaks Running: _____
Number of Unmetered Flat Rate Accounts: _____
Number of Water Theft Investigations: _____

Retirement of Parallel Mains: _____
Small Diameter Main Replacement: 300' of 8" to replace 6" on O. Fairtown Rd @ Ca.

Penn Water Unaccountable April 2005

Well #	Last Read	New Read	Diff
12	0	0	0
13	0	0	0
16	202,590	205,800	3,210
18	0	0	0
19	57,010	57,310	300
20	142,040	143,590	1,550
21	911,930	911,990	60
23	128,090	131,290	3,200
27	0	0	0
28	0	0	0
Blanton	38,150	38,190	40
Shiloh	179,922	180,370	448
Wyo Hills	373,490	373,580	90
Cush Peak	0	0	0
		Total	8,898

Meter Shop	Last Read	New Read	Diff
1	7,028,530	7,029,870	1,340
2	256,125	256,575	450
3	144,975	145,950	975
			2,765

	Last Read	New Read	Diff
Warehouse	452	534	82
Events			118,000

Grand Total	129,745

Events	Totals
4-1-05 Flushed Hydrant 1122 Columbia Ave.	10,000gals
4-6-05 Flushed Apen Ave. (New Service)	3,000gals
4-13-05 Flushed Aspen Ave. (Valve Replacement)	10,000gals
4-14-05 Flushed Spring Ridge West	10,000gals
4-16-05 Flushed Hydrant 1122 Columbia Ave	10,000gals
4-19-05 Flushed Hydrant Calco & Sell (O. Fritz. Tie- In)	25,000gals
4-20-05 Flushed Old Fritztown Rd. (O. Fritz. @ S Bend)	30,000gals
4-21-05 Loaded and Tested Well 18a Lines and Tank	20,000gals

Penn District
Unaccounted Water

Period : May 2005

Water Main Breaks: _____
Service Line Leaks: 43,000 gals
Estimated NRW loss: _____
Usage of Hydrants & Blowoffs: 183,000 gals
Usage of fixed Blowoffs : _____
Water Used at Sources: 190,223 gals
Water Used for Meter Testing: 2,315 gals
Water Used at Warehouse: 180 gals
Water Used by Municipalities: _____

TOTAL: 418,918

//

Number of Unmetered Fire Services Checked: _____
1)_____ 2)_____ 3)_____
4)_____
Number of Right of Ways Checked: _____
1) Green Valley 2) Weaver Farm 3) Lewes
4) Wynwood 5) O. Fritztown Rd.
Number of River Crossings Checked: _____
1) Reedy Rd 2) Lily Field 3) Park Ave
Number of Leaks Repaired: 1
Number of Services Replaced: _____
Number of Identified Leaks Running: _____
Number of Unmetered Flat Rate Accounts: _____
Number of Water Theft Investigations: _____

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Retirement of Parallel Mains: _____
Small Diameter Main Replacement: 580' 4" on O. Fritztown Rd
Replaced with 8"

Penn Water Unaccountable May 2005

Well #	Last Read	New Read	Diff
12	0	0	0
13	0	0	0
16	205,800	208,101	2,301
18	0	0	0
19	57,310	57,760	450
20	143,590	144,810	1,220
21	911,990	912,220	230
23	131,290	134,533	3,243
27	0	0	0
28	0	0	0
Blanton	38,190	38,220	30
Shiloh	180,370	182,033	1,663
Wyo Hills	373,580	374,666	1,086
Cush Peak	0	0	0
		Total	10,223

Meter Shop	Last Read	New Read	Diff
1	7,029,870	7,031,260	1,390
2	256,575	256,950	375
3	145,950	146,700	750
			2,515

	Last Read	New Read	Diff
Warehouse	534	714	180
Events		406,000	406,000

Grand Total	**418,918**

Events	Totals
4/22/05 Service Leak 2308 Monroe Ave.	43,000gals
4/22/05 Blew Off Well 18	10,000gals
4/24/05 Grings Hill Tank Overflowed	120,000gals
4/26/05 Flushed Hydrant 1122 Columbia Ave	72,000gals
4/26/05 Blew Off Well 18	50,000gals
5/3/05 Flushed Hydrant 1122 Columbia Ave.	6,000gals
5/5/05 4 Flow Tests in Sinking Spring	75,000gals
5/18/05 Flushed Hydrant Cushion Peak	15,000gals
5/18/05 Loaded Main to Half of Green Valley Ph 12	15,000gals

Penn District
Unaccounted Water

Period : 5/21/05 - 6/21/05

Water Main Breaks: 100,000 gals (Hen Kng Unit)
Service Line Leaks: 200,000 gals
Estimated NRW loss: 5,000 gals
Usage of Hydrants & Blowoffs: 295,000 gals
Usage of fixed Blowoffs :
Water Used at Sources: 81,934 gals
Water Used for Meter Testing: 3,780 gals
Water Used at Warehouse: 200 gals
Water Used by Municipalities:

TOTAL:

Number of Unmetered Fire Services Checked:
1) 2) 3)
4)
Number of Right of Ways Checked: 5
1) Lewis 2) Mennen Farm 3) Groundview
4) Green Valley 5) O. Fritztown
Number of River Crossings Checked: 3
1) Park Ave 2) Mt. Home Rd 3) Lilyfield
Number of Leaks Repaired: 2
Number of Services Replaced:
Number of Identified Leaks Running: 1 - Shillington Rd.
Number of Unmetered Flat Rate Accounts:
Number of Water Theft Investigations:

Retirement of Parallel Mains:
Small Diameter Main Replacement: 430' 8" next to well 20
Replaced w/ 12" DIP

Penn Water Unaccountable June 2005

Well #	Last Read	New Read	Diff
12	0	0	0
13	0	0	0
16	208,101	217,980	9,879
18	0	0	0
19	57,760	62,450	4,690
20	144,810	145,500	690
21	912,220	912,310	90
23	134,533	140,970	6,437
27	0	0	0
28	0	0	0
Blanton	38,220	38,270	50
Shiloh	182,033	182,075	42
Wyo Hills	374,666	374,722	56
Cush Peak	0	0	0
		Total	21,934

Meter Shop	Last Read	New Read	Diff
1	7,031,260	7,032,040	780
2	256,950	258,150	1,200
3	146,700	148,500	1,800
			3,780

	Last Read	New Read	Diff
Warehouse	714	914	200
Events		660,000	660,000

Grand Total	**685,914**

Events	Totals
5/24/05 Loaded Half of Green Valley Ph. 12	20,000gals
5/27/05 Leaking Blowoff Hillpoint Cir.	100,00gala
6/7/05 Blew off main at Well 20	75 000gals
6/9/05 Meter Head removed 21 Kevin Ct	5,000gals
6/17/05 Sevice Leak 102 Montieth Ave.	200,000gals
6/17/05 Blew off Green Valley Ph. 12	200,000gals
6/18/05 Blanton Overflowed	20,000gals
6/19/05 Blanton Overflowed	20,000gals
6/20/05 Blanton Overflowed	20,000gals

Penn District
Unaccounted Water

Period : 6-21-05 to 7-21-05

Water Main Breaks: 780,000 gals
Service Line Leaks: 135,000 gals
Estimated NRW loss: _____
Usage of Hydrants & Blowoffs: 115,000 gals
Usage of fixed Blowoffs : _____
Water Used at Sources. 209,680 gals
Water Used for Meter Testing: 137,520 gals
Water Used at Warehouse: 73 gals
Water Used by Municipalities: _____

TOTAL: 1,377,273 gals

Number of Unmetered Fire Services Checked:
1) _____ 2) _____ 3) _____
4) _____
Number of Right of Ways Checked: 5
1) E. Fairtown Rd 2) Grandview 3) Lowes
4) Green Valley 5) Wenger Farm
Number of River Crossings Checked: 3
1) Lily field 2) Mt. Hope Rd. 3) Reedy Rd.
Number of Leaks Repaired: 6
Number of Services Replaced: 0
Number of Identified Leaks Running: 0
Number of Unmetered Flat Rate Accounts: _____
Number of Water Theft Investigations: _____

Retirement of Parallel Mains: _____
Small Diameter Main Replacement: _____

Penn Water Unaccountable June 2005

Well #	Last Read	New Read	Diff
12	0	0	0
13	0	0	0
16	217,980	227,870	9,890
18	0	0	0
19	62,450	66,460	4,010
20	145,500	146,630	1,130
21	912,310	912,430	120
23	140,970	145,500	4,530
27	0	0	0
28	0	0	0
Blanton	38,270	38,270	0
Shiloh	182,075	182,075	0
Wyo Hills	374,722	374,722	0
Cush Peak	0	0	0
		Total	19,680

Meter Shop	Last Read	New Read	Diff
1	7,032,040	7,033,210	1,170
2	258,150	344,200	86,050
3	148,500	198,800	50,300
			137,520

	Last Read	New Read	Diff
Warehouse	714	787	73
Events		1,220,000	1,220,000

Grand Total	1,377,273

Events	Totals
6/22/05 Mainbreak Shillington Rd	200,000gals
6/23/05 Blanton Overflowed	25,000gals
6/28/05 Flushed Hydrant Yerger Blvd.	5,000gals
6/28/05 Service Leak 2134 Reading Ave	75,000gals
6/29/05 Blanton Overflowed	25,000gals
6/30/05 Blew off Well 20	75,000gals
7/11/05 8" Mainbreak Bradley	300,000gals
7/14/05 Grings Hill Tank Overflowed	140,000gals
7/14/05 6" Mainbreak Spohn Rd.	80,000gals
7/14/05 Blew Off Green Valley Ph 12	20,000gals
7/15/05 6" Mainbreak Penn Ave. @ Alum. Alloys	200,000gals
7/15/05 Flushed Hydrant @ Well 20	15,000gals
7/20/05 Service Leak 3800 Wyoming Dr. South	60,000gals

Penn District
Unaccounted Water

Period : 7-21-05 to 8-21-05

Water Main Breaks: _____
Service Line Leaks: _____
Estimated NRW loss: _____
Usage of Hydrants & Blowoffs: 40,000 gals
Usage of fixed Blowoffs : _____
Water Used at Sources: 509,448 gals
Water Used for Meter Testing: 1,610 gals
Water Used at Warehouse: 90 gals
Water Used by Municipalities: 100 gals

TOTAL: 571,358 gals

Number of Unmetered Fire Services Checked: _____
1)_____ 2)_____ 3)_____
4)_____
Number of Right of Ways Checked: 5
1) Wenuca Farm 2) Green Valley 3) Lewes
4) O. Fairtown Rd 5) Grandview
Number of River Crossings Checked: 3
1) Reedy Rd 2) Monkello Rd 3) Lilyfield
Number of Leaks Repaired: _____
Number of Services Replaced: _____
Number of Identified Leaks Running: _____
Number of Unmetered Flat Rate Accounts: _____
Number of Water Theft Investigations: _____

Retirement of Parallel Mains: _____
Small Diameter Main Replacement: 550' of 6"

Penn Water Unaccountable August 2005

Well #	Last Read	New Read	Diff
12	0	0	0
13	0	0	0
16	227,870	231,940	4,070
18	0	0	0
19	66,460	67,330	870
20	146,630	146,740	110
21	912,430	912,630	200
23	145,500	149,450	3,950
27	0	0	0
28	0	0	0
Blanton	38,270	38,380	110
Shiloh	180,750	180,750	0
Wyo Hills	374,722	375,060	338
Cush Peak	0	0	0
		Total	9,648

Meter Shop	Last Read	New Read	Diff
1	7,033,210	7,034,020	810
2	344,200	344,400	200
3	198,800	199,400	600
			1,610

	Last Read	New Read	Diff
Warehouse	787	877	90
Events		560,100	560,100

Grand Total	**571,358**

Events	Totals
8/11/05 Loaded new main Spohn Rd.	10,000gals
8/12/05 Blew off new main on Spohn Rd.	20,000gals
8/14/05 High Tank overflowed due to SCADA	500,000gals
8/15/05 Wyomissing Boro used hydrant	100gals
8/15/05 Flow test on Fredrick Dr	5,000gals
8/18/05 Loaded main to Greystone Bus Center	25,000gals

Penn District
Unaccounted Water

Period : Aug 22 - Sept. 21 2005

Water Main Breaks: _____
Service Line Leaks: 36,000 gals
Estimated NRW loss: _____
Usage of Hydrants & Blowoffs: 95,000 gals
Usage of fixed Blowoffs : 7,000 gals
Water Used at Sources: 19,126 gals
Water Used for Meter Testing: 1,990 gals
Water Used at Warehouse: 108 gals
Water Used by Municipalities: _____

TOTAL: 211,224 gals

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Number of Unmetered Fire Services Checked: _____
1)_____ 2)_____ 3)_____
4)_____
Number of Right of Ways Checked: 5
1) Lowes 2) Green Valley 3) O. Fairlawn Rd
4) Wenwen Funm 5) Grandview
Number of River Crossings Checked: 3
1) Park Ave 2) Montello Rd 3) Lilyfield
Number of Leaks Repaired: 3
Number of Services Replaced: 1
Number of Identified Leaks Running: 0
Number of Unmetered Flat Rate Accounts: _____
Number of Water Theft Investigations: _____

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Retirement of Parallel Mains: _____
Small Diameter Main Replacement: _____

Penn Water Unaccountable September 2005

Well #	Last Read	New Read	Diff
12	0	0	0
13	0	0	0
16	231,940	236,570	4,630
18	0	0	0
19	67,330	71,400	4,070
20	146,740	147,050	310
21	912,630	912,746	116
23	149,450	159,090	9,640
27	0	0	0
28	0	0	0
Blanton	38,380	38,440	60
Shiloh	180,750	180,820	70
Wyo Hills	375,060	375,290	230
Cush Peak	0	0	0
		Total	19,126

Meter Shop	Last Read	New Read	Diff
1	7,034,020	7,035,010	990
2	344,400	344,500	100
3	199,400	200,300	900
			1,990

	Last Read	New Read	Diff
Warehouse	877	985	108
Events		190,000	190,000

Grand Total	211,224

Events	Totals
8/22/05 Blew off Greystone Business Center	40,000gals
8/24/05 New service Sieberts Ct.	9000gals
8/26/05 Replace curbstop Cleveland Ave.	6000gals
9/13/05 Service leak 1657 Sherwood	40000gals
9/16/05 Service leak 50 North Hull St	40000gals
9/19/05 Blew off Gringa Hill Estates Ph. 4	55000gals

Penn District
Unaccounted Water

Period : October 2005

Water Main Breaks: _____
Service Line Leaks: 4,000 gals
Estimated NRW loss: _____
Usage of Hydrants & Blowoffs: 10 000 gals
Usage of fixed Blowoffs : _____
Water Used at Sources: 72 274 gals
Water Used for Meter Testing: 2,340 gals
Water Used at Warehouse: 51 gals
Water Used by Municipalities: 25 000 gals

TOTAL: 105,614 gals

Number of Unmetered Fire Services Checked: _____
1)_____ 2)_____ 3)_____
4)_____
Number of Right of Ways Checked: 4
1) Green Valley 2) 0 Fosterlawn Rd 3) Norwood Farm
4) Leaves 5)_____
Number of River Crossings Checked: 3
1) Lilyfield 2) Montello Rd 3) Peek Ave
Number of Leaks Repaired. 1
Number of Services Replaced: 2
Number of Identified Leaks Running: 0
Number of Unmetered Flat Rate Accounts: _____
Number of Water Theft Investigations: _____

Retirement of Parallel Mains: _____
Small Diameter Main Replacement: _____

Services Replaced - 34 Upland 1/2 to 3/4" copper
100 Norwood galvanized to 3/4" copper

Penn Water Unaccountable October 200

Well #	Last Read	New Read	Diff
12	0	0	0
13	0	0	0
16	236,570	240,640	4,070
18	0	0	0
19	71,400	71,950	550
20	147,050	150,430	3,380
21	912,746	912,930	184
23	159,090	163,120	4,030
27	0	0	0
28	0	0	0
Blanton	38,440	38,500	60
Shiloh	180,820	180,820	0
Wyo Hills	375,290	375,290	0
Cush Peak	0	0	0
		Total	12,274

Meter Shop	Last Read	New Read	Diff
1	7,035,010	7,036,250	1,240
2	344,500	344,700	200
3	200,300	201,200	900
			2,340

	Last Read	New Read	Diff
Warehouse	985	1,036	51
Events		91,000	91,000

Grand Total	**105,614**

Events	Totals
9/22/05 Drain Wyomissing Hills Tank	50,000gals
10/13/05 Flush sinkhole @ Maria & Diane	10,000gals
10/17/05 Service Leak 100 Morwood Ave	6,000gals
10/19/05 Sinking Spring Boro Sewer Flushing	25,000gals

Penn District
Unaccounted Water

Period : 10-21-05 to 11-17-05

Water Main Breaks: 115,000 gals
Service Line Leaks: 80,000 gals
Estimated NRW loss: _____
Usage of Hydrants & Blowoffs: 86,000 gals
Usage of fixed Blowoffs : _____
Water Used at Sources: 14,475 gals
Water Used for Meter Testing: 4,300 gals
Water Used at Warehouse: 710 gals
Water Used by Municipalities: 5,300 gals

TOTAL: 305,785 gals

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Number of Unmetered Fire Services Checked: _____
1)_____ 2)_____ 3)_____
4)_____
Number of Right of Ways Checked: 5
1) Lanes 2) Pleasant Home 3) Grandview
4) Penn Ave - Hill Terrace 5) Erie Dr.
Number of River Crossings Checked: 3
1) Mowbello Rd 2) Lily Field 3) Park Ave
Number of Leaks Repaired: 4
Number of Services Replaced: _____
Number of Identified Leaks Running: _____
Number of Unmetered Flat Rate Accounts: _____
Number of Water Theft Investigations: _____

//

Retirement of Parallel Mains: _____
Small Diameter Main Replacement: _____

Penn Water Unaccountable Nov. 2005

Well #	Last Read	New Read	Diff
12	0	0	0
13	0	0	0
16	240,640	244,870	4,230
18	0	0	0
19	71,950	75,030	3,080
20	150,430	150,570	140
21	912,930	913,050	120
23	163,120	167,350	4,230
27	0	0	0
28	0	0	0
Blanton	38,500	38,690	190
Shiloh	180,820	182,025	1,205
Wyo Hills	375,290	375,370	80
Cush Peak	0	0	0
		Total	13,275

Meter Shop	Last Read	New Read	Diff
1	7,036,250	7,038,650	2,400
2	344,700	345,500	800
3	201,200	202,300	1,100
			4,300

	Last Read	New Read	Diff
Warehouse	10,360	11,070	710
Events		287,500	287,500

Grand Total	[illegible]

305,785

Events	Totals
10/25/05 Service Leak 101 Oak Hill Ln.	40,000gals
10/31/05 Mainbreak 1620 Westwood Dr.	75,000gals
11/1/05 Service Leak 2530 Girard Ave.	40,000gals
11/2/05 & 11/3/05 Flow Testing	86,000gals
11/7/05 & 11/8/05 Raw Water Samples	1,200gals
11/15/05 Mainbreak 1 Bristol Ct.	40,000gals
10/4/05 - 11/11/05 Hose Testing Spring Twp. Fire Dept.	5,300gals

Penn District
Unaccounted Water

Period : 11-17-05 to 12-21-05

Water Main Breaks: 950,000 gals
Service Line Leaks: 250,000 gals
Estimated NRW loss: _____
Usage of Hydrants & Blowoffs: 7,500 gals
Usage of fixed Blowoffs : _____
Water Used at Sources. 57,544 gals
Water Used for Meter Testing: 2,750 gals
Water Used at Warehouse: 460 gals
Water Used by Municipalities: _____

TOTAL: 1,268,254 gals

Number of Unmetered Fire Services Checked: _____
1)_____ 2)_____ 3)_____
4)_____
Number of Right of Ways Checked: 4
1) Neenen Farm 2) Erie Dr. 3) Groundview
4) Penn Ave W. Team 5)_____
Number of River Crossings Checked: 3
1) Lilyfield 2) Montello 3) Park Ave
Number of Leaks Repaired: 3
Number of Services Replaced: _____
Number of Identified Leaks Running: _____
Number of Unmetered Flat Rate Accounts: _____
Number of Water Theft Investigations: _____

Retirement of Parallel Mains: _____
Small Diameter Main Replacement: _____

Penn Water Unaccountable Dec. 2005

Well #	Last Read	New Read	Diff
12	0	0	0
13	0	0	0
16	244,870	245,677	807
18	0	0	0
19	75,030	75,223	193
20	150,570	150,701	131
21	913,050	913,700	650
23	167,350	167,466	116
27	0	0	0
28	0	0	0
Blanton	38,690	38,722	32
Shiloh	182,025	182,100	555
Wyo Hills	375,370	375,430	60
Cush Peak	0	0	0
		Total	2,544

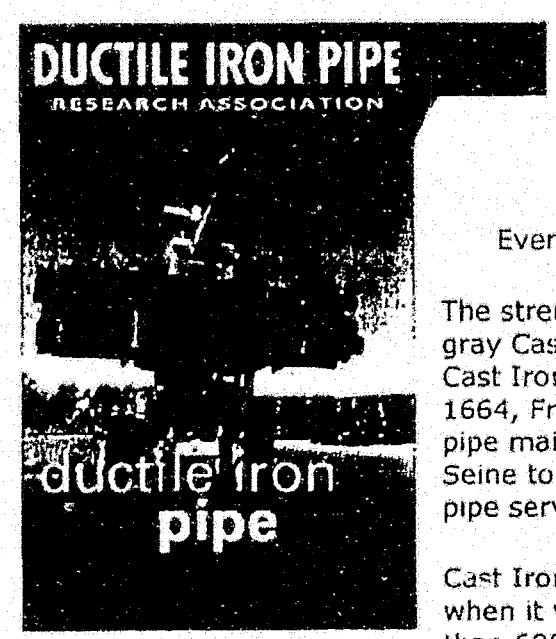
Meter Shop	Last Read	New Read	Diff
1	7,038,650	7,039,500	850
2	345,500	346,400	900
3	202,300	203,300	1,000
			2,750

	Last Read	New Read	Diff
Warehouse	11,070	11,530	460
Events		1,262,500	1,262,500

Grand Total	**1,268,254**

Events	Totals
11/23/05 Overflowed Tank	55,000gals
11/27/05 Flushed Line at Low Tank	7,000gals
11/28/05 6" Water Mainbreak Ellen Ave.	300,000gals
12/13/05 Danella Used Water for Street Restoration	500gals
12/14/05 6" Mainbreak 912 Evergreen Dr.	300,000gals
12/17/05 3/4" Service Leak 57 Wilson St	250,00gals
12/17/05 6" Mainbreak 777 Commerce St.	350,000gals

EXHIBIT TLF-5



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Updated DIPRA Computer

DUCTILE IRON PIPE

Even Stronger and Tougher Than Cast Iron | Ductile Iron Pipe

The strength, durability, and long service life of Ductile's predecessor gray Cast Iron pipe, are widely recognized. The first official record of Cast Iron pipe installation was in 1455 in Siegerland, Germany. In 1664, French King Louis XIV ordered the construction of a Cast Iron pipe main extending 15 miles from a pumping station at Marly-on-Seine to Versailles to supply water to the fountains and town. This pipe served the palace gardens for more than 330 years.

Cast Iron pipe was introduced to the United States as early as 1817, when it was installed in the Philadelphia water system. Today, more than 600 utilities (in the United States and Canada) have had Cast Iron mains in continuous service for more than 100 years. Additionally, at least 21 utilities have had Cast Iron mains in continuous service for more than 150 years.

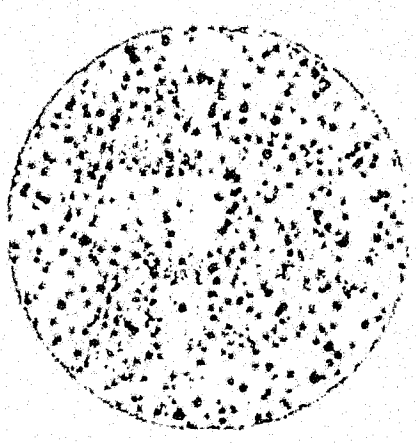
Cast Iron Pipe Century Club (Downloadable PDF file)

Stronger and Tougher than Cast Iron for Unmatched Dependability

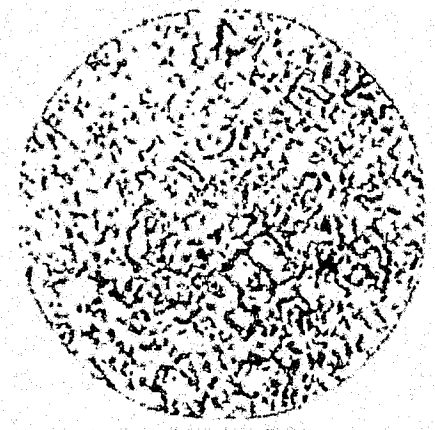
Ductile Iron not only retains all of Cast Iron's attractive qualities, such as machinability and corrosion resistance, but also provides additional strength, toughness, and ductility. It is lighter, stronger, more durable and more cost effective than Cast Iron.

Although its chemical properties are similar to those of Cast Iron, Ductile Iron incorporates significant casting refinements, additional metallurgical processes, and superior quality control.

Ductile Iron's improved qualities are derived from an improved manufacturing process that changes the character of the graphite content of the iron. Ductile Iron's graphite form is spheroidal, or nodular, instead of the flake form found in Cast Iron. This change in graphite form is accomplished by adding an inoculant, usually magnesium, to molten iron of appropriate composition during manufacture.



DUCTILE IRON



CAST IRON

Due to its spheroidal graphite form, Ductile Iron has approximately twice the strength of Cast Iron as determined by tensile, beam, ring bending, and bursting tests. Its impact strength and elongation are many times greater than Cast Iron's.

Why Ductile Iron Pipe Defines Durability: The Stuff Legends Are Made Of

Since its introduction into the marketplace in 1955, Ductile Iron pipe has been recognized as the industry standard for modern water and wastewater systems. More than four decades of field experience have proven its strength, durability, and reliability for transporting raw and potable water, sewage, slurries, and process chemicals.

Find out why Ductile Iron Pipe is superior to substitute materials

Ductile's high degree of dependability is primarily due to its high strength, durability, and impact and corrosion resistance. Ductile Iron has minimum strength requirements of 60,000 psi tensile strength, 42,000 psi yield strength, and 10 percent minimum elongation. Designed and manufactured to the industry's most stringent standards, Ductile Iron pipe resists damage during shipping and handling, and, once installed, withstands the most demanding operating conditions, including water hammer, frozen ground, deep trenches, areas of high water table and heavy traffic, river crossings, pipe on supports, rocky trenches, and areas of shifting, expansive, and unstable soils. Additionally, numerous laboratory and field tests have proven that Ductile Iron's corrosion resistance is equal to or greater than that of Cast Iron, which has a service history that is unequaled by any other piping material.

Design of Ductile Iron Pipe
Corrosion Protection for Ductile Iron Pipe

Installation is simple. Unlike some pipe materials, Ductile Iron pipe requires no complex line-and-grade drawings or laying schedules. It can be installed in a wide variety of trench and standard laying

conditions and can be easily cut in the field. Direct tapping, even in straight lines, doesn't affect its integrity. And, once installed, Ductile Iron pipe is virtually maintenance-free.

Tapping Ductile Iron Pipe

The pipe is manufactured in 18- or 20-foot nominal laying lengths and 3- to 64-inch diameters in a range of standard pressure classes and nominal wall thicknesses. Ductile Iron is furnished with several different types of joints and a wide variety of standard fittings is available without special order. Although Ductile Iron is usually furnished with cement-mortar lining, optional internal linings are alsc available for a wide range of special applications.

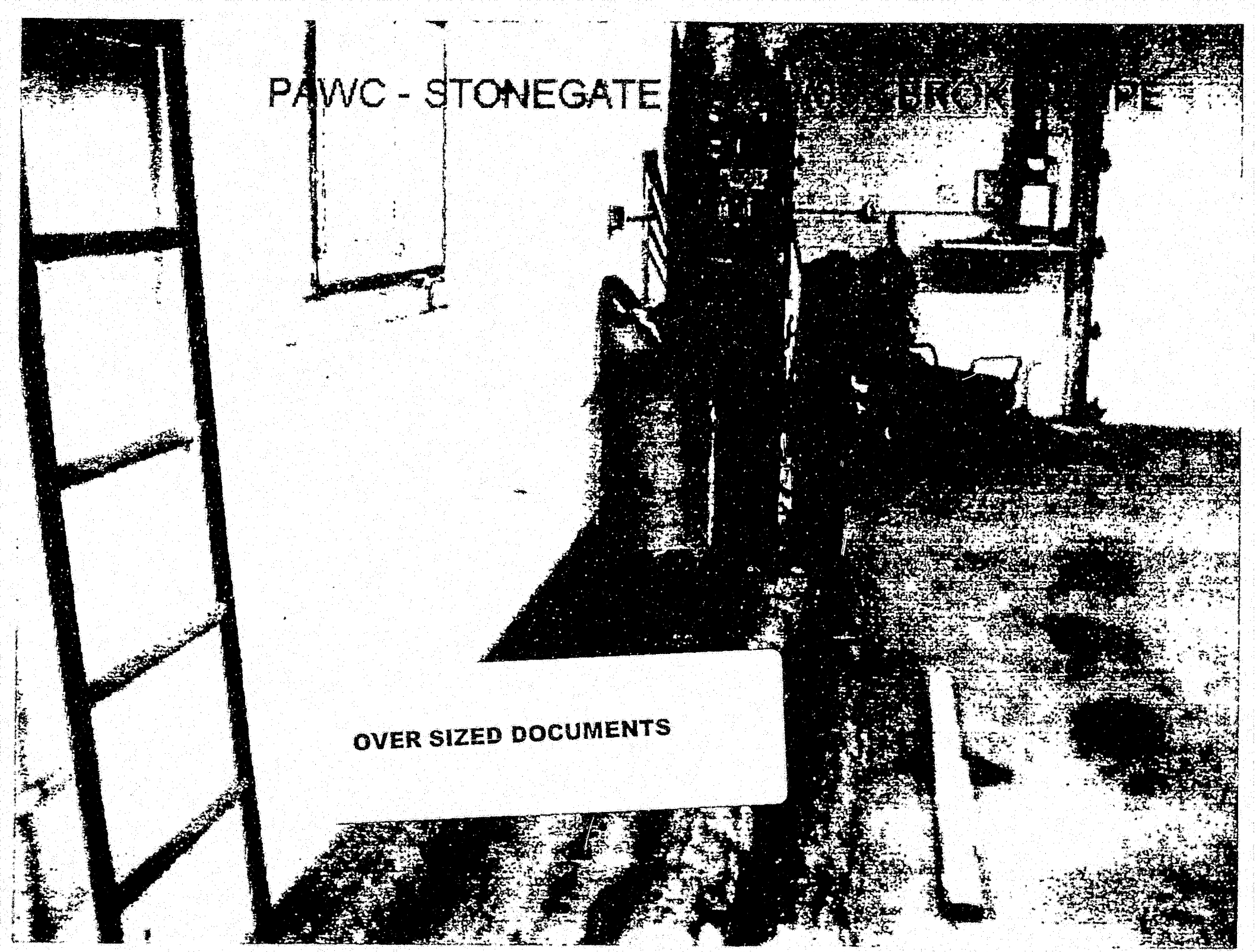
And Ductile Iron's generally larger than nominal inside diameters, combined with its high flow coefficient (C = 140), offers substantial savings on pumping and power costs over the life of the pipeline.

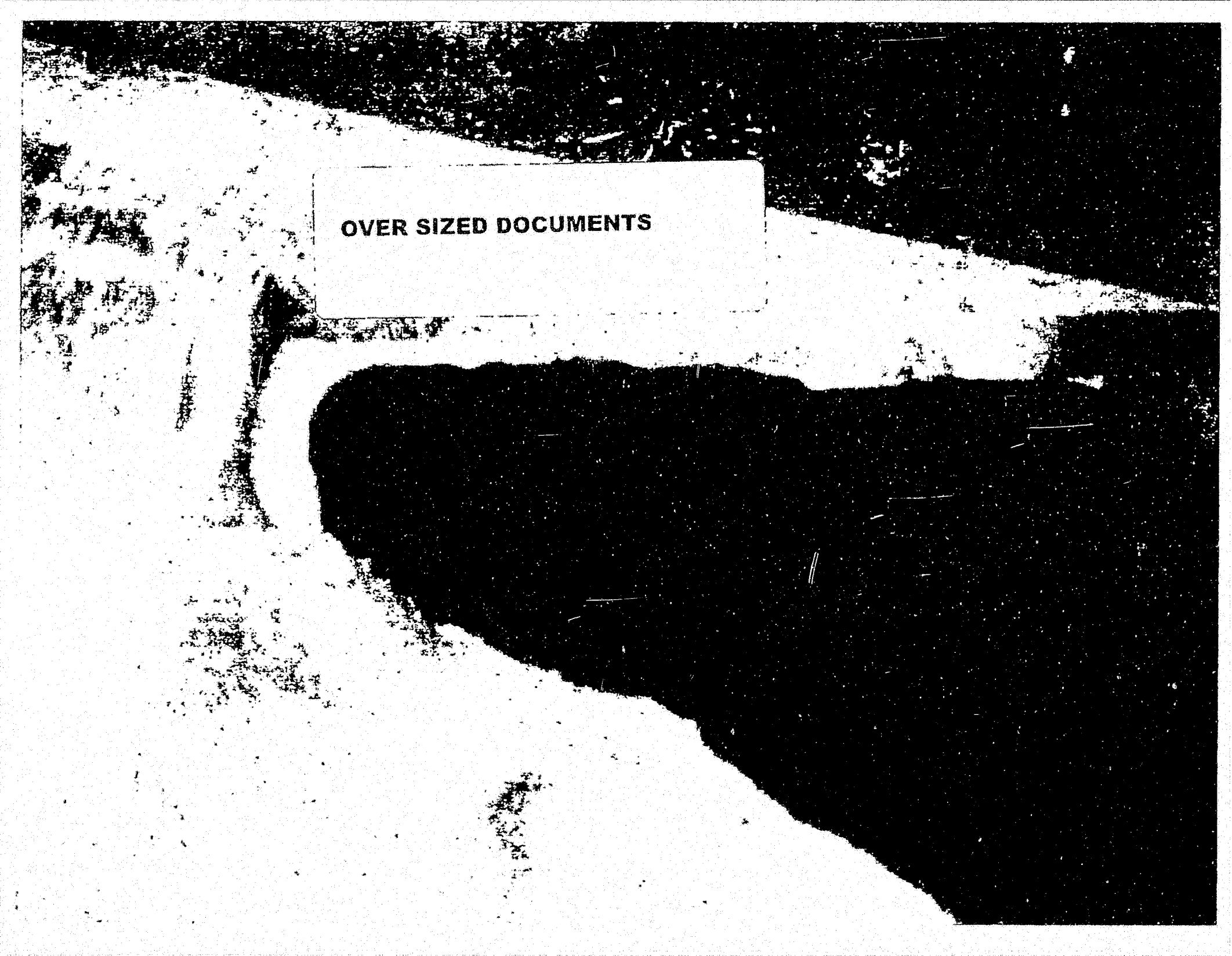
Hydraulic Considerations for Ductile Iron Pipe

Ductile Iron pipe is the kind of pipe that utility engineers dream of. Its reliability, derived from its strength and adaptability, give those engineers the peace of mind that can only come from using a produc that they know will be there when duty calls. They know that the good service they demand for their customers follows directly from their decision to install Ductile Iron pipe ... the Right Decision

EXHIBIT TLF-6

PARK - STONEGATE - 12/20/05 - BROKEN PIPE


PAWC - STONEGATE
OVER SIZED DOCUMENTS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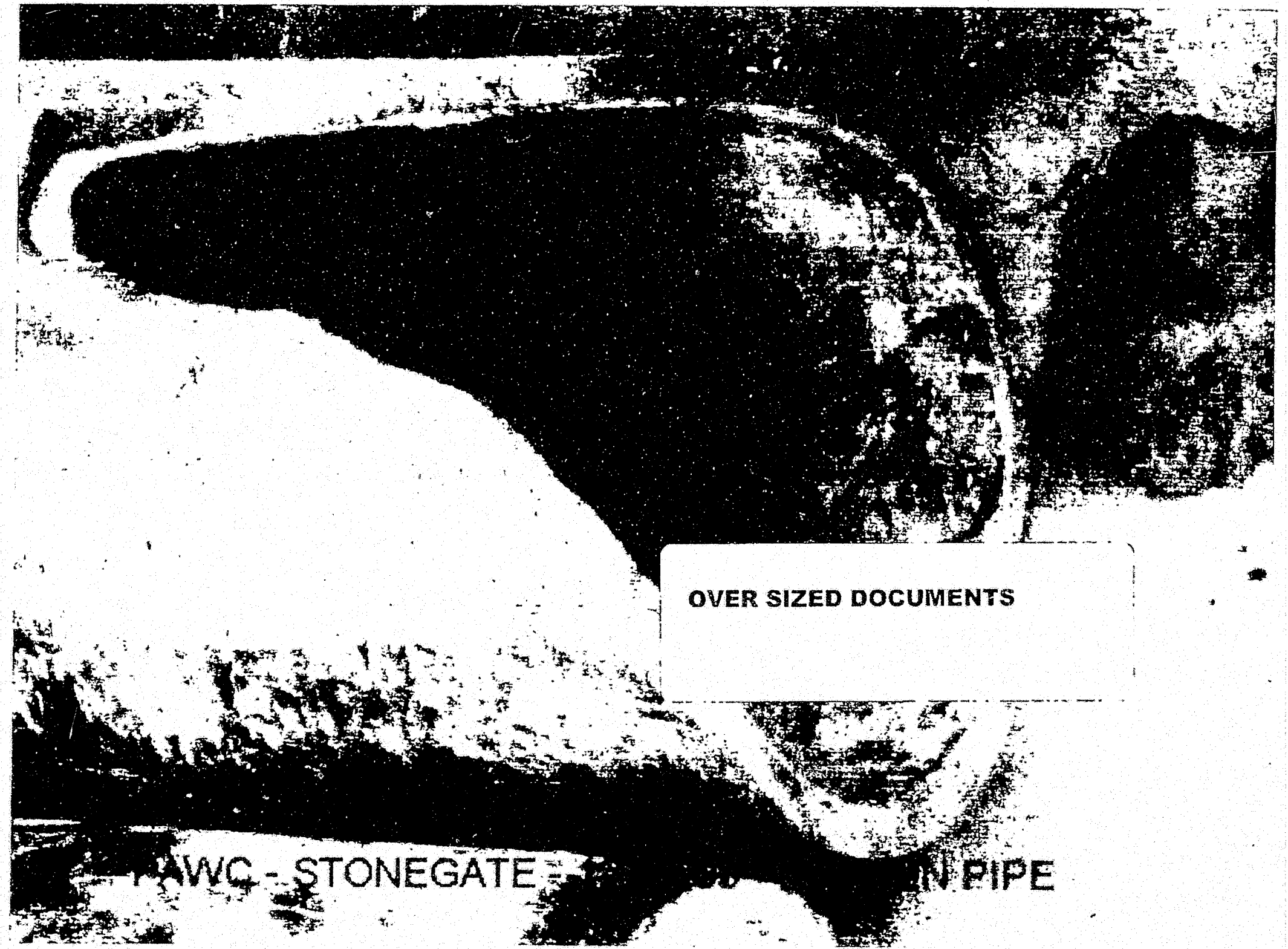

OVER SIZED DOCUMENTS
AWC - STONEGATE
PIPE

EXHIBIT TLF-7

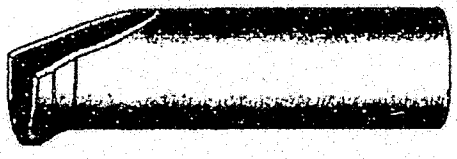
Failures in Gray Cast Iron Distribution Pipes

Types of Failures in Grey Cast Iron Pipes

There are many different types of grey cast iron pipe failures, with the variations caused by both the size of the pipe and the type of loading it experienced. The links below lead to pictures and descriptions of the different failure modes. More details can be found in the papers in the publications section of the site.

Additional information
- Project home
- Cast iron
- Types of failures in grey cast iron pipes
- Circumferential failures in grey cast iron pipes
- Finding failed and damaged pipes

Wedge Splitting

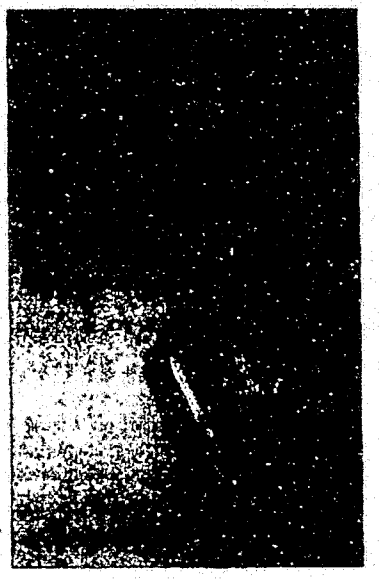


Large diameter grey cast iron pipes are normally too thick to experience circumferential cracking when they experience high bending loads. However, they can fail by an alternative mechanism, where a wedge of pipe at the bell is split off to relieve the bending stresses. Corrosion pitting or manufacturing defects may also be associated with this type of failure, but further research is needed to completely understand how wedge splitting occurs.

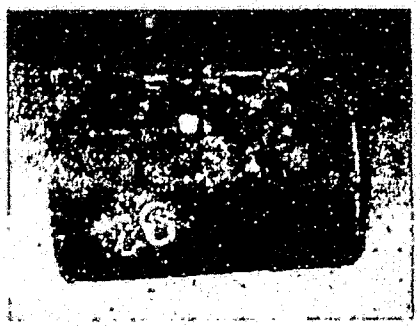
Spiral Cracking

This type of failure appears to be common in medium sized pipes (approximately 400-500 mm diameter). The failure started as a circumferential crack, but then a section of the pipe broke and the crack propagated down the pipe barrel in a spiral.

The above picture shows a section taken out of the pipe, with the right edge of the section showing the rusty fracture surface. The spiral fracture appears to take place as a form of transition between circumferential cracking of small pipes loaded in bending and the longitudinal cracking seen in large diameter pipes. While some spiral fractures have been associated with pressure surges, the pipe shown here failed in normal service due to manufacturing defects.



Corrosion Pitting



Corrosion in a ductile iron pipe

While corrosion pitting is associated with bell splits and circumferential failures, it can also cause failures by itself, by reducing the wall thickness of the pipe until to the point where the internal water pressure removes any remaining wall material. The resulting leaks can be very small in size or quite large.

Not all corrosion pits are as easily identified. Both grey cast iron and ductile iron pipes can experience graphitisation, a process by which much of the iron is removed from the metal, leaving behind a network of graphite, iron oxide and other elements from the surrounding soil. The surface of the pipe may look to be in perfect condition, but the corrosion product is much weaker than the metal pipe, leaving the pipe very vulnerable to failure. Ductile iron pipes have often been assumed to be immune to graphitisation, but examples from both Ottawa and Toronto clearly show graphitisation in this pipe material.

Graphitisation in a ductile iron pipe

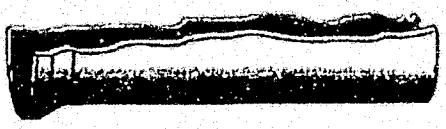
Unless they receive some form of corrosion protection, all cast iron pipes can be vulnerable to corrosion. However, human actions can worsen the problem.

These pits appear to have been caused by the being pipe

dragged on the ground, probably during installation. The surface of the pipe was scratched, promoting local corrosion. When the pit was deep enough that only a little metal remained (the top edge of the hole in the picture was sharp enough to cut paper when the pipe was removed from the ground), water pressure caused it to blow out.

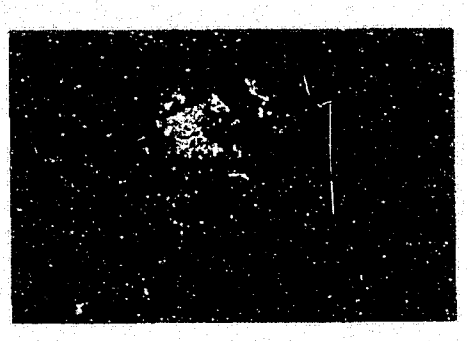
Conditions that promote pipe corrosion may also mean that simple repairs are inadequate to solve the underlying problem. The pictures below show a gray cast iron pipe that failed four times before it was finally removed from service. The first three failures were circumferential breaks. In each case, a stainless steel clamp was placed over the break and the pipe was returned to service (the two sections of pipe shown were joined together by one of the clamps and the other breaks were at either end of the section). Finally, corrosion blow out holes appeared along the pipe's length, causing it to be removed from service.

Longitudinal Cracking



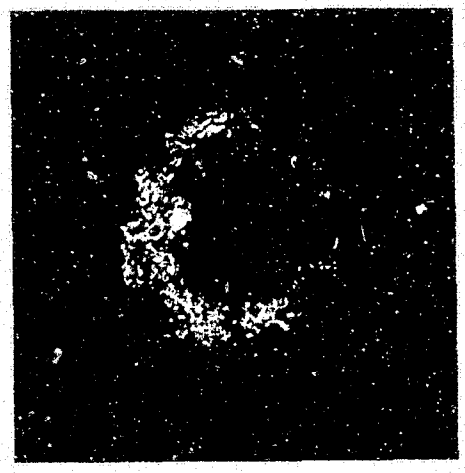
Longitudinal cracking is a failure mode in large diameter pipes. A crack propagates down the length of the pipe and the internal water pressure may even cause the top of the pipe to break off entirely and flip over. These failures are often associated with unusual water pressure surges, water hammer and some type of weakening of the pipe wall, either through corrosion pitting or manufacturing defects. However, further research is required to completely understand this type of failure.

Circumferential Breaks



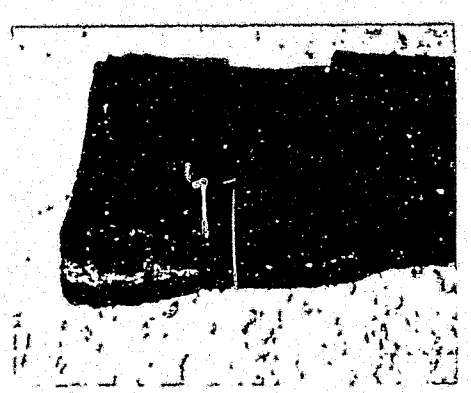
Over 90% of the circumferential pipe failures examined by IRC have had corrosion pits or graphitisation located on the fracture surface (the metal exposed when the pipe breaks). The above picture shows a large pit with a crack in the middle. Grey cast iron pipes can also be weakened by porosity or inclusions, both of which are forms of manufacturing defects.

While pipes are often assumed to fail all at once, 95% of the circumferential failures we

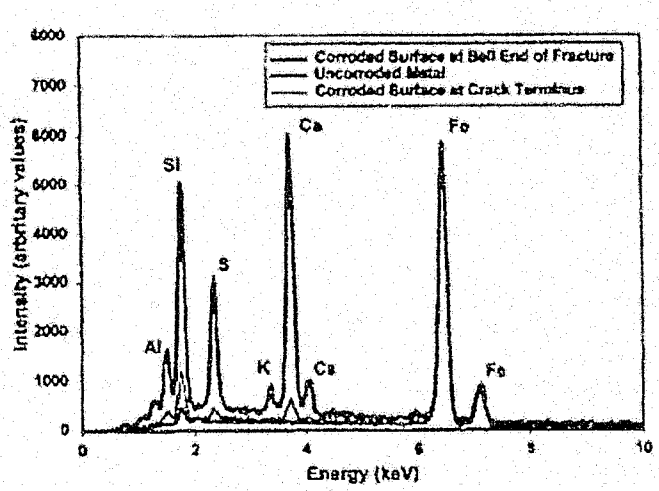


have examined have shown visual or chemical evidence of a multi-stage failure. In this case, the pipe cracks part way through and then stops. It may leak without completely failing. In some cases a later cracking episode will completely break the pipe, while in others the damaged pipe is found before it completely fails and is removed from service. The picture below shows such a pipe. The grey area on the right of the pipe's fracture surface was intact when the pipe was removed from the ground, while the remaining area showed signs of two separate cracking episodes, as indicated by the different colours of the rust. Chemical analysis of similar failures shows different trace elements in the lighter corrosion products as on the left side of this picture than in the dark red products as on the right-central side next to the grey metal. This suggests that the fracture surfaces were exposed to the surrounding soils for different lengths of time.

Bell Splits



A bell split takes the form of a crack that starts at the bell of a pipe and travels a short way down its length before turning towards the pipe circumference and stopping. They are associated with grey cast iron pipes from the 1940s and 1950s that were sealed at the bell with a combination of rope and a sulphur based compound called leadite. Earlier pipes were sealed with rope and lead, while later pipes used gaskets made of rubber or similar compounds. Leadite is a rigid, solid compound. It is also non-metallic. It is believed that bell splits are caused by a difference between the coefficients of thermal expansion of the pipe and of the leadite seal. When the pipe is at very cold or very warm temperatures, the metal tries to contract or expand more than the seal will allow. As a result it cracks, often at corrosion pit or other weakness in the pipe. Bell splits can show evidence of multiple stage failures. The fracture surface at the left hand side of the picture above had been exposed to the surrounding soil for a much longer period of time than that on the right hand side. The picture below shows the different chemistry of the fracture surface and the pipe metal itself



Date Published: 2005-05-26

Important Notices

EXHIBIT TLF-8

ENVIROSCAN, INC

Final Report
Geophysical Survey
Void/Subsidence Detection/Delineation
Approximately 120' x 120' Survey Area
Creveling Property
3123 South Wagner Circle
Sinking Springs, PA
Enviroscan Reference Number 020535

Prepared For: USAA
Prepared By: Enviroscan, Inc.
March 22, 2005

1051 Columbia Avenue • Lancaster, Pennsylvania 17603 • 717/396 8922 • Fax 717/396 8746 • email@enviroscan.com • www.enviroscan.com

ENVIROSCAN, INC.

March 22, 2005

Ms. Marilyn Reilly
USAA
P.O. Box 88
Hamburg, NJ 07419

RE: Geophysical Survey
Void/Subsidence Detection/Delineation
Approximately 120' x 120' Survey Area
Creveling Property
3123 South Wagner Circle
Sinking Springs, PA
Enviroscan Reference Number 020535

Dear Ms. Reilly:

Pursuant to our proposal dated February 18, 2005, Enviroscan, Inc. (Enviroscan) has completed a combined microgravity, seismic refraction, and ground penetrating radar (GPR) geophysical survey of the above-referenced site. The following report and figures describe the methods and results of the investigation.

Purpose and Background

The site is located at a private residence where sinkhole activity has been observed within close proximity to a recent water main breakage. The site, as designated by the client, measures approximately 120' by 120', and according to mapping, compiled by MacLachlan and others (1975), is underlain by the Millbach Formation The Millbach Formation is a pinkish- to medium-gray laminated limestone (Geyer and Wilshusen, 1982). The Millbach Formation typically has well-developed fractures, is moderately resistant, and is often characterized by bedrock pinnacles. Additional mapping, compiled by Kochanov (1988), depicts a number of closed topographic depressions within close proximity to the study area.

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Karst Processes

Pinnacled bedrock and sinkholes are among the geologic features characteristic of karst terranes — i.e. terranes underlain by soluble carbonate (limestone or dolomite) bedrock in wet climates. In karst terranes, infiltrating precipitation dissolves the carbonate bedrock surface, causing the top-of-rock to retreat downward leaving behind a soil mantle of the insoluble clay and/or silica particles formerly bonded in the rock (see Appendix A, panels I and II). Within the bedrock, percolating water enlarges fractures, bedding planes, etc. to produce solution openings ranging in size from minor seams to scenic caverns.

Sinkholes form where particularly enhanced infiltration into a sufficiently wide solution opening (often called a throat or chimney) washes the soil mantle down into cavities in the underlying rock — a process commonly called soil piping. In areas where the residual soil mantle is clay-rich and cohesive, incipient sinkholes may not display any surficial topographic expression, and are present only as air-, water-, or mud-filled voids which may grow or "stope" upward (see Appendix A, panel III). Eventually, the overlying soil arch collapses under its own weight or under the weight of an overlying structure or passing vehicle. The resulting collapse sink or "sinkhole" is commonly filled with the remains of the soil arch and may display rock at its base (see Appendix A, panel IV). In some cases, surficial subsidence may keep pace with soil piping at depth such that a sinkhole forms by progressive deepening of a surficial depression (sometimes called a subsidence sink) rather than by catastrophic collapse of a stoping void.

Note that the dissolution of bedrock occurs on a time scale measured in thousands to tens of thousands of years. Therefore, the natural occurrence of new sinkholes is a rare occurrence on a human time scale (see Newton, 1987). However, concentration of storm water and excess infiltration due to man's activities can trigger man-made sinkholes virtually anywhere in a karst terrane — even on topographic highs or beneath paved streets or buildings.

Since sinkhole activity is allowed by bedrock cavities, and triggered/driven by infiltrating water, hydraulically active geologic features can act as foci for sinkhole activity. In particular, where open faults, fractures, bedding planes or contacts act as preferred pathways for groundwater infiltration or flow, the water can dissolve networks of solution openings along the fault/fracture/bedding plane/contact. The enhanced infiltration also encourages movement of soil or soil fines into the solution openings, which may cause surficial subsidence and enhanced capture and infiltration of storm water, etc. in a positive-feedback process.

Survey Methods

To fulfill the survey purpose, a combined seismic refraction, microgravity, and GPR survey was completed during the week of March 4, 2005. The principles and scopes of work for each technique are described below.

Seismic Refraction

In order to determine bedrock depths beneath the study area, Enviroscan performed a seismic refraction survey. Knowledge of bedrock depths is desirable for proper interpretation of microgravity data (see below), and can provide information on the presence of deeply weathered zones indicative of faults or fractures. The seismic refraction survey consisted of two profiles or lines oriented roughly east-west (Figure 1). The principles of seismic refraction are described in the accompanying Introduction to Seismic Refraction (Appendix B), and generally involve measuring the travel times of shock waves traveling from a surficial source (shot point) to a linear array of ground motion sensors (geophones). At a distance from the shot point, the first arrivals of seismic energy are waves that have been refracted along whatever density contrast or contrasts (called refractors) are present in the subsurface. The travel times of these refracted arrivals can be used to compute a cross sectional profile of the density contrast(s).

For this survey, a Geometrics 24-channel Smartseis seismograph was used to record seismic travel times at linear arrays of Mark Products 9.5 Hertz geophones spaced at constant 5-foot intervals along each of the two lines. Shot points were spaced at approximately 30-foot intervals, but were occasionally adjusted due to site conditions (see shot point locations on Figure 1) to provide multi-fold, reversed seismic data. At each shot point, seismic signal was generated with the repeated blows of 35-lb airless jackhammer. Waveform data were recorded on the internal hard drive of the seismograph, and were transferred to a 3.5-inch floppy disk for backup. The original seismic waveform data are on permanent file in digital format at Enviroscan. The location of each shot point and geophone was surveyed using a Trimble ATS Robotic Total Station.

Processing and interpretation of the seismic refraction data were completed using the SIP package of computer programs developed for the U.S. Geological Survey by Rimrock Geophysical. First arrival travel times or first breaks were selected on the waveform data using the automatic picking routine SIPIK (with occasional minor manual adjustment) to ensure consistent and objective picking. From the first arrival times and geophone locations, T-X graphs (see Appendix B) were compiled for each line using the routine SIPIN. In general, the T-X data roughly defined two linear segments consistent with a two-layer stratigraphy (presumed to consist of unconsolidated soils over limestone bedrock). Inversion of the T-X data using the iterative ray tracing routine SIPT2 yielded the statistically best-fitting refractor or layer boundary depths and layer velocities.

The P-wave arrival times, together with the shot point-receiver geometry, were then inverted using SeisOPT Pro. SeisOPT Pro uses a globally optimized mathematical inversion to determine the statistically best-fitting velocity distribution in the plane between the surface receivers and a given set of observed arrival times. The velocity models from SeisOPT Pro are presented as seismic profile cross-sectional images on Figure 2. Note that on each profile section, the vertical scale represents elevation in feet. The horizontal axis represents an along-profile distance in feet. Note that the shot points are labeled to facilitate comparison with the survey layout. Figure 2 shows the inferred stratigraphic profiles based on both the SIP and SeisOPT Pro calculations.

Microgravity

In order to map potential sinkholes/voids or other low-density areas in soil and bedrock, Enviroscan performed microgravity measurements at 10-foot intervals along profiles spaced 10 feet apart (see Figure 1). Microgravity meters are capable of measuring the force of gravity with great precision. Worldwide, the acceleration of gravity has been adopted as 980 centimeters per second squared (cm/s^2). However, this is really an average value since the actual measured value of gravity at a given station is dependent upon many things including:

- The elevation of the station reading (since higher stations are farther from the center of mass of the earth),
- The latitude and longitude of the station (since the earth is not truly spherical),
- The positions of the sun and the moon (which creates not only the readily observed ocean tides, but small deformations of the entire earth called earth tides),
- Minute changes in the calibration of the gravity meter (called instrument drift),
- The attraction of massive landforms near or obliquely above the station (i.e. the mass of a nearby mountain actually produces a gravitational attraction which can have a significant effect on a precise gravity reading), and
- The density of materials immediately beneath a station.

The variations in gravity due to the first four factors above typically have magnitudes measured in milligals (where 1000 milligals equal one cm/s^2). The fifth and sixth factors are typically measured in microgals (where 1000 microgals equal one milligal). Since the purpose of a microgravity survey is generally to determine factor six above (i.e. the density or mass distribution in the subsurface of a survey site), the raw gridded or profile gravity measurements that comprise a gravity survey must be corrected for factors one through five. This produces a set of numbers (which are generally several parts per billion of the earth's adopted average gravity) that can be interpreted to determine subsurface density of mass distribution (see e.g. Telford, 1990).

To arrive at a number representative of the subsurface mass distribution, raw gravity readings are subjected to the following corrections:

Reference ellipsoid correction – corrects for the non-spherical shape of the earth based on the latitude and longitude of a station

Earth tide correction – corrects for deformation of the earth under the gravitational influence of the sun and moon

Drift correction – corrects for slow changes in the calibration of a gravity meter based on repeated measurements at a fixed base station

Free air correction – corrects for the elevation of a station above (or below) mean sea level based on a surveyed station elevation

Bouguer slab correction – corrects for the density of the hypothetical slab of material between the station elevations and mean sea level based on an assumed average terrain density

Terrain correction – corrects for the oblique attraction of nearby landforms and the assumed average landform density.

Microgravity data that have been corrected as described above are called complete bouguer gravity, and if collected and processed properly, should retain only information on the mass or density distribution beneath a survey station.

Elevated bouguer gravity anomalies are caused by subsurface mass excesses such as locally shallow bedrock pinnacles or float blocks in the soil profile, or zones of particularly massive bedrock. Low bouguer gravity is caused by mass deficiencies – e.g. lenses of low-density soils, locally deep bedrock (where soil or fill displaces bedrock), and air-, water-, or mud-filled voids. Note that since microgravity alone cannot discriminate between locally deep bedrock and a potential void or low-density soils (both representing local mass deficiencies), precise identification of gravity anomaly sources often requires bedrock depth data from borings or a seismic survey (such as described above).

At each station, the acceleration of gravity was measured using a Scintrex CG-3M Autograv gravimeter. The internal memory of the instrument was used at each station to record the average gravity for a 60-second time-period, the standard error of the average, the reading date and time, and the meter height. A designated station was established as a base station and was occupied approximately every hour and a half to provide drift control data. The elevation and location for each of the microgravity data stations, as well as the seismic shotpoint and geophone locations, were surveyed using a Trimble ATS Robotic Total Station.

The gravity data were processed by applying the reference ellipsoid, earth tide, drift, free air, and bouguer corrections were applied using standard formulae as computed in a spreadsheet. The resulting bouguer gravity, representing only mass variations beneath individual gravity stations, was contoured using the statistical kriging routine in SURFER for WINDOWS by Golden Software. The bouguer gravity response contours are depicted in Figure 3.

Ground Penetrating Radar

In an effort to identify potential voids located beneath the building's foundation, Enviroscan also completed a GPR investigation in both the basement and garage of the residence. Scanning was performed using a GSSI SIR-2000 GPR controller with a color display and internal hard drive, utilizing a 500-megaHertz scanning antenna. GPR systems produce cross-sectional images of subsurface features and layers by continuously emitting pulses of radar-frequency energy from a scanning antenna as it is towed along a survey profile. The radar pulses are reflected by interfaces between materials with differing dielectric properties. The reflections return to the antenna and are displayed on a video monitor as a continuous cross section in real time. Since the electrical properties of metal are distinctly different from soil and backfill materials, metallic pipes and other structures produce dramatic and characteristic reflections. Fiberglass, plastic, concrete, and terra-cotta targets as well as subsurface voids, rock surfaces, soil type changes and concentrations of many types of non-metallic wastes also produce recognizable, but less dramatic reflections.

For this investigation, variously oriented GPR profiles were collected in both the basement and the garage. The orientation of these profiles was determined primarily by the location of stored items in the basement and the garage. The individual radar profiles were examined in the field for variable, high amplitude anomalies of the type commonly associated with voids and/or less dense soils. Areas having this type of anomaly were placed onto a site sketch (Figure 4) for later comparison with the processed gravity data.

Site Inspection

In an effort to identify evidence of pre-existing sinkhole activity, or sources of concentrated infiltration of the type that commonly trigger sinkhole activity, Enviroscan also performed a surficial site inspection. The property rests upon a topographic high allowing surface water to drain away from the property. All of the impermeable surfaces (i.e. paved roadways, etc) at the residence also appear to be graded to shed water away from the house. Furthermore, inspection of the basement did not reveal the presence of any water damage of the type that would suggest previous subsurface water problems near the house. There are no reported water or sewer leakages on the property. The most notable local source of concentrated infiltration was the water main breakage, as reported to Enviroscan by Marilyn Reilly, discharging approximately 1.5 million gallons of water into the subsurface. The reported location of the water main breakage is adjacent to the largest of the observed sinkholes, close to the curb along Iroquois Avenue.

Results

Seismic Refraction

Figure 2 represents the best-fitting seismic models for the two profiles. The seismic profiles suggest the presence of an irregular soil thickness profile -- with depths locally exceeding 20 feet, created by an irregular limestone bedrock surface. Note that the inferred bedrock surface along each profile represents an average or smoothed approximation of an actually even more irregular soil-rock interface (see Appendix B, Figure SR-5). Lower velocity materials, consistent with less dense soils, occur at greater depths within close proximity to the identified sinkholes. This indicates that there may be bedrock solution cavities filled with low density transported soils. Note that bedrock solution cavities develop over thousands of years, and would thus represent a pre-existing and allowative (although not directly causative) condition for sinkhole activity.

Microgravity

The color-contoured microgravity survey results are presented in Figure 3. Mass deficiencies are represented with increasing shades of red, while mass excesses are represented with increasing shades of blue. The range of gravity values across the entire survey area is 0.30 milligals, ranging from -0.22 to 0.08 milligals. There are several mass-deficient zones located beneath the survey area. In particular, there appear to be two significantly mass-deficient zones beneath the northwestern and southcentral portions of the building (Figure 3). These zones may represent cavities or disturbed zones in the soil mantle, or cavities in the underlying bedrock. Note that if they are bedrock cavities, they do not coincide closely with the footprints of the observed sinkholes.

Ground Penetrating Radar

The results from the GPR survey are overlain on top of the gravity survey for comparison on Figure 4. Two anomalous areas (depicted with orange shading) of the type commonly associated with subsurface voids and/or less dense soils were detected beneath the basement. The anomalies were located within close proximity to cracks in the concrete as well as mass-deficient zones mapped during the gravity investigation (Figure 4). Due to the presence of steel reinforcing mats within the garage floor, it was not possible to collect any useful radar data in that area.

Conclusions

The seismic, microgravity and GPR data all display clear evidence of sinkhole activity and sinkhole-related features. The seismic data display low velocity zones consistent with disturbed soils and bedrock solution cavities. The gravity data show subsurface mass deficiencies consistent with either disturbed soils or voids (in the soil mantle or bedrock). GPR profiling in the basement also detect anomalously reflective zones whose location were consistent with cracking of the basement slab. Enviroscan recommends that future remediation efforts concentrate within the footprints of the areas having the largest mass deficiencies (depicted with increasing shades of red on Figure 3).

Although it is not possible to determine the exact timing of sinkhole-related activities at this site based solely on the geophysical data, we can offer the following interpretation based on Enviroscan's extensive experience with sinkholes, similar experience of many other geoscientists, as well as Newton (1987). First of all, and in general, the occurrence of new sinkholes is a rare occurrence on a human timescale in the absence of human alteration of natural drainage, and conversely, human alteration of natural drainage is a common cause of sinkholes. In this particular case, the roadway above the sinkhole is paved and would have served as a barrier to infiltration. Outside of a water main that traverses the largest sinkhole, Enviroscan was unable to find another source of water capable of initiating soil transport and subsequent sinkhole development. In addition, the footprints of the sinkholes do not coincide closely with the footprints of subsurface mass deficiencies that may represent the bedrock solution cavities that allow sinkhole activity. Instead, the largest of the sinkholes is coincident with the reported water main break, and at a distance form the inferred possible bedrock cavities. Therefore, it is Enviroscan's professional opinion that the sinkhole location is controlled by the location of concentrated infiltration from the water main break, and that the sinkhole activity was triggered by the water main breakage, and consequent loss of 1.5 million gallons of water into the subsurface.

Limitations

The geophysical survey described above was completed using standard and/or routinely accepted practices of the geophysical industry and equipment representing the best available technology. Enviroscan does not accept responsibility for survey limitations due to inherent technological limitations or unforeseen site-specific conditions. Note that the measurements reflect conditions at the locations of actual survey stations, and that interpolation of data and interpretations between survey stations can be highly speculative in karst terranes. Note also that since soil piping/sinkhole activity can be triggered virtually anywhere in karst terranes under the influence of significant changes in surface or subsurface hydraulics (e.g. re-grading, stormwater re-routing, etc.) Enviroscan cannot make any warranties concerning the future occurrence or distribution of sinkhole activity. However, we make every effort to identify and notify the client of such limitations or conditions.

We have enjoyed and appreciated the opportunity to have worked with you. If you have any questions, please do not hesitate to contact me.

Sincerely,
Enviroscan, Inc.

James E. Bock, M.Sc., P.G
Geophysics Project Manager

Technical Review By:
Enviroscan, Inc.

Felicia Kegel Bechtel, M.Sc., P.G.
President

Enc.: Figure 1: Geophysical Survey Data Coverage
Figure 2: Seismic Refraction Profiles
Figure 3: Bouguer Gravity Data Contours
Figure 4: Ground Penetrating Radar Results
Appendix A: Schematic Sinkhole Formation Processes
Appendix B: Introduction to Seismic Refraction
References

Cc.: Mr. Russel Daniels, Paul Zamrowski & Associates

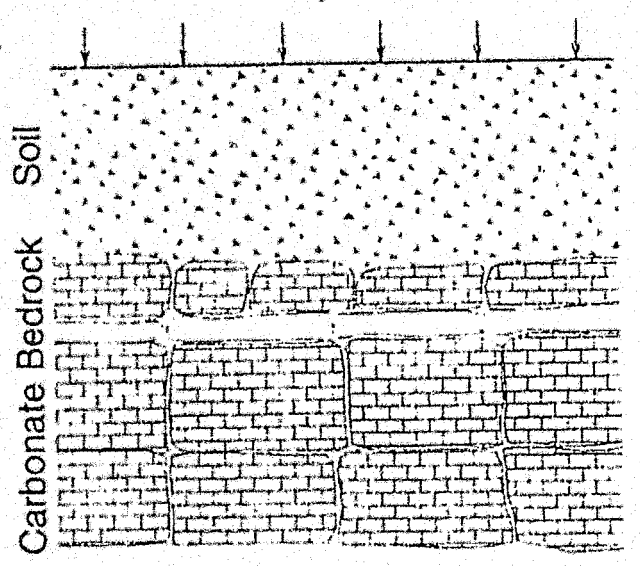
Appendix A

Schematic Sinkhole Formation Processes

1951 Columbia Avenue • Lancaster, Pennsylvania 17603 • 717/396-8972 • fax 717/396-8746 • email@enviroscan.com • www.enviroscan.com

I

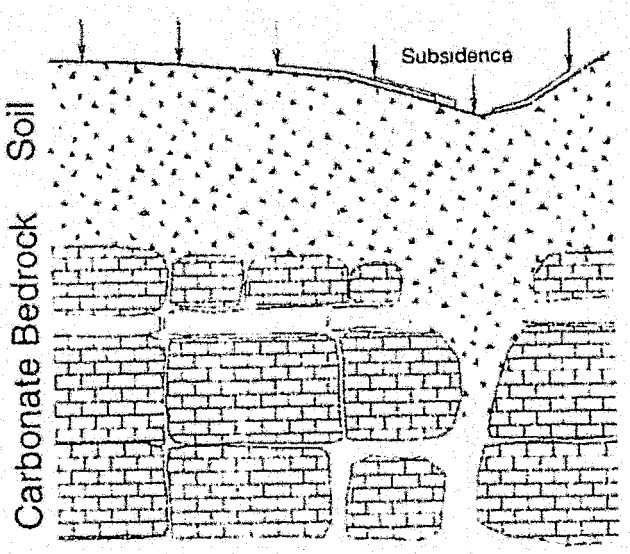
Precipitation



Infiltration

II

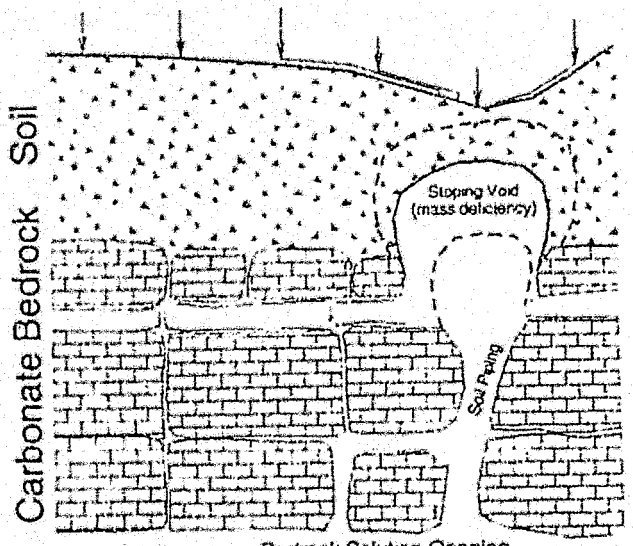
Precipitation And Run-Off



Concentrated Infiltration into and Dissolution of Bedrock Cavities
(mass deficiencies)

III

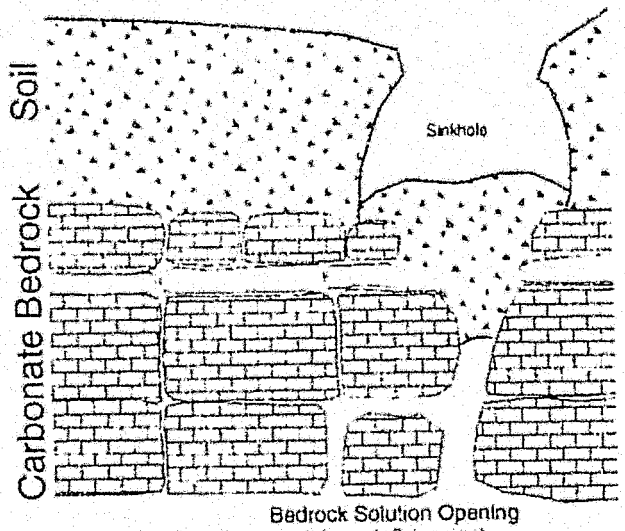
Enhanced Precipitation and Run-Off



Bedrock Solution Opening
(Mass deficiencies)

IV

Soil Arch Collapse



Bedrock Solution Opening
(Mass deficiencies)

Typical Time Scale

I — Thousands to Millions of Years

II — Indefinite (may be stable until activated by enhanced precipitation)

III — Hours to Months (may be accelerated by enhanced precipitation)

IV

Schematic Karst Processes

Rev. 01/2001

Appendix B

Introduction to Seismic Refraction

1051 Columbia Avenue • Lancaster, Pennsylvania 17603 • 717/396 8922 • Fax 717/396 8246 • email@enviroscan.com • www.enviroscan.com

Introduction to Seismic Refraction

by

Timothy D. Bechtel, Ph.D., P.G.

Energy

Mechanical elastic (seismic) waves generated by a hammer blow, weight drop, or explosion.

Sensitivity

Sensitive to elastic properties or moduli – generally strongly correlated with density.

Basic Equipment

Recording Seismograph (generally 24 or more channels); Geophones (one for each channel); Geophone cable; Hammer or weight plus strike plate or explosives; Trigger switch.

Common Applications

Determination of the depth and dip of soil horizons and bedrock surfaces. Recent processing advances allow some detection and delineation of discrete targets.

Principles

In a uniform isotropic earth, the shock wave from a blow or explosion at the surface travels outward and downward in a hemispherical wave front like a three-dimensional ripple from a pebble in a still pond. At any point on the wave front, a straight line from the shock source to the wave front depicts the path of the seismic wave, and is called a ray path (see Figure SR-1). In reality, there are several independent shock waves; the fast-moving primary, compressional or P wave front; the slower moving secondary, shear or S wave (both of which form hemispherical wavefronts); and several disk-like wave fronts that travel only along the surface of the earth (called surface waves or ground roll). For the purposes of most seismic refraction surveys, only the fastest moving wave front — the P wave — is considered. S-wave refraction is used in selected circumstances where complete determination of elastic moduli is desired – particularly when it may be desirable to eliminate the effects of water saturation.

In a layered earth, the hemispherical P shock wave defined by the radially distributed P ray paths are deflected according to the laws of optics (Snell's Law) at interfaces between materials with differing seismic velocities (i.e. densities or elastic properties). Figure SR-2 depicts the deflection of ray paths due to an increase in P velocity at a bedding plane. The type of deflection that a ray path will undergo is dependent upon the angle at which it strikes the interface, and falls into one of four categories:

1) Some direct rays (green in Figures SR-2 and SR-3) travel parallel to the ground surface at the seismic velocity of the upper layer, do not strike the underlying interface, and consequently are not deflected.

2) Reflected rays (purple in Figures SR-2 and SR-3) arise where direct rays strike the interface, and a portion of the energy is reflected symmetrically back towards the surface.

3) The portion of the energy of the incident direct wave that is not reflected upward is refracted, or bent as it crosses the interface – making refracted waves in the lower layer (red in Figures SR-2 and SR-3).

4) At a precise angle called the critical angle, the incident ray is refracted directly along the interface, and travels at the higher seismic velocity of the lower layer (see Critically Refracted Wave in Figure SR-3). As this critically refracted or head wave races along beneath the interface, it generates a secondary elastic disturbance that travels back to the surface along ray paths that define a wave front analogous to the bow wake of a ship. These returning rays again travel at the slower velocity of the upper layer.

To perform a refraction survey, a linear array of ground motion sensors or geophones is spaced out from the seismic source or shot point, forming a geophone spread. Each geophone is connected to a separate channel in a seismograph which records a wiggle trace representing the ground motion resulting from the passage of the various seismic rays.

As depicted in the time-distance (T-X) curve in Figure SR-4, the layered earth structure can be determined by analyzing the seismographic wiggle traces. At distances close to the seismic source, the first wiggle or ground motion (the first arrival after the shot) is due to passage of the direct wave travelling at the velocity of the upper layer. Reflected waves arrive later since they have by definition traveled a greater distance at the same velocity (additional later wiggles are caused by passage of the more slowly travelling S and surface waves). Beyond a distance dictated by the critical angle, the first arrival of seismic energy represents the head wave of the critically refracted ray. These refracted rays also by definition travel a greater distance than the direct wave. However, along part of their path, they have traveled at the higher velocity of the underlying more consolidated layer. At greater distances from the shot point, where the path length in the higher velocity layer becomes significant, the head wave arrivals actually race past the direct wave and become the first arrival (see labeled crossover in Figure SR-4). By extension, it can be shown that if a third layer with even greater velocity lies at greater depth, the head wave from this layer will become the first arrival at a sufficient distance from the shot point.

In conventional seismic refraction, only the first P wave arrivals can be reliably selected on a wiggle trace record. The later reflected P wave arrivals are generally obscured by the slower-travelling S and surface waves, and the very slow air blast or sound wave from the shot. To interpret a seismic refraction record, the first arrival travel times are measured for each wiggle trace and plotted at the appropriate point on a time-distance (T-X) curve (see Figure SR-4). In a plane-layered earth, these first arrivals define a series of line segments, each representing a discrete layer. The seismic velocity of each layer is simply the reciprocal of the slope of the associated line segment. The thickness of each layer can be calculated from the distances where the line segments intersect. The mathematics for these calculations are easily derived, and can be found in any introductory geophysics text.

True geologic strata are rarely perfectly horizontal. The effect of a dipping interface on a travel time curve cannot be recognized using a single shot point. Calculations based on a T-X curve from a single shot point should always be considered as producing apparent depths to interfaces and apparent seismic velocities for all but the uppermost layer. To determine the true depths and dips of interfaces and the true seismic velocities, it is necessary to reverse the seismic line; that is, move the shot point to a location at or beyond the farthest geophone in the spread, and repeat the shot. The calculation of true depths, dips and velocities from reversed seismic lines is also readily performed.

Capabilities

Conventional seismic refraction can yield accurate measurements of depths and attitudes of soil horizons, groundwater tables, and other relatively distinct and planar strata. Modern computer analysis of multi-fold seismic refraction data (i.e. with many and overlapping shot points) can provide delineation of undulating or even irregular (as opposed to simply planar) interfaces. The latest generation of computer processing techniques require very high-fold data, but in favorable conditions, are capable of resolving even discrete targets such as foundation elements, tunnels or cavities, and can resolve gradational boundaries as well as distinct interfaces. The seismic P-wave velocities of materials are generally an indication of relative density or compaction. S-wave refraction data (collected using specialized geophones, shock sources and field procedures) can provide S-wave velocities that bear a well-constrained empirical relationship to standard penetration test (SPT) N values and therefore bearing capacity. For surveys where matching P- and S-wave velocities are determined, the dynamic elastic moduli of subsurface materials can be calculated (including Poisson's Ration, Young's or Bulk Modulus, and Shear Modulus or Rigidity).

Limitations

Seismic data is collected at spaced geophones, and therefore does not provide continuous profile data. If geophones are spaced too widely, thin layers can be missed entirely.

Conventional refraction interpretations are only accurate where the velocity of strata increase with depth. Velocity inversions not only alter the data, but are particularly insidious since the presence of a low velocity zone at depth is not apparent in first arrival data. The latest generation of computer processing techniques do allow detection and delineation of laterally restricted low velocity zones (e.g. tunnels, cavities, gravel lenses, etc.).

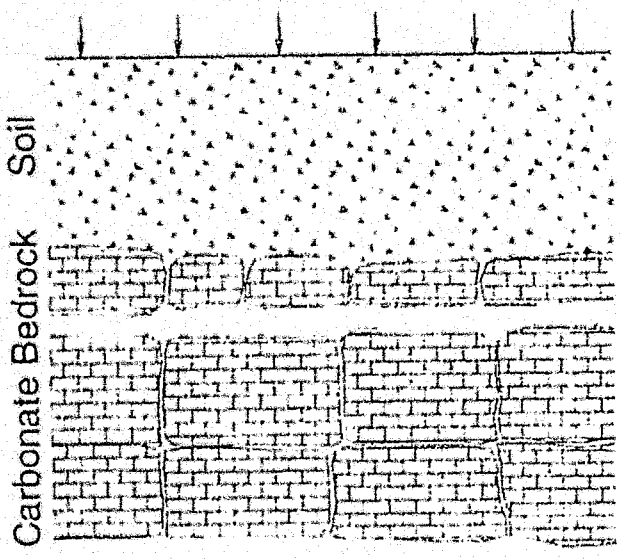
Sharp or dramatic interface relief such as limestone pinnacles cannot always be resolved even with very tight geophone spacing. Therefore, refraction profiles of expectedly irregular interfaces should be assumed to represent somewhat smoothed versions of actual relief (see e.g. Figure SR-5).

Seismic records can contain noise due to heavy machinery vibrations, vehicular traffic, and sometimes even wind or distant earthquakes. Care must be taken to identify potential sources of seismic noise prior to beginning a survey.

The effective survey depth is limited to approximately 1/5 of the greatest shotpoint to geophone distance. Therefore, very deep surveys may require impractically long lines (requiring consideration of other geophysical techniques such as seismic reflection).

I

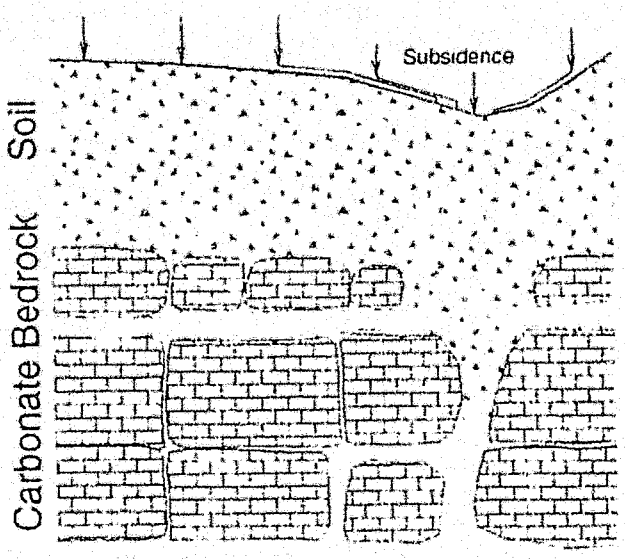
Precipitation



Infiltration

II

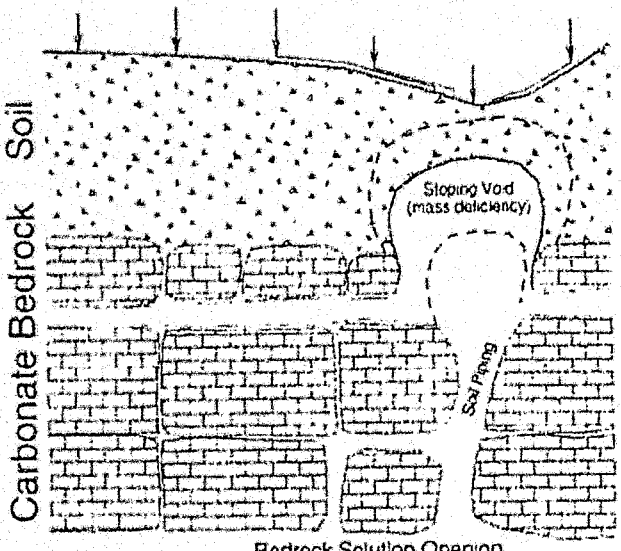
Precipitation And Run-Off



Concentrated Infiltration into and Dissolution of Bedrock Cavities
(mass deficiencies)

III

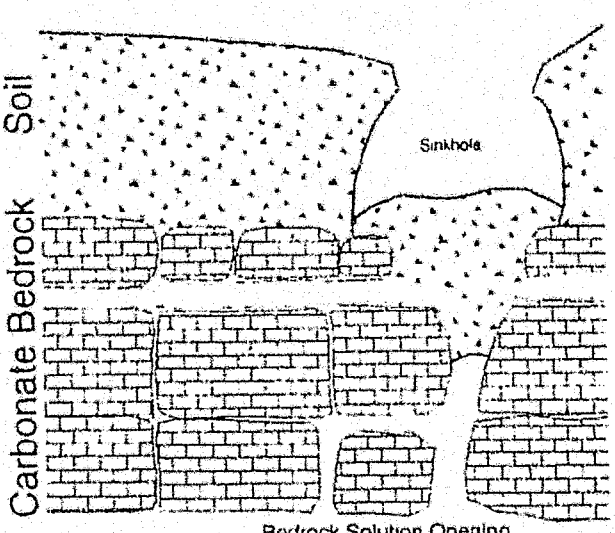
Enhanced Precipitation and Run-Off



Bedrock Solution Opening
(Mass deficiencies)

IV

Soil Arch Collapse



Bedrock Solution Opening
(Mass deficiencies)

Typical Time Scale

I — Thousands to Millions of Years

II — Indefinite (may be stable until activated by enhanced precipitation)

III — Hours to Months (may be accelerated by enhanced precipitation)

IV

Schematic Karst Processes

Rev. 01/2001

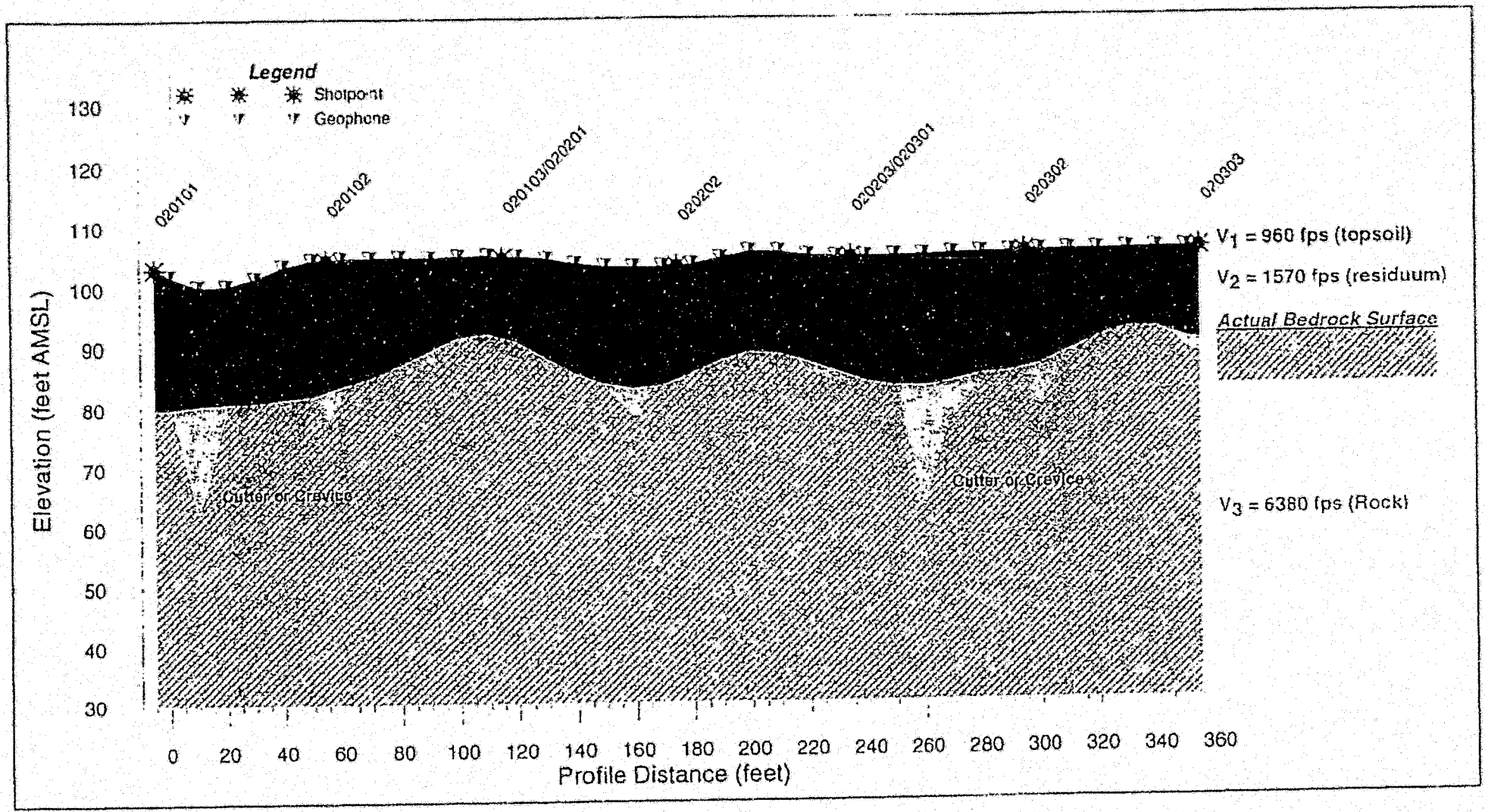
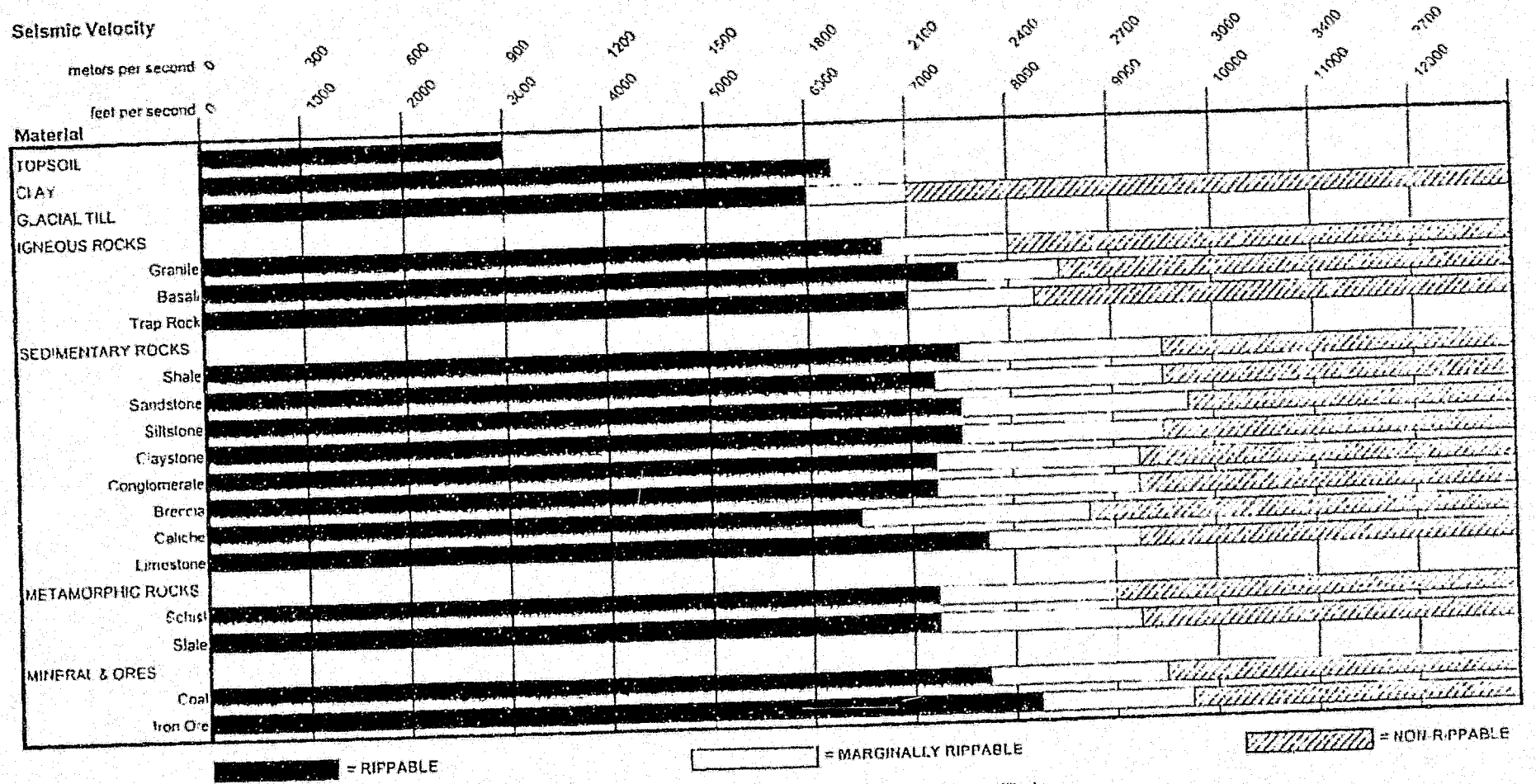


Figure SR-5 **Example Karst Terrane Seismic Profile** Revised 01/2001

Appendix C

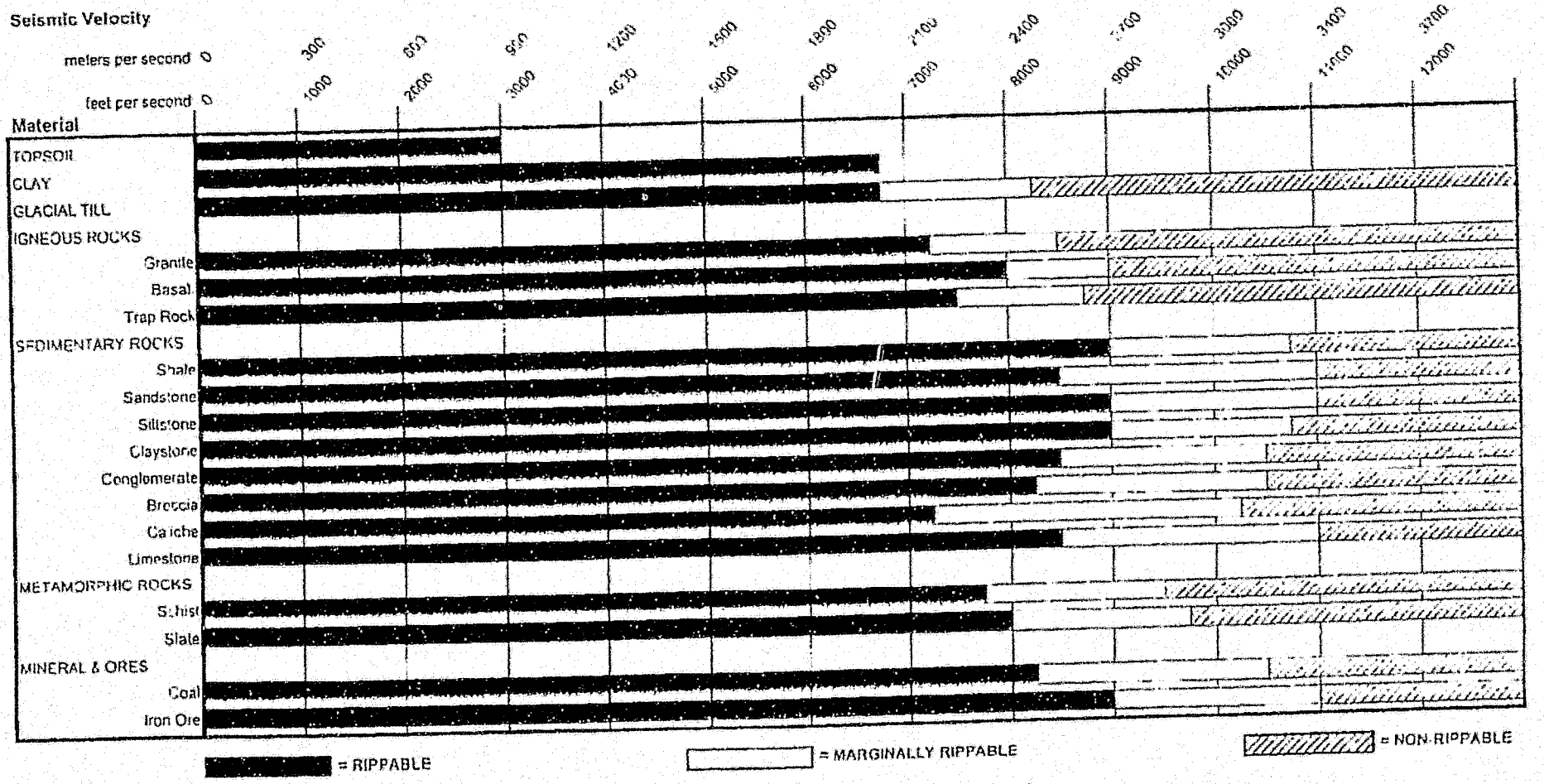
Ripping Charts

Ripping Chart *
D9R
Multi or Single Shank No. 9 Ripper
Estimated by Seismic P-Wave Velocities



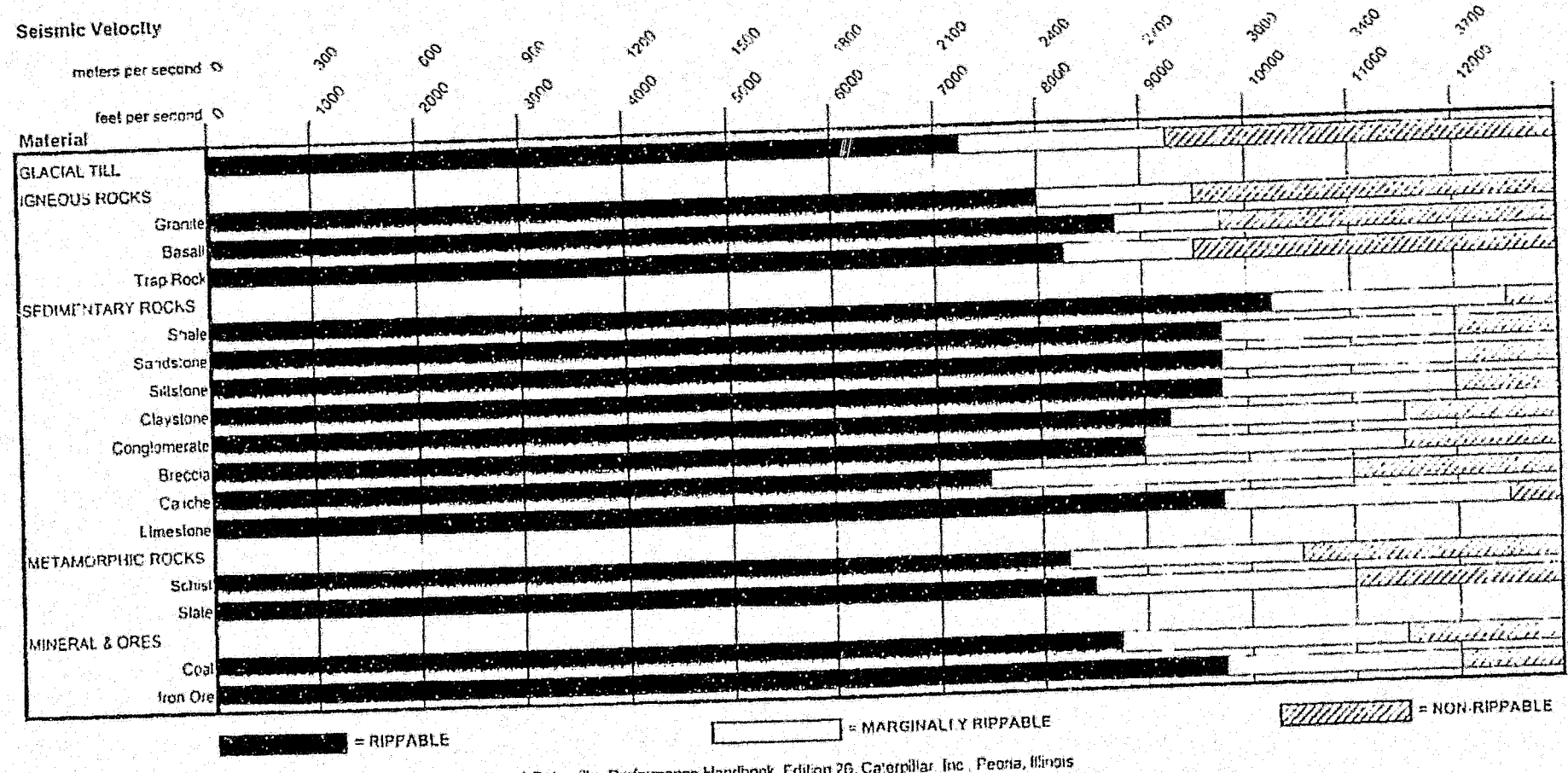
* Caterpillar Performance Handbook, Edition 26, Caterpillar, Inc., Peoria, Illinois

Ripping Chart *
D10N
Multi or Single Shank No. 10 Ripper
Estimated by Seismic P-Wave Velocities



* Caterpillar Performance Handbook Edition 26 Caterpillar, Inc., Peoria, Illinois

Ripping Chart *
D11N
Multi or Single Shank No. 11 Ripper
Estimated by Seismic P-Wave Velocities



* Caterpillar Performance Handbook Edition 20, Caterpillar Inc., Peoria, Illinois

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MacLachlan, D.B., Buckwalter, T.V., McLaughlin, D.B., 1975, Geology and Mineral Resources of the Sinking Spring 7-1/2-minute Quadrangle, Berks and Lancaster Counties, Pennsylvania, Pennsylvania Geologic Survey, 4th ser., Atlas 177d, 228p.

Newton, J.G. (1987) Development of Sinkholes Resulting from Man's Activities in the Eastern United States, U.S. Geological Survey Circular 968.

Telford, W.M., Geldart, L.P., and Sheriff, R.E., 1990. Applied Geophysics, Cambridge University Press.

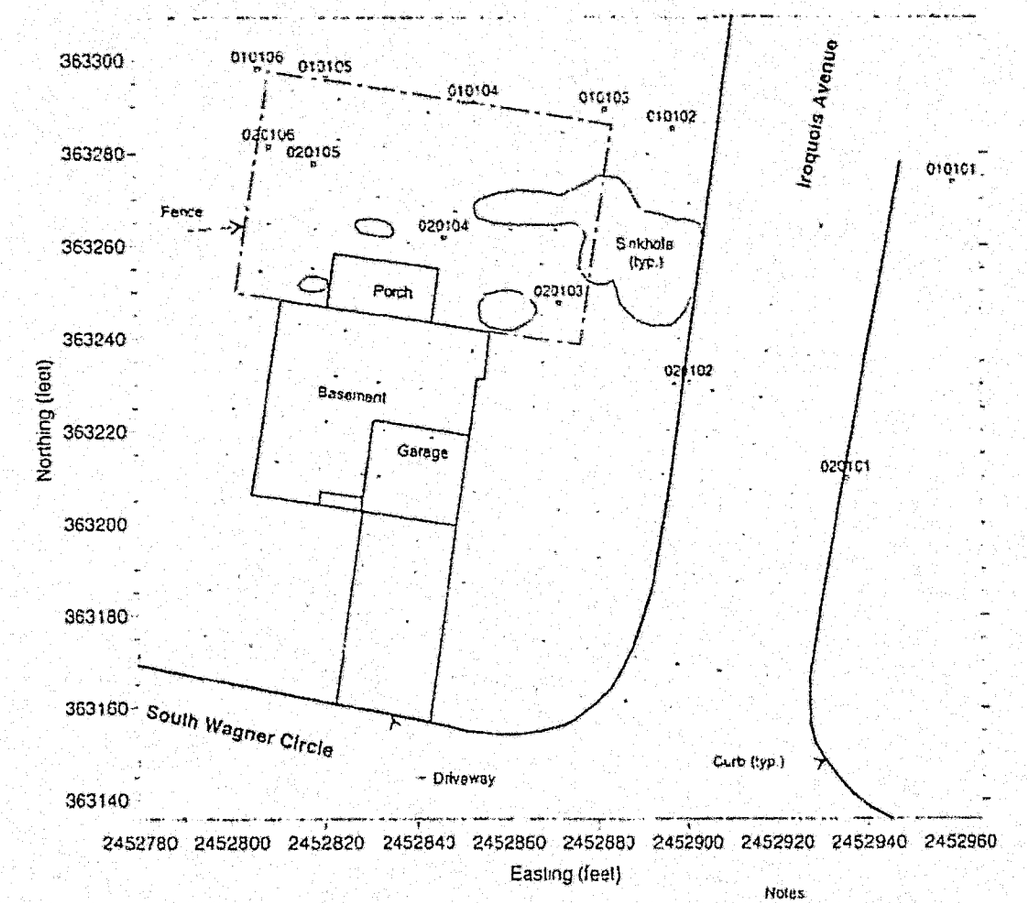
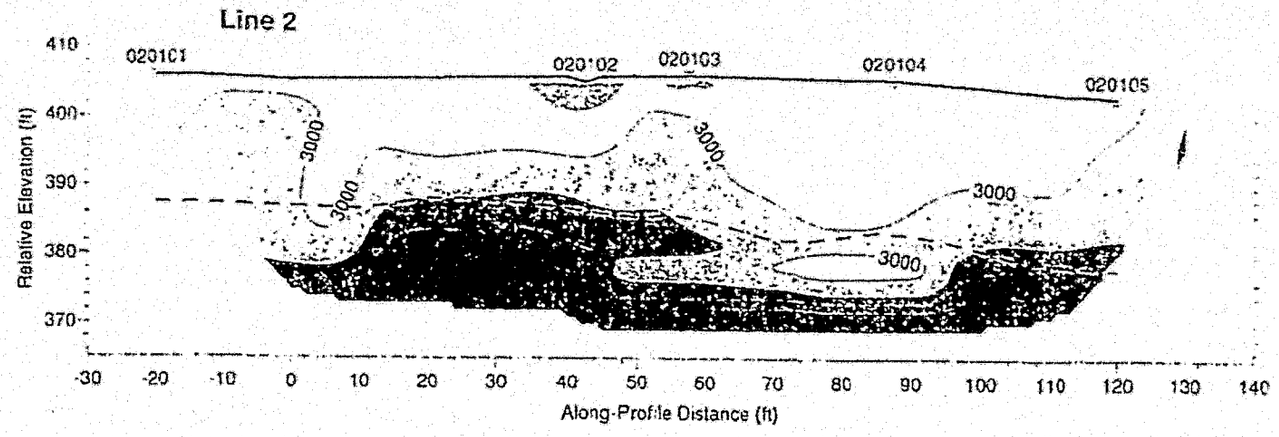


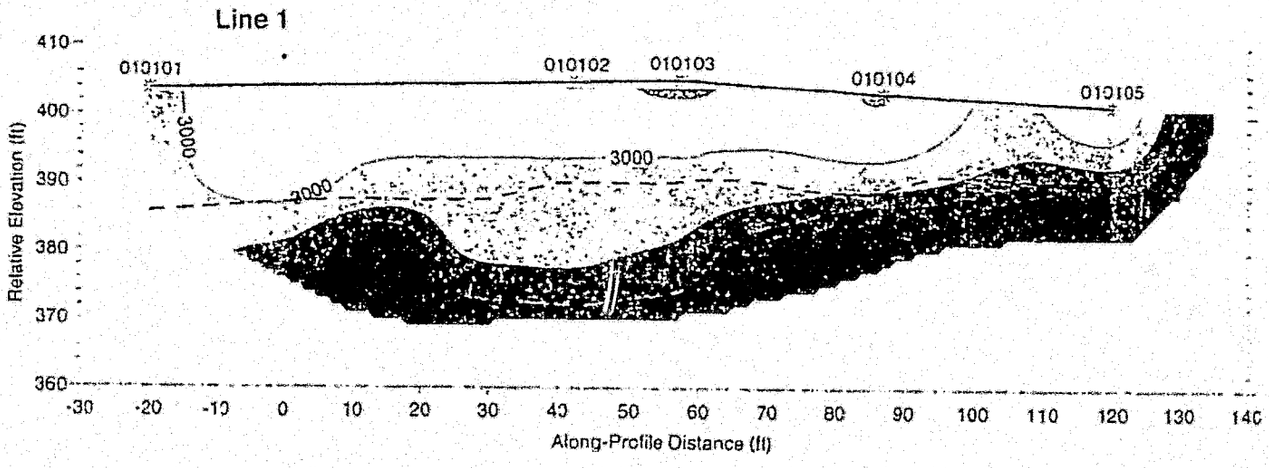
Figure 1

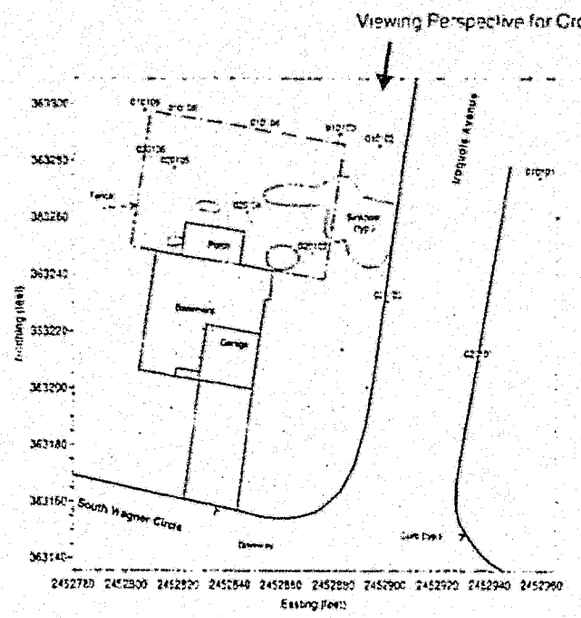
Geophysical Survey Data Coverage

Creveling Property
3123 South Wagner Circle
Sinking Spring, PA

Enviroscan, Inc.
Project No. 020535
Rev 03/17/05







Notes:

Data from Geophysics Inc S24 seismic instrument

Seismic models from SIP by Rimrock Geophysics and SeisOpt Pro by Optim, LLC

Legend

Seismic Shotpoint

Inferred Top of Rock (SIP)

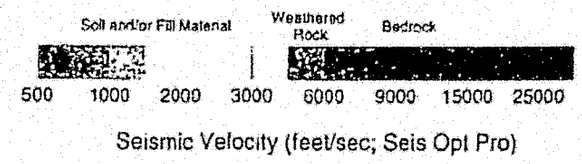
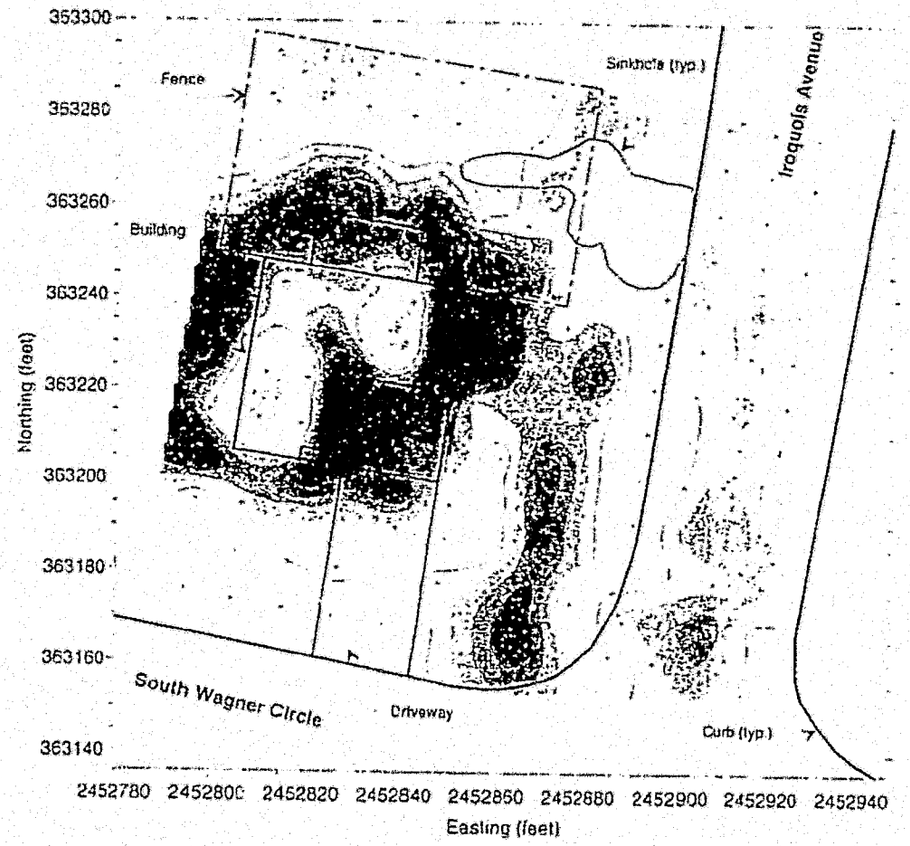


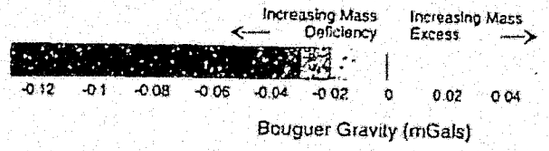
Figure 2

Seismic Refraction Profiles

Creveling Property
3123 South Wagner Circle
Sinking Spring, PA

Enviroscan, Inc.
Project No. 020535
Rev 03/18/05





Notes

Coordinates in PA South State Plane Grid, NAD 27 geodetic datum.

Gravity data from Scintrex Autograv CG-3M Automated Gravity Meter

Legend

Gravity Station

Scale (feet)

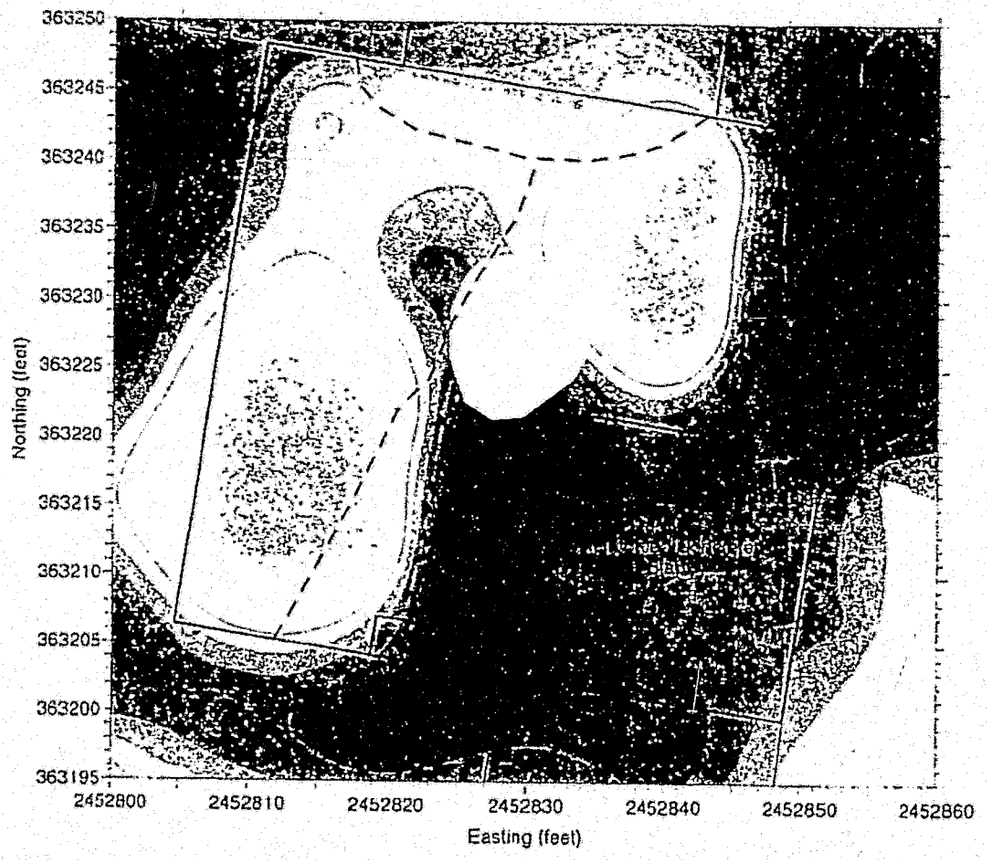
0' 30' 60'

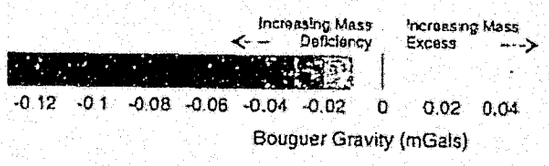
Figure 3

Bouguer Gravity Data Contours

Creveling Property
3123 South Wagner Circle
Sinking Spring, PA

Enviroscan, Inc.
Project No. 020535
Rev 03/17/05





Notes

Coordinates in PA South State Plane Grid, NAD-27 geodetic datum

Gravity data from Scintrex Autograv CG-3M Automated Gravity Meter

GPR data from a GSSI SIR2000 GPR controller with a 500-megaHertz scanning antenna

Legend

Gravity Station

GPR Anomaly Area

Scale (feet)

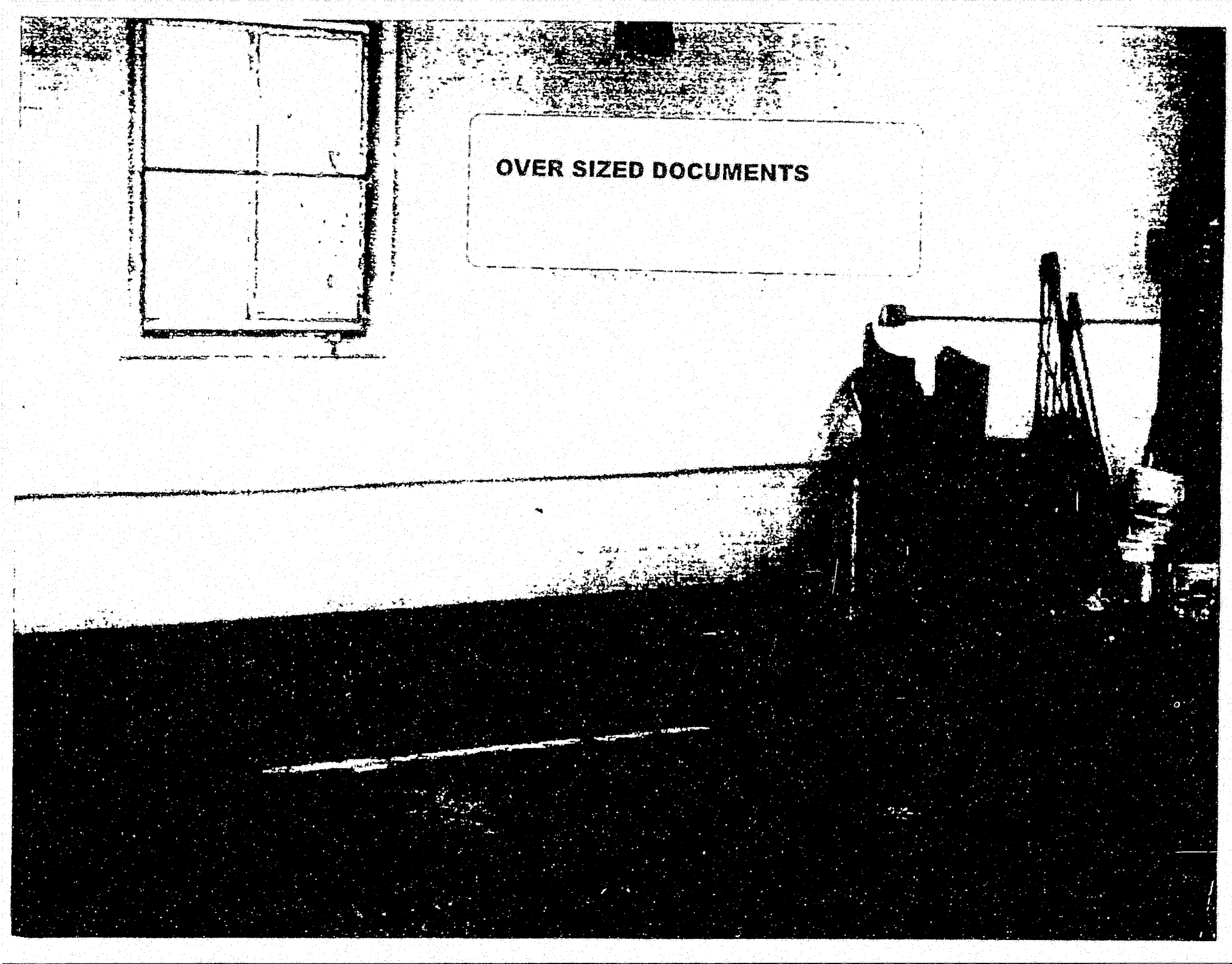
0' 10' 20'

Figure 4

Ground Penetrating Radar Results

Creveling Property
3123 South Wagner Circle
Sinking Spring, PA

Enviroscan, Inc.
Project No. 020535
Rev 03/17/05


OVER SIZED DOCUMENTS

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Spring Township	:	
v.	:	Docket No. C-20054746
Pennsylvania American Water Company	:	
Neil R Rahn and David Singerling, et al.	:	
v.	:	Docket No. C-20054919
Pennsylvania-American Water Company	:	
Wilson School District	:	
v.	:	Docket No. C-20055371
Pennsylvania American Water Company	:	

OCA EXHIBIT B

DATED: JUNE 27, 2006

Pennsylvania American Water

3

LEGIBLE COPY

PAWC STATEMENT NO.1

DIRECT TESTIMONY
OF
WILLIAM C. KELVINGTON

WITH REGARD TO SCOPE OF OPERATIONS AND DESCRIPTION OF THE SYSTEMS, PROPOSED SWITCH TO BI-MONTHLY METER READING AND MONTHLY BILLING IN CERTAIN OPERATIONS, AND CONSERVATION MANAGEMENT

RWE GROUP

I. INTRODUCTION

Q. Please state your name and business address.

A. William C. Kelvington, 800 West Hershey Park Drive, Hershey, PA 17033.

Q. By whom are you employed and in what capacity

A. I am employed by Pennsylvania American Water ("Pennsylvania American," "PAWC" or the "Company") as Vice President of Operations.

Q. Will you please outline your business experience in the water utility industry?

A. I began my career in the water utility industry in 1971 with the Washington District of Western Pennsylvania Water Company ("WPW"), one of the corporate predecessors of PAWC. From 1971 to 1979, I held the positions of staff accountant, assistant office manager, production supervisor, customer service superintendent and district manager in the Washington District. From July 1979 to August 1980, I was the Director of Budget Procedures for WPW. In August 1980, I became the Business Manager of the Washington District of WPW. I held that position until July 1981, when I became the Business Manager of WPW's Pittsburgh District. In March 1994, I became the Manager of the McMurray District of PAWC, which encompasses all of the Company's operations in Western Pennsylvania outside the Pittsburgh District. In September 1998, I was promoted to Vice President of Operations (Western Pennsylvania). On April 16, 2001, I was promoted to my current position as Vice President of Operations for the entire PAWC system and transferred to the Company's corporate headquarters in Hershey, Pennsylvania.

Q. Do you belong to any professional or industry associations?

A. Yes. I am a member of the American Water Works Association ("AWWA"), the Pennsylvania Chapter of the National Association of Water Companies and the Water Works Operators' Association of Pennsylvania.

Q. What is your educational background?

A. I am a 1971 graduate of West Liberty State College where I received a Bachelor of Science Degree in Business Administration and Economics. I received my MBA in 1996 from the Indiana University of Pennsylvania.

Q. What is the nature of your duties with Pennsylvania-American?

A. As Vice President of Operations, I am responsible for providing technical assistance and supervision with regard to water quality, operation and maintenance to the Company's operating areas.

Q. Have you testified previously before the Commission?

A. Yes, I testified in PAWC's last general base rate increase proceeding, at Docket No. R-00016339 and in the Company's recent request to institute a Facilities Protection Charge ("FPC"), at Docket No. R-00027983.

Q. What is the purpose of your testimony?

A. I will discuss three separate areas. First, I will explain the Company's scope of operations and provide a general description of its water supply systems. Second, I will describe PAWC's proposed switch from quarterly or bi-monthly meter reading in those operations where meter are not currently read monthly. Third, I will summarize the Company's efforts with regard to conservation planning since the Company's last rate filing.

II. SCOPE OF OPERATIONS

Q. Please begin by describing PAWC's scope of operations.

A. PAWC is a wholly-owned subsidiary of American Water Works Company, Inc ("American"). On January 10, 2003, American was acquired by Thames Water Aqua US Holdings, Inc. ("Thames"), the water division of RWE Aktiengesellschaft ("RWE AG"). As of December 31, 2002, PAWC provided water service to approximately 609,110 water and 12, 922 wastewater customers. These services are provided in 357 communities located in 35 of 67 counties in Pennsylvania. As a public utility operating in Pennsylvania, the Company operates under the rules and regulations of the Pennsylvania Public Utility Commission ("Commission") which, in addition to regulating specific aspects of service, approves the rates charged for water and wastewater service. The Company also must comply with drinking water and other operational standards established by the Pennsylvania Department of Environmental Protection (DEP") and the Federal Environment Protection Agency ("EPA").

The Company will employ approximately 1,029 people by the end of the future test year who have expertise in all areas of water and wastewater utility operations including

engineering, water quality, filtration, plant operation and maintenance, distribution system operation and maintenance, materials management, risk management, human resources, legal, finance and accounting. Additionally, as a subsidiary of American, the Company has available the resources of American Water Works Service Company, Inc., ("Service Company"). The Service Company provides access to highly trained professionals with expertise in various specialized areas who work exclusively for American's operating subsidiaries, as more fully described by Mr. Freeston in his direct testimony.

Q. Please provide a general description of PAWC's water systems.

A. The Company's water supply is provided principally from surface supplies such as rivers, streams and reservoirs. In certain locations, water is also supplied from wells and through purchase contracts and interconnections with other water suppliers In 2002, the total amount of water delivered by the systems averaged approximately 185 million gallons per day (MGD), of which surface water accounted for approximately 90%, well water approximately 6%, and purchased water approximately 4%.

PAWC has water allocation permits from the DEP and various River Basin Commissions, where required. Available supplies are capable of meeting existing demands with reasonable margins for drought and expansion contingencies.

Transforming water found in nature into consumable water requires treatment and processing to remove natural and manmade contaminants. All surface water is filtered and all water supplies are chemically treated with chlorine. In some cases, special treatment is provided to address specific conditions of the water. The Company owns

and operates 38 surface water purification plants having a combined operating capacity of approximately 375 MGD for filtering and chemically treating water supplies.

Water pumped from well sources generally requires treatment by means of chlorination and pH adjustment. In some cases, naturally-occurring iron and manganese is removed by filtration and air stripping. In isolated situations, more elaborate treatment is needed to remove organic compounds. Current water treatment methods allow for these substances to be readily removed from the water supply.

The Company supplies the treated water to its customers through separate water transmission and distribution systems located throughout its service territory. These systems consist of water mains, pumping stations and distribution system towers (storage facilities). Water mains range in diameter from 2 inches up to 48 inches and are generally made from ductile iron, cast iron, or prestressed concrete. As of December 31, 2002, the Company owned and operated approximately 8,713 miles of water transmission and distribution mains. The Company has 213 water distribution towers with a capacity of approximately 199 million gallons.

Headquartered in Hershey, the Company has six geographically diverse operating areas serving an estimated population of more than 2 million people throughout the state.

The Western District serves an estimated population of 575,000 in various western Pennsylvania, communities served including, but not limited to, Butler, New Castle, Indiana, Warren and Washington. Its larger customers are U.S. Steel, Washington Steel, Osram Sylvania, Armco Steel, Koppel Steel and Universal. The Western District's business office is located in McMurray located between the cities of Pittsburgh and Washington, Pennsylvania.

The Pittsburgh District comprises a distribution system serving an estimated population of 550,000 in Allegheny County. In addition to supplying the southern Pittsburgh suburbs, its two large filtration plants provide a major portion of the water needs of the Western District's water need in Allegheny and Washington Counties. The office for the Pittsburgh District is also located in McMurray. Its larger customers include Bettis Research, General Electric, Polar Water Company, and Schneider Dairy.

The Central District serves a population of over 200,000 people in 10 counties. Communities served include Milton, Philipsburg, Hershey, Palmyra, Berwick, Frackville, the West Shore of Harrisburg, and the Lake Heritage gated community located near Gettysburg. The Central District's regional office is located in Mechanicsburg. ConAgra Grocery, the U.S. Penitentiary at Allenwood, Hershey Foods, the Hershey Medical Center, and the U.S. Navy Depot are large customers.

The East District serves an estimated population of 115,000 in the Yardley and Norristown areas of Bucks and Montgomery Counties, respectively. Its large customers are Unisys, Bethlehem-Lukens Steel, and Norristown State Hospital. The office is located in Norristown.

The Northeast District serves an estimated population of 550,000 in northeastern Pennsylvania. Its larger customers are Fairchild Semiconductor, Lion Brewery, and Quaker Oats Company. The Northeast District's office is located in Wilkes-Barre.

Finally, the Southeast District serves an estimated population of 69,000 in five southeastern Pennsylvania counties and includes two significant and relatively recent acquisitions by the Company. In March 2001, the Company purchased the assets of the City of Coatesville Authority Water and Wastewater Systems. In January 2002,

Pennsylvania-American purchased the water assets of Citizens Utilities serving customers outside of Reading, Royersford and Nazareth. Its larger customers include Glaxo SmithKline, Wyeth Pharmaceuticals, Bethlehem-Lukens Steel, Alcon Manufacturing, and Surgical Specialties. The regional office is located in Wyomissing.

III. METER READING AND BILLING

Q. Please describe PAWC's proposed change regarding meter reading

A. At December 31, 2002, approximately 70% of the Company's 609,110 water accounts were read and billed monthly. The balance of the customer base, all acquired since February 1996, is currently either read and billed bi-monthly (the former Pennsylvania Gas & Water Company customers that comprise PAWC's Scranton/Wilkes-Barre system), or read and billed quarterly (the former City of Coatesville Authority, Citizens Utilities, Inc., Lehman Pike Water and Sewer Company and Mid-Monroe Water Company customers). The Company is proposing to continue reading bi-monthly, but to bill monthly in its Scranton/Wilkes-Barre operations. Similarly, PAWC proposes to begin reading bi-monthly, but bill monthly, in all operations that are currently read and billed quarterly. This proposed change is an interim step to reading and billing all customers monthly at some point in the future.

Q. Please explain why this change is in customers' best interests.

A. The greatest benefit to customers that this change produces is affordability and manageability of the water bill. For example, under proposed rates, if continued to be billed quarterly for 13,800 gallons, current customers who were formerly customers of

The City of Coatesville Authority, Citizens Utilities, Lehman Pike Water and Sewer Company and Mid-Monroe Water Company, would pay $121.83 every three months. If billed monthly, these customers would pay $40.61. Although the monthly amount is simply one-third of the quarterly amount, it is my understanding and belief that the majority of these customers do not set aside money monthly for the purpose of paying a utility bill a month or two in the future. In fact, we learned this to be true of our other customers when the Company originally converted from quarterly to monthly billing in 1992. Similarly, it will be much easier for our Scranton/Wilkes-Barre system customers to pay $40.61 monthly instead of $81.22 every other month for the same reason.

Q. Are there any other benefits to customers?

A. Yes, by billing more frequently, the Company can reduce its cash working capital requirements. In fact, the reduction in working capital needs has served to reduce the Company's rate request by approximately $348,000. Additionally, the Company's pro forma adjustment to uncollectibles expense in this case was calculated based on the actual 2002 historic test year ratio for write-offs to water sales. This ratio could potentially improve due to decreased write-offs as a result of customers being better able to pay their bills or, if bills aren't paid timely, the Company's collections personnel chasing smaller delinquent amounts more quickly. If the write-off to sales ratio did improve, customers would realize savings in future rate proceedings.

Q. Have you identified any additional expenses associated with this meter reading change?

A. PAWC would incur the following additional expenses and associated amounts: wages and benefits for four additional meter readers, $185,000; bill forms and envelopes, $96,000; and, postage, $258,000. Total additional expenses, therefore, are $539,000 ($185,000 + $96,000 + $258,000). When netted against cash working capital savings of $348,000, the net cost to the Company, and therefore its customers, is $191,000 ($348,000 - $539,000).

Q. Why should this Commission approve a meter reading and billing change that produces additional expenses of $191,000?

A. First, the increased burden to residential customers is insignificant. Secondly, the eliminated burden of high quarterly or bi-monthly bills for some customers is substantial. Finally, as I indicated earlier in my testimony, this switch hopefully will reduce expense in the future.

Q. Mr. Kelvington, you indicated earlier in your testimony that this proposed change is an interim step to reading and billing all customers monthly at some point in the future. Please elaborate.

A. PAWC continually evaluates both technological advances in this area and its meter reading efficiency. In late 2002 and early this year, the Company replaced its old meter reading equipment and software with DAP9800 meter reading equipment. The DAP9800 equipment represents the latest in manual reading technology and is adaptable to radio-frequency meter reading. Radio-frequency meters are being installed at PAWC's most

recent acquisition, the Mid-Monroe Water Company, to further study the reliability and efficiency of these types of meters.

IV. CONSERVATION

Q. Focusing on the topic of conservation, are you aware that the Commission has issued regulations to be used to evaluate the performance of water utilities in encouraging cost-effective conservation by customers?

A. Yes. The Company has reviewed those regulations and believes that it is meeting and, in some instances, exceeding the minimum standards established by the Commission. For example:

- The Company distributes conservation-related material to its customers at least twice a year.
- Sounds all hydrants for leaks every year during inspection and flushing of the distribution system via the hydrants.
- Employs eight state-of-the-art electronic leak detection vans to detect and locate fractured transmission and distribution mains. These vans are geographically dispersed throughout the state to provide maximum coverage.
- Provides and installs, free of charge, retrofit kits in the homes of customers meeting specific low-income and household consumption criteria. These kits include toilet dams, low flow shower heads, kitchen and bathroom faucet aerators and toilet leak-identifying dye tablets.
- Has incorporated into its tariff plumbing standards that require low water-use fixtures for new homes or significant remodeling projects.

- Has purchased and utilizes state-of-the art water-use monitoring equipment which allows the Company to properly size its larger meters to accurately measure water use.

PAWC's response to questions QS6 in its prefiled Quality of Service Exhibit summarizes the Company's efforts with respect to water conservation since the last rate proceeding.

Q. Does this conclude your testimony?

A. Yes, it does.

OVERSIZED
DOCUMENT(S)

VCR.

C-2005-4746 et al

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OVERSIZED
DOCUMENT(S)

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RECEIVED
MAY 22 2005
PA PUBLIC UTILITY COMMISSION
SECRETARY'S BUREAU

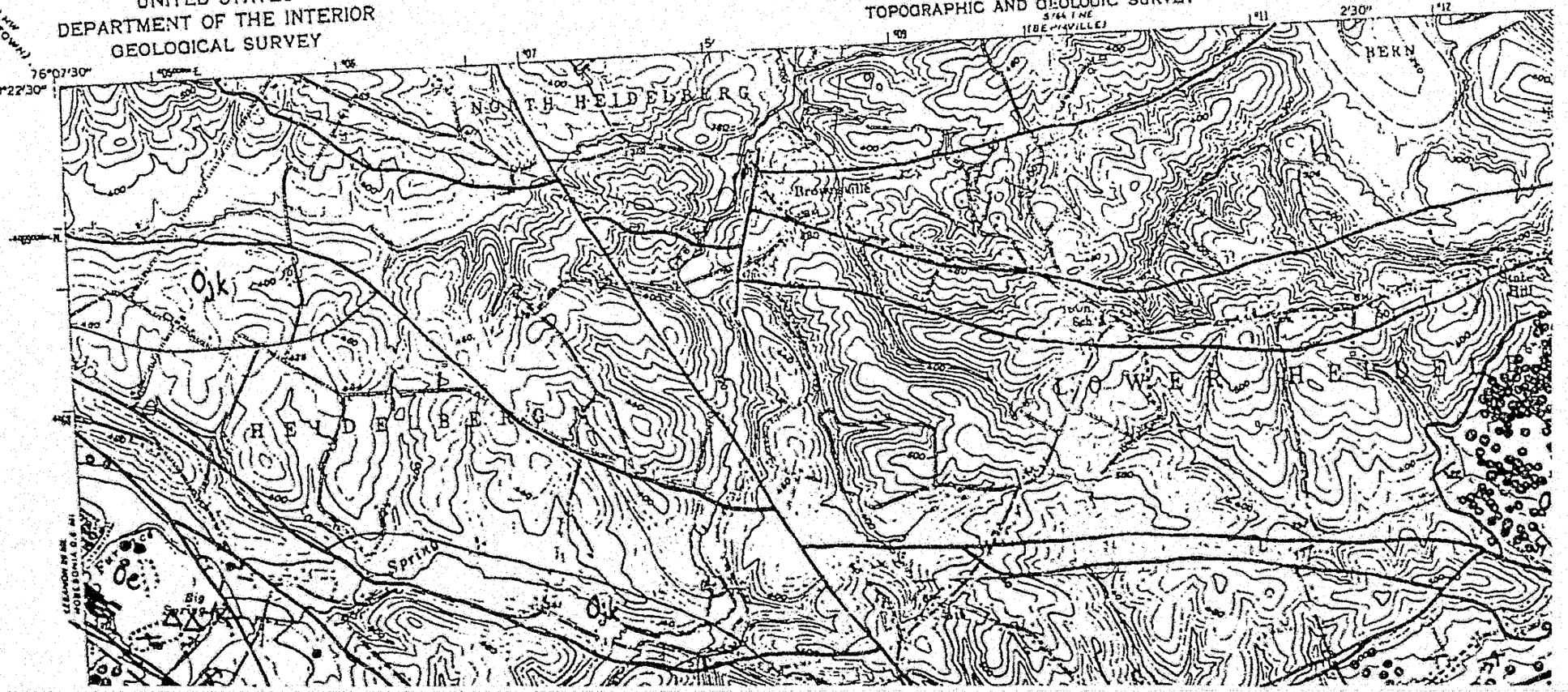
OF BERKS COUNTY, PENNSYLVANIA

by W.E.Kochanov

1988

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
TOPOGRAPHIC AND GEOLOGIC SURVEY



OCA STATEMENT No. 1S

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Spring Township	:	
v.	:	Docket No. C-20054746
Pennsylvania American Water Company	:	
Neil R Rahn and David Singerling, et al.	:	
v.	:	Docket No. C-20054919
Pennsylvania-American Water Company	:	
Wilson School District	:	
v.	:	Docket No. C-20055371
Pennsylvania American Water Company	:	

SURREBUTTAL TESTIMONY

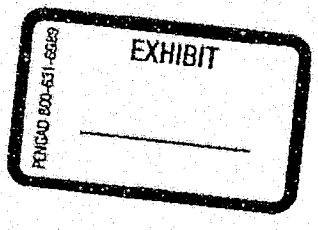
OF

TERRY L. FOUGHT, P.E.

ON BEHALF OF

PENNSYLVANIA OFFICE OF CONSUMER ADVOCATE

JUNE 22, 2006



Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS FOR THE RECORD.

A. Terry L. Fought, 780 Cardinal Drive, Harrisburg, Pennsylvania, 17111.

Q. MR. FOUGHT, ARE YOU THE SAME PERSON WHO SUBMITTED DIRECT TESTIMONY IN THIS PROCEEDING ON BEHALF OF THE OFFICE OF CONSUMER ADVOCATE?

A. Yes.

Q. WHAT IS THE PURPOSE OF YOUR SURREBUTTAL TESTIMONY?

A. The purpose of my surrebuttal testimony is to respond to the direct testimony of the Company's witnesses Richard L. Kanaskie, P.G. and Craig D. Clauser, P.E.. First, I will address Mr. Kanaskie's testimony and then I will respond to Mr. Clauser's testimony.

Response to Mr. Kanaskie's Testimony

Q. WHAT ISSUES IN MR. KANASKIE'S TESTIMONY ARE YOU RESPONDING TO?

A. Mr. Kanaskie provided direct testimony as an expert in the field of geology. See page 2, lines 6-7. I am responding to the following issues included in Mr. Kanaskie's testimony: Mr. Kanaskie (1) states that wet/dry and freeze/thaw cycles will cause pipe movement, loss of pipe support, and pipe failure; (2) implies that the allowable leakage from water main is not relevant to the cause of the collapse of the sinkhole; (3) suggests that 5% of precipitation can infiltrate through the Iroquois Avenue road surface; (4) identifies other sources of water that he states could have caused the collapse of the sinkhole; (5) states

that frost action can move a pipe just enough to facilitate a leak/break; and (6) states that only an 8 inch void would be required below grade to accept the amount of water from the main break.

I disagree with all of the above points and I also disagree with his ultimate conclusion that "many factors led to the main break due to multiple sources of water, climate issues, and karst geology..." Kanaskie St. at 10.

Q. WHAT IS MR. KANASKIE'S POSITION ON WET/DRY AND FREEZE/THAW CYCLES CAUSING PIPE MOVEMENT, LOSS OF PIPE SUPPORT, AND PIPE FAILURE?

A. On page 7, lines 5-9, Mr. Kanaskie states "As the clay filled solution channels on either side of the pinnacle go through wet/dry and freeze/thaw cycles the pipe will have the opportunity to move. Movement of the pipe will not happen at the point where it is underlain by the bedrock pinnacle. Therefore, as more clay soil is moved away from the pipe from infiltration, etc., support is lost and a failure will occur."

Q. WHAT ARE YOUR COMMENTS REGARDING MR. KANASKIE'S POSITION ON WET/DRY AND FREEZE/THAW CYCLES CAUSING PIPE MOVEMENT, LOSS OF PIPE SUPPORT, AND PIPE FAILURE?

A. At the location of the water main break, the pipeline on Iroquois Avenue is buried approximately 5 feet deep (from the ground surface to the top of the pipe). The extreme depth of frost penetration (depth of record) in the Reading, Pa. area is approximately 1

meter. See Exhibit TLF-9. One meter is 3.28 feet Since the water main is buried 5 feet deep, freeze/thaw cycles could not have caused movement of the water main at the break location.

Q. WHAT DOES MR. KANASKIE SAY ABOUT THE ALLOWABLE LEAKAGE FROM WATER MAINS?

A. On page 7, lines 13-21, Mr. Kanaskie repeats my direct testimony regarding acceptable pipe leakage upon completion of construction. On page 7, line 21 through page 8, line 2, he states "However, if that is the case, Mr. Fought states that the 0.6 gallons per hour loss is acceptable loss for this type of pipe. It could not be detected or pinpointed. It also must be pointed out that the same allowable water loss of 0.6 gallons per hour is also standard for ductile iron pipe of the same size."

Q. HOW DO YOU RESPOND?

A. I provided testimony on the acceptable leakage of water mains to show that properly installed water mains are not 100% water tight even at the time of initial installation. It is my position that leakage from the water main over time eroded areas adjacent to the pipe and thus is responsible for the water main break. Leak detection test records submitted by the Company indicate that the Company did not have (or did not follow) a routine leak detection program in the Sinking Springs area until a month before the water main break. And, even then, the Company did not perform any leak detection tests in the vicinity of the Iroquois Avenue water main break.

Q. IS IT IMPORTANT FOR A WATER COMPANY TO HAVE A ROUTINE LEAK DETECTION PROGRAM?

A. Yes. A routine leak detection program is desirable in all areas, but especially in karst areas, to detect leaks early in order to prevent the type of damage that occurred here. In fact, after the water main break, the Company installed Permalog units as part of a new leak detection program throughout this service area.

Q. IS MR. KANASKIE'S POSITION THAT 5% OF PRECIPITATION CAN INFILTRATE THROUGH THE IROQUOIS AVENUE ROAD SURFACE VALID?

A. No. On page 8, lines 4-5, Mr. Kanaskie states "Paved roadways are not impervious. In fact, Spring Township stormwater regulations require that paved area runoff be calculated at 0.95. This would suggest that 5% can infiltrate through the road surface." Mr. Kanaskie's testimony continues with the calculation of how much water can infiltrate through 2,000 feet of roadway tributary to the water main break from each inch of rainfall. These conclusions are not valid.

Q. PLEASE EXPLAIN.

A. Mr. Kanaskie is misinterpreting stormwater regulations and wrongly suggesting that the Iroquois Avenue pavement is not impervious. I am familiar with all formulas commonly used to calculate stormwater runoff in Pennsylvania. Mr. Kanaskie is probably referring to the Rational Method of hydrology which is used to calculate "peak runoff". In calculating the peak runoff by the Rational Method of hydrology, $Q = C \times i \times A$, C is a non-

dimensional runoff coefficient, i is the average rainfall intensity in inches, and A is the tributary area in acres. See Exhibit TLF-10.

It can be noted from Table 5.5 on Exhibit TLF-10 that the Normal Range of Runoff Coefficients for Asphalt and Concrete Pavement range between 0.70 and 0.95 and for Roofs range between 0.75 and 0.95. A C-value of 0.95 is commonly used in calculating the peak runoff from impervious areas. Mr. Kanaskie has mistakenly suggested that asphalt pavement is not impervious since a runoff factor of 0.95 is used instead of 1.00. The remaining 0.05 (5%) is not included in the peak runoff calculations because some precipitation is stored on the impervious material, evaporates after the storm, and therefore does not contribute to the peak runoff. Apparently, Mr. Kanaskie would also suggest that 5% of the precipitation infiltrates through roofs.

Q. WHAT DOES MR. KANASKIE SAY ABOUT OTHER SOURCES OF WATER AND THE WATER MAIN FAILURE?

A. On page 8, lines 12-14, Mr. Kanaskie states "This percentage (the 5% he mistakenly thought infiltrated through the roadway pavement) will only increase as the road ages and cracks form. Joints along curb lines will also allow infiltration. Every sewer manhole, water valve box and gas valve provides additional conduits for water to enter the road subgrade."

On page 8, line 15 through page 9, line 16, Mr. Kanaskie identifies the following other possible sources of water that he believes could have contributed to the water main failure: springs or seeps flowing above the water table, water entering the grass areas adjacent to the roadway and high seasonal water tables

Also, on page 9, line 17 through page 10, line 3, Mr. Kanaskie discusses the detention pond that abuts and drains into the Wagner Farms development. He states that sinkholes in the detention pond allow large amounts of water to directly enter the ground and he provides a calculation of the amount of water entering the pond. He concludes his discussion with the following statement: "There is no telling what impact this could have on the existing utilities in this area."

Q. WHY ARE THESE STATEMENTS IRRELEVANT?

A. The Iroquois Avenue pavement is in good condition and has not aged to the point that cracks have formed. Water simply does not soak through pavement that is in good condition, as he suggests it is doing.

Iroquois Avenue is generally on ground higher than the areas abutting the road. Uphill of the water main break, there are three street and driveway intersections on both sides of Iroquois Avenue that slope down and away from Iroquois Avenue. Any water entering the road subgrade from openings of sewer manholes and gas valves would tend to flow underground away from Iroquois Avenue. There are not any sanitary or storm sewer manholes on Iroquois Avenue near the location of the main break. Surface water is also diverted away from Iroquois Avenue at these intersections with the uphill streets and driveways. Since Iroquois Avenue is generally on higher ground than the abutting areas, springs or seeps, water flowing above the water table and water entering adjacent grass areas would flow away from Iroquois Avenue, not beneath it.

According to the applicable U.S. Geological Survey topographic map, the detention pond that abuts the Wagner Farms development is on ground with a lower elevation than the water main break location.

In regard to Mr. Kanaskie's testimony about a seasonal high water table, Mr. Alan King, 303 Shelly Drive, has stated that the only time his basement sump pump has operated was during the water main break. Mr. King's house is located between the above mentioned detention pond and the water main break. His house is also at a lower elevation than the water main break and water flowed underground from the break and entered Mr. King's basement. This is a clear indication that the water main break was not related to an un-seasonable high water table.

Iroquois Avenue (and the water main) have a relatively flat slope in the vicinity of the water main break. Therefore, if the pipeline was subject to any subsurface water from the other sources discussed by Mr. Kanaskie, that subsurface water would not have sufficient pressure to wash away the bedding and backfill material supporting the pipe.

In summary, Mr. Kanaskie identifies other possible sources of water generally, but none of them could have contributed to this water main break for the above reasons.

Q. MR. KANASKIE SUGGESTS THAT FROST ACTION CAN MOVE A PIPE JUST ENOUGH TO FACILITATE A LEAK/BREAK. IS THIS VALID?

A. On page 10, line 12 -14, Mr. Kanaskie states "The extreme cold coupled with the wet soil conditions that existed from the last half of 2004 would have allowed frost to penetrate deep into the soil. This frost action can move a pipe just enough to facilitate a leak/break."

Q. WHY IS THIS IRRELEVANT?

A. Mr. Kanaskie is again making a generalized statement that is not applicable to this water main break. The Iroquois Avenue water main pipe was not moved by frost action because the pipeline is buried below the extreme depth of frost penetration in the Reading Area (approximately 1 meter or 3.28 feet). See Exhibit TLF-9.

Q. IS MR. KANASKIE'S STATEMENT THAT ONLY AN 8 INCH VOID WOULD BE REQUIRED BELOW GRADE TO ACCEPT THE AMOUNT OF WATER FROM THE MAIN BREAK CORRECT? (Page 12, l. 1-3)

A. No. Determining the minimum size of the void required to accept the water from the main break is not as simple as saying that it is the same size as the broken pipeline. Proper calculations would consider the shape of the void, the friction factor of the void's surface and take into account the head (or pressure) of the water upstream of the void opening. In any case, since the pipeline is looped the flow to the break comes from two directions. Once the 8-inch pipe broke apart, the discharge into the trench would be from both of the two segments of the 8-inch pipeline.

Q. DO YOU AGREE WITH MR. KANASKIE'S OPINION THAT MANY FACTORS LED TO THE MAIN BREAK DUE TO MULTIPLE SOURCES OF WATER, CLIMATE ISSUES, AND KARST GEOLOGY?

A. No, I disagree that the factors of multiple sources of water and climate issues led to the water main break in this case. Mr. Kanaskie's position that the Iroquois pavement is not

impervious is incorrect; water does not flow through asphalt in good condition. His testimony of water sources other than the water main were generalizations and not specific to the location of this water main break. Also, it is not possible that frost action caused movement of the pipe in this case, as it lies at approximately 1.75 feet below the record frost depth. I do agree that the presence of karst geology was a factor here, but sinkholes do not collapse on their own.

It is my opinion that leakage from the water main both prior to and after the main break caused the collapse of the karst structures in the areas adjacent to the main and the resulting damages to customers' properties.

Response to Mr. Clauser's Testimony

Q. WHY DO YOU DISAGREE WITH MR. CLAUSER'S TESTIMONY?

A. Mr. Clauser provided testimony as a metallurgical expert. See page 2, lines 1-3. Mr. Clauser stated that his examination of the pipe revealed no evidence of pipe joints which had been leaking prior to the time of this incident. See page 5, lines 1-4. On page 6, lines 9-10, Mr. Clauser again states "Examination of the pipe revealed no evidence of pipe joints which had been leaking prior to the time of this incident. My opinions expressed are to a reasonable degree of metallurgical engineering certainty based on the material reviewed, my examination and testing, and my experience and training."

Q. WHAT IS YOUR RESPONSE?

A. Mr. Clauser is testifying as a metallurgical engineer. The water main that broke had US Pipe Tyton "push-on" joints. All "push-on" joints use a circular rubber gasket that is intended to prevent the joint from leaking. See Exhibit TLF-11, pages 2-3. Mr. Clauser's testimony makes no mention of this rubber gasket, nor do the photographs provided in discovery reveal that these gaskets were retained. Mr. Clauser's testimony indicates that he only inspected about 54 feet of pipe (three 18-foot long pipe lengths). In repairing the water main break, the Company replaced approximately 125 feet of pipe.

Mr. Clauser's conclusion that there is "no evidence" of leakage is therefore meaningless and does not mean that there was no leakage.

Q. DO YOU BELIEVE THAT THE PIPELINE WAS LEAKING PRIOR TO THE PIPELINE BREAK?

A. Yes. If installation specifications include "allowable leakage" at the time of installation, this 35-year old pipeline with its 35-year old gaskets was leaking.

Q. WHAT OTHER INFORMATION LEADS YOU TO CONCLUDE THAT THE PIPELINE WAS LEAKING PRIOR TO THE PIPELINE BREAK?

A. The pipeline was leaking prior to the pipeline break because, as Mr. Clauser agrees, lack of support caused the pipe to break. Leakage from the water main was the only available source of water of sufficient quantity and pressure to wash away the material supporting the pipe.

Q. HOW CAN A PIPELINE LEAK WITHOUT THE PIPE METAL CRACKING?

A. As stated above, pipelines can leak at the joint even when first installed and leaks tend to increase over time. As mentioned in my Direct Testimony, water can leak at the joint if the joint is improperly assembled during construction or if the joint becomes overly deflected. See Exhibit TLF-11, pages 4-6 & 17 for assembly instructions and deflection data. The increasing washing away of the pipe bedding and support at one or more pipe joints, resulted in a gradually greater joint deflection(s) and a gradually increased leakage(s) until the water main broke.

Q. DO YOU HAVE ANY OTHER REASONS TO CONCLUDE THAT THE WATER MAIN WAS LEAKING PRIOR TO THE WATER MAIN BREAK?

A. Yes, I do. I performed two analyses of water supply data provided by the Company by cover letter dated June 13, 2006. The Company submitted this data in response to OCA IV-3 and it consists of "Penn Water District Operators Logs" (Operators Logs) for January, February and March for the years 2003 through 2006.

Q. WHAT INFORMATION IS CONTAINED IN THE OPERATOR'S LOGS?

A. The Operator's Logs contain information on (1) the depth of water in storage tanks; (2) the quantity of water supplied to the distribution system; (3) the quantity of water pumped from wells; and (4) miscellaneous information regarding water quality and water pressure at the wells and pumping stations.

Q. BRIEFLY, DESCRIBE THE TWO ANALYSES YOU PERFORMED ON DATA INCLUDED IN THE OPERATORS LOGS.

A. The first analysis consisted of comparing the total water supplied by the Company's water supply sources for January, February and March, 2004 through 2006.

The second analysis consisted of a comparison of the water supplied by the Company's sources for a seven-day period before the main broke with a seven-day period after the main break. Both analyses indicate that there was continuous leakage in the Company's system prior to the water main break that was substantially reduced after the Iroquois Avenue main was repaired.

Q. PLEASE EXPLAIN WHY YOUR FIRST ANALYSIS SHOWS THAT THERE WAS CONTINUOUS LEAKAGE IN THE SYSTEM PRIOR TO THE WATER MAIN BREAK THAT WAS REDUCED AFTER THE REPAIR.

A. The comparison shows a significant reduction in the amount of water supplied to the system after the Iroquois Avenue water main break was repaired. The average daily water supplied to the system for these months are tabulated below:

TOTAL WATER SUPPLIED (AVERAGE GALLONS PER DAY)

Month/Year	2004	2005	2006
January	2,835,501	3,365,217	3,211,671
February	3,032,383	3,219,480	3,132,825
February 10 thru 28		3,141,149	
March	2,923,748	3,100,716	3,169,210

As can be noted from the above table, the average daily water supplied drastically reduced after the water main break was repaired in early February 2005. For example, the average daily water supplied for January 2005 is 3,365,217 gallons and the average daily water supplied in February 2005 between the 10th and the 28th is 3,141,149 gallons. This

is a reduction of 224,068 gallons per day (gpd) or 155.6 gallons per minute (gpm). If all other factors remain nearly the same, this supports the conclusion that some continuous pipe leakage was eliminated after the repair of the water main break. Schedule TLF-1, Pages 1-3 of 4, provides a tabulation of the daily data presented in the above table, taken from the data received on June 14, 2006.

Q. PLEASE DISCUSS HOW YOUR SECOND ANALYSIS SUPPORTS THE CONCLUSION OF CONTINUOUS LEAKAGE IN THE SYSTEM PRIOR TO THE WATER MAIN BREAK.

A. In this analysis, I compared the water supplied during the week of January 17-23, 2005 before the main break with the week of February 10-16, 2005 after the main break. Since water use varies by the day of the week, I used consecutive seven day periods. I selected those particular two seven day periods because, according to records provided, the Company did not repair any leaks during those days. The total gallons of water supplied to the system during the two seven day periods are shown in the last column to the right on Schedule TLF-1, page 4 of 4. As can be noted from this schedule, the total reduction in supply after the break was 321,243 gpd or 223 gpm (a total weekly difference of 2,248,700 gallons). Again, all other factors remaining constant, this comparison supports my conclusion that some continuous pipe leakage was repaired around the time of the water main break.

It should be noted that since I did not have storage vs. elevation data for all the Company's storage tanks, this analysis did not take into the account the change in storage of the water tanks. If I had included the change in storage of the Blanton tanks, the reduc-

tion in water supplied would have increased to 240 gpm. The Operator Logs did not show a significant changes in the water depths of the other tanks so the 223 gpm figure should be considered a minimum reduction in water supplied after the water main break.

Q. HOW MANY WATER MAIN BREAKS AND LEAKS DID THE COMPANY REPAIR DURING THE PERIOD BETWEEN JANUARY 23 AND FEBRUARY 16, 2005?

A. The records provide by the Company show that there were seven different locations of water main breaks and leaks repaired during that period, including the one on Iroquois Avenue. The dates, locations, and estimated water loss (Usage) of these breaks as shown on the Company records are as follows:

Date	Description/Location	Usage
01/31/05	Mainbreak, Warwick	700,000
02/01/05	Mainbreak, Ruth & Elwyn	500,000
02/03/05	Mainbreak Sherwood & Gage	500,000
02/06/05	Iroquois Mainbreak & Sinkhole	1,600,000
02/07/05	Mainbreak 1 Vista Rd.	300,000
02/07/05	Mainbreak Wilson School Lane	400,000
02/08/05	Mainbreak 52 Warwick Dr.	250,000

Q. AFTER REVIEWING THE TESTIMONY OF MR. KANASKIE AND MR. CLAUSER, IS IT STILL YOUR OPINION THAT THERE WAS A WATER MAIN LEAK AT THE WATER MAIN BREAK LOCATION PRIOR TO THE PIPELINE BREAK?

A. Yes.

Q. WHY IS IT YOUR OPINION THAT THERE WAS A LEAK AT THE WATER MAIN BREAK PRIOR TO THE PIPELINE BREAK?

A. For two reasons. First, as I previously mentioned, leakage from the water main is the only available source of water that has sufficient quantity and pressure to wash away the material supporting the pipe. Second, the Iroquois Avenue water main break did not cause water to surface, which means that pipe leakage prior to the break could have gone undetected, especially since, according to the responses to discovery, the Company had never performed any leak detection tests in the vicinity prior to the break.

Q. DOES THIS COMPLETE YOUR WRITTEN SURREBUTTAL TESTIMONY?

A. Yes, at this time. However, I reserve the right to supplement this testimony either in writing or orally if additional information is received relevant to the above issues.

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Exhibit TLF-9

NOAA Manual NOS NGS 1

Geodetic Bench Marks

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Survey, Rockville Md.

Lt. Richard P. Floyd

September 1978

Jump to TABLE OF CONTENTS

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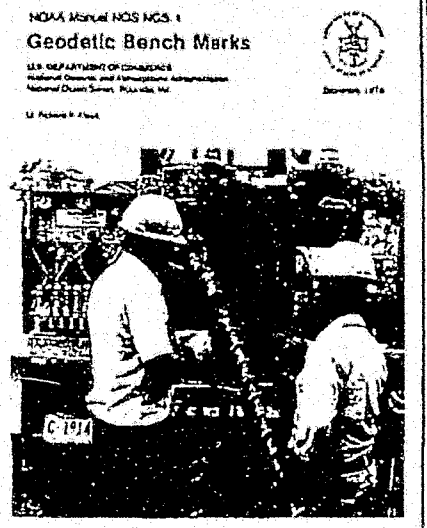

NOAA Manual NOS NGS 1

Geodetic Bench Marks

Lt. Richard P. Floyd
NOAA Corps
National Geodetic Survey
Rockville, Md.
September 1978

U.S. DEPARTMENT OF COMMERCE
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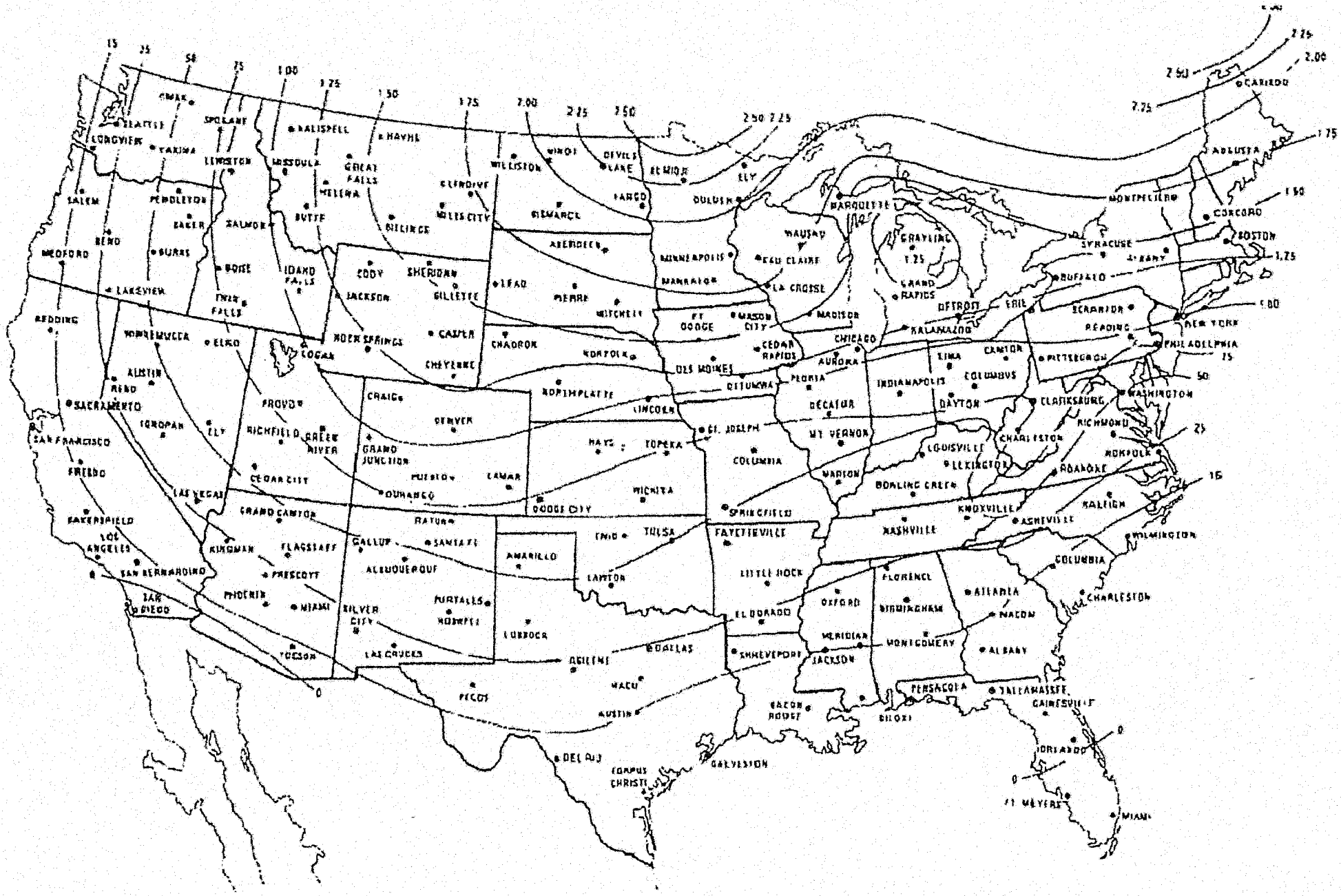

Figure 13.- Extreme depth of frost penetration (in meters).

Exhibit TLF-10

Design and Construction of Urban Stormwater Management Systems

Prepared by
The Urban Water Resources Research Council of the American Society of Civil Engineers and the Water Environment Federation (formerly the Water Pollution Control Federation)

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345 East 47th Street
New York, New York 10017-2398
and the
Water Environment Federation
601 Wythe Street
Alexandria, VA 22314-1994

whenever the rainfall intensity drops below the potential infiltration rate. In reality, infiltration does continue for some time after rainfall ceases, but the area over which infiltration continues to occur decreases rapidly with time. Thus the runoff that occurs after rainfall ceases would tend to be underestimated by the nonlinear-reservoir methods and overestimated by the excess-rainfall methods, though the difference will depend on the degree of discretization used, since a more detailed schematization can partially account for the phenomenon of decreasing area of infiltration.

C. Rational Method For Peak Discharge

In the rational method, known as the Lloyd-Davies method in the United Kingdom, peak discharge is related to rainfall intensity by the formula:

$$Q = CiA \qquad (5\text{-}13)$$

in which Q is the peak discharge, in cfs; C is a non-dimensional runoff coefficient; i is the average rainfall intensity, in in./hr, over a duration equal to the time of concentration for the contributing area; and A is the contributing area, in acres (1 acre-inch/hr = 1.008 cfs).

The rational method is based on the following assumptions:

(a) The peak discharge at any point is directly proportional to the average rainfall intensity during the time of concentration to that point.
(b) The return period of the peak discharge is the same as the return period of the average rainfall intensity.
(c) The time of concentration is the travel time from the most remote point in the contributing area to the point under consideration. This assumption applies to the point most remote in time, not necessarily in distance.
(d) The contributing area can be the entire drainage area upstream of the design point or some subset of this area, such as only the directly connected impervious portion of the drainage area.

1. *Limitations of the Rational Method*

Experience has shown that when applied properly, the rational method can provide satisfactory estimates for peak discharges on small catchments where storage effects are insignificant. The rational method is not recommended for drainage areas much larger than 100–200 acres, for any catchment where ponding of stormwater in the catchment might affect peak discharge, or where the design and operation of large (and hence more costly) drainage facilities is to be undertaken, particularly if they involve storage.

It may be possible to use the rational method in some cases where ponding affects peak discharge, by adjusting the runoff coefficient to compensate for the ponding. While procedures have been developed

for the use of the rational method in detention basin design (see Chapter 11), care should be exercised since the rational method does not produce a discharge hydrograph (Adams and Howard 1986). Procedures that use the rational method as a basis for constructing pseudo-hydrographs are not recommended.

2. *Runoff Coefficient*

The runoff coefficient, C, accounts for the integrated effects of rainfall interception, infiltration, depression storage, and temporary storage in transit on the peak rate of runoff. When estimating a value for the runoff coefficient, the engineer should consider the roles played by these hydrologic processes. The runoff coefficient depends on rainfall intensity and duration as well as the catchment characteristics. The greater the rainfall depth, the lesser the relative effect of rainfall abstractions on the peak discharge, and therefore the greater the runoff coefficient.

Decades of practical experience with the rational formula have led to some accepted ranges of values for the runoff coefficient. Table 5.5 shows normal ranges of values for several types of surfaces. Table 5.6 shows some typical ranges for the composite runoff coefficient for various urban land uses. In practice, the composite runoff coefficient for a heterogeneous catchment should be computed as the area-weighted average of the runoff coefficients for the different types of surfaces in the catchment.

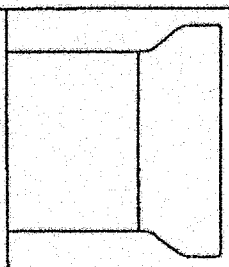
The ranges of values in Tables 5.5 and 5.6 are typical for return periods of 2–10 years. Higher values are appropriate for longer return

TABLE 5.5: Normal Range of Runoff Coefficients*

Character of Surface (1)	Runoff Coefficients (2)
Pavement	
Asphalt and Concrete	0.70 to 0.95
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Lawns, Sandy Soil	
Flat (2 percent)	0.05 to 0.10
Average (2 to 7 percent)	0.10 to 0.15
Steep (>7 percent)	0.15 to 0.20
Lawns, Heavy Soil	
Flat (2 percent)	0.13 to 0.17
Average (2 to 7 percent)	0.18 to 0.22
Steep (>7 percent)	0.25 to 0.35

*The range of "C" values presented are typical for return periods of 2–10 years. Higher values are appropriate for larger design storms.

Exhibit TLF-11



TYTON JOINT® Pipe

Pressure Class

Nominal Thickness for Standard Pressure Classes of Ductile Iron Pipe

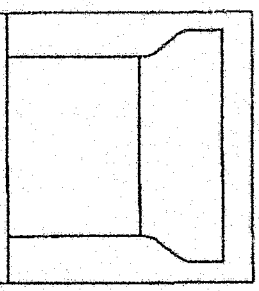
SIZE Inches	OUTSIDE DIAMETER Inches	NOMINAL THICKNESS Inches PRESSURE CLASS*					CASTING TOLERANCES Inches
		150	200	250	300	350	
3	3.96	—	—	—	—	0.25**	0.05
4	4.80	—	—	—	—	0.25**	0.05
6	6.90	—	—	—	—	0.25**	0.05
8	9.05	—	—	—	—	0.25**	0.05
10	11.10	—	—	—	—	0.26	0.06
12	13.20	—	—	—	—	0.28	0.06
14	15.30	—	—	0.28	0.30	0.31	0.07
16	17.40	—	—	0.30	0.32	0.34	0.07
18	19.50	—	—	0.31	0.34	0.36	0.07
20	21.60	—	—	0.33	0.36	0.38	0.07
24	25.80	—	0.33	0.37	0.40	0.43	0.07
30	32.00	0.34	0.38	0.42	0.45	0.49	0.07
36	38.30	0.38	0.42	0.47	0.51	0.56	0.07
42	44.50	0.41	0.47	0.52	0.57	0.63	0.07
48	50.80	0.46	0.52	0.58	0.64	0.70	0.08
54	57.56	0.51	0.58	0.65	0.72	0.79	0.09
60	61.61	0.54	0.61	0.68	0.76	0.83	0.09
64	65.67	0.56	0.64	0.72	0.80	0.87	0.09

NOTE: *Per ANSI/AWWA C150/A21.50 the thicknesses in above table include the 0.08" service allowance and the casting tolerance by size ranges.*

Dimensions and weights of Special Classes (Thickness Classes) are found on pages 13, 14, 15 and 16.

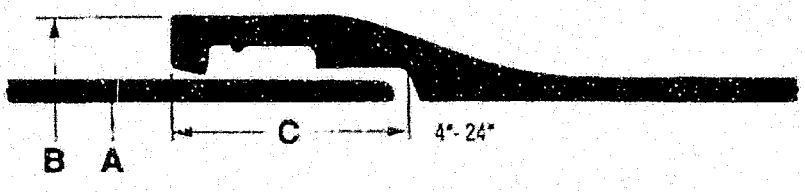
** Pressure Classes are defined as the rated water pressure of the pipe in psi. The thicknesses shown are adequate for the rated water working pressure plus a surge allowance of 100 psi. Calculations are based on a minimum yield strength of 42,000 and a 2.0 safety factor times the sum of the working pressure and 100 psi surge allowance.*

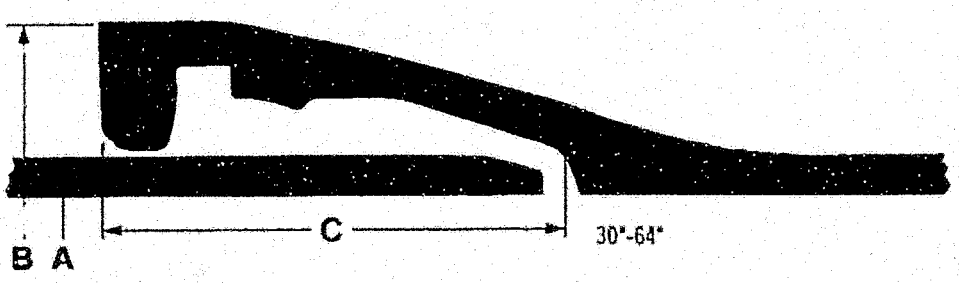
*** Calculated thickness for these sizes and pressure ratings are less than those shown above. Presently these are the lowest nominal thicknesses available in these sizes.*



TYTON JOINT® Pipe

Bell Dimensions

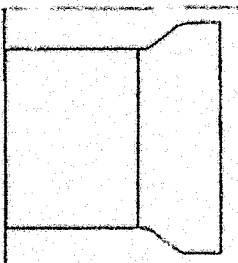




NOTE: *Actual bell configuration may vary from illustration shown.*

SIZE Inches	A PIPE OUTER DIAMETER Inches	B BELL OUTER DIAMETER Inches	C SOCKET DEPTH Inches
4	4.80	6.52	3.15
6	6.90	8.66	3.38
8	9.05	10.82	3.69
10	11.10	12.91	3.75
12	13.20	15.05	3.75
14	15.30	17.62	5.00
16	17.40	19.74	5.00
18	19.50	21.86	5.00
20	21.60	23.98	5.50
24	25.80	28.16	5.95
30	32.00	35.40	6.55
36	38.30	41.84	7.00
42	44.50	49.36	7.90
48	50.80	55.94	8.60
54	57.56	63.38	9.40
60	61.61	67.38	10.10
64	65.67	71.56	10.65

**Subject to manufacturing tolerances. Dimensions in inches.*

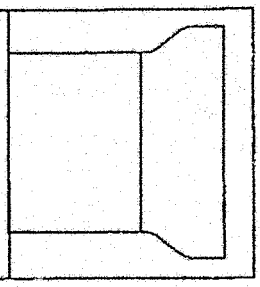


TYTON JOINT® Pipe

Products for Water, Wastewater and Fire Protection

Ductile Iron Pipe	SIZE RANGE
TYTON JOINT® Pipe	4"-64" Ductile Iron
Mechanical Joint Pipe	4"-12" Ductile Iron
TR FLEX® Pipe	4"-64" Ductile Iron
Flanged Pipe	3"-64" Ductile Iron
USIFLEX® Boltless Flexible Joint Pipe — for Subaqueous Installations	4"-48" Ductile Iron
Restrained Joints	
TR FLEX® Pipe	4"-64" Ductile Iron
MJ FIELD LOK® Gaskets	4"-24"
FIELD LOK 350® Gaskets	4"-24"
FIELD LOK® Gasket	30" & 36"
TR FLEX GRIPPER® Rings	4"-36" Ductile Iron
TR TELF FLEX® Assemblies	4"-24" Ductile Iron
HP LOK™ Restrained Joint	30"-42"
Ductile Iron Fittings	
TYTON® Fittings	14"-64" Ductile Iron
TRIM TYTON® Fittings	4"-12" Ductile Iron
TR FLEX® Fittings and TR FLEX® Telescoping Sleeves	4"-64" Ductile Iron
Mechanical Joint Fittings	3"-48" Ductile Iron
TRIM TYTE® MJ Fittings	3"-48" Ductile Iron
Flanged Fittings	3"-64" Ductile Iron
XTRA FLEX® Couplings	4"-24" Ductile Iron
Miscellaneous Products	
PROTECTO 401™ Lined Ductile Iron Pipe for Domestic Sewage and Industrial Wastes	4"-64" Ductile Iron
FLANGE-TYTE® Gaskets	4"-64"
Polymeric Linings	For all pipe sizes
Saddle Outlets	Various Ductile Iron
Welded Outlets	Various Ductile Iron
Polyethylene Encasement	4"-64"

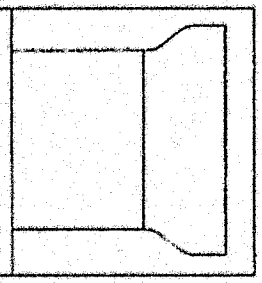
Our products are manufactured in conformance with National Standards so that our customers may be assured of getting the performance and longevity they expect. Use of accessories or other appurtenances that do not comply with recognized standards may jeopardize the performance and longevity of the project.



TYTON JOINT® Pipe

Maximum Deflection – Full Length Pipe

SIZE Inches	MAXIMUM JOINT DEFLECTION Degrees	DEFLECTION Inches		PRODUCED BY SUCCESSION OF JOINTS Feet	
		18 FT. LENGTH	20 FT. LENGTH	18 FT. LENGTH	20 FT. LENGTH
4	5°	19	—	206	—
6	5°	19	—	206	—
8	5°	19	—	206	—
10	5°	19	—	206	—
12	5°	19	—	206	—
14	5°	19	—	206	—
16	5°	19	21	206	229
18	5°	19	—	206	—
20	5°	19	21	206	229
24	5°	19	21	206	229
30	5°	19	—	206	—
36	5°	19	—	206	—
42	4°	15	—	258	—
48	4°	—	17	—	287
54	4°	—	17	—	287
60	4°	—	17	—	287
64	4°	—	17	—	287



TYTON JOINT® Pipe

Thickness Class – Thicknesses, Dimensions and Weight

				18-FOOT LAYING LENGTH		20-FOOT LAYING LENGTH	
SIZE Inches	THICKNESS CLASS	THICKNESS Inches	OUTSIDE DIAMETER* Inches	AVG. WEIGHT LENGTH† Pounds	WEIGHT PER PER FOOT†† Pounds	AVG. WEIGHT LENGTH† Pounds	PER FOOT†† Pounds
42	50	0.47	44.50	3935	218.6	—	—
42	51	0.53	44.50	4385	243.6	—	—
42	52	0.59	44.50	4835	268.6	—	—
42	53	0.65	44.50	5285	293.6	—	—
42	54	0.71	44.50	5735	318.6	—	—
42	55	0.77	44.50	6110	339.4	—	—
42	56	0.83	44.50	6625	368.1	—	—
48	50	0.51	50.80	5410	270.5	—	—
48	51	0.58	50.80	—	—	6080	304.0
48	52	0.65	50.80	—	—	6745	337.3
48	53	0.72	50.80	—	—	7410	370.5
48	54	0.79	50.80	—	—	8075	403.8
48	55	0.86	50.80	—	—	8735	436.8
48	56	0.93	50.80	—	—	9395	469.8
54	50	0.57	57.56	—	—	7170	358.5
54	51	0.65	57.56	—	—	8035	401.8
54	52	0.73	57.56	—	—	8900	445.1
54	53	0.81	57.56	—	—	9765	488.3
54	54	0.89	57.56	—	—	10620	531.1
54	55	0.97	57.56	—	—	11480	574.0
54	56	1.05	57.56	—	—	12335	616.8

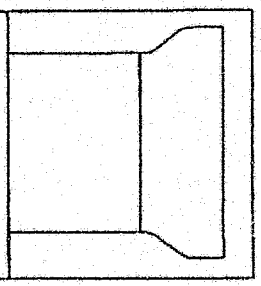
NOTE: *Thicknesses and dimensions of 4" through 64" Ductile Iron pipe conform to ANSI/AWWA C151/A21.51*
Weights may vary from the standard because of differences in bell weights

60" and 64" classified as pressure class only

**Tolerance of O.D. of spigot end 4-12 in., ±0.06 in.; 14-24 in., +0.05 in., -0.08 in., 30-48 in., +0.08 in., -0.06 in., 54-64 in., +0.04 in., -0.10 in.*

† Including bell, calculated weight of pipe rounded off to nearest 5 lbs.

†† Including bell, average weight, per foot, based on calculated weight of pipe before rounding



TYTON JOINT® Pipe

Thickness Class – Thicknesses, Dimensions and Weight (cont.)

				18-FOOT LAYING LENGTH		20-FOOT LAYING LENGTH	
SIZE Inches	THICKNESS CLASS	THICKNESS Inches	OUTSIDE DIAMETER* Inches	AVG. WEIGHT LENGTH† Pounds	WEIGHT PER PER FOOT†† Pounds	AVG. WEIGHT LENGTH† Pounds	PER FOOT†† Pounds
20	50	0.36	21.60	1395	77.5	1542	77.1
20	51	0.39	21.60	1505	83.6	1662	83.1
20	52	0.42	21.60	1610	89.4	1782	89.1
20	53	0.45	21.60	1720	95.6	1902	95.1
20	54	0.48	21.60	1825	101.4	2021	101.1
20	55	0.51	21.60	1935	107.5	2140	107.0
20	56	0.54	21.60	2040	113.3	2259	113.0
24	50	0.38	25.80	1765	98.1	1955	108.1
24	51	0.41	25.80	1895	105.3	2095	115.9
24	52	0.44	25.80	2025	112.5	2240	123.9
24	53	0.47	25.80	2155	119.7	2385	132.0
24	54	0.50	25.80	2285	126.9	2530	140.0
24	55	0.53	25.80	2415	134.2	2670	148.0
24	56	0.56	25.80	2540	141.1	2915	161.4
30	50	0.39	32.00	2275	126.4	—	—
30	51	0.43	32.00	2490	138.3	—	—
30	52	0.47	32.00	2705	150.3	—	—
30	53	0.51	32.00	2920	162.2	—	—
30	54	0.55	32.00	3135	174.2	—	—
30	55	0.59	32.00	3350	186.1	—	—
30	56	0.63	32.00	3560	197.8	—	—
36	50	0.43	38.30	3005	166.9	—	—
36	51	0.48	38.30	3330	185.0	—	—
36	52	0.53	38.30	3655	203.1	—	—
36	53	0.58	38.30	3975	220.8	—	—
36	54	0.63	38.30	4295	238.6	—	—
36	55	0.68	38.30	4615	256.4	—	—
36	56	0.73	38.30	4935	274.2	—	—

NOTE: *Thicknesses and dimensions of 4" through 64" Ductile iron pipe conform to ANSI/AWWA C151/A21.51*
Weights may vary from the standard because of differences in bell weights

**Tolerance of O.D. of spigot end: 4-12 in., ±0.06 in., 14-24 in., +0.05 in., -0.08 in., 30-48 in., +0.08 in., -0.06 in., 54-64 in., +0.04 in., -0.10 in.*
† Including bell, calculated weight of pipe rounded off to nearest 5 lbs
†† Including bell, average weight, per foot, based on calculated weight of pipe before rounding

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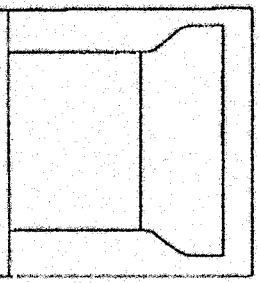

TYTON JOINT® Pipe

Thickness Class – Thicknesses, Dimensions and Weight (cont.)

				18-FOOT LAYING LENGTH		20-FOOT LAYING LENGTH	
SIZE Inches	THICKNESS CLASS	THICKNESS Inches	OUTSIDE DIAMETER* Inches	AVG. WEIGHT LENGTH† Pounds	WEIGHT PER PER FOOT†† Pounds	AVG. WEIGHT LENGTH† Pounds	PER FOOT†† Pounds
12	50	0.31	13.20	725	40.3	—	—
12	51	0.34	13.20	790	43.9	—	—
12	52	0.37	13.20	855	47.5	—	—
12	53	0.40	13.20	920	51.1	—	—
12	54	0.43	13.20	985	54.7	—	—
12	55	0.46	13.20	1045	58.1	—	—
12	56	0.49	13.20	1110	61.7	—	—
14	50	0.33	15.30	910	50.6	—	—
14	51	0.36	15.30	985	54.7	—	—
14	52	0.39	15.30	1060	58.9	—	—
14	53	0.42	15.30	1135	63.1	—	—
14	54	0.45	15.30	1210	67.2	—	—
14	55	0.48	15.30	1285	71.4	—	—
14	56	0.51	15.30	1360	75.6	—	—
16	50	0.34	17.40	1065	59.2	1177	58.9
16	51	0.37	17.40	1150	63.9	1273	63.7
16	52	0.40	17.40	1240	68.9	1369	68.5
16	53	0.43	17.40	1325	73.6	1465	73.3
16	54	0.46	17.40	1410	78.3	1560	78.0
16	55	0.49	17.40	1495	83.1	1655	82.8
16	56	0.52	17.40	1580	87.8	1750	87.5
18	50	0.35	19.50	1225	68.1	—	—
18	51	0.38	19.50	1325	73.6	—	—
18	52	0.41	19.50	1420	78.9	—	—
18	53	0.44	19.50	1520	84.4	—	—
18	54	0.47	19.50	1615	89.7	—	—
18	55	0.50	19.50	1710	95.0	—	—
18	56	0.53	19.50	1805	100.3	—	—

NOTE: *Thicknesses and dimensions of 4" through 64" Ductile Iron pipe conform to ANSI/AWWA C151/A21.51. Weights may vary from the standard because of differences in bell weights.*

**Tolerance of O.D. of spigot end: 4-12 in., ±0.06 in.; 14-24 in., +0.05 in., -0.08 in.; 30-48 in., +0.08 in., -0.06 in.; 54-64 in., +0.04 in., -0.10 in.*

† Including bell, calculated weight of pipe rounded off to nearest 5 lbs.

†† Including bell, average weight, per foot, based on calculated weight of pipe before rounding.

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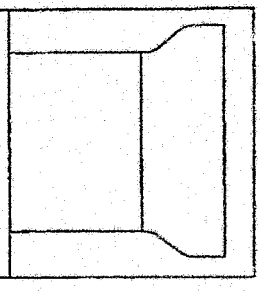

TYTON JOINT® Pipe

Thickness Class – Thicknesses, Dimensions and Weight

				18-FOOT LAYING LENGTH		20-FOOT LAYING LENGTH	
SIZE Inches	THICKNESS CLASS	THICKNESS Inches	OUTSIDE DIAMETER* Inches	AVG. WEIGHT LENGTH† Pounds	WEIGHT PER PER FOOT†† Pounds	AVG. WEIGHT LENGTH† Pounds	PER FOOT†† Pounds
4	51	0.26	4.80	215	11.9	—	—
4	52	0.29	4.80	235	13.1	—	—
4	53	0.32	4.80	260	14.4	—	—
4	54	0.35	4.80	280	15.6	—	—
4	55	0.38	4.80	300	16.7	—	—
4	56	0.41	4.80	320	17.8	—	—
6	50	0.25	6.90	305	16.9	—	—
6	51	0.28	6.90	335	18.6	—	—
6	52	0.31	6.90	370	20.6	—	—
6	53	0.34	6.90	400	22.2	—	—
6	54	0.37	6.90	435	24.2	—	—
6	55	0.40	6.90	465	25.8	—	—
6	56	0.43	6.90	495	27.5	—	—
8	50	0.27	9.05	430	23.9	—	—
8	51	0.30	9.05	475	26.4	—	—
8	52	0.33	9.05	520	28.9	—	—
8	53	0.36	9.05	560	31.1	—	—
8	54	0.39	9.05	605	33.6	—	—
8	55	0.42	9.05	650	36.1	—	—
8	56	0.45	9.05	690	38.3	—	
10	50	0.29	11.10	570	31.7	—	—
10	51	0.32	11.10	625	34.7	—	—
10	52	0.35	11.10	680	37.8	—	—
10	53	0.38	11.10	730	40.6	—	—
10	54	0.41	11.10	785	43.6	—	—
10	55	0.44	11.10	840	46.7	—	—
10	56	0.47	11.10	890	49.4	—	—

NOTE: *Thicknesses and dimensions of 4" through 64" Ductile Iron pipe conform to ANSI/AWWA C151/A21.51*
Weights may vary from the standard because of differences in bell weights

**Tolerance of O.D. of spigot end: 4-12 in., ±0.05 in.; 14-24 in., +0.05 in., -0.08 in.; 30-48 in., +0.08 in., -0.06 in.; 54-64 in., +0.04 in., -0.10 in.*

† Including bell, calculated weight of pipe rounded off to nearest 5 lbs.

†† Including bell, average weight, per foot, based on calculated weight of pipe before rounding.

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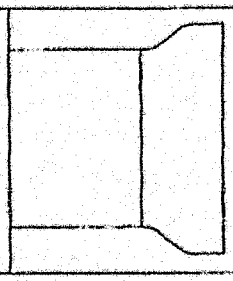


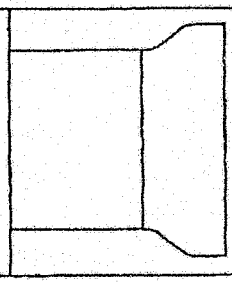
TYTON JOINT® Pipe

Pressure Class – Thicknesses, Dimensions and Weight (cont.)

SIZE Inches	PRESSURE CLASS psi	THICKNESS Inches	OUTSIDE DIAMETER* Inches	18-FOOT LAYING LENGTH WEIGHT PER LENGTH† Pounds	18-FOOT LAYING LENGTH AVG. WEIGHT PER FOOT†† Pounds	20-FOOT LAYING LENGTH WEIGHT PER LENGTH† Pounds	20-FOOT LAYING LENGTH AVG. WEIGHT PER FOOT†† Pounds
42	150	0.41	44.50	3480	193.3	—	—
42	200	0.47	44.50	3945	219.2	—	—
42	250	0.52	44.50	4310	239.4	—	—
42	300	0.57	44.50	4685	260.3	—	—
42	350	0.63	44.50	5135	285.3	—	—
48	150	0.46	50.80	—	—	4930	246.5
48	200	0.52	50.80	—	—	5505	275.3
48	250	0.58	50.80	—	—	6080	304.0
48	300	0.64	50.80	—	—	6650	332.5
48	350	0.70	50.80	—	—	7220	361.0
54	150	0.51	57.56			6520	326.0
54	200	0.58	57.56	—	—	7280	364.0
54	250	0.65	57.56	—	—	8035	401.8
54	300	0.72	57.56	—	—	8795	439.8
54	350	0.79	57.56	—	—	9550	477.5
60	150	0.54	61.61	—	—	7501	375.0
60	200	0.61	61.61	—	—	8316	415.0
60	250	0.68	61.61	—	—	9126	456.3
60	300	0.76	61.61	—	—	10056	457.8
60	350	0.83	61.61	—	—	10861	543.0
64	150	0.56	65.67	—	—	8303	415.2
64	200	0.64	65.67	—	—	9293	464.7
64	250	0.72	65.67	—	—	10283	514.2
64	300	0.80	65.67	—	—	11268	563.4
64	350	0.87	65.67	—	—	12113	506.7—

NOTE. *Thicknesses and dimensions of 4" through 64" Ductile Iron pipe conform to ANSI/AWWA C151/A21.51*
Weights may vary from the standard because of differences in bell weights.

**Tolerance of O.D. of spigot end: 4-12 in., ±0.06 in.; 14-24 in., +0.05 in., -0.08 in.; 30-48 in., +0.08 in., -0.06 in.; 54-64 in., +0.04 in., -0.10 in.*
† Including bell, calculated weight of pipe rounded off to nearest 5 lbs
†† Including bell, average weight, per foot, based on calculated weight of pipe before rounding



TYTON JOINT® Pipe

Pressure Class – Thickness, Dimensions and Weight

SIZE Inches	PRESSURE CLASS psi	THICKNESS Inches	OUTSIDE DIAMETER* Inches	18-FOOT LAYING LENGTH WEIGHT PER LENGTH† Pounds	18-FOOT LAYING LENGTH AVG. WEIGHT PER FOOT†† Pounds	20-FOOT LAYING LENGTH WEIGHT PER LENGTH† Pounds	20-FOOT LAYING LENGTH AVG. WEIGHT PER FOOT†† Pounds
4	350	0.25	4.80	205	11.4	—	—
6	350	0.25	6.90	305	16.9	—	—
8	350	0.25	9.05	400	22.2	—	—
10	350	0.26	11.10	515	28.6	—	—
12	350	0.28	13.20	660	36.7	—	—
14	250	0.28	15.30	780	43.3	—	—
14	300	0.30	15.30	835	46.4	—	—
14	350	0.31	15.30	860	47.8	—	—
16	250	0.30	17.40	950	52.8	1048	52.40
16	300	0.32	17.40	1010	56.1	1113	55.65
16	350	0.34	17.40	1065	59.2	1177	58.85
18	250	0.31	19.50	1095	60.8	—	—
18	300	0.34	19.50	1195	66.4	—	—
18	350	0.36	19.50	1260	70.0	—	—
20	250	0.33	21.60	1285	71.4	1422	71.10
20	300	0.36	21.60	1395	77.5	1542	77.10
20	350	0.38	21.60	1465	81.4	1622	81.10
24	200	0.33	25.80	1550	86.1	1712	85.6
24	250	0.37	25.80	1725	95.8	1905	95.3
24	300	0.40	25.80	1855	103.1	2049	102.5
24	350	0.43	25.80	1985	110.3	2193	109.7
30	150	0.34	32.00	2005	111.4	—	—
30	200	0.38	32.00	2220	123.3	—	—
30	250	0.42	32.00	2435	135.3	—	—
30	300	0.45	32.00	2600	144.4	—	—
30	350	0.49	32.00	2815	156.4	—	—
36	150	0.38	38.30	2680	148.9	—	—
36	200	0.42	38.30	2940	163.3	—	—
36	250	0.47	38.30	3265	181.4	—	—
36	300	0.51	38.30	3525	195.8	—	—
36	350	0.56	38.30	3845	213.6	—	—

NOTE: *Thicknesses and dimensions of 4" through 64" Ductile iron pipe conform to ANSI/AWWA C151/A21.51. Weights may vary from the standard because of differences in bell weights*

**Tolerance of O.D. of spigot end: 4-12 in. ±0.06 in.; 14-24 in., +0.05 in. -0.08 in.; 30-48 in., +0.08 in. -0.06 in.; 54-64 in. +0.04 in., -0.10 in.*

† Including bell; calculated weight of pipe rounded off to nearest 5 lbs

†† Including bell; average weight per foot, based on calculated weight of pipe before rounding.

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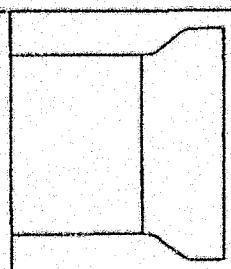


TYTON JOINT® Pipe

Pipe Diameters

Suitable Pipe Diameters for Field Cuts and Restrained Joint Field Fabrication.

NOMINAL PIPE SIZE Inches	PIPE DIAMETER Inches		PIPE CIRCUMFERENCE Inches	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
4	4.74	4.86	14-29/32	15-9/32
6	6.84	6.96	21-1/2	21-7/8
8	8.99	9.11	28-1/4	28-5/8
10	11.04	11.16	34-11/16	35-1/16
12	13.14	13.26	41-9/32	41-21/32
14	15.22	15.35	47-13/16	48-7/32
16	17.32	17.45	54-13/32	54-13/16
18	19.42	19.55	61	61-13/32
20	21.52	21.65	67-19/32	68
24	25.72	25.85	80-13/16	81-7/32
30	31.94	32.08	100-11/32	100-25/32
36	38.24	38.38	120-1/8	120-9/16
42	44.44	44.58	139-5/8	140-1/16
48	50.74	50.88	159-13/32	159-27/32
54	57.46	57.60	180-17/32	180-31/32
60	61.51	61.65	193-1/4	193-11/16
64	65.57	65.71	206	206-7/16

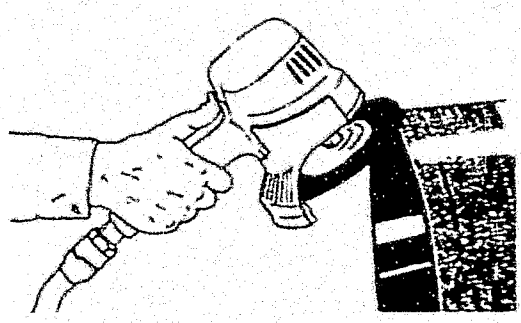
Above table based on ANSI/AWWA C151/A21.51 guidelines for push-on joints.

TYTON JOINT® Pipe

Field Cut Pipe

When pipe are cut in the field, the cut end may be readily conditioned so that it can be used to make up the next joint. The outside of the cut end should be beveled with a portable grinder about 1/4 - inch at an angle of about 30 degrees. This operation removes any sharp, rough edges which otherwise might damage the gasket.

When Ductile Iron pipe 14" and larger is to be cut in the field, the material should be ordered as "GAUGED FULL LENGTH." A *Full Length Gauged Pipe* is a pipe whose barrel outside diameter is within the spigot diameter dimensional specifications as determined by diameter tape measurements over the pipe's length to within approximately two feet of the bell chime. Pipe that is "gauged full length" is specially marked to avoid confusion. ANSI/AWWA C151 Standard for Ductile Iron pipe requires factory gauging of the spigot end. Accordingly, pipe selected for field cutting should also be field gauged in the location of the cut and ensured to be within the tolerances shown in the table on page 8. In the field a mechanical joint gland can be used as a gauging device.



NOTE: *When necessary, pipe may be rounded in accordance with U.S. Pipe's Brochure, Recommended Methods For Rounding The Cut Ends Of Out-Of-Round 14" And Larger Diameter Ductile Iron Pipe.*

TYTON JOINT® Pipe

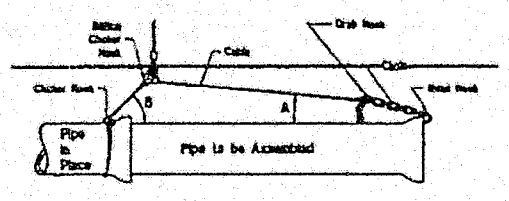
Alternate Methods of Assembly (cont.)

The most common field method of assembling larger diameter TYTON JOINT Pipe is to use a backhoe to push against the face of the bell end of the pipe to be assembled. Occasionally, there are installations where a backhoe cannot be located in line with the pipe and it is, therefore, difficult to develop enough axial force to assemble the pipe. In such cases, it may be possible to use the method described below to assemble the pipe from the side of the trench. With this method, the weight of the pipe is used to provide the axial force required for assembly. In general, a choker chain or cable is hooked around the bell of the previously laid pipe. The spigot end of the pipe to be assembled is first inserted as far as possible into the bell end of the previously laid pipe. The end of the choker is then hooked into the bell end of the pipe to be laid.

One such rigging is made from a long cable with a choker on one end and a chain grab hook on the other end with a sliding choker hook between the two other hooks. A second section of the rigging is a shorter chain with a wide throat hoisting hook on one end. The cable is first "choked" around the bell of the previously laid pipe using the fixed choker hook. The chain is hooked into the bell end of the pipe to be laid. The cable is hooked to the chain with the grab hook. The connected length of the rigging can thus be adjusted with the connection between the cable grab hook and the chain. The pipe assembly is made by lifting up on the sliding choker hook.

A few rules of thumb:

1. Angle 'A' should be no greater than 15 degrees.
2. Angle 'B' should be from 45 to 60 degrees.
3. The sliding choker hook should be located from 2 to 8 feet from the bell of the previously laid pipe.
4. Trial assembly may be made to get a "feel" for the correct amount of slack to be left in the rigging and the proper location of the sliding choker hook.



A few precautions:

1. The smaller the angle (A), the larger will be the assembly force and the tension in the rigging. The assembly force and the tension will generally range from 2 to 10 times the weight of the pipe being assembled. These forces are at a maximum when the assembly is bottomed out and lift is still being applied to the rigging. To minimize the loads on the rigging, it is recommended that the assembly be made slowly and the assembly stopped as soon as the joint is bottomed out.
2. The rigging should be properly designed to accommodate the diameter, length, and weight of the pipe on the job and the loads previously described.

NOTE: *This method should not be employed when installing FIELD LOK 350® Gaskets since alignment of the joint cannot be assured. For the proper installation practice, refer to U.S. Pipe Brochure FIELD LOK 350® Gasket Joint Restraint for 4"-24" Ductile Iron Pipe for Water, Wastewater, Fire Protection and Industrial Applications.*

TYTON JOINT® Pipe

Alternate Methods of Assembly

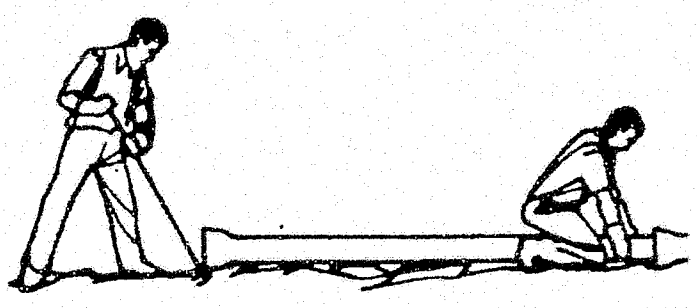
Procedures outlined in figures 1-3 on page 3, showing the assembly of TYTON JOINT Pipe, should be followed before proceeding with the methods shown below.

Backhoe Method of Assembly

A backhoe may be used to assemble pipe of intermediate and larger sizes. The plain end of the pipe should be carefully guided by hand into the bell of the previously assembled pipe. The bucket of the backhoe may then be used to carefully push the pipe until fully seated. A timber header should be used between the pipe and the backhoe bucket to avoid damage to the pipe. Caution: Avoid "slamming" the pipe home to prevent damage to lining material inside the bell at the back of the socket.

Crowbar Method of Assembly

Smaller sizes of pipe may be assembled using a crowbar as a lever and pushing against the face of the bell.



Come-along Method of Assembly

Installers may prefer to use come-alongs to assemble pipe of all sizes. Two (2) 3/4 ton chain hoists, 24 feet of chain and two (2) bell choker slings for 4"-24" sizes or two (2) 1-1/2 ton (minimum) chain hoists for 30"-64" sizes.

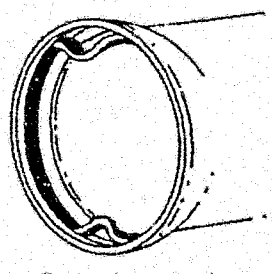
TYTON JOINT® Pipe

Assembly

Figure 1. Insertion of Gasket

All foreign matter in the socket must be removed, i.e., mud, sand, cinders, gravel, pebbles, trash, frozen material, etc. The gasket seat should be thoroughly inspected to be certain it is clean. Foreign matter in the gasket seat may cause a leak. The gasket must be wiped clean with a clean cloth, flexed, and then placed into the socket with the rounded bulb end entering first. Looping the gasket in the initial insertion will facilitate seating the gasket heel evenly around the retainer seat. 4" through 12" sizes require only one loop. For larger sizes, additional loops may be required. 14" through 36", two to three loops; 42" through 54", four to six loops; 60" and 64", six or more loops. When installing TYTON JOINT Pipe in sub-freezing weather, the gaskets, prior to their use, must be kept at a temperature of at least 40°F by suitable means, such as storing in a heated area or keeping them immersed in a tank of warm water. If the gaskets are kept in warm water, they should be dried before placing in the pipe socket.

1.



One loop for smaller sizes.

Figure 2. Application of Lubricant

A thin film of TYTON JOINT® Lubricant should be applied to the inside surface of the gasket, which will come in contact with the plain end of the pipe. Spray-on lubricants should not be used as it may not provide sufficient lubricity. The plain end of the pipe must be cleaned of all foreign matter on the outside from the end to the stripes. Frozen materials may cling to the pipe in cold weather and must be removed. A thin film of lubricant is applied to the outside of the plain end for about 3" back from the end. Do not allow the plain end to touch the ground or trench side after lubricating since foreign matter may adhere to the plain end and cause a leak.

2.

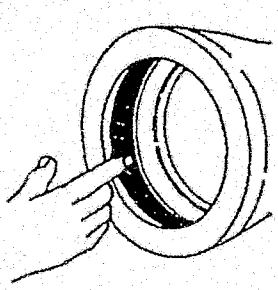


Figure 3. Initial Entry of Plain End in Socket

The plain end of the pipe should be aligned and carefully entered into the socket until it just makes contact with the gasket. This is the starting position for the final assembly of the joint. Note the two painted stripes on the plain end.

3.

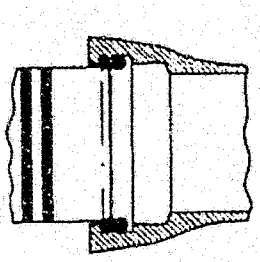
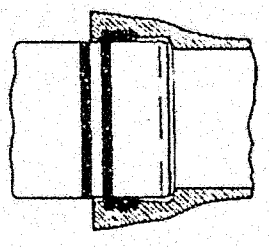


Figure 4. Completely Assembled Joint

Joint assembly should be completed by forcing the plain end of the entering pipe past the gasket (which is thereby compressed) until the plain end makes contact with the bottom of the socket. Note that the first painted stripe will have disappeared into the socket and the front edge of the second stripe will be approximately flush with the bell face. Joint deflection may be achieved after the pipe is fully inserted. If assembly is not accomplished with the application of reasonable force by the methods indicated, the plain end of the pipe should be removed to check for the proper positioning of the gasket, adequate lubrication, and removal of foreign matter in the joint.

A feeler gage may be inserted between the bell and the plain end of the assembled joint to verify the position of the gasket. When the gage encounters the gasket, increased resistance will be felt. Note the depth of insertion of the gage. Continue probing around the periphery of the joint, noting the depth to resistance each time. If the depth of insertion is uniform, the gasket has remained in place. If, at any point, the depth of insertion increases significantly, this indicates a dislodged gasket. The joint should be disassembled, thoroughly cleaned with water, and examined for any condition that might have caused the gasket to become dislodged before attempting to reassemble the joint.

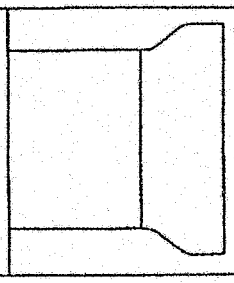
4.



NOTE: *When using FIELD LOK 350® Gaskets or pipe with special linings, assemble the joint until the inside edge of the first painted stripe (or the assembly mark) is flush with the bell face.*

CAUTION: *The inside of the socket, the gasket, and the plain end to be inserted must be kept clean through-out the assembly. Joints are only as water-tight as they are clean. If the joint is somewhat difficult to assemble, inspect for proper gasket positioning, adequate lubrication, and foreign matter in the joint.*

866.DIP.PIPE



TYTON JOINT® Pipe

NSF

2005 EDITION | P3

TYTON JOINT Pipe

TYTON JOINT is U.S. Pipe's trademark for pipe with a push-on type connection. Simplicity, sturdiness and water-tightness of the system are built into the system by design. Convincing proof of its worldwide acceptance is shown by the fact that more than 95% of the pipe now sold by U.S. Pipe is TYTON JOINT Pipe.

TYTON JOINT Pipe is available in sizes 4" through 64". Sizes 4" through 42" are available in nominal 18-foot laying lengths. 16", 20" and 24" sizes along with sizes 48" through 64" are available in nominal 20-foot laying lengths.

TYTON JOINT Pipe in sizes 4" through 36" are UL Listed and sizes 4" through 16" are FM Approved.

When TYTON JOINT Pipe are used for bridge crossings or other above-ground installations, each length of pipe must be supported in a manner to restrict both vertical and horizontal movement.

TYTON® Gasket is the only accessory required when installing TYTON JOINT Pipe. It is a circular rubber gasket which has a modified bulb shape in cross section. Gaskets are furnished in accordance with ANSI/AWWA C111/A21.1. Composition and dimensions of the gasket have been carefully engineered to ensure a water-tight and lasting seal. The standard TYTON Gasket is manufactured of SBR - styrene butadiene rubber. Gaskets of special elastomers may be ordered for special applications. The gasket contour and bell socket contour ensure that the gasket will remain seated during proper assembly of the pipe. When joint restraint is required for push-on joint pipe, two options are available from U.S. Pipe. For joint restraint of 4" through 24", FIELD LOK 350® Gaskets may be used and for joint restraint for 30" and 36", FIELD LOK® Gaskets may be used. FIELD LOK 350 Gaskets are rated for 350 psi in sizes 4" through 24". In addition for 4" through 64" sizes, TR FLEX® Pipe and Fittings may be used. TR FLEX Pipe and Fittings are rated for working pressures for 350 psi in 4" through 24" sizes, 250 psi in sizes 30" through 48", and 200 psi in sizes 54" through 64". For higher pressure applications contact your U.S. Pipe representative. Complete details on both FIELD LOK 350 Gaskets and TR FLEX Pipe and Fittings can be found on our website, www.uspipe.com.

NOTE: *U.S. Pipe qualifies for Federal Procurement under Public Law No. 94-580, Section 6002, known as the Resource Recovery Act of 1976, since due to modern technology, recycled iron and steel scrap is used to a large degree in our Ductile Iron Pipe production.*

The plain end of the pipe is furnished beveled or with a quarter ellipse on the edge to allow assembly. More than 40 years of successful experience have proved its sealing capabilities. Hydrostatic tests have shown that the system will withstand pressures far in excess of rated pressures.

ANSI/AWWA Standards

ANSI/AWWA C151/A21.5, Ductile-Iron Pipe, Centrifugally Cast for Water.

Ductile Iron TYTON JOINT Pipe is centrifugally cast in metal molds in accordance with ANSI/AWWA C151/A21.5.

ANSI/AWWA C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

The asphaltic outside coating is in accordance with ANSI/AWWA C151/A21.51.

As specified in ANSI/AWWA C151/A21.51, pipe weights have been calculated using standard barrel weights and weights of bells being produced.

ANSI/AWWA C104/ A21.4, Cement-Mortar Lining For Ductile-Iron Pipe and Fittings For Water.

The cement-mortar lining and inside coating are in accordance with ANSI/AWWA C104/ A21.4. Special linings and/or coatings can be furnished for specific conditions.

ANSI/AWWA C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

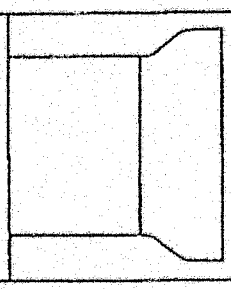
TYTON® Gaskets are furnished in accordance with ANSI/AWWA C111/A21.11.

ANSI/ AWWA C105/A21.5, Polyethylene Encasement for Ductile Iron Pipe Systems.

If specifiers and users believe that corrosive soils will be encountered where our products are to be installed, please refer to ANSI/AWWA C105/A21.5, for proper external protection procedures.

TYTON®, TYTON JOINT®, TR FLEX® and FIELD LOK 350® are Registered Trademarks of U.S. Pipe and Foundry Company.

866.DIP.PIPE



TYTON JOINT® Pipe

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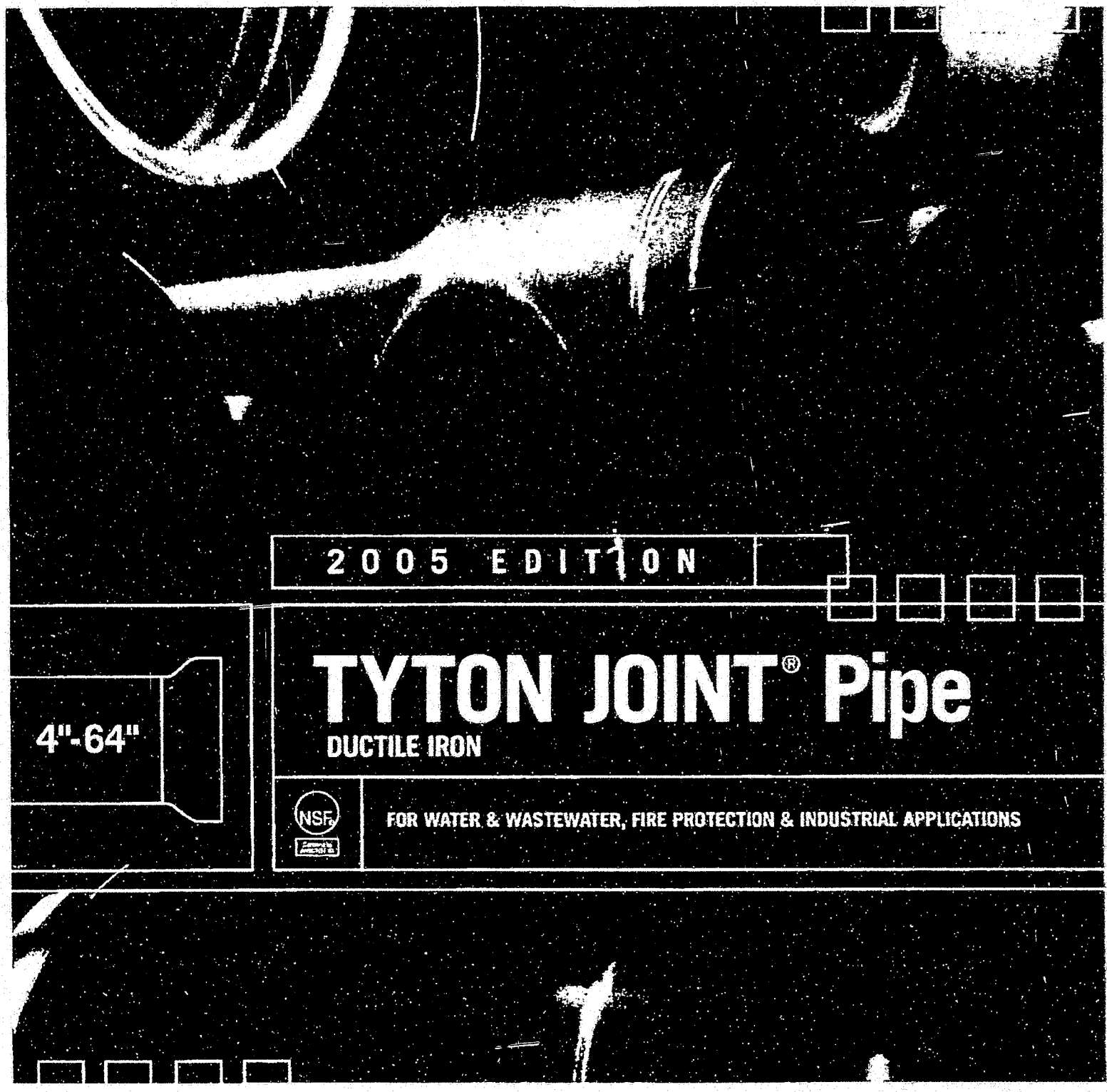

2005 EDITION

4"-64"

TYTON JOINT® Pipe

DUCTILE IRON

NSF

FOR WATER & WASTEWATER, FIRE PROTECTION & INDUSTRIAL APPLICATIONS

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MORE THAN JUST PIPE.

US PIPE

Schedule TLF-1

DATA FROM OPERATOR'S LOGS

Date on Log	Total Supply to Penn Water District (gal.) Year 2004	Year 2005	Year 2006
1-Jan	2,519,400	3,214,600	3,608,000
2-Jan	2,862,000	3,124,200	3,333,400
3-Jan	2,729,800	3,577,800	3,491,200
4-Jan	2,714,600	3,296,900	3,753,400
5-Jan	2,963,900	3,314,200	3,380,600
6-Jan	2,797,700	3,275,900	3,063,600
7-Jan	2,812,700	3,336,700	2,908,600
8-Jan	2,848,400	2,980,700	3,264,200
9-Jan	2,597,500	3,469,500	3,378,000
10-Jan	2,189,400		3,190,700
11-Jan	2,681,000	3,374,100	3,123,700
12-Jan	2,975,300	3,137,900	2,675,900
13-Jan	2,857,800	3,287,300	3,017,600
14-Jan	3,048,800	3,347,700	2,914,700
15-Jan	2,721,300	3,211,200	3,270,900
16-Jan	2,868,100	3,464,100	3,393,100
17-Jan	2,692,400	3,454,200	3,208,300
18-Jan	2,982,100	3,411,500	3,011,100
19-Jan	2,937,400	3,492,500	3,201,500
20-Jan	2,961,700	3,313,000	3,812,400
21-Jan	2,895,200	3,142,500	2,964,700
22-Jan	2,976,800	3,675,900	3,064,600
23-Jan	2,783,700	3,249,000	3,483,300
24-Jan	2,995,200	3,836,700	3,267,100
25-Jan	3,013,400	3,684,300	3,215,300
26-Jan	3,261,865	3,312,100	2,684,200
27-Jan	2,883,100	3,346,904	3,057,400
28-Jan	2,676,900	3,159,300	2,933,600
29-Jan	3,142,478	3,307,400	3,308,600
30-Jan	2,815,100	3,286,400	3,440,800
31-Jan	2,695,500	3,872,000	3,141,300
Minimum	**2,189,400**	**2,980,700**	**2,675,900**
Average	**2,835,501**	**3,365,217**	**3,211,671**
Maximum	**3,261,865**	**3,872,000**	**3,812,400**

DATA FROM OPERATOR'S LOGS

Date on Log	Total Supply to Penn Water District (gal.) Year 2004	Year 2005	Year 2006
1-Feb	3,163,300	3,264,200	3,164,500
2-Feb	3,253,400	3,402,800	3,224,300
3-Feb	3,205,600	3,486,700	2,936,400
4-Feb	2,616,500	3,107,300	3,021,700
5-Feb	2,853,300	3,159,500	3,026,100
6-Feb	2,938,900	3,772,200	3,429,000
7-Feb	2,747,800	4,061,100	3,163,500
8-Feb	3,067,100	3,583,100	2,785,700
9-Feb	3,249,300	3,247,450	3,255,700
10-Feb	2,872,700	2,988,000	3,091,000
11-Feb	2,872,200	3,027,100	2,935,700
12-Feb	3,338,200	2,973,300	3,210,600
13-Feb	3,191,300	3,133,000	3,426,500
14-Feb	3,177,900	3,284,500	3,006,000
15-Feb	3,302,800	2,963,900	3,023,500
16-Feb	3,381,000	3,134,500	3,030,100
17-Feb	3,089,300	3,083,200	3,176,600
18-Feb	3,090,000	3,095,700	2,781,300
19-Feb	2,913,400	2,763,600	3,224,000
20-Feb	2,978,100	3,192,600	3,345,800
21-Feb	2,834,600	3,484,700	3,277,300
22-Feb	2,984,600	3,098,700	3,157,600
23-Feb	3,172,200	3,198,000	3,150,100
24-Feb	2,911,500	3,180,200	3,094,600
25-Feb	2,951,200	2,910,000	3,057,500
26-Feb	2,956,400	3,021,700	3,148,000
27-Feb	2,952,800	2,849,000	3,340,300
28-Feb	2,768,500	3,679,400	3,235,700
29-Feb	3,105,200		
Minimum	**2,616,500**	**2,763,600**	**2,781,300**
Average	**3,032,383**	**3,219,480**	**3,132,825**
Maximum	**3,381,000**	**4,061,100**	**3,429,000**

Minimum (Feb 10 thru 28)	**2,763,600**
Average (Feb 10 thru 28)	**3,141,149**
Maximum (Feb 10 thru 28)	**4,061,100**

DATA FROM OPERATOR'S LOGS

Date on Log	Total Supply to Penn Water District (gal.) Year 2004	Year 2005	Year 2006
1-Mar	3230700.0	3,146,300	3,110,100
2-Mar	2883200.0	3,212,000	3,114,500
3-Mar	2734200.0	3,120,300	3,146,200
4-Mar	2882400.0	3,101,400	2,955,700
5-Mar	2827700.0	2,783,000	3,104,000
6-Mar	2811200.0	3,216,300	3,420,500
7-Mar	2856000.0	3,478,500	3,080,800
8-Mar	3217900.0	2,985,600	3,149,500
9-Mar	2958000.0	2,944,900	3,002,800
10-Mar	2949300.0	3,175,600	3,091,000
11-Mar	3009300.0	3,046,800	2,899,700
12-Mar	2891000.0	2,712,900	3,292,000
13-Mar	2799100.0	3,114,200	3,396,800
14-Mar	2974100.0	3,534,000	3,075,700
15-Mar	3173660.0	3,060,200	3,202,000
16-Mar	2871800.0	3,177,700	3,027,800
17-Mar	2889000.0	2,937,200	3,152,100
18-Mar	3346080.0	3,187,100	2,814,600
19-Mar	2723400.0	3,208,300	3,248,700
20-Mar	2733280.0	2,886,900	3,343,700
21-Mar	2803140.0	3,295,100	3,000,500
22-Mar	3257340.0	3,070,900	3,215,500
23-Mar	3134300.0	3,053,900	3,214,400
24-Mar	2660900.0	2,670,000	3,192,400
25-Mar	2914700.0	3,114,500	3,058,600
26-Mar	2836080.0	3,058,600	3,405,300
27-Mar	2473000.0	3,161,600	3,599,200
28-Mar	2814700.0	3,031,900	3,244,300
29-Mar	3103400.0	3,371,300	3,102,000
30-Mar	2986000.0	3,193,900	3,103,400
31-Mar	2891300.0	3,071,300	3,481,700
Minimum	**2,473,000**	**2,670,000**	**2,814,600**
Average	**2,923,748**	**3,100,716**	**3,169,210**
Maximum	**3,346,080**	**3,534,000**	**3,599,200**

PENN WATER DISTRICT - WATER SUPPLIED BEFORE BREAK OCCURRED (GALLONS)

Facility/Date	1/17/2005	1/18/2005	1/19/2005	1/20/2005	1/21/2005	1/22/2005	1/23/2005	Totals
Well 12	419,400	400,800	415,900	406,300	398,800	405,300	401,600	
Well 13	373,500	361,200	379,100	363,200	357,000	384,200	362,400	
Well 16	331,700	333,500	366,500	326,200	349,300	381,000	319,300	
Well 18	423,300	418,200	429,000	413,400	410,400	419,300	415,500	
Well 19	527,300	500,200	511,300	510,100	497,000	528,400	488,700	
Well 20	551,100	529,100	550,900	528,300	534,100	508,000	500,300	
Well 21	0	0	0	0	0	0	0	
Well 23	120,000	140,000	140,400	85,900	92,700	122,600	131,000	
Total Pumping	2,746,300	2,683,000	2,793,100	2,633,400	2,639,300	2,748,800	2,618,800	
Purchase	15,200	15,100	14,000	13,800	13,200	16,300	12,400	
Purchase	723,100	713,400	685,400	665,800	490,400	910,800	616,800	
Total Purchase	738,300	728,500	699,400	679,600	503,600	927,100	629,200	
Grand Total	3,484,600	3,411,500	3,492,500	3,313,000	3,142,900	3,675,900	3,248,000	23,768,400

PENN WATER DISTRICT - WATER SUPPLIED AFTER BREAK REPAIRED (GALLONS)

Facility/Date	2/10/2005	2/11/2005	2/12/2005	2/13/2005	2/14/2005	2/15/2005	2/16/2005	
Well 12	330,500	414,900	353,900	401,600	430,800	417,600	419,000	
Well 13	328,900	323,800	329,600	367,200	373,800	366,700	367,400	
Well 16	355,300	323,000	282,900	336,700	344,700	339,900	341,500	
Well 18	410,900	414,500	413,100	417,300	417,900	419,000	422,300	
Well 19	484,600	484,400	487,400	498,200	513,300	502,200	503,000	
Well 20	510,200	524,300	515,200	507,400	528,800	471,600	439,800	
Well 21	451,500	445,000	425,300	498,000	510,900	313,000	499,000	
Well 23	100,600	97,200	153,100	93,900	147,800	121,000	130,000	
Total Pumping	2,972,500	3,027,100	2,960,500	3,120,300	3,268,000	2,951,000	3,122,000	
Purchase	15,500	0	0	0	0	0	0	
Purchase	0	15,500	12,800	12,700	16,400	12,900	12,500	
Total Purchase	15,500	15,500	12,800	12,700	16,400	12,900	12,500	
Grand Total	2,988,000	3,042,600	2,973,300	3,133,000	3,284,400	2,963,900	3,134,500	21,519,700

Total Reduction After Break, gallons per 7 day period 2,248,700

Total Reduction After Break, Average gallons per day 321,243
Total Reduction After Break, Average gallons per minute 223

OCA STATEMENT No. 2S

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Spring Township	:	
v.	:	Docket No. C-20054746
Pennsylvania American Water Company	:	
Neil R Rahn and David Singerling, et al.	:	
v.	:	Docket No. C-20054919
Pennsylvania-American Water Company	:	
Wilson School District	:	
v.	:	Docket No. C-20055371
Pennsylvania American Water Company	:	

SURREBUTTAL TESTIMONY

OF

DONALD M. HOSKINS, Ph.D., P.G.

ON BEHALF OF

PENNSYLVANIA OFFICE OF CONSUMER ADVOCATE

JUNE 22, 2006

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS FOR THE RECORD.

A. Donald M. Hoskins, 5403 Rodgers Avenue, Harrisburg, Pennsylvania, 17111.

Q. DR. HOSKINS, ARE YOU THE SAME PERSON WHO SUBMITTED DIRECT TESTIMONY IN THIS PROCEEDING ON BEHALF OF THE OFFICE OF CONSUMER ADVOCATE?

A. Yes.

Q. WHAT IS THE PURPOSE OF YOUR SURREBUTTAL TESTIMONY?

A. The purpose of my surrebuttal testimony is to respond to the direct testimony of the Company's witnesses Richard L. Kanaskie, P.G.

Response to Mr. Kanaskie's Testimony

Q. WHAT ISSUES IN MR. KANASKIE'S TESTIMONY ARE YOU RESPONDING TO?

A. Mr. Kanaskie provided direct testimony as an expert in the field of geology. (Page 2, lines 6-7). I am responding to the following statements and opinions that he provided in his testimony: Mr. Kanaskie proposes (1) that perched water from underground springs, seeps or surface percolation upheld by soil hardpan can find zones of weakness in pipe trenches; (2) that associated with perched water from these sources are high seasonal water tables; and (3) his opinion that it is unreasonable for PAWC to perform testing to identify subsurface features throughout the Wagner Farms development.

Q. WHAT IS MR. KANASKIE'S POSITION ON PERCHED WATER?

A. On page 8, lines 15 to 18 Mr. Kanaskie states: "Water can be naturally occurring as springs and seeps that would flow underground above the true water table. Water will also enter the ground in grass areas adjacent to the roadway and percolate into the ground. This water will generally get held up above the bedrock surface or in areas that may have a hard pan in the soil that retards infiltration of the water. This water will begin to move laterally and it may find zones of weakness such as pipe trenches."

Q. ARE THESE STATEMENTS SUPPORTED BY ANY DATA?

A. Mr. Kanaskie identifies multiple sources of water that he claims could have caused sink-hole activity without providing any other evidence that his position is supported by available data. No subsurface springs or seeps have been identified at or near the water main break. No evidence is presented that a soil "hard pan" exists in the soils underlying or adjacent to the area of the water main break. No data is provided to indicate that water was perched on a soil "hard pan" in or near to the area of the water main break. No evidence is presented showing that water has moved laterally into the water main trench.

Q. WHAT DOES MR. KANASKIE'S SAY ABOUT HIGH WATER TABLES?

A. On page 8, lines 20-21 Mr. Kanaskie states: "Also, closely associated with the perched water table is high seasonal water tables accompanying months with above normal rainfall."

Q. IS THAT STATEMENT SUPPORTED?

A. No. Mr. Kanaskie provides no data as to the state of the ground water table at the time of the water main break. Such data is available from the U. S. Geological Survey, the na-

tional public service agency that maintains ground water observation wells throughout Pennsylvania that hourly record the level of water in these wells. He assumes, without supporting data that the area's rainfall could have produced a high water table.

Q. IS MR. KANASKIE'S OPINION ABOUT REQUIRING THE UTILITY TO PERFORM GEOPHYSICAL TESTING VALID?

A. No. Mr. Kanaskie states, "It is my opinion, within a reasonable degree of geological certainty, that it is not reasonable to do so, as any subsurface findings cannot be determined to be related to the escape of water from the water main break". I disagree with his opinion.

The presently visible damage on property adjacent to the site of the water main break plus the visible evidence of water flow from the water main break site to additional property within the Development are all geological and hydrogeological evidence that water flow was initially directed west south westerly along geologically controlled subsurface channels, eroding the stabilized infilling material. The surface evidence is that this water flow was of such high intensity to undermine vegetation, land surface and building structure through creating of voids above the bedrock into which the surface soil and vegetation collapsed.

Similar voids were likely developed following the geologically controlled channels elsewhere beneath paving and structures of the Development. These voids are discoverable using geophysical testing procedures that are specifically designed to identify voids. Once identified by the appropriate geophysical testing procedures, the voids can be con-

firmed with drill or probe testing similar to that performed by PAWC in the parking lot of the nearby school on Iroquois Avenue. Once direct drilling or probing confirms voids, remediation can then be performed.

No visible evidence of karst related surface features (such as closed depressions) existed prior to the construction of the Wagner Farms Development. This is borne out by examination of aerial photography of the area. From this data a reasonable geological conclusion can be drawn that such sinkholes that likely exist in the bedrock had become stabilized. They were filled with the normal materials resulting from the dissolution of the underlying bedrock. Voids into which the surface soil could collapse, such as adjacent to the water main break, were absent in the Development.

Thus voids discovered during the recommended geophysical testing and probing, if any, would be the direct result of the water main break and the resulting high intensity water flow. These voids should be identified and remediated in order to protect the welfare of the community.

89438

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Spring Township	:	
v.	:	Docket No. C-20054746
Pennsylvania American Water Company	:	
Neil R Rahn and David Singerling, et al.	:	
v.	:	Docket No. C-20054919
Pennsylvania-American Water Company	:	
Wilson School District	:	
v.	:	Docket No. C-20055371
Pennsylvania American Water Company	:	

EXHIBIT A

EXCERPTS OF PUBLIC DOCUMENTS AND RECORDS OF OTHER PROCEEDINGS PURSUANT TO 52 PA. CODE §§5.406-5.407 SUBMITTED BY THE OFFICE OF CONSUMER ADVOCATE

DATED: JUNE 27, 2006

shall be sized and designed to accommodate the standards contained in this chapter, particularly in regard to §§ 65.6 and 65.17 (relating to pressures; and standards of design) and this section.

(d) *Company's service lines.* Company's service lines shall include the following.

(1) Whenever feasible, all service pipes shall be installed below the frost line to prevent freezing, and the pipe shall be installed at a depth adequate to protect the pipe from surface activity.

(2) Service connections should not be connected to hydrant branch lines, and they should not cross intervening properties unless there is no other way in which service can be provided and appropriate easements are obtained.

Authority

The provisions of this § 65.18 issued under the Public Utility Code, 66 Pa.C.S. §§ 317, 501, 1301, 1304, 1501, 1502, 1504, 1507, 1508, 1702 and 1704.

Source

The provisions of this § 65.18 adopted August 15, 1980, August 16, 1980, 10 Pa.B. 3356, amended April 8, 1983, effective April 9, 1983, 13 Pa.B. 1257. Immediately preceding text appears at serial pages (52652) and (52653).

§ 65.19. Filing of annual financial reports.

Under 66 Pa.C.S. §§ 504 and 3301 (relating to reports by public utilities; and civil penalties for violations), the Commission may require a public utility to file, and invoke penalties for failure to file, certain reports. In this regard, the following apply:

(1) Unless prior permission to do otherwise is granted, a public utility, other than transportation, subject to the jurisdiction of the Commission, shall file annual financial reports with the Commission by April 30 immediately following the reporting year, for reports based upon the calendar year; or by July 31 immediately following the reporting year, for reports permitted to be based upon the fiscal year ending May 31. A request for an extension of time for filing an annual report shall be submitted to the Commission prior to the filing dates specified in this paragraph.

(2) If a public utility, other than transportation, fails to file its annual report in compliance with this section, the public utility may be subject to a penalty as provided under 66 Pa.C.S. § 3301. Continued failure to file annual reports may result in additional penalties.

Authority

The provisions of this § 65.19 issued under the Public Utility Code, 66 Pa.C.S. §§ 501 and 504.

Source

The provisions of this § 65.19 adopted May 6, 1988, effective May 7, 1988, 18 Pa.B. 2106.

Cross References

This section cited in 52 Pa. Code § 101.2 (relating to definitions); and 52 Pa. Code § 101.4 (relating to reporting requirements).

§ 65.20. Water conservation measures—statement of policy.

In rate proceedings of water utilities, the Commission intends to examine specific factors regarding the action or failure to act to encourage cost-effective conservation by their customers. Specifically, the Commission will review utilities' efforts to meet the criteria in this section when determining just and reasonable rates and may consider those efforts in other proceedings instituted by the Commission.

(1) *Education.* At least once a year a utility should provide each customer with a brochure or similar type of material which discusses efficient water use practices, the expensive waste caused by leaking plumbing fixtures, the availability of retrofitting plumbing devices to curtail unnecessary water use, and the possible savings on water and fuel bills that could ensue when these conservation methods are implemented.

(2) *Water audit for large users.* On an annual basis each large, nonresidential customer, such as a college, motel or health club, should receive, or be directed to the availability of the large water user audit procedure developed by the Department of Environmental Resources, or other, similar format, via a printed message on or with their bill.

(3) *Efficiency plumbing fixtures.* Customers should be notified annually that water-saving plumbing fixtures should be installed in new construction or when remodeling. If construction or renovations are not scheduled, customers should be encouraged to retrofit existing plumbing fixtures.

(4) *Unaccounted-for water.* Levels of unaccounted-for water should be kept within reasonable amounts. Levels above 20% have been considered by the Commission to be excessive.

(5) *Leak detection.* A system of leak detection should be utilized on a regular basis, with leaks being repaired as expeditiously and economically as possible.

(6) *Metering.* A comprehensive metering program should be in place which includes metering sources of supply, metering service to customers—aside from formally granted interim exemptions, and the regular testing and maintenance of meters in service.

(7) *Conservation plan.* The mandatory conservation contingency plan should be properly filed within each utility's tariff.

Authority

The provisions of this § 65.20 issued under the Public Utility Code, 66 Pa.C.S. § 523(b).

Source

The provisions of this § 65.20 adopted April 7, 1989, effective April 8, 1989, 19 Pa.B. 1575.

(311944) No. 369 Aug. 05

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STATEMENTS OF POLICY

25—ENVIRONMENTAL RESOURCES

MENT OF ENVIRONMENTAL RESOURCES

[25 PA. CODE CH. 16]

[CORRECTION]

Quality Toxics Management Strategy

or appeared in the document adopting a state-policy at 25 Pa. Code Chapter 16 (relating to ility toxics management strategy—statement of hich appeared at 19 Pa.B. 1059, 1079—1089 1989).

d "inorganics" should have been "organics" in ng of Table 2 from 19 Pa.B. 1079 to 19 Pa.B. correct version of the heading for these pages ROVED EPA ANALYTICAL METHODS AND TION LIMITS: ORGANICS."

Pa.B. Doc. No. 89-371. Filed March 10, 1989, 9:00 a.m.]

52—PUBLIC UTILITIES

NNSYLVANIA PUBLIC UTILITY COMMISSION

[52 PA. CODE CH. 65]

[I-880049]

Water Utility Conservation Measures

public meeting held February 16, 1989, the lvania Public Utility Commission adopted a final olicy statement on performance criteria regarding tility conservation measures under 52 Pa. Code The policy establishes the basic criteria to be d in future rate proceedings filed by jurisdic-water utilities. The Commission has the authority ose this policy statement under 66 Pa.C.S. §§ 501 3(b) (relating to general powers; and performance onsideration). The contact person is Carol J. Conservation, Economics and Energy Planning, 83-1646.

missioners Present: Bill Shane, Chairman; William Vice Chairman; Joseph Rhodes, Jr.; Frank

Public Meeting
held February 16, 1989

Order

Commission:

section 523(b) of the Public Utility Code (66 § 523(b)) we are required to set forth criteria to future fixed utility performance in areas which matters of efficiency, effectiveness and adequacy Specifically, we are required to consider, *inter* [a]ction or failure to act to encourage cost-effective conservation by customers of water utilities" (§ 523(b)(5)). On April 7, 1988, we approved a proposed policy statement on performance criteria regarding water conservation measures at 52 Pa. Code § 65.20.

These specific performance factors will be examined in future rate proceedings. Since the principles and standards are relatively new and of potential importance, we issued the proposed policy statement for comment. The policy statement was published in the *Pennsylvania Bulletin* on July 9, 1988 (18 Pa.B. 3069) with a 30-day comment period. The criteria upon which we proposed to judge the utilities' performance was categorized into the two major sections of utility programs for customers, and utility conservation efforts. The former section was further categorized into the subsections of education and water audits for large users. The latter section was similarly sub-categorized as follows: efficient plumbing fixtures, unaccounted-for water, leak detection, metering and the conservation plan.

Comments were received from the National Association of Water Companies (NAWC), Pennsylvania Chapter; the Department of Environmental Resources (DER); the Delaware River Basin Commission (DRBC); the Susquehanna River Basin Commission (SRBC); and Lawrence G. Spielvogel, Inc. These comments represent the record in this proceeding.

General endorsement of the proposed policy statement was offered by the NAWC, DER, DRBC and the SRBC. DER commented that conservation has long been considered to be the most cost-effective means by which "additional" water can be developed to meet increasing service territory demands. Furthermore, DER pointed out that reduced system demands resulting from conservation will serve to reduce operations and maintenance costs, which will, in turn, improve the cost accountability of our regulated water utilities. DER added that its conservation program, established in 1980, will be further served by our adoption of this policy statement by formalizing and enhancing the credibility of that agency's efforts. Finally, DER concluded that the policy is "well conceived" and will be of "significant benefit to the citizenry of the Commonwealth."

The DRBC commended us for our efforts in proposing this policy statement. Similarly, the NAWC stated, in part, that the imposition of standards for conservation practices are a positive step towards water conservation. General endorsement aside, several issues were isolated for further discussion and several differing viewpoints were offered.

The NAWC suggested that the minimum standard for unaccounted-for water be revised by both this Commission and DER. The NAWC explained that under the present system, the calculation of unaccounted-for water involves estimations of unmetered uses, such as for fire-fighting, public services, and identified leakage. The combination of estimates, which may be liberal, according to the NAWC, along with the potential for "imaginative procedures" in the accounting process, can result in a very subjective figure. Thus, the NAWC recommended that a standardized method of determining unaccounted-for water be adopted, such as the metered ratio method.

Details relating to fiscal notes see the box at the bottom of the first page of the Proposed Rulemaking heading of *Pennsylvania Bulletin*.

While this Commission has used a modified version of the American Water Works Association method in the determination of unaccounted-for water for many years, its use does not preclude the use of any other comparable methodology, such as the metered ratio method. Rather, we feel it more appropriate for each company to make this management decision based on individual need. Accordingly, we see no difficulty in adapting the results from a metered ratio, for example, to our minimum standard, if that were the chosen method of a particular company.

The DRBC stated that unaccounted-for water in excess of 15 percent, rather than 20 percent be used as the minimum standard. Our experience has shown, that while this would be more ideal, in reality, 20 percent has been found to be a reasonable figure for many of this Commission's jurisdictional water utilities.

On the issue of water audits for large users and water-saving plumbing fixtures, the NAWC offered as its opinion that DER would be delegating its responsibilities to the state's investor-owned water utilities. The NAWC stated that while the proposal's logic may be sound, "the job belongs to DER." An alternative recommended by NAWC, however, would be to require PUC regulated water utilities to identify large users and provide this list to DER for its use.

While it may be ideal for DER to conduct such audits, to do so on such a large scale would require an enormous increase in staffing and resources. Such capabilities are not possible under that agency's present budget and structure, nor does it appear likely for this to change in the near future.

Lawrence G. Spielvogel, Inc. offered a number of comments concerning the water audit procedure as set forth in the policy statement, the crux of which are as follows: 1) that the large water user be specifically defined; 2) that DER's procedure does not address many of the large water uses; 3) that water utilities be prohibited from providing audits; and, 4) that DER recommended specifications for various types of plumbing fixtures as listed within that agency's publication, *Listing of Water Saving Plumbing Fixtures*, are inconsistent with those of the Pennsylvania Building Energy Conservation Act of 1980. Spielvogel concluded that the water conservation audits should be eliminated from our policy statement.

The large water user has been defined in the report accompanying the proposed policy statement [published in the *Pennsylvania Bulletin* on July 9, 1988] as any nonresidential water user such as motels and universities. At Annex A of the same report, health clubs were listed as another example. Other examples of large nonresidential water users could be industrial customers which use large quantities of water in the manufacturing of a product or for cooling purposes.

The DER water audit procedure, which applies to sanitary uses only (lavatories, water closets and showers), is designed to generally meet the overall water conservation needs of water users named above and listed within the report accompanying the policy statement when first proposed. This audit procedure can similarly be applied to the water conservation needs of the industrial sector for their sanitary water uses. However, a water audit procedure relating to water used in the specific processing or manufacturing application of a particular product must be sought on an individual basis. Thus, it is recommended that, dependent upon resources and need, utilities determine the amount of individualized effort necessary, if any, beyond the minimum standard of notification of the availability of an audit procedure such as DER's for sanitary purposes for their large nonresidential water users.

As for Mr. Spielvogel's contention that utilities should not conduct audits, all water utilities (along with all gas and electric and steam heat) have the right to offer conservation audits if they so choose, with or without the implementation of this policy statement. Utilities have the responsibility, through their own management and staff, to operate and manage their systems in a cost-effective manner in their provision of safe and reliable service. If conservation audits assist in meeting this goal, utilities should offer such audits, conducted either by their own staff or by hiring a qualified consultant.

The policy statement states that, as a minimum, utilities direct the large, nonresidential users to such audits on an annual basis. As stated in the report, and especially applicable here, utilities should take actions beyond the minimum standards as their individual needs direct and resources allow. Thus, it is expected that the larger jurisdictional utilities may offer a number of audits using their own staff or consultant, and/or individually work with their large water-using industrial customers to enable them to maximize the efficient use of the water they purchase.

As for Mr. Spielvogel's concern with standards listed within Pennsylvania's Building Energy Conservation Act, known as Act 222, and DER's guidebook of water-saving plumbing fixtures, we do not see any conflict. Act 222 (at Subchapter F, Plumbing Systems, Section 225), mandates flow rates limited to 0.5 gallons per minute (Gpm) for lavatories in public rest rooms. The Act also requires a maximum flow rate of no greater than 3 Gpm for showers used for purposes other than that of safety.

DER's handbook lists recommended specifications for residential plumbing fixtures as well as for nonresidential lavatories. These were primarily compiled in order to provide guidelines to anyone interested in achieving improved water efficiencies with their home plumbing. The flow levels stated are not mandated but recommendations only. There are two areas where comparison is possible, that of lavatories (public only) and showers. For the former, both Act 222 and DER's handbook call for a maximum flow rate of 0.5 Gpm. For the latter, DER recommends that the flow rate for shower heads be limited to 2.75 Gpm, less than that required by Act 222. However, this recommendation, as with all the rest within DER's handbook, are but guidelines in the effort to educate the public about the possible water efficiencies that may be achieved with the installation of water-saving hardware.

The DRBC asserted that a more stringent requirement be pursued in the future, such as mandatory water audits. However, the DRBC specifically endorsed the concept of water audits for large users and pointed out that the use of DER's format be encouraged. Therefore, due to the reasons we have stated above, in addition to the most important, that of working towards the prevention of wasted water on a large scale, we will retain the concept of water audits for large users within our policy statement.

As to water-saving plumbing fixtures, the DRBC stated that the annual notification of their availability is appropriate for the Commission at this time. However, the DRBC explained that a statewide plumbing code in Pennsylvania would be the most beneficial action, thereby mandating the installation of such devices. We agree that a statewide plumbing code could be the most effective way to coordinate and ensure that more water-efficient fixtures are being installed in new construction and in retrofits in Pennsylvania. Until that time, how-

ever, we look toward our jurisdictional water utilities to encourage their usage by customers who are informed of their benefit and value.

As for consumer education, the NAWC stated that it is a good proposal, barring the possibility of an adverse financial impact upon the smaller utilities. The solution offered by the NAWC would be to exempt these systems until a general rate increase could be granted which would include an approved amount of expenses for an appropriate education program. While we can appreciate the NAWC's concerns, we do not feel it necessary at this time to exempt the small utilities from this very important standard. However, the frequently limited resources of the smallest of our regulated water utilities will be taken under consideration at the time of the rate case. We do not expect the educational efforts of these utilities to approach the efforts of the larger utilities.

Nevertheless, it is common that many of these smaller utilities do not enjoy as ample a water supply as most of the larger utilities. Therefore, it may be even more critical for some of these systems to employ conservation education as a tool to maximize their supplies. In addition, and as we have previously mentioned, inexpensive methods can be found. One example is DER's brochure on wise water usage, the cost of which is currently 5¢ a copy or free, dependent upon volume needed. The annual distribution of such a brochure would meet with our minimum standard for the smaller water utilities without placing an undue burden upon their resources.

The DRBC strongly supported our minimum standard relating to the annual distribution of educational materials to all customers. The DRBC stated that, based on its experience, education has been proven to be a successful tool in reaching conservation goals at a nominal expense.

The NAWC commented that although customer conservation is a worthwhile endeavor, the possibility of adverse affects upon waste water systems must also be considered. The NAWC pointed out the necessity of maintaining minimum sewage collection and processing flows that, if diminished as a result of conservation, could negate the benefits of the conservation efforts.

We will not argue that a dramatic reduction in the flows of waste water could potentially affect waste water systems. However, the conservation efforts that we foresee under normal, non-emergency conditions, are not expected to have a dramatic impact upon the waste systems. It would not be unforeseen, however, that if such an adverse affect did occur, an adjustment to our policy on water conservation could be considered.

The NAWC further pointed out that the need will continue to exist for conservation to be addressed on a statewide level following implementation of the Commission's policy statement. The NAWC recommended that DER similarly adopt these "regulations" (the policy statement) so that the entire Commonwealth can meet the goals outlined.

The SRBC stated that demand management, which includes effective conservation programs, has been a neglected area of water resources management. Accordingly, the SRBC stated that the criteria set forth in our policy statement will form a solid basis on which to build such programs.

In light of the comments received as discussed above, we hold that the policy statement as originally proposed will remain unchanged. Accordingly, by issuing this final policy statement, we are establishing guidelines both to assist jurisdictional water utilities in their compliance with 66 Pa.C.S. § 523(b)(5), as well as to provide criteria by which we can evaluate their water conservation efforts. We deem it necessary, proper and in the public interest to finally adopt this policy statement. The Commission has the authority to promulgate this policy statement under 66 Pa.C.S. §§ 308, 331, 501, 504, and 523; *Therefore,*

It is Ordered:

1. That the Commission policy statement on Performance Criteria Regarding Water Conservation Measures—52 Pa. Code § 65.20 be added, as set forth at 18 Pa.B. 3071 (July 9, 1988).

2. That the Secretary shall submit this order and 18 Pa.B. 3071 to the Office of Budget for review of fiscal impact.

3. That the Secretary shall certify this order and 18 Pa.B. 3071 and deposit them with the Legislative Reference Bureau for publication in the *Pennsylvania Bulletin.*

4. That a copy of this order and 18 Pa.B. 3071 be served upon all jurisdictional water utilities, the Office of Consumer Advocate, the Pennsylvania Energy Office, and all parties of record.

5. That this order shall become effective upon publication in the *Pennsylvania Bulletin.*

JERRY RICH,
Secretary

Fiscal Note: Fiscal Note 57-83 remains valid for the final adoption of the subject statement of policy.

[Pa.B. Doc. No. 89-587. Filed April 7, 1989, 9:00 a.m.]

OCA EXHIBIT A
PUBLIC DOCUMENTS AND RECORDS OF OTHER PROCEEDINGS
PURSUANT TO 52 PA. CODE §§5.406-5.407
SUBMITTED BY THE OFFICE OF CONSUMER ADVOCATE

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2. Pa. P.U.C. v. Pennsylvania-American Water Company, Docket No. R-932670, PAWC Exhibit No. 2-A, Water Resource Management Program, (Excerpt pp. 1-19, 51-74).

3. Pa. P.U.C. v. Pennsylvania-American Water Company, Docket No. R-00943231, PAWC St. No. 1, Direct Testimony of David V. Modeer with Regard to Scope of Operations, Description of the System and Water Conservation Planning.

4. P.U.C. v. Pennsylvania-American Water Company, Docket No. R-00943231, PAWC Exhibit No. 1-H, Pennsylvania-American Water Company 1994 Action Plans.

5. Pa. P.U.C. v. Pennsylvania-American Water Company, Docket No. R-994638, PAWC St. No. 1, Direct Testimony of Richard V. Neubauer with Regard to Scope of Operations, Description of the System and Water Conservation Planning.

6. Pa. P.U.C. v. Pennsylvania-American Water Company, Docket No. R-994638, PAWC Exhibit 1-C, Water Resource Management Program (Excerpt pp. 1-15, 45-69).

7. Pa. P.U.C. v. Pennsylvania-American Water Company, Docket No. R-00016339, PAWC St. No. 1, Direct Testimony of William C. Kelvington with Regard to Scope of Operations, Description of the System and Water Conservation Planning.

8. Pa. P.U.C. v. Pennsylvania-American Water Company, Docket No. R-00016339, PAWC Exhibit No. 1-C, Water Resource Management Program (Excerpt pp. 1-15, 45-69).

9. Pa. P.U.C. v. Citizens Utilities Water Company of Pennsylvania, Docket No. R-009953300, Volume I, Appendix E, Statement of Water Conservation Policy.

10. Management and Operations Audit of the Citizens Utilities Water Companies of Pennsylvania, Prepared by the Pennsylvania Public Utility Commission, Bureau of Audits, Management Audit Division, June 1994 (Excerpt pp. 12-32).

11 Citizens Utilities Water Company of Pennsylvania, Management Efficiency Investigation Evaluating the Implementation of Selected Recommendations in the Areas of Company Management, Operations, Financial Operations, Administrative and Support Functions, and Other Specific Issues, Prepared by the Pennsylvania Public Utility Commission, Bureau of Audits, Management Audit Division, Issued December 1997 (Excerpt pp. 7-19).

12. Focused Management and Operations Audit of Pennsylvania-American Water Company, Prepared by the Pennsylvania Public Utility Commission, Bureau of Audits, Management Audit Division, Issued August 2000 (Excerpt pp. 16-21).

13 Pennsylvania-American Water Company, Management Efficiency Investigation Evaluating the Implementation of Selected Management Audit Recommendations From The 2000 Management Audit, Prepared by the Pennsylvania Public Utility Commission, Bureau of Audits, Management Audit Division, Issued November 2004 (Excerpt pp. 16-21).

14. Pennsylvania-American Water Company, Implementation Plan in Response to the Public Utility Commission's Management Efficiency Investigation, December 1, 2004 (Excerpt 4 pages).

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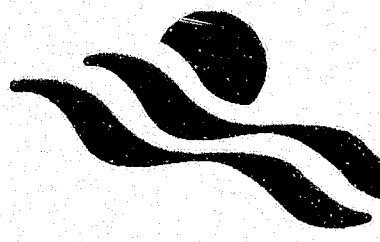


Pennsylvania-American
Water Company

PAWC STATEMENT NO. 2

DIRECT TESTIMONY
OF
NICK O. ROWE

DOCKET NO. R-932670

WITH REGARD TO
WATER CONSERVATION PLANNING

PENNSYLVANIA-AMERICAN WATER COMPANY

DIRECT TESTIMONY OF NICK O. ROWE

Line No.

Q. Please state your name and business address.

A. Nick O. Rowe, 800 West Hersheypark Drive, Hershey, Pennsylvania 17033.

Q. By whom are you employed and in what capacity?

A. I am employed by Pennsylvania-American Water Company ("Pennsylvania-American" or the "Company") as the Director of Operations.

Q. Will you please outline your business experience in the water utility industry?

A. I began my career as a junior engineer for the CSX Railroad Corporation in 1981 in Huntington, West Virginia. From that period on, I held several positions in the engineering headquarters office, as well as the divisional office, both in Huntington, West Virginia. In September of 1987, I joined the American Water Works System as a Management Assistant-Operations for West Virginia American Water Company. At that time, the responsibilities of that position within the Company were two-fold. First, it had a management training component, which required that I familiarize myself with all aspects of the water business, including business and accounting

Line No.

functions, production, distribution, and customer service. Secondly, I directed and oversaw the engineering department of the Huntington office. In December of 1988 I was promoted to Operations Manager of Virginia-American Water Company in Hopewell, Virginia. In this capacity I was responsible for the day-to-day operations of that district, which served customers in an area south of Richmond, Virginia. As an additional responsibility, I directed the construction and design of a new water treatment facility, chemical feed facilities, and distribution system improvements. In May of 1992, I transferred to Pennsylvania American Water Company as Director of Operations.

Q. Do you belong to any professional or industry associations?

A. Yes, I am a member of the American Water Works Association.

Q. What is your educational background?

A. I am a 1981 graduate of Western Kentucky University, in Bowling Green, Kentucky, where I received a Bachelor of Science Degree in Civil Engineering. I am presently pursuing a Masters of Business Administration Degree from Lebanon Valley College with a summer 1994 anticipated

Line No.

completion date.

Q. What is the nature of your duties with Pennsylvania-American?

A. I oversee the Engineering, Water Quality, Regulatory Relations, Corporate Communications, Loss Control, Maintenance Services and Fleet & Materials functions for the Company. I also assist the President and Vice President in the management of the daily operations of the utility.

Q. What is the purpose of your testimony?

A. I will discuss the Company's efforts to encourage cost-effective conservation.

Q. Mr. Rowe, focusing on the topic of conservation, are you aware that the Commission has issued regulations to be used to evaluate the performance of water utilities in encouraging cost-effective conservation by customers?

A. Yes. The Company has reviewed those regulations and believes that it is meeting and, in some instances, exceeding the minimum standards established by the Commission. For example, the Company:

- Distributes conservation-related materials to its customers at least twice a year.

- Has implemented a program to sound for leaks on all customer service control valves once every five

Line No.

years.

- Sounds all hydrants for leaks every year during inspection and flushing of the distribution system via the hydrants.

- Employs seven state-of-the-art electronic leak detection vans to detect and repair fractured transmission and distribution mains. These vans are geographically dispersed throughout the state to provide maximum coverage.

- Has conducted a comprehensive water audit in each of its operations in Pennsylvania. The comprehensive water audits performed by the Company are designed to analyze, in one exercise, all potential sources of water loss. This form of audit was developed and is used primarily in the water scarce areas of the Western United States, but it has proven itself to be a valuable tool for PAWC by identifying ways to increase water available for customers' use other than capacity additions.

- Provides and installs, free of charge, retrofit kits in the homes of customers meeting specific low-income and household consumption criteria. These kits include toilet dams, low flow shower heads, kitchen and bathroom faucet aerators and toilet leak-identifying dye tablets.

- Makes available to all customers at a cost of $7.95 the same high quality retrofit kits referred to above. The availability of these kits at this reduced cost from Resource Conservation, Inc., a company unaffiliated with PAWC, was communicated via bill insert to all customers. As of September 30, 1993, 19,130 customers had ordered 23,478 kits.

- Has incorporated into its tariff plumbing standards that require low water use fixtures for new homes or significant remodeling projects.

- Has purchased and utilizes state-of-the-art water use monitoring equipment which allows the Company to properly size its larger meters to accurately measure water use.

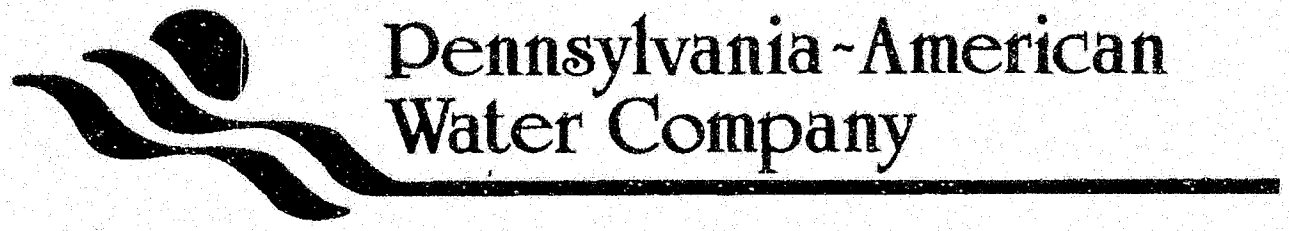
Line No.

Q. Are you sponsoring any additional evidence regarding the Company's conservation efforts?

A. Yes. The Company has filed as Exhibit No. 2-A in this case its current Water Resource Management Program. This document describes in detail the types of programs the Company either has in place, or are under way, to promote the wise and efficient use of water. This document will be supplemented in the future as new programs are added to the Company's overall Water Resource Management Program, but stands now as clear evidence of the Company's commitment to this important environmental issue.

Q. Does this conclude your testimony at this time?

A. Yes, it does.



WATER RESOURCE MANAGEMENT PROGRAM

EXHIBIT 2-A

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INTRODUCTION

Water utilities, whether municipal or investor-owned, have viewed themselves over the years as guardians and protectors of the public water supply. Traditionally, they have taken the position that their job is to make sure that there is enough water available and that it is safe for the public to use. What happens to that water — how much is consumed and for what purpose — has been regarded as solely the province of the customer.

Water companies have the distinction of being the "original conservationists." Over the years, water companies have been in the forefront of seeking to protect the quality of water supplies. Water companies have gone to court to stop the dumping of pollutants. They have shown concern about chemical wastes, agricultural run-off, erosion and mine acid drainage, among other issues.

Water is a renewable resource and abundant on a global scale. However, the importance of water conservation as a policy question at all levels of government can only grow in the coming years. *The Global 2000 Report to the President*, as quoted in the National Regulatory Research Institute's recently published *Compendium on Water Supply, Drought, and Conservation*, points out that the world's supply of freshwater was 10 times greater than demand as of 1980, but predicts that by the year 2000, supply will be only 3.5 times greater than demand. Part of the challenge of the water supply industry and its regulators is the development of a conservation policy that addresses this problem, but which is fair to everybody.

As the largest investor-owned water company in the United States, Pennsylvania-American Water Company has accepted its responsibility for creating sound conservation programs. However, Pennsylvania-American realizes it must explain to its customers that their efforts, combined with those of the Company, may have little initial impact on the Company's overall cost of service. The Company's current overall cost of service cannot be significantly reduced through conservation efforts even though some future costs may be delayed or avoided. Conservation efforts must focus on ways to reduce peak usage if new plant construction costs are to be avoided. Since many construction expenditures are to replace the aging infrastructure, it is not anticipated that overall costs will be significantly reduced.

Rate structures as they now exist make it virtually impossible for customers to translate less water use into savings, or peak usage as an increased cost. As an example: A 10 percent reduction in water use does not currently result in a 10 percent reduction in a customer's bill, nor does a 10 percent increase in usage on the maximum day result in a 10 percent increase in a customer's bill to discourage such usage.

As a matter of perspective it is worth noting water-use figures from the state Department of Environmental Resources that were quoted by Public Utility Commissioner Joseph Rhodes Jr. at the Great Lakes Conference of Public Utility Commissioners in July 1989. Of 75 billion gallons of water withdrawn per day in Pennsylvania, only 1.6 billion gallons are withdrawn for public needs. Seventy billion gallons are withdrawn for electrical generation; 3.4 billion gallons are used by industry. Of the 1.6 billion taken for public needs, only 500 million gallons per day are taken by investor-owned water companies under the jurisdiction of the Pennsylvania Public Utility Commission. Therefore, the task of this Company and the PUC to have an impact on the conservation of water use of the Commonwealth must extend beyond the responsibilities and procedures outlined in this document.

Of the 500-million-gallon daily withdrawal by investor-owned water companies referenced by Commissioner Rhodes, Pennsylvania-American accounts for about 142 million gallons withdrawn daily. Since Pennsylvania-American serves a population of about 1.5 million, the average per-capita use is 94 gallons per day. According to information published by the National Regulatory Research Institute (NRRI), the average per-capita use for the Commonwealth of Pennsylvania is 196 gallons per day.

The information published by NRRI further indicates the comparable per-capita use in New Jersey is 156 gallons; in Maryland, 216 gallons; in Ohio, 159 gallons, in New York, 180 gallons; in West Virginia 115 gallons; and in Delaware, 151 gallons. This data only reflects withdraw of the natural resource and not the eventual use of finished water by the customer. However, it provides a clear indication of the beginning point for Pennsylvania-American's increased conservation efforts.

As these statistics indicate, the Company's prior conservation efforts, universal metering and leak detection programs have already had a significant impact on the use of water resources in this state. Additional improvements realized from the program outlined herein may be difficult due to the low daily per-capita use Pennsylvania-American has already achieved.

Further evidence is reflected in the data related to the usage of that treated water. The average indoor and outdoor residential use by Pennsylvania-American's customers is 60 gallons per capita per day, or 6 gallons per day less than the average in Pennsylvania. Compare this usage with 103 gallons in Maryland, 92 in New York, 75 in New Jersey; 70 in Delaware; 62 in West Virginia and 52 in Ohio.

An additional consideration in any conservation discussion must be its impact on economic development. As noted in committee reports in Case No. 88-W-221 before the State of New York, Department of Public Service, a proceeding investigating conservation issues, "The committee recommends that any plan recognize the importance of maintaining a favorable business climate so as to retain existing businesses and encourage the entrance of new business in communities served by the suppliers." Pennsylvania-American shares this concern of protecting the economic base of its service areas, and has designed its water conservation program to manage a natural resource and discourage wasteful uses. In this manner, potential businesses can see our concern for the environment and our management of the resource as an assurance of an adequate supply of water to meet their needs.

Water companies regulated by the PUC will have a minimal effect on the big picture. Policy linkage across a broad spectrum of interests and jurisdictions is necessary to accomplish the intended goals. The common tie among these diverse interests and jurisdictions will be a focus on the "wise use" principle. As explained by the National Regulatory Research Institute, this principle consists of three elements: wise management of resources, use of advancing technology and discouraging waste.

STRATEGIC PLANNING FOR CONSERVATION

POLICY — Pennsylvania-American will consider the cost and impact of its conservation program in all of its engineering and financial plans.

DISCUSSION — American Water Works Company, Inc., the corporate parent of Pennsylvania-American Water Company, recognizes the importance of conservation as a strong element in resource management. In its 1988 annual report, the American Water Works Company included "A Statement on Conservation." Among other things, that statement says:

"We have augmented supplies when it was apparent this was required. Consumers expected this of us. This may be changing."

The statement continues, "Today, in certain service areas, people are questioning whether or not they are willing to pay for the next supply increment. We respect this position and will work to help those communities consider their alternatives." (See Appendix A for the full text of the American Water Works statement.)

In an effort to fulfill the commitment to explore alternatives, American Water Works Service Company, Inc., a subsidiary of the American Water Works Company, Inc., has created an Ad Hoc Committee on Conservation that is examining conservation from a system-wide perspective. It is seeking to develop a consistent set of policies that address varying regulatory, engineering and political considerations.

Gerald C. Smith, President of Pennsylvania-American Water Company, and William E. Luta, Director of Resource Conservation for Pennsylvania-American, serve as members of the Ad Hoc Committee. Therefore, Pennsylvania-American will have a voice in the development of corporate policy. In turn, the findings of the committee will be immediately available to Pennsylvania-American. The chairman of the Ad Hoc Committee is Edward W. Limbach, Senior Vice President of Corporate Development and Governmental Affairs of American Water Works Service Company. Mr. Limbach has addressed conservation issues as part of his former duties as president of other American Water Works subsidiary companies.

The Ad Hoc Committee is seeking to produce a series of "layered" policies that will assist each constituent company in developing conservation procedures required by its individual circumstances. The committee's timetable calls for completion of a final report in 1990.

It must be noted that while this policy development may be new, conservation has always been an aspect considered in the comprehensive planning conducted by the American Water Works Service Company for Pennsylvania-American. However, that consideration is now documented and included in the written portion of those reports. The current comprehensive planning study highlights areas in which conservation/demand control may be able to reduce or defer capital improvement recommendations. The areas discussed include a supply project in the Butler service area, the second phase of a plant expansion in the Riverton service area and a groundwater development program in the Frackville service area.

PILOT RETROFIT PROGRAM

POLICY — Pennsylvania-American will offer to install retrofit kits in the homes of customers on settlement agreements whose annual consumption is greater than average annual consumption levels of Pennsylvania-American's other residential customers, as well as customers who currently qualify for the Low-Income Housing Energy Assistance Program.

DISCUSSION — Pennsylvania-American will implement during 1990, a single program aimed at achieving separate goals in two areas of interest. One goal is the establishment and introduction of a pilot conservation program involving distribution of retrofit kits for showerheads and toilets. The other goal is finding a way to reduce the financial burden on low-income customers who have settlement agreements. Pennsylvania-American recognizes that achieving this second goal may also help reduce its write-offs for nonpayment, which, in turn, may offset some of the costs of the pilot program.

The pilot program is now in the planning stage but will be carried out during the remainder of 1990. As now envisioned, the program will be established on a pilot basis in all Pennsylvania-American divisions. If successful, consideration will be given to expanding this program to other customers in the future.

The pilot program will be implemented by purchasing high-quality retrofit kits consisting of a low-flow showerhead, two toilet dams, two sink aerators and dye tablets for detecting toilet leaks. These kits will be made available and installed without charge to the following qualifying customers (1) Those who are now on settlement agreements because of an inability to pay in full and whose water usage has been identified as exceeding average annual consumption levels of Pennsylvania-American's residential customers; and (2) those who have qualified under the eligibility standards of the Low-Income Housing Energy Assistance Program. The estimated cost of providing and installing the retrofit devices and conducting a water audit is $25 per household. Customers so identified will be notified by mail that they are eligible for the program.

The Company personnel made available to install the retrofit devices will also conduct water audits upon request to determine if any leaks exist in the homes of these customers. Literature explaining a variety of water-conservation methods and techniques will be delivered to customers along with the retrofit devices.

All installations under this program will be scheduled on one day each week to minimize interference with normal service calls. Pennsylvania-American will provide special training to its customer-service personnel prior to the start of the program.

In addition to this pilot program, customers in the Eastern Division will be advised of the availability of retrofit kits that can be purchased from the manufacturer at cost — about $7 each. Pennsylvania-American will also include detailed instructions for self-installation. Announcements and reminders about the availability of these retrofit kits will be mailed with monthly bills. These notices will include mail-in cards for ordering the retrofit kits directly from Pennsylvania-American's supplier. Pennsylvania-American also will issue releases to all local news media informing the public about the start of the additional pilot program for the customers served in the Eastern Division. The Eastern Division was chosen for such a pilot program because it has already converted to monthly billing.

This additional project is planned for future use in the remainder of the divisions of Pennsylvania-American as these divisions convert to monthly billing. Monthly billing allows more efficient identification of customers with higher-than-average usage, provides a more frequent avenue of communication and also permits faster feedback of information after installation.

According a study conducted for the U.S. Department of Housing and Urban Development in 1984, the use of low-flow showerheads can save 7.2 gallons of water per capita per day. Additional savings of 1.5 million BTUs of energy per capita per year for gas-heated water and 1.3 million BTUs per capita per year for electric-heated water can also be realized.

The study compared interior water use among three household groups: (1) non-conserving; (2) intermediate (equipped with shower flow restrictors and toilet dams or displacement bags); and (3) conserving (equipped with low-flow showerheads, low-flow toilets and faucet aerators). Reported water consumption was 77.3 gallons per capita per day for the the non-conserving group; 68.4 for the intermediate group; and 66.2 gallons per day for the conserving group. (The average size of the households in the study population was 2.73 persons.)

The cost-benefit of Pennsylvania-American's retrofit conservation program will be monitored along with water savings. By addressing the problems of low-income customers on settlement agreements because of inability to pay for service on a timely basis, the Company believes that the reduction of such outstanding bills may offset a significant portion of the initial pilot program costs.

LEAK DETECTION

POLICY — Pennsylvania-American Water Company's Leak Detection Specialists will survey three or more miles of water distribution mains per day when they are not pinpointing known leaks.

POLICY — Operating personnel in each district will sound 100 percent of all hydrants, 20 percent of all system valves and 33 percent of all service line control valves for hidden leaks annually. These programs will be conducted in a fashion that ensures that all valves are sounded at least once every five years and all service line control valves are sounded at least once every three years.

DISCUSSION — Pennsylvania-American distribution employees have historically listened for leaks on valves and service line control valves as part of sound water works operating practices. However, due to new technology, this program was enhanced in 1981 by the addition of leak detection vans. The program was further expanded in March of 1989 when Pennsylvania-American created the new position of Director of Resource Conservation. First to hold this title is William E. Luta, a veteran of the company's leak detection program.

Among other duties, Luta oversees an aggressive leak-detection program in which seven maintenance service employees, who specialize in leak detection, travel the state in specially equipped vans that contain more than $65,000 of sophisticated leak-detection equipment. These seven specialists cover a system composed of 28 different service districts and 4,800 miles of main.

As indicated earlier, Pennsylvania-American's leak-detection program began with one van in 1981 and grew to its present size by late 1988. The original assignment of the unit was under the direction of the Company's Risk Management Department. However, demand became so great that van assignments were moved into the new Resource Conservation Department.

The maintenance service employees who specialize in leak detection use electronic sounding devices and computerized correlators to find leaks. Upon arriving at a district, they collect information pointing to problem areas and initially concentrate in those areas. They begin by listening for leaks on hydrants and valves and then move on to small mains. A single specialist in a van can cover about three to five miles of distribution main per day. Besides the capital costs of the equipment, the company incurs more than $400,000 per year in operating expenses for this program.

As discussed earlier, in addition to these roving vans, employees in each of the Company's districts continue to conduct an active hydrant, valve, and service line control valve leak-detection program that has existed for years. This program is part of scheduled operations at the district level. All hydrants are inspected annually. All valves in each district are inspected at least once every five years. The Company's goal is to inspect all service line control valves at least once every three years.

As of December 31, 1984, Pennsylvania-American had 312,525 customers. As of December 31, 1989, there were 362,089 customers, or an increase of roughly 16 percent. Yet during this same time period, the number of gallons of water delivered annually to the distribution systems decreased by 8 percent. Pennsylvania-American attributes this decrease, in part, to its aggressive and successful leak-detection program.

On average, each leak-detection specialist identifies about 150 leaks each year, for a total of 1,050 leaks across the state. Based on previous experience, Mr. Luta estimates that as many as 60 percent of those leaks might go undetected were it not for the leak-detection task force.

From 1984 to 1989, unaccounted-for water for Pennsylvania-American dropped from 21.5 percent of system delivery to 17.1 percent. The 20.5 percent drop has resulted in the conservation of more than 2.8 billion gallons of water annually. This amount of water by comparison is equivalent to stopping the water going over the American Falls at Niagara for seven hours and 47 minutes, which is almost a full eight-hour work day.

Conservation in the form of detecting leaks and reducing unaccounted-for water also has played a significant role in decisions about expansion. For example, in 1987-88, Pennsylvania-American evaluated system demands in Hallstead in the Northeast District and determined that reduction of unaccounted-for water could lessen the need for new wells. The company drew up a plan to reduce unaccounted-for water from the 40-percent range to the 20-percent range. By initiating a special leak-detection effort, the number of new wells required was cut from four to three. Estimated savings in capital costs was $200,000.

In the Moshannon Valley District, the commitment to reduce unaccounted-for water through leak detection before the use of zone measurement in 1987 had a significant effect on plans for new facilities. In 1982-83, in order to meet peak demand, Pennsylvania-American had to choose between two options. One option called for constructing two new treatment plans and bringing on an additional source of supply. The other option called for building one new treatment plant and substantially reducing unaccounted-for water. Pennsylvania-American chose the latter. The estimated savings in capital costs were approximately $2 million.

While Pennsylvania-American does not have any plans now to increase the number of leak-detection specialists, it is investigating more technologically advanced equipment as a means of improving productivity. If the current downward trend in unaccounted-for water continues, the percentage of unaccounted-for water will decrease in 2003 to 15 percent of total water delivered to the distribution system.

PUBLIC EDUCATION

POLICY — Pennsylvania-American Water Company will distribute conservation-related information to all customers twice a year.

POLICY — Conservation information centers will be located and maintained in each division office.

POLICY — Pennsylvania-American Water Company employees will participate in community events and provide information on conservation at *every* available opportunity.

DISCUSSION — One of the most important elements in achieving conservation is public education. Providing reliable and persuasive information in an easy-to-understand manner can substantially influence customer attitudes and consumer practices.

All customers have received conservation-related informational pamphlets at least twice a year since 1982. In 1989, Pennsylvania-American created a colorful, fully illustrated, easy-to-read pamphlet filled with water-saving tips. (See Appendix B for a copy of this pamphlet.) The publication stresses how customers can benefit by practicing water conservation.

The pamphlets have been or are continuing to be mailed to customers with their bills. Each division office also has a supply of 1,500 copies for further localized distribution at plant tours, etc. In many instances, meter readers are carrying pamphlets and providing them to customers. Additionally, when Pennsylvania-American participated in concert performances by the U.S. Air Force Band in Indiana, Pa., and Hershey, Pa., in 1989, a copy of the pamphlet was distributed in each copy of the concert program.

The Company also developed a cartoon character easily identified with conservation. This character, named "Otto the Otter," is associated with the motto, "You Really Otter Not Waste Water." A costume has been created for the character in order to enhance appearances at schools, home shows and other public forums to deliver conservation-related material.

The Company also has made available to its customers a pamphlet that describes finding leaks as a "treasure hunt." The pamphlet shows the customer he or she is the eventual winner of the "hunt." (See Appendix B for a copy of this publication.)

In 1980-81, a series of ready-for-use public-service advertisements about water conservation were produced explaining drought conditions. These advertisements have been updated and distributed to the Company's division managers for local distribution.

As part of its regular, active public relations program, Pennsylvania-American issues news releases on water conservation by cooperating with the media in preparation of news stories. The Company also conducts plant tours and encourages its employees to speak before civic clubs and community organizations. The Company also publishes tips on protecting indoor plumbing and efficient water use during winter months.

Pennsylvania-American is currently developing a survey of customer attitudes about conservation as part of a larger survey on a wide variety of topics. The Company is working with the Pennsylvania State Data Center at Penn State - Harrisburg on this project. Pennsylvania-American believes the information received from this survey will help determine what features might be the most successful motivators in structuring future education and public relations efforts.

Promoting conservation as part of an "environmental ethic" may be helpful to a point. However, Pennsylvania-American believes the real key to a good program is personalizing the message. This personalization requires finding an approach that shows customers how conservation can save them money for total utility bills while not severely affecting their lifestyle.

PROTECTION OF RESOURCES

POLICY — Pennsylvania-American Water Company will monitor its sources of supply on a regular scheduled basis and notify proper authorities of any degradation detected in quality or quantity of this natural resource.

DISCUSSION — Protection of existing resources is a significant component of conservation. Pennsylvania-American exercises that component through vigilance and up-to-date knowledge of activities in watershed areas. Water quality specialists of Pennsylvania-American oversee a vigorous monitoring program designed to protect the company's sources of supply.

In all, Pennsylvania-American operates 22 filter plants that draw from reservoirs, more than 60 operating wells, all of the state's major rivers, and a variety of small streams. Pennsylvania-American keeps records at these sites of all water discharged into the surface water which its water is drawn. The state Department of Environmental Resources (DER) regulates such discharge through permits issued under the National Pollution Discharge Elimination System.

Pennsylvania-American conducts daily monitoring of water sources so it can be aware of any change in water quality as soon as possible.

In 1981, for example, Pennsylvania-American called DER's attention to increased bacteriological counts in water downstream from a cheese processing factory along the Shenango River in New Castle. That action resulted in a DER order for upgraded treatment facilities at that factory so the processing facility could meet the discharge standards specified in its permit.

In another example, Pennsylvania-American in 1988 detected an unusual concentration of ammonia in water in the intake of its Pittsburgh plant. The Company notified DER and began treatment with extra chlorine. DER in turn identified the source of the ammonia as a licensed discharger who was exceeding permit limits. Additionally, the Company filed a notice of intent to sue U.S. Steel in 1985, under the Resource Conservation and Recovery Act (RCRA) for violation of regulations regarding benzene discharges.

Pennsylvania-American reviews The Pennsylvania Bulletin weekly for permit applications or re-applications. In instances where it feels concern is warranted, it will seek detailed data from DER and make its views known to the agency.

Once DER issues a permit, the permit holder must file monthly discharge reports with the agency. Pennsylvania-American routinely reviews such reports from its source areas at least once a year. If changes in water quality are detected through its own testing, Pennsylvania-American immediately turns to these reports for clues as to the source of the change.

Pennsylvania-American maintains an information exchange network with upstream utilities to provide early warning should a spill occur. Pennsylvania-American maintains a close working relationship with DER and the Pennsylvania Fish Commission, and is prepared to work with an emergency response coordinator in each DER region and in each county within its various service territories.

Pennsylvania-American also monitors groundwater sources. Pollution in groundwater tends to linger longer and even small spills can cause serious contamination. Small amounts of volatile organic chemicals such as benzene, degreasers and paint thinners can percolate down into the water table. Eventually they work their way into the water supply, and it can then take decades for contaminants to pass through.

Pennsylvania-American performs quarterly analyses of its groundwater sources, looking for even low concentrations of contaminants that might signal a more serious problem down the road. Testing for 63 contaminants is conducted every three months. Pennsylvania-American also offers speakers to talk to civic organizations about water pollution and its prevention.

METERING

POLICY — Pennsylvania-American Water Company will universally meter all customer accounts, exclusive of public fire hydrants.

POLICY — Pennsylvania-American Water Company will utilize monthly reading and billing, and promote conservation information through that billing process.

DISCUSSION — Except for water used in fire protection, the Pennsylvania-American distribution system is a universally metered system with no unmetered customers. The company is also installing meters on sprinkler systems used for private fire protection. The purpose is to stop unauthorized use of water from such systems and to measure and charge for water used in testing of the systems. In one recent instance, at a large industrial site, Pennsylvania-American discovered as that as much as 45,000 gallons of water a week was being used to test sprinkler systems.

Pennsylvania-American is also converting to reading meters and billing monthly. This system will make it easier to detect leaks on customer services more quickly and will allow closer monitoring of average use demands. In addition to the billing change, Pennsylvania-American has been replacing old meters with new meters equipped for remote reading. In the Company's Eastern Division, the task of billing each month is already in place for the 42,000 customers served. During 1990, the changeover in the Western Division will begin by July and in the Capitol and Central Divisions by October. During 1991, the project will be completed with the changeover in the West Central, Southwestern and Pittsburgh Divisions.

In connection with the switch to monthly billing, Pennsylvania-American has developed a new format to be used beginning in 1990. That bill will plot for customers, in the form of a graph, their average usage in gallons per day for a 13-month period. (See sample bill format in Appendix C). For most customers it will be a useful tool in consciousness-raising. For the first time, customers will be able to relate the gallons of water used per day to their lifestyle, and will be able to see the results of their decisions about conservation.

In 1989, Pennsylvania-American hired a uniquely qualified meter specialist who examines and determines the accuracy of all large meter settings. Additionally, he will review changing customer demands to assure continued accurate meter sizing.

WATER AUDITS

POLICY — Pennsylvania-American Water Company will conduct home water audits upon request.

POLICY — Pennsylvania-American Water Company will annually mail Water Audit Procedures to all large users and assist in the performance of water audits upon request.

DISCUSSION — Pennsylvania-American in 1989 sent to its large, non-residential water users (industries, motels, universities, etc.) a do-it-yourself water audit form developed by the state Department of Environmental Resources. Generally, those customers who use one-half million gallons of water or more each month received the water audit procedure. The list of recipients will be expanded in the future. (See Appendix D for a sample of the cover letter used by Pennsylvania-American in circulating the DER water audit form.)

In addition, Pennsylvania-American has produced a "Water Loss Audit Handbook" that gives direction to each operating district for conducting water audits on a local level. (See Appendix E for full text.)

MATERIALS AND ENGINEERING

POLICY — Pennsylvania-American Water Company will utilize high-quality materials in its distribution system to minimize leakage potential, and will include impacts of conservation in its engineering plans.

DISCUSSION — Pennsylvania-American has undertaken several efforts in the areas of materials and engineering that contribute to its general conservation plan.

The company has gone almost exclusively to the use of ductile iron pipe in its mains. Though more costly than asbestos-cement, cast iron or plastic, its durability will cut down on leaks and maintenance costs for many years to come. The ductile iron pipe used by the Company is cement-lined to thwart internal corrosion and polyethylene wrapped to protect against external corrosion.

Pennsylvania-American does not accept newly constructed mains until leak testing has been done in agreement with standards set by the American Water Works Association. Also, in the last several years, the company has covered and lined six of eight remaining open storage reservoirs, thus eliminating loss through evaporation and leaking.

Pennsylvania-American has installed water backwash turbidity monitors at an existing plant in Bangor to improve the efficient use of water in its purification process. Pennsylvania-American also plans to install such monitors at two plants at White Deer and one at Silver Springs. Plans are also in place to install one in the new plant scheduled for Hershey.

In the filtration process, solids removed in the filters cause the filters to become clogged. Periodically, these filters must be removed from service and backwashed in order to restore performance. Water that has been previously treated is used for backwash purposes. The use of these monitors provides plant personnel with a clear, instant indication of the cloudiness of the backwash water, helping to conserve process water used for backwash. This amount generally represents about 2 to 6 percent of total plant flow. The new monitors determine when the backwash operation may be terminated. Under the old method, backwash operations were conducted for a fixed time, regardless of the length of filter run. Use of the backwash turbidity monitors allows termination of the backwash cycle at a time when the filter is neither overwashed nor underwashed, resulting in optimum use of the water supply.

The new plants at Philipsburg and Bangor are referred to as "zero discharge" plants because the water used in backwash, instead of being discharged back into the source, goes to a tank where sediment settles out. Then, the clear water on top is recycled back to the beginning of the plant for treatment and entry into the distribution system, resulting in a zero discharge system. Similar facilities have also been provided and are in service at the Canonsburg, Butler, New Castle and White Deer filter plants. The same type of facility is to be constructed at the Silver Springs plant in the near future.

CONSERVATION CODES

POLICY — Pennsylvania-American Water Company will promote conservation-oriented ordinances in local municipalities where it provides service.

DISCUSSION — Pennsylvania-American in 1989 supplied all of its division managers with copies of a model water-conservation ordinance developed by the state Department of Environmental Resources. The ordinance sets water conservation standards for plumbing fixtures and fittings. Adoption by a municipality would mandate, in newly constructed or remodeled buildings, the installation of 1.6-gallon-per-flush toilets. Also required would be 1.5-gallon-per-flush urinals and showerheads with discharge rates not exceeding three gallons per minute. Division managers sent copies of this ordinance in November 1989 to all municipalities within their divisions. The Company's cover letter asked local officials to support the enactment of regulations mandating low-flow fixtures and fittings and offered the company's help. (See Appendix F for a sample cover letter and a copy of the model ordinance.)

Pennsylvania-American is reviewing draft legislation for creating a statewide plumbing code. The code would mandate the use of water-conservation fixtures and fittings.

EMERGENCY CONSERVATION PROCEDURES

POLICY — Pennsylvania-American Water Company will maintain a drought contingency plan in each of its operations.

DISCUSSION — Should a drought emergency arise, Pennsylvania-American has developed a series of steps to help its customers conserve water. In many instances, water allocation permits governing Pennsylvania-American's sources of supply specify certain steps when flows reach a pre-determined level. (An outline of Pennsylvania-American's water conservation contingency plan and a list of water-saving suggestions developed for residential customers are included in Appendix G.)

RATES AND CONSERVATION

POLICY — Pennsylvania-American Water Company will promote rate and tariff changes that encourage conservation.

DISCUSSION — Pennsylvania-American recognizes that the rate and cost dynamics under which water utilities now operate are not conducive to promoting water conservation. This is because customers cannot save money in equal measure to the water they save, and further compounds the task of promoting conservation strictly as a matter of economic self-interest.

Over the years, investor-owned water utilities have been concerned that water conservation on a large scale would depress revenues without any offsetting reduction in costs. The National Regulatory Research Institute's (NRRI) Compendium on Water Supply, Drought, and Conservation confirms the sensitive link between conservation and revenues. "When conservation measures or water use prohibitions are in full force, absent an accompanying rate increase [emphasis added], utility revenues will be reduced," it says.

NRRI points out that, using typical demand elasticity estimates and a no-growth hypothetical model, a doubling of the price of water "results in a 32 percent reduction in demand but a 36 percent increase in revenue for the water utility. Without a price increase, the revenue loss caused by the same level of conservation would be about [32 percent]."

Due to the tremendous amount of fixed costs and the amount of investment per dollar of revenue, the largest part of the cost of providing water remains unchanged no matter how much water a customer may require. Costs do not go down proportionally if usage goes down. Once a plant and distribution system exist, the cost of that plant and system don't come down because people are conserving and drawing less water from the system. While similar economic results exist in other types of utilities, water companies are particularly sensitive to such results since the investment per dollar of revenue is much higher for water utilities than any other utility service.

Even designing a system with conservation in mind is difficult. Main size in the system is dictated by the capacity needed for firefighting. A water system must be built to meet peak requirements rather than average requirements, which in turn mandates a higher front-end investment. Even though Pennsylvania-American is committed to conservation as part of its comprehensive planning process, the Company estimates that $758 million of some $770 million in potential construction expenditures over the next 15 years would not be affected by even the most successful conservation activities, since much of that construction is required to replace aging plant and meet water quality requirements. Operators and service people still have to be on hand, whether the amount used is 1 million gallons or 5 million gallons on any given day. Of Pennsylvania-American's $66 million in operating expenses in 1989, only $14 million were related to consumption. Savings from conservation show up only in the reduced use of treatment chemicals and less energy used because less water is pumped.

The division of the water bill into two portions — a minimum charge and a volumetric charge — reflects the reality that the bulk of costs of providing water service are associated with the set-up, the readiness to serve, rather than the amount of "product" used. This cost of service "difference" from the variable cost dependence for energy utilities must be recognized in higher fixed service charges for water utilities. As Pennsylvania-American gradually continues to reduce the minimum allowance, a process authorized by the PUC in its last few rate cases, even greater emphasis can be placed on conservation by charging for all water use.

The paradox involved — that a consumer won't see a 10 percent savings on his or her bill after having used 10 percent less water — is, in fact, a public relations obstacle that must be solved in any water conservation program. Pennsylvania-American realizes that customers will save in other ways, such as reduced energy costs for heating water and reduced costs for sewerage service. However, these savings do not show up at the only point at which the Company is involved — the water bill.

One way of translating public policy in favor of conservation into working encouragement is to align rates realistically. This will allow utilities to recover up-front costs, necessary for service, independently of usage charges. Now, for example, Pennsylvania-American's $23.40 per-quarter minimum charge for service includes an allowance for use of up to 3,600 gallons. At one time, the minimum charge included use of 6,000 gallons per quarter. Pennsylvania-American intends to request authorization to continue that trend of reducing minimum allowance usage until all such usage is eliminated from the minimum charge while at the same time recognizing the need to maintain the fixed charges at those levels, in order to recover the higher fixed cost of water utilities. Usage should be isolated where it belongs, in the rate blocks. This pricing technique will result in a more realistic division of costs. It also will allow customers to associate savings when they practice conservation. Pennsylvania-American will also consider establishment of peak-use rates or seasonal rates as future pricing alternatives to encourage conservation.

As the NRRI compendium points out, "The economic value of water lies not in the water itself but in the processes required to withdraw it from natural sources and deliver it in sufficient quantities and of acceptable quality to the consumer." It also says, "Prices that accurately reflect costs send correct signals to consumers and discourage wasteful consumption."

APPENDIX A

CONSERVATION STATEMENT OF AMERICAN WATER WORKS COMPANY

A STATEMENT ON CONSERVATION

The theme of this Annual Report brings up an issue which merits separate comment. This issue is conservation and its applicability to water.

Conservation is defined in Webster's dictionary as "planned management of a natural resource to prevent exploitation, destruction and neglect."

Water is a natural resource. So are oil, gas and coal. There is, though, a very real distinction between water and other natural resources. Water is a renewable resource. The others are not.

We hear the terms "use" and "destruction" employed synonymously in discussions concerning the conservation of water. When this happens, the uniqueness of water as a resource is overlooked. Its "use" does not "destroy" it.

We have always supported and, in fact, pleaded for conservation of the natural resource water. Our commitment to this cause is to prevent exploitation and neglect. Its pollution and waste are shameful.

Water use by the customers of the American Water System does not exploit, destroy or neglect the resource. Our customers are not "consuming" water in the sense that what they use will no longer be available for those who follow them.

There is not now and, as far as we know, never will be a reduction in the volume of water on the earth. In fact, billions of gallons of fresh, usable water flow to the oceans every day.

On the other hand, certain areas of the world and parts of this country, including some of our service territories, have developed to a point where the water supply requires augmentation. This often mistakenly prompts a discussion of conservation. Consequently attention is distracted from the real issue, which is the management of the resource.

We hope by this statement to better focus the important decisions faced by those who must consider water supply augmentation.

A water system typically develops over time by utilizing the least costly source of supply first. As this supply is utilized to its fullest, the next least costly increment is developed.

The cost of development of these supplies is function of the size and number of pipes, pumps ters, dams, wells and all of the related equipmen required to collect, treat and deliver water to consumers.

The decision whether or not to develop the r least costly supply is basically a choice of how m spend for water service. If consumers are willing the cost of development for the next increment o water, then the answer is obvious: build the new system.

If, on the other hand, those served are not w to incur this cost, other steps are required. These include limiting community growth and develop restricting recreational or decorative water use a trolling everyday household and business use

For those who confront the need to expand water supply, these questions are important and require very careful analysis. It must be recogniz water supply limitations can cause economic de a community.

This kind of analysis has been a significant p the business of the American Water System for r years. We call it planning. In fact, no utility can s without it.

We have augmented supplies when it was a ent this was required. Consumers expected this This may be changing.

Today, in certain service areas, people are c tioning whether or not they are willing to pay for next supply increment. We respect this position will work to help those communities consider th alternatives.

On the other hand, we see no reason to cor that a decision to expand the water supply woul late a conservation ethic.

We renew our plea: Do not exploit or neglec water. Remember, it cannot be destroyed.

Use it wisely and enjoy it. It will continue to us well.

APPENDIX E

WATER AUDIT HANDBOOK

FOREWARD

For years, the operators of water treatment and distribution systems have lived with the problems of unaccounted-for water. Although water has had and will always have a source of significance and value, in the past its economic value was taken for granted because of its abundance.

Today, water has taken on an economic significance it has never had. It is no longer over-abundant, especially in highly urbanized and industrialized areas. Many of our once plentiful sources are now polluted and unusable; many of our densely-populated areas require more supply than is locally available; and even in areas where there is sufficient supply to satisfy local needs, the regulatory climates in which we live require us to allocate the resource as though it were scarce.

For years, we have had a variety of programs which, when viewed broadly, were aimed at controlling water loss. However, we have never taken a comprehensive view of the unaccounted-for water situation. For instance, we annually allocate resources to large meter testing, residential meter change-outs, testing and correction of plant output meters, hydrant inspection programs, valve operating programs, and more recently, curb box sounding programs. But we have not taken a managerial approach and viewed these programs in the combined sense of being a Water Loss Audit Program.

In November, 1986, a meeting was held which assembled approximately 60 managerial employees of the Pennsylvania Region and a comprehensive water loss audit program was developed. The results of that four-day meeting are summarized in the following sections of this handbook.

INTRODUCTION

This handbook has been prepared to assist Pennsylvania-American Water Company and Western Pennsylvania Water Company reduce water and revenue losses. It includes procedures for conducting a comprehensive systemwide water audit to assess the delivery efficiency of the water distribution system.

The water audit is a thorough examination of the accuracy of the company's records and system control equipment. The overall goal of the audit is to identify, quantify, and verify water and revenue losses. It also helps in prioritizing the allocation of money and manpower. The audit should be performed annually and should continue on an on-going basis as one of the company's top priorities.

The leak detection survey part of the water audit is a systematic method of using listening equipment to survey the distribution system, identify leak sounds, and pinpoint the exact locations of hidden underground leaks.

Water losses, whether attributed to leakage, theft, underbilling of customers, or faulty system controls, represent monetary losses to the company. This is water that the company has already paid to obtain, treat, and make available to the distribution system for sale to its customers. However, because it is lost, the water produces no revenue. Likewise, reduction of unaccounted-for water has the potential of not only improving fire protection capabilities, but also delaying capacity-oriented future construction.

Once the initial water audit is conducted, annual updates will provide data to assist the manager in deciding how to adjust his priorities and monitor progress on system maintenance. Equally important, the audit can identify new areas of system losses to establish new annual maintenance goals.

The company's water audit master plan will be a valuable planning tool which can be used to set priorities and schedule corrective actions to maintain the distribution system.

Since water conservation is of prime importance and the company desires to increase the efficiency of its operations, an ongoing water loss control program will continue to be a top priority of the company.

DEFINITION OF A WATER LOSS AUDIT

A water loss audit is a systematic, coordinated effort which analytically tests the integrity of the entire production, distribution and commercial systems of a water utility. The audit is a starting point. It is the foundation from which the whole picture can be viewed.

The term "audit" carries with it a financial connotation. In a simple accounting sense, a financial balance sheet of an organization must have its assets equal the sum of its liabilities and surplus.

From the viewpoint of water loss, the assets are the amount of water entering the system. The liabilities equal metered consumption, and the surplus is unaccounted-for water.

In the same manner that a financial auditor tests the validity of the assets and the validity of the liabilities such that he proves the surplus, the water loss auditor tests the validity of the metered measurement of water entering the distribution system and the validity of the metered sales such that he analytically confirms the amount of water that is lost.

In the same sense of a financial auditor's guidelines, this handbook does not necessarily instruct in the basics of water works operation (it assumes professional status already exists), but it does present check lists, guidelines, and signal points that should be reviewed by the auditor.

In the same sense that a company's financial balance sheet is viewed in its entirety, a water loss audit views the system in its entirety. There are five basic points in a water loss audit:

1. Confirmation of production station master meter registration
2. Confirmation of large meter registration
3. Confirmation of small meter registration
4. Review of unauthorized use, such as private fire service
5. Location of underground leakage

DATA COLLECTION

The following data should be collected, analyzed, and inserted in this section of the handbook:

1. Form 329 - annual and 12-month year-to-date ending for the audit period.
2. A listing of the largest customers.
3. An evaluation of the largest customers for proper meter sizing.
4. A listing of private fire service accounts to evaluate the following:
   a. Are they metered?
   b. Do they have detector checks?
   c. Are they unmetered and not detector-checked?
   d. Are they active and are they being billed?
   e. Have they been inspected annually?
5. The plant description and the elevation chart from the distribution map should be confirmed as still relevant.
6. Miles of main in the distribution system.
7. Number of customers and footage of main per customer.
8. Listing of the number of hydrants in the distribution system.
9. Area coding data.
10. The distribution map.
11. A distribution map marked for metered high service zones and booster zones.
12. A distribution map marked with the elevations of all hydrants.
13. A conversion of the gallons of unaccounted-for in the 12-month period analyzed to gallons per minute.
14. An anaylsis of leaks in the past year, listing number of main line leaks, hydrant leaks, and service leaks. Include size and type of pipe under main line leaks.
15. The meter aging report for the purpose of reviewing length of service change-outs.
16. A random sampling of 10 meters removed every month and tested at flows as follows: ¼, 2, 6, 15 gpm.

PROCEDURES FOR CARRYING OUT A COMPREHENSIVE WATER AUDIT

1. The company's production or pumping station output meters must be checked and verified for accuracy at least once a year. It may be necessary to verify these meters on a more frequent basis which will be left to the judgement of the operating district.
2. Testing of large commercial, industrial, and other meters measuring water sales to customers must be performed annually. The meters for the 10 largest customers of each operating unit must be verified annually. The testing of these meters ideally should be done in place with a fire-flow type of a meter.
3. All fire service lines should be identified and inspected on an annual basis to confirm that there is no theft of water via the fire service line. It may be necessary to undertake a program to install large full-flow meters on all fire lines at company expense and charge for fire service to the customer based upon size of connection in tariff and not meter size. This would apply to existing customers; however, all new customers desiring a fire service line should include a full-flow meter.
4. A leak detection survey should be undertaken initially by employees listening for sounds on all main line valves and fire hydrants. When distance between valves or hydrants is great, customer service lines or curb stops will have to be listened on in order to minimize the area covered, thus being able to sound out the complete area between the valves. Subsequent to listening on valves and hydrants, it may be necessary to listen on random, or even all, customer curb stops to assure the area is free of underground leaks.
5. Each operating district has its own characteristics; therefore, vehicle and equipment needs as well as the complement of employees assigned to perform the leak detection survey will vary.

The above items will be detailed under the sections in this handbook designated "Production, Distribution, and Commercial."

QUICK ASSESSMENT FORMULA

Once the accuracy of the plant output meter has been verified and system delivery restated based on recalibration of the output meter, a quick evaluation may be made. This phase of the audit will isolate generally where the largest portion of unaccounted-for water is.

There are two broad areas where water which is pumped but not billed may occur:

1. It may be missing due to underground leakage.
2. It may be unmeasured due to meter error, unmetered usage or improper meter setting conditions.

Each of the situations is correctable. The assessment formula as follows will help direct the strongest effort in salvaging unaccounted-for.

The formula has been developed over years of practical evaluation in the field. Its basis is to isolate all metered usage except residential from accurately-measured system delivery. Once commercial, industrial, and other usage has been subtracted from system delivery and divided by 365, the residual is daily residential usage and unaccounted-for. By dividing this amount by the population served (residential customers x per capita per residence) a usage + loss per capita is derived.

Normal ranges for this number is 50 to 70 gallons per capita per day. If the number is less than 50, chances are great that the largest portion of unaccounted-for is meter error. If greater than 70, the system is probably suffering most from underground leakage or unauthorized or unmetered usage.

(See Example - Page 7)

QUICK ASSESSMENT FORMULA

Example

	Situation 1	Situation 2
1. Daily Metered Delivery	3,135,000	3,405,000
2. Daily Metered Ind., Comm., Other Usage	1,245,000	1,245,000
3. Metered Residential Sales and Unaccounted-for	1,890,000	2,160,000
4. Metered Residential Sales	1,215,000	1,620,000
5. 10,000 Customers x 2.7 Residents per home = population	27,000	27,000

Audit

$$\frac{\#4}{\#5} = \frac{1,215,000}{27,000} = 45 \qquad \frac{1,620,000}{27,000} = 60$$

less than 50 — greater than 50, less than 70

$$\frac{\#3}{\#5} = \frac{1,890,000}{27,000} = 70 \qquad \frac{2,160,000}{27,000} = 80$$

equal or less than 70: metering problem; no appreciable leakage

greater than 70: leakage a problem; no appreciable meter error

WATER AUDIT CHECK LIST

This check list will enable the Company to institute an in-house water loss control program. This check list can be put into practice immediately with the existing complement of employees and can be utilized as a continuous program for water loss control.

1. Check production or station output meters for accuracy at least once a year.
2. Perform clearwell drawdown test as frequently as practical to confirm station output meters.
3. Clean and maintain venturi flow tubes as required or at least annually. Make arrangements to construct vault for venturi meter for easy access.
4. Test meters supplying large commercial and industrial customers annually.
5. Listen on valves, fire hydrants and curb stops.
6. Listen on mains, services and meters.
7. Check all stream crossings.
8. Inspect sewer manholes and catch basins.
9. Check for unmetered use.
10. Follow up on low pressure complaints from customers.
11. Investigate for large leak in system when daily station delivery suddenly increases or storage vessels are not refilling to proper levels.
12. Inspect all private fire services annually for unauthorized use.
13. Investigate the development of a new low pressure area in the distribution system.
14. Periodically check consumption recorded on 2" meters and larger for proper sizing and application.
15. Check altitude valves on tanks for overflow of water.

The term unaccounted-for water and its measurement have no meaning if the plant output meters do not accurately reflect the precise delivery of water into the distribution system. All calculations are based upon delivery to the system. Not only are unaccounted-for statistics based on the delivery meter, but budget decisions and future construction decisions are generated from this information as well.

1. There are three methods of metering production output:
   - A. Sonic meters
   - B. Turbine meters
   - C. Venturi meters
2. The advantages and disadvantages of the three meters are:
   - A. Sonic meters
     1. Advantages
        - a. Measure to +/− 1% of rate of flow
        - b. Little maintenance
     2. The disadvantage of sonic meters is that their accuracy is affected by solids in the water.
   - B. Turbine meters
     1. Advantages
        - a. Measure low flows well
        - b. Parts replacement is easy via plug-in parts
        - c. Low head loss
        - d. Range of 20 - 1
        - e. Accurate within ½% over the range
     2. The disadvantage is that the measurement is severely affected by turbulence and the setting is critical to accuracy
   - C. Venturi meters
     1. Advantages
        - a. No working parts
        - b. Low head loss
        - c. Ease of checking the primary element
        - d. Accurate to ½% in the flow range
     2. Disadvantages
        - a. Difficult to remove
        - b. Need frequent checking
        - c. Must specify accurately the delivery range

d. Overall testing is difficult
e. Test operator qualifications must be impeccable
f. Manometer readings must be precise to recalibrate accurately

3. There are three methods to verify the accuracy of plant output meters
   A. The easiest and least costly is the clearwell drop test. This procedure discontinues filtering and by determining volume pumped over specified time and comparing to metered recording, an accurate comparison can be made. This procedure should be used as often as practical.
   B. Another method of testing is to install a calibrated turbine meter at an appropriate distance downstream of the output meter and compare the readings.
   C. Pitometer measurement is the final and most common measurement. This method is normally accurate to within +/— 5% because of the necessity to have ideal and absolute known test conditions and the variance in reading the manometer.
4. Frequency of output meter testing
   A. Clearwell drop test - as often as is practical.
   B. Output meter verification by test meter - at least annually.
5. Accessibility of the output meter
   A. Every output meter should be accessible by occupying its own ventilated pit.
   B. Ideally, there should be a bypass setting arrangement wherein the bypass should be of known and controlled distance and diameter and have no conditions creating turbulence.
6. Other testing considerations
   A. All tests should be conducted over at least a 24-hour period.
   B. Each pumping configuration should be tested over a 24-hour period.
   C. The entire system, meter primary flow device, transmitter, recorder and totalizer should be tested as a system.
   D. The system should be retested following adjustment.
   E. Calibration adjustments should be recorded on meter records.
   F. Every meter should be evaluated no less than annually comparing the manufacturer's specifications and flow range to meter output conditions.
   G. Every output meter setting should be analyzed for compliance with manufacturer's recommendations regarding set location and exposure to turbulence.

H. Pressure lines and pressure taps should be routinely maintained.
I. Spare parts should be inventoried

7. Other production responsibilities
   A. Check system instrumentation, telemetering repeater systems and altitude valves to avoid overflowing tanks and reservoirs
   B. Adjust treatment techniques to avoid corrosivity within the system and evaluate possible precipitates that will affect meter accuracy.
   C. Evaluate the location and the setting conditions to assure that conditions in the field are in strict compliance with the manufacturer's specification.
   D. Test the meter under laboratory conditions.
   E. Test the meter under all operational conditions for at least 24 hours.
   F. Review all plant production records including, but not limited to, results of previous tests, pump efficiency tests, and pump specifications.
   G. Require meter test certification for all new plant meters.
   H. It is recommended that individual flow meters be installed on each high service (Distributive) pumping unit whenever possible to facilitate tests for pump efficiency and station output meter accuracy.

Accurate water measurements is the means by which our company produces revenue to cover expenses. Inaccurate water measurements contribute to unaccounted-for water. The following procedures are means of maintaining revenues and reducing unaccounted-for water.

1. Maintain compliance with Pennsylvania rules and regulations; i.e. Chapter 65, Testing of Meters, as well as Procedures contained in the American Water Works Service Operations Manual.
2. Review and continue to provide training to all outside commercial employees on an ongoing basis to insure that they have the proper knowledge to identify the following:
   A. To inspect and look for illegal connections.
   B. To insure that meters are properly installed, have not been tampered with and sealing devices are intact.
   C. To inspect meter if registration has not increased from prior reading. Run water to see if dial moves or meter is stuck.
3. Establish procedures for all outside commercial personnel to sound and investigate as follows as part of a water loss audit in performing this routine work:
   A. Sound service line for possible leak.
   B. Investigate wet spots in lawns.
   C. Sound fire hydrants if encountering or passing same while performing meter reading or service work.
   D. Sound outside hose bib where meter is a remote installation.
4. Inspect and test all meters 3" and larger annually with fire flow test meter to insure meter accuracy.
5. Inspect and test all battery settings of meters in line with comparison test meter.
6. Evaluate correct meter size by use of a meter master for all large customer accounts.
7. Review all Class 1 turbine meter installations for correct application.
8. Establish data base system and compare various data for identifying meter situations which need investigations.
9. Inspect all private fire services annually. When unauthorized use of water is suspected or found, Company will install properly-sized meter and vault at its expense, thus eliminating the unauthorized use.

(a) *Allowance Error.* No water meter which has an error in registration of more than 2.0% may be placed in service, nor may a water meter which has an error in registration of more than 4.0% be allowed to remain in service, when water is passing through it at approximately the following rates of flow:

Meter size (inches)	*Gallons per minute*
5/8	6
¾	10
1	20
1½	30
2	50
3	90
4	180
6	300

(b) *Periodic Tests.* No public utility furnishing metered water service may allow a water meter of 1 inch or less nor a water meter of more than 1 inch to remain in service for a period longer than 20 years and 8 years respectively without testing it for accuracy and readjusting it if it is found to be incorrect beyond the limits established in subsection (a).

Upon a customer's request the public utilities shall also perform a meter test without charge if a meter has been in service and has not been tested for a period greater than that specified in the following table:

Inch Meter	*Years*
5/8	10
¾	8
1	6
More than 1	4

(c) *Meter Test Records.*

Whenever a water meter is tested, the original test record should be kept indicating the information necessary for identifying the meter, the reason for making the test, the reading of the meter before being disturbed, and the accuracy of the meter together with data taken at the time of the test. This record shall be sufficiently complete to permit the convenient checking of the methods employed and the calculations made. A record shall also be kept, preferably numerically arranged, indicating the date of meter purchase, name of manufacturer, its size, its identification, its various places of installation with dates of installation and removal, and the dates and general results of all tests.

(d) Installation and Removal of Meters.

(1) *Installation of meters.* A water meter whenever installed shall be inspected by the public utility for proper connections, mechanical condition, and suitability of location within 60 days after installation. In the case of a new meter or a meter reconditioned by a manufacturer, the test results of the manufacturer may be accepted as the installation test if the utility has verified the manufacturer's reported test results by testing the greater of 10% or 10 meters of a shipment of meters. In case of emergency, a meter not meeting the requirements of this section may be installed temporarily.

(2) *Removal of Meters.* A water meter which is removed from service shall be tested within 30 days for accuracy to complete that meter's test history. When a meter is removed from service, it shall be properly sealed to secure registers and measuring devices until it can be properly tested for accuracy.

(e) *Facilities for Testing.* A public utility shall provide and keep available suitable and adequate facilities for testing its meters, and shall maintain these facilities in good condition and in correct adjustment so that they are capable of deterimining the accuracy of a service meter within 0.5%. A public utility not maintaining a standardizing laboratory may, upon written permission from the Commission, have its meters and instruments certified by a standardizing laboratory approved by the Commission. The accuracy of testing equipment will be established and checked annually by representatives of the Commission. After making final adjustments, the tester shall seal and date tag the testing facilities and furnish the public utility with a certificate of accuracy properly dated and signed.

(f) *Meters in Service without Test Records.* A water meter of a public utility which does not meet the requirements with respect to tests and records of tests shall be immediately removed from service by the public utility and may not again be placed in service until the requirements are met.

(g) *Request Test.* A public utility shall make a test of the accuracy of registration of a water meter upon written request of the customer for whom the meter is furnished, upon payment of the fee specified in § 1.43 (relating to schedule of fees payable to the Commission). If a customer desires personally or by a representative to witness the testing of a meter, he may require the seal of the meter to be broken in his presence or that of his representative. If the meter tested upon the request is found to be accurate within the limits specified in subsection (a), the fee shall be retained by the utility; but if not so found, the cost shall be borne by the utility and the fee paid by the customer shall be refunded. A report of the test shall be made to the customer.

(h) *Schedule of Fees for Testing Water Meters.* The schedule of fees for testing meters is as follows:

(1) For a water meter having an outlet not exceeding 1 inch—$10.

(2) For other water meters having an outlet not exceeding 2 inches—$20.

(3) Rates for testing other meters, including those which are so located that the cost is out of proportion to the fee specified, will be furnished by the Commission upon the receipt of complete specifications.

(i) *Fees for Testing Facilities of Public Utilities.* The Commission will charge and collect from utilities for the testing of their meter testing facilities and water meters the following fees:

(1) For testing meter testing facilities at the utility plant—$15.

(2) For a water meter tested at the Commission laboratory—$3.00

§65.9. Adjustments of bills for meter error.

(a) *Fast Meters.* If upon test of a meter, the meter is found to have an error of more than 4.0% fast, the public utility shall refund to the consumer the overcharge based upon what the meter would have registered had it not been fast or slow for a period equal to ½ the time elapsed since the last previous test but not to exceed 12 months. If the period of registration error is fixed with a reasonable degree of certainty, the overcharge shall be computed for the period. If the meter has not been tested under §65.8 (relating to meters), the period for which it has been in service beyond the regular test period shall be added to the 12 months in computing the refund.

(b) *Slow meters.* If upon test of a meter, the meter is found to have an error of more than 4.0% slow, the public utility may render a bill for the water consumed but not covered by previously rendered

bills equal to ½ of the time elapsed since the last previous test but not to exceed 12 months. If the period of registration error is fixed with a reasonable degree of certainty, the charge may be computed for the period. Payment of this previously unbilled consumption shall be under §56.83(5) (relating to unauthorized termination of service).

(c) *Nonregistering Meters.* If a meter is found not to have registered for a period or not to have fully measured the entire flow due to meter interference, the public utility shall compute the water used by taking the average of the water used for the nearest meter reading period immediately preceding and the meter reading period immediately following the date when the meter was found to be not registering or interfered with, which amount shall be assumed to be the amount of water used by the customer during the billing period in which the meter was found not to have registered. Exceptions may be made only if the facts clearly show that the stated method does not give the correct consumption for the period.

§65.8. Meters.

You may not place a meter into service if it has an error in registration of more than 2% (a meter which registers 98%-102% of consumption is considered accurate). Additionally, you may not allow a meter to remain in service if it has an error in registration of more than 4% (a meter which registers 96%-104% of consumption is considered accurate). The rates of flow are shown in the regulation on the preceding page. For example a 5/8" meter must be tested at 6 g.p.m. and a 2" meter at 50 g.p.m. These are the only tests you must conduct for these meters.

Meters measuring 1" and less must be tested once every 20 years. Meters measuring more than 1" must be tested once every 8 years.

For all new meters, you must verify the manufacturer's test results by testing 10% or 10 meters (whichever is greater) of each shipment.

Every meter removed from service must be out tested within 30 days following its removal. Again, you should conduct the test at the rates of flow shown in the regulation - 6 g.p.m. for 5/8" meters and 50 g.p.m. for 2"meters.

§65.9. Adjustment of bills for meter error.

If a meter is tested and found to have an error in registration of more than 4% fast, you must refund to the customer the overcharge. If you know the exact period of registration error, you compute the overcharge for that specific period. If you don't know the exact period, you compute the refund by determining what the meter would have registered had it not been running fast for the period

equal to ½ the time elapsed since the previous meter test. The period shall not exceed 12 months. However, if you have not tested the meter within the period of time prescribed by §65.8 (for example, a 5/8" meter in service over 20 years without being tested), the period for which the meter has remained in service beyond the regular test period shall be added to the 12 months in computing the refund.

If a meter is tested and found to have an error in registration of more than 4% slow, you may charge the customer for the unbilled water used during the period equal to ½ the time elapsed since the previous meter test. The period shall not exceed 12 months. Again, if you know the exact period of registration error, you compute the charge for that specified period. However, if the customer does not pay the bill, you may not terminate his/her service.

A leak detection survey is a process of elimination and discovery. The goal is to eliminate the contact points where water sounds are not heard and discover the contact points where leaks can heard.

Prior to conducting a leak detection survey, you must review the specifications of your distribution system. The following information is important to review:

1. How much water is lost from the system in gallons as well as gallons per minute.
2. Types of pipelines in the system, ages, diameters, joints, installation methods, leak histories, and operating pressures.
3. Number and type of valves in the system, including location records and drawings, types of valves, open left or right, number of turns to exercise valves, and how often valves are exercised.
4. Hydrant records - types, sizes, locations, flushing frequencies, static pressure and residual flow.
5. Location of pressure-reducing valves, pressure-sustaining valves, pressure-relief valves and dates of inspections and maintenance of valves.
6. Location of blow-offs and air-release valves and records as to maintenance.
7. Accurate distribution system map.
8. Verify what is shown on map as to its accuracy, how current is the information, and how often is the information updated.

PROCEDURES FOR CONDUCTING A WATER LOSS AUDIT FOR DISTRIBUTION PERSONNEL

1. Formulate a plan to survey the distribution system taking into account the following:
   A. Determine number of miles to be surveyed.
   B. Need updated distribution maps for use in the survey along with current valve and hydrant records.
   C. Establish miles per day and length of time to conduct survey.
   D. Assign trained personnel to survey.
   E. Equipment necessary to conduct survey:
      1. Sonic Equipment
      2. Geophone
      3. Aquaphones
      4. Valve & curb keys
      5. Wrench & hand tools
      6. Pick, Shovel & Sledge
      7. Danger signs, cones, flags
      8. Marking Paint & Chalk
      9. Radio communications
      10. Valve Box & Curb Box
      11. Pipe locator
      12. Measuring(tape-wheel)
      13. Valve operator
      14. Vehicles
      15. Portable lighting outfit
      16. Flashers
      17. Arrow Board
      18. Altimeter

2. Segregation of Distribution System:
   A. Evaluate distribution system for problem areas using information from records on hand, leak cards, and computerized reports.
   B. Segregation of distribution system, if required, will be dependent upon number of miles to be surveyed.
   C. Divide distribution system into districts and further sub-divide sections into areas where known consumption can be determined, such as:
      1. Area coding
      2. Booster areas, etc.
   D. Install distribution system metering where feasible to isolate sections.

3. Procedures for conducting leak sounding survey:
   A. Sound all fire hydrants and verify static as per elevation and gradient.
   B. Sound main line valves, random curb boxes and meter pits. For complete audit, sound all curb boxes and meter pits.
   C. Investigate, inspect, and sound all fire services.

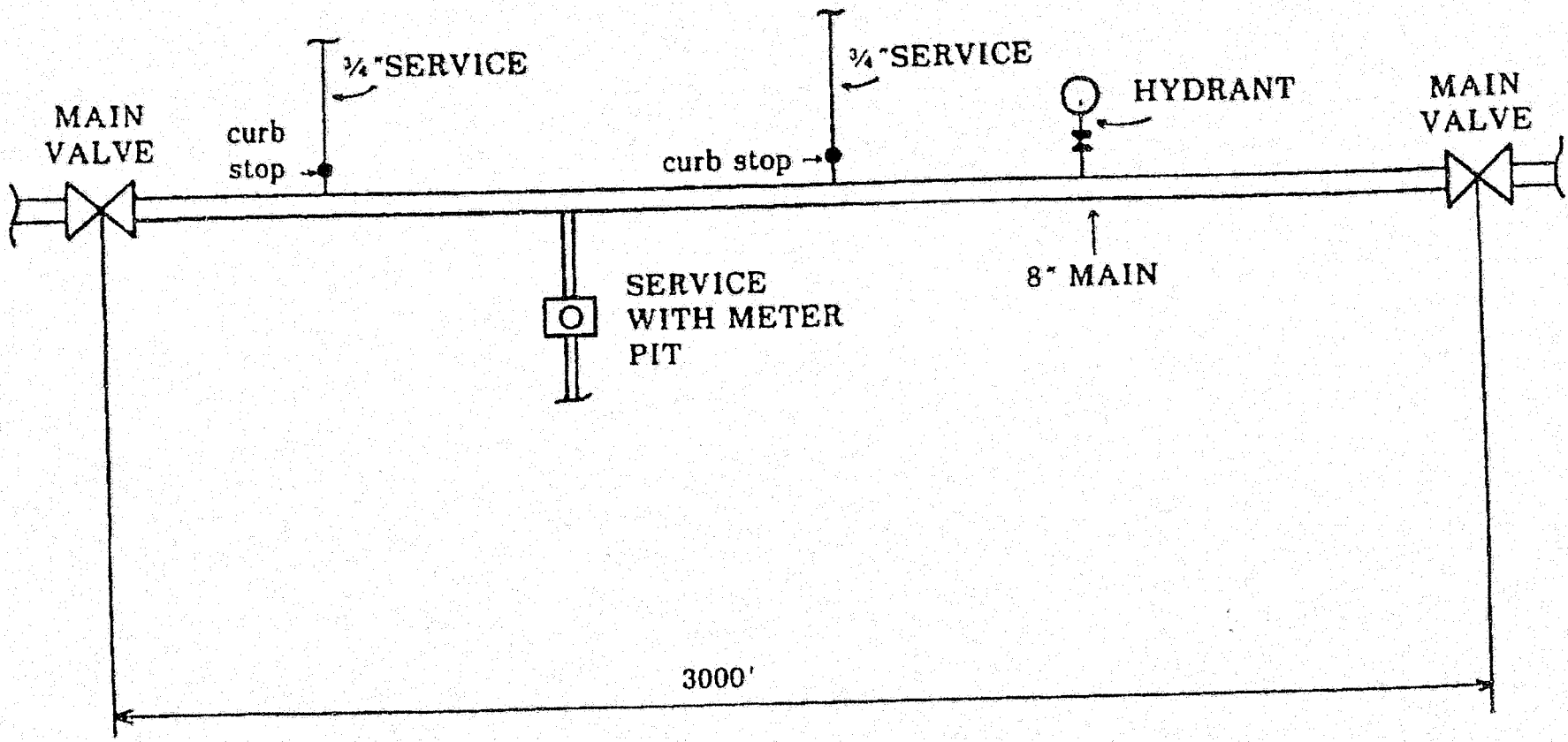
D. Investigate, inspect, and sound all large commercial and industrial services.
E. Sound blow offs and bleeders.
F. Inspect and sound exposed pipelines on bridges and railroad crossings.
G. Isolate and sound river crossings. A meter and bypass should be provided whenever possible.
H. Inspect and sound mains in easements. Line markers which provide sounding points should be installed whenever possible.

4. Perform Visual Inspection:
   A. Inspect manholes and catch basins for unusual flow of water.
   B. Inspect streams and springs in dry weather for unusual flow of water.
   C. Inspect and walk pipeline right-of-ways.
   D. Review and compare recording charts for changes in pressures and flows.
   E. Review Fire Department records for unreported usage after fire.
   F. Adopt and enforce a strong policy prohibiting the unauthorized use of fire hydrants for the following:
      1. Streets sweepers
      2. Sewer flushings
      3. Swimming pools
      4. Paving contractors
      5. Lawn care companies
      6. Exterminators
   G. Investigate wet spots or sunken areas in lawns and roads.
   H. Inspect tank and reservoir overflows and altitude valves.
   I. Service personnel should be alert for illegal connections before meters.

5. System for recording soundings on distribution maps via color-coded legend:
   A. Example:
      Blue dot -- confirm sound was taken at specific location.
      Red dot -- confirm leak sound located.
      Red X -- leak location pinpointed.
      Green circle around red dot -- indicates leak repaired.
      Brown circle around red dot -- no sound on recheck.

6. Prioritize Repairs to Leaks:
   A. Leaks found should be scheduled for repairs as soon as possible depending on the flow and water supply affecting system and public health and welfare.
      1. Public Safety Priorities should be established on a case-by-case basis considering the following factors:
         a. Fire flows.
         b. Service to large customers; i.e. hospitals, schools, nursing homes, industry, etc.
         c. Streets, sidewalks, and property damage. Public safety - streets and sidewalks.
         d. Weather conditions.
         e. Property damage.
7. Data accumulation and analysis.
   A. Data obtained during leak surveys should be maintained in a computer data base per analysis.
   B. Twelve-month cumulative totals for system delivery volumes and percentages should be developed each month and depicted graphically to show trends.
   C. All data should be collected, maintained and presented in a standard format.

NOTE
SOUND ALL VALVES SERVICE, HYDRANT CURB STOPS



CONCLUSION

A Water Loss Audit as presented in this handbook is not an additional job. It is instead a coordination of effort and resources organized to view a water production and distribution network as an interrelated system. Unaccounted-for water does not occur because of leaks alone; it is not a single large main break; it is not only meter misregistration; it is not just unauthorized use. It is, however, a combination of all of these circumstances.

A water loss audit requires planning, organization, follow through and control, as well as the coordinated, dedicated and enthusiastic effort of every employee in every district. A well constructed audit will examine every source of loss to pinpoint leakage and lost revenue.

As a suggestion to focus effort and measure success, it is recommended that in the future, the M-Work Order process summarize the individual efforts into a single multi-section work authorization entitled "Water Loss Audit."

Pennsylvania-American Water Company

PAWC STATEMENT NO. 1

DIRECT TESTIMONY
OF
DAVID V. MODEER

WITH REGARD TO
SCOPE OF OPERATIONS, DESCRIPTION OF THE SYSTEM AND WATER CONSERVATION PLANNING

PENNSYLVANIA-AMERICAN WATER COMPANY

DIRECT TESTIMONY OF DAVID V. MODEER

1. Q. Please state your name and business address.

A. David V. Modeer, 800 West Hersheypark Drive, Hershey, Pennsylvania 17033.

2. Q. By whom are you employed and in what capacity?

A. I am employed by Pennsylvania-American Water Company ("Pennsylvania-American" or the "Company") as Vice President and Manager.

3. Q. Will you please outline your business experience in the water utility industry?

A. I began my career in the American Water Works System at Missouri-American Water Company, St. Joseph, Missouri in 1972 as a Management Trainee. The Management Trainee Program was a comprehensive two-year training program which included my assignment to all areas of Company activities including the business office and the production, distribution and customer service departments. In addition, I participated in the areas of rates and revenues, finance, accounting and labor relations. In 1974 I was promoted to Manager of the Cairo District of Illinois-American Water Company. In 1976 I was transferred to the Northern Division of Illinois-American Water Company headquartered in Peoria, Illinois, as Customer Service Superintendent. In this capacity I was responsible for the operation of

the business office and the customer service and outside commercial departments. My work responsibilities included the areas of budgeting, accounting, finance and customer service. In 1980 I was promoted to the position of Operations Manager for the Northern Division of Illinois-American Water Company. In this capacity I was responsible for the overall operation of the water treatment facilities and the distribution department, as well as the engineering activities of this Division. In 1984, I was transferred to the headquarters of the Western Region of American Water Works Service Company, located in Chula Vista, California, as Regional Manager of Operating Services and Vice President of the companies in that region. In that capacity, I was responsible for the overall operation of the six districts of the California-American Water Company as well as the companies located in Arizona and New Mexico. My areas of responsibility included all day-to-day operational activities, budgeting, engineering, loss control, water quality, labor and employee relations and regulatory activities. In 1991, I was transferred to my current position.

4. Q. Do you belong to any professional or industry associations?

A. Yes, I am a member of the American Water Works Association, the Pennsylvania Chapter of the National Association of Water Companies and the Water Works Operators' Association of Pennsylvania.

5. Q. What is your educational background?

A. I am a 1970 graduate of The Creighton University, Omaha, Nebraska, where I received a Bachelor of Science Degree in Biology and Chemistry. Between 1980 and 1984 I attended Bradley University in pursuit of my Masters of Business Administration Degree.

6. Q. What is the nature of your duties with Pennsylvania-American?

A. As Vice President of Operations. I have overall responsibility for all operational activities, statewide, for Pennsylvania-American.

7. Q. What is the purpose of your testimony?

A. I will discuss two separate areas. First, I will explain the Company's scope of operations and provide a general description of its system. In connection with this area, I will sponsor and explain Exhibit Nos. 1-A and 1-B. Second, I will discuss the Company's efforts to encourage cost-effective conservation, as summarized in Exhibit No. 1-C.

8. Q. Please begin by explaining the Company's scope of operations and describing its system for producing, treating, pumping, storing and distributing water to customers.

A. These explanations are set forth in Exhibit No. 1-A. Exhibit No. 1-A includes an explanation of the scope of operations of each of the seven operating areas of the Company. Additionally, Exhibit No. 1-A contains a section captioned "Corporate Overview of Pennsylvania-American Water Company," which sets forth a narrative description of corporate objectives and how the Company is organized to enable it to achieve these objectives. The narrative also provides a summary of the work the Company does and the functions of the Company that I supervise. Following the narrative are eight pages of organizational charts showing the management structure of the Company at the corporate level and for each operating division.

The foregoing information is, in turn, supplemented by the detailed system maps which have been submitted with this filing as Exhibit No. 1-B. Those maps depict the major pipeline and storage facilities of the Company in relation to principal roads, highways and other geographic features.

9. Q. Mr. Modeer, focusing on the topic of conservation, are you aware that the Commission has issued regulations to be used to evaluate the performance of water utilities in encouraging cost-effective conservation by customers?

A. Yes. The Company has reviewed those regulations and believes that it is meeting and, in some instances, exceeding the minimum standards established by the Commission. For example, the Company:

- Distributes conservation-related material to its customers at least twice a year.
- Has implemented a program to sound for leaks on all customer service control valves once every five years.
- Sounds all hydrants for leaks every year during inspection and flushing of the distribution system via the hydrants.
- Employs seven state-of-the-art electronic leak detection vans to detect and repair fractured transmission and distribution mains. These vans are geographically dispersed throughout the state to provide maximum coverage.
- Has conducted a comprehensive water audit in each of its operations in Pennsylvania. The comprehensive water audits performed by the Company are designed to analyze, in one exercise,

all potential sources of water loss. This form of audit was developed and is used primarily in the water scarce areas of the Western United States, but it has proven itself to be a valuable tool for PAWC by identifying ways to increase water available for customers' use other than through capacity additions.

- Provides and installs, free of charge, retrofit kits in the homes of customers meeting specific low-income and household consumption criteria. These kits include toilet dams, low flow shower heads, kitchen and bathroom faucet aerators and toilet leak-identifying dye tablets.
- Makes available to all customers at a cost of $7.95 the same high quality retrofit kits referred to above. The availability of these kits at this reduced cost from Resource Conservation, Inc., a company unaffiliated with PAWC, was communicated via bill insert to all customers. As of September 30, 1994, 19,130 customers had ordered 23,478 kits.
- Has incorporated into its tariff plumbing standards that require low water use fixtures for new homes or significant remodeling projects.
- Has purchased and utilizes state-of-the-art water use monitoring equipment which allows the Company

to properly size its larger meters to accurately measure water use.

10. Q. Are you sponsoring any additional evidence regarding the Company's conservation efforts?

A. Yes. The Company has filed as Exhibit No. 1-C in this case its current Water Resource Management Program. This document describes in detail the types of programs the Company either has in place, or are under way, to promote the wise and efficient use of water. This document will be supplemented in the future as new programs are added to the Company's overall Water Resource Management Program, but stands now as clear evidence of the Company's commitment to this important environmental issue.

11. Q. Does this conclude your testimony at this time?

A. Yes, it does.

Pennsylvania-American Water Company

EXHIBIT NO. 1-H

PENNSYLVANIA-AMERICAN WATER COMPANY

1994 ACTION PLANS

Production Department

1. Test plant meters semi-annually.
2. Semi-annual clearwell drawdown test.
3. Review plant non-revenue usage.
4. Conduct complete water audit as per Company Operations Manual procedures.

Commercial Department

1. Annual testing of large meters - 3" and above.
2. Replace remote meters with encoder meters as variances are found between the inside and outside reads.
3. Review meter sizing and downsize when necessary.
4. Have all meter readers and service persons sound on customer service lines during turn on and turn offs and when they have access to the customer's home.
5. Testing of small diameter meters in accordance with American System Procedures.
6. Conduct complete water audit as per Company Operations Manual procedures.
7. Review non-revenue usage.

Distribution Department

1. Continue leak detection surveys.
2. Continue valve operating and sound program on an ongoing basis.
3. Continue curb box program on an ongoing basis.
4. Increase inspection of all fire services from annually to semi=annually.
5. Sound all fire hydrants semi-annually.
6. Conduct a study of high maintenance, small diameter mains and develop a replacement program based on priority.
7. Discuss unauthorized use of fire hydrants with municipalities, fire departments, etc.
8. Conduct complete water audit as per Company Operations Manual procedures.
9. Continue program of converting services to eliminate duplicate mains.
10. Review non-revenue usage.
11. Meter and monitor blow-offs when we must run water for water quality purposes.

Pennsylvania-American Water Company

MECHANICSBURG

1994 PLAN TO CONTROL UNACCOUNTED-FOR WATER

1. Continue the on-going review for proper sizing of large meters.

2. Continue the multi-year program to replace 20 year old meters, cubic foot meters and Kent, Rockwell and Badger remote meters with Neptune encoder meters.

3. Establish flow metering points to check large areas and compare flows to consumption in those areas.

4. Continue the sounding of all hydrants and valves. Distribution and Outside Commercial personnel will sound whenever time is available.

5. Have plant meters tested and meter instrumentation calibrated twice per year.

6. Continue to develop methods for measuring water used during main flushing.

7. Continue to have service people sound on all occasions when inside customer premises.

8. Continue to sound hydrants before and after flushing and during the winterizing program.

9. Continue to check for leaks in areas of new construction within one year of installing new mains and services.

10. Continue to survey all stream crossings and long isolated lines.

11. Inspect fire services for leaks and/or unauthorized use of water.

12. Continue to promptly repair all Water Company leaks and follow up on repair of customer leaks.

13. Continue to sound valves during turning program.

14. More accurately account for water used for fire department activities, fire fighting, blow-offs, etc.

15. Continue to test all large customer meters annually.

16. Continue the curb box location program.

17. Continue to read detector check meters monthly.

18. Continue to include inactive accounts in meter routes and check "vacant" buildings for occupancy.

MAIL COPY

Pennsylvania-American Water Company

PAWC STATEMENT NO. 1

DIRECT TESTIMONY
OF
RICHARD C. NEUBAUER

WITH REGARD TO
SCOPE OF OPERATIONS, DESCRIPTION OF
THE SYSTEM AND WATER CONSERVATION PLANNING

Q. Please state your name and business address.

A. Richard C. Neubauer, 800 West Hershey Park Drive, Hershey, Pennsylvania 17033.

Q. By whom are you employed and in what capacity?

A. I am employed by Pennsylvania-American Water Company ("Pennsylvania-American," "PAWC" or the "Company") as Vice President of Operations.

Q. Will you please outline your business experience in the water utility industry?

A. I began my career with the American Water Works Company in June 1971 as a staff accountant in Richmond, Indiana. In October of 1971, I was promoted to Tax and Cost Control Supervisor for the East St. Louis and Interurban Water Company in East St. Louis, Illinois. In August of 1973, I was transferred to the Granite City District of East St. Louis and Interurban Water Company as Office Manager. In this capacity I was responsible for the operation of the business office and the customer service and outside commercial departments. My work responsibilities included the areas of budgeting, accounting, finance and customer service. In 1975, I was promoted to the position of Manager for the Palmyra District of Keystone Water Company in Palmyra, Pennsylvania. In this capacity I was responsible for the overall operations of the water treatment facility, the distribution department, and the customer service and business office activities of this district. In 1977, I also became Manager of the Hershey Water Company, and in 1986 I assumed additional responsibilities as Manager of the Riverton District of Pennsylvania-American, located on the West Shore of the Susquehanna River from Harrisburg, Pennsylvania. In 1989, I was transferred to the Pittsburgh Division of PAWC and

promoted to Manager of that Division. In 1998, I was promoted to my current position as Vice President of Operations (Central and Eastern Pennsylvania) and transferred to PAWC's Corporate Office in Hershey.

Q. Do you belong to any professional or industry associations?

A. Yes. I am a member of the American Water Works Association, the Pennsylvania Chapter of the National Association of Water Companies and the Water Works Operators' Association of Pennsylvania.

Q. What is your educational background?

A. I am a 1971 graduate of Missouri Western College in St. Joseph, Missouri, where I received a Bachelor of Science Degree in Business Administration.

Q. What is the nature of your duties with Pennsylvania-American?

A. As Vice President of Operations (Central and Eastern Pennsylvania), I am responsible for providing technical assistance and supervision with regard to water quality, operations and maintenance to the Company's operating areas located in Central and Eastern Pennsylvania. Mr. William Kelvington is PAWC's Vice President of Operations (Western Pennsylvania) and provides similar services to the Company's operating areas located in Western Pennsylvania.

Q. What is the purpose of your testimony?

A. I will discuss two separate areas. First, I will explain the Company's scope of operations and provide a general description of its system. In connection with this area, I will

sponsor and explain Exhibit Nos. 1-A and 1-B. Second, I will discuss the Company's efforts to encourage cost-effective conservation, as summarized in Exhibit No. 1-C.

Q. Please begin by explaining the Company's scope of operations and describing its system for producing, treating, pumping, storing and distributing water to customers.

A. These explanations are set forth in Exhibit No. 1-A. Exhibit No. 1-A includes an explanation of the scope of operations of each of the four operating areas of the Company. Additionally, Exhibit No. 1-A contains a section captioned "Operational Overview of Pennsylvania-American Water Company," which sets forth a narrative description of corporate objectives and how the Company is organized to enable it to achieve these objectives. The narrative also provides a summary of the work the Company does and the functions of the Company that Mr. Kelvington and I supervise. Following the narrative are eleven pages of organizational charts showing the management structure of the Company at the corporate level and for each operating area.

The foregoing information is, in turn, supplemented by the detailed system maps which have been submitted with this filing as Exhibit 1-B. Those maps depict the major pipeline and storage facilities of the Company in relation to principal roads, highways and other geographic features.

Q. Mr. Neubauer, focusing on the topic of conservation, are you aware that the Commission has issued regulations to be used to evaluate the performance of water utilities in encouraging cost-effective conservation by customers?

A. Yes. The Company has reviewed those regulations and believes that it is meeting and, in some instances, exceeding the minimum standards established by the Commission. For example, the Company:

- Distributes conservation-related material to its customers at least twice a year.
- Sounds all hydrants for leaks every year during inspection and flushing of the distribution system via the hydrants.
- Employs eight state-of-the-art electronic leak detection vans to detect and locate fractured transmission and distribution mains. These vans are geographically dispersed throughout the state to provide maximum coverage.
- Provides and installs, free of charge, retrofit kits in the homes of customers meeting specific low-income and household consumption criteria. These kits include toilet dams, low flow shower heads, kitchen and bathroom faucet aerators and toilet leak-identifying dye tablets.
- Has incorporated into its tariff plumbing standards that require low water-use fixtures for new homes or significant remodeling projects.
- Has purchased and utilizes state-of-the-art water-use monitoring equipment which allows the Company to properly size its larger meters to accurately measure water use.

Q. Are you sponsoring any additional evidence regarding the Company's conservation efforts?

A. Yes. The Company has filed Exhibit No. 1-C in this case, which is its current Water Resource Management Program. This document describes in detail the types of programs the Company either has in place, or are under way, to promote the wise and efficient use of water. This document will be supplemented in the future as new programs are added to the Company's overall Water Resource Management Program, but stands now as clear evidence of the Company's commitment to this important environmental issue.

Q. Does this conclude your testimony at this time?

A. Yes, it does.

4

Pennsylvania-American Water Company

WATER RESOURCE MANAGEMENT PROGRAM

EXHIBIT 1-C

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INTRODUCTION

Water utilities, whether municipal or investor-owned, have viewed themselves over the years as guardians and protectors of the public water supply. Traditionally, they have taken the position that their job to make sure that there is enough water available and that it is safe for the public to use. What happens that water — how much is consumed and for what purpose — has been regarded as solely the province o the customer.

Water companies have the distinction of being the "original conservationists." Over the years, water companies have been in the forefront of seeking to protect the quality of water supplies. Water companie have gone to court to stop the dumping of pollutants. They have shown concern about chemical wastes, agricultural run-off, erosion and mine acid drainage, among other issues.

Water is a renewable resource and abundant on a global scale. However, the importance of water conservation as a policy question at all levels of government can only grow in the coming years. *The Global 2000 Report to the President*, as quoted in the National Regulatory Research Institute's recently published *Compendium on Water Supply, Drought, and Conservation*, points out that the world's supply of freshwater was 10 times greater than demand as of 1980, but predicts that by the year 2000, supply will b only 3.5 times greater than demand. Part of the challenge of the water supply industry and its regulators the development of a conservation policy that addresses this problem, but which is fair to everybody.

As the largest investor-owned water company in the United States, Pennsylvania-American Water Com pany has accepted its responsibility for creating sound conservation programs. However, Pennsylvania-American realizes it must explain to its customers that their efforts, combined with those of the Company may have little initial impact on the Company's overall cost of service. The Company's current overall co of service cannot be significantly reduced through conservation efforts even though some future costs may be delayed or avoided. Conservation efforts must focus on ways to reduce peak usage if new plant construction costs are to be avoided. Since many construction expenditures are to replace the aging infrastruc ture, it is not anticipated that overall costs will be significantly reduced.

Rate structures as they now exist make it virtually impossible for customers to translate less water use into savings, or peak usage as an increased cost. As an example: A 10 percent reduction in water use does not currently result in a 10 percent reduction in a customer's bill, nor does a 10 percent increase in usage on the maximum day result in a 10 percent increase in a customer's bill to discourage such usage.

As a matter of perspective it is worth noting water-use figures from the state Department of Environmental Resources that were quoted by Public Utility Commissioner Joseph Rhodes Jr. at the Great Lakes Conference of Public Utility Commissioners in July 1989. Of 75 billion gallons of water withdrawn per day in Pennsylvania, only 1.6 billion gallons are withdrawn for public needs. Seventy billion gallons are withdrawn for electrical generation; 3.4 billion gallons are used by industry. Of the 1.6 billion taken for public needs, only 500 million gallons per day are taken by investor-owned water companies under the jurisdiction of the Pennsylvania Public Utility Commission. Therefore, the task of this Company and the PUC to have an impact on the conservation of water use of the Commonwealth must extend beyond the responsibilities and procedures outlined in this document.

Of the 500 million-gallon daily withdrawal by investor-owned water companies referenced by Commissioner Rhodes, Pennsylvania-American accounts for about 184 million gallons withdrawn daily. Since Pennsylvania-American serves a population of about 2 million, the average per-capita use is 92 gallons per day. According to information published by the National Regulatory Research Institute (NRRI), the average per-capita use for the Commonwealth of Pennsylvania is 196 gallons per day.

The information published by NRRI further indicates the comparable per-capita use in New Jersey is 156 gallons; in Maryland, 216 gallons; in Ohio, 159 gallons; in New York, 180 gallons; in West Virginia, 115 gallons; and in Delaware, 151 gallons. This data only reflects withdraw of the natural resource and not the eventual use of finished water by the customer. However, it provides a clear indication of the beginning point for Pennsylvania-American's increased conservation efforts.

As these statistics indicate, the Company's prior conservation efforts, universal metering and leak detection programs have already had a significant impact on the use of water resources in this state. Additional improvements realized from the program outlined herein may be difficult due to the low daily per-capita use Pennsylvania-American has already achieved.

Further evidence is reflected in the data related to the usage of that treated water. The average indoor and outdoor residential use by Pennsylvania-American's customers is 60 gallons per capita per day, or 6 gallons per day less than the average in Pennsylvania. Compare this usage with 103 gallons in Maryland, 92 in New York, 75 in New Jersey; 70 in Delaware; 62 in West Virginia and 52 in Ohio.

An additional consideration in any conservation discussion must be its impact on economic development. As noted in committee reports in Case No. 88-W-221 before the State of New York, Department of Public Service, a proceeding investigating conservation issues, "The committee recommends that any plan recognize the importance of maintaining a favorable business climate so as to retain existing businesses and encourage the entrance of new business in communities served by the suppliers." Pennsylvania-American shares this concern of protecting the economic base of its service areas, and has designed its water conservation program to manage a natural resource and discourage wasteful uses. In this manner, potential businesses can see our concern for the environment and our management of the resource as an assurance of an adequate supply of water to meet their needs.

Water companies regulated by the PUC will have a minimal effect on the big picture. Policy linkage across a broad spectrum of interests and jurisdictions is necessary to accomplish the intended goals. The common tie among these diverse interests and jurisdictions will be a focus on the "wise use" principle. As explained by the National Regulatory Research Institute, this principle consists of three elements: wise management of resources, use of advancing technology and discouraging waste.

STRATEGIC PLANNING FOR CONSERVATION

POLICY — Pennsylvania-American will consider the cost and impact of its conservation program in all of its engineering and financial plans.

DISCUSSION — American Water Works Company, Inc., the corporate parent of Pennsylvania-American Water Company, recognizes the importance of conservation as a strong element in resource management. In its 1988 annual report, the American Water Works Company included "A Statement on Conservation." Among other things, that statement says:

"We have augmented supplies when it was apparent this was required. Consumers expected this of us. This may be changing."

The statement continues, "Today, in certain service areas, people are questioning whether or not they are willing to pay for the next supply increment. We respect this position and will work to help those communities consider their alternatives." (See Appendix A for the full text of the American Water Works statement.)

LEAK DETECTION

POLICY - Pennsylvania-American Water Company's Leak Detection Specialists will survey three or more miles of water distribution mains per day when they are not pinpointing known leaks.

POLICY - Operating personnel in each district will sound 100 percent of all hydrants, 20 percent of all system valves and 33 percent of all service line control valves for hidden leaks annually. These programs will be conducted in a fashion that ensures that all valves are sounded at least once every five years and all service line control valves are sounded at least once every three years.

DISCUSSION - Pennsylvania-American distribution employees have historically listened for leaks on valves and service line control valves as part of sound water works operating practices. However, due to new technology, this program was enhanced in 1981 by the addition of leak detection vans.

Pennsylvania-American's aggressive leak-detection program utilizes eight maintenance service employees, who specialize in leak detection, travel the state in specially equipped vans that contain more than $65,000 of sophisticated leak-detection equipment. These eight specialists cover a system composed of 32 different service districts and 7,589 miles of main.

The maintenance service employees who specialize in leak detection use electronic sounding devices and computerized correlators to find leaks. Upon arriving at a district, they collect information pointing to problem areas and initially concentrate in those areas. They begin by listening for leaks on hydrants and valves and then move on to small mains. A single specialist in a van can cover about three to five miles of distribution main per day.

As discussed earlier, in addition to these roving vans, employees in each of the Company's districts continue to conduct an active hydrant, valve, and service line control valve leak-detection program that has existed for years. This program is part of scheduled operations at the district level. All hydrants are inspected annually. All valves in each district are inspected at least once every five years. The Company's goal is to inspect all service line control valves at least once every three years.

PUBLIC EDUCATION

POLICY — Pennsylvania-American Water Company will distribute conservation-related information to all customers twice a year.

DISCUSSION — One of the most important elements in achieving conservation is public education. Providing reliable and persuasive information in an easy-to-understand manner can substantially influence customer attitudes and consumer practices.

All customers have received conservation-related informational pamphlets at least twice a year since 1982. In 1989, Pennsylvania-American created a colorful, fully illustrated, easy-to-read pamphlet filled with water-saving tips. (See Appendix B for a copy of this pamphlet.) The publication stresses how customers can benefit by practicing water conservation.

PROTECTION OF RESOURCES

POLICY — Pennsylvania-American Water Company will monitor its sources of supply on a regular scheduled basis and notify proper authorities of any degradation detected in quality or quantity of this natural resource.

DISCUSSION — Protection of existing resources is a significant component of conservation Pennsylvania-American exercises that component through vigilance and up-to-date knowledge of activities in watershed areas. Water quality specialists of Pennsylvania-American oversee a vigorous monitoring program designed to protect the company's sources of supply.

In all, Pennsylvania-American operates 32 filter plants that draw from reservoirs, more than 60 operating wells, all of the state's major rivers, and a variety of small streams. Pennsylvania-American keeps records at these sites of all water discharged into the surface water which its water is drawn. The state Department of Environmental Resources (DER) regulates such discharge through permits issued under the National Pollution Discharge Elimination System.

Pennsylvania-American conducts daily monitoring of water sources so it can be aware of any change in water quality as soon as possible.

In 1981, for example, Pennsylvania-American called DER's attention to increased bacteriological counts in water downstream from a cheese processing factory along the Shenango River in New Castle. That action resulted in a DER order for upgraded treatment facilities at that factory so the processing facility could meet the discharge standards specified in its permit.

In another example, Pennsylvania-American in 1988 detected an unusual concentration of ammonia in water in the intake of its Pittsburgh plant. The Company notified DER and began treatment with extra chlorine. DER in turn identified the source of the ammonia as a licensed discharger who was exceeding permit limits. Additionally, the Company filed a notice of intent to sue U.S. Steel in 1985, under the Resource Conservation and Recovery Act (RCRA) for violation of regulations regarding benzene discharges.

Pennsylvania-American reviews The Pennsylvania Bulletin weekly for permit applications or re-applications. In instances where it feels concern is warranted, it will seek detailed data from DER and make its views known to the agency.

Once DER issues a permit, the permit holder must file monthly discharge reports with the agency. Pennsylvania-American routinely reviews such reports from its source areas at least once a year. If changes in water quality are detected through its own testing, Pennsylvania-American immediately turns to these reports for clues as to the source of the change.

Pennsylvania-American maintains an information exchange network with upstream utilities to provide early warning should a spill occur. Pennsylvania-American maintains a close working relationship with DER and the Pennsylvania Fish Commission, and is prepared to work with an emergency response coordinator in each DER region and in each county within its various service territories.

Pennsylvania-American also monitors groundwater sources. Pollution in groundwater tends to linger longer and even small spills can cause serious contamination. Small amounts of volatile organic chemicals such as benzene, degreasers and paint thinners can percolate down into the water table. Eventually they work their way into the water supply, and it can then take decades for contaminants to pass through.

Pennsylvania-American performs quarterly analyses of its groundwater sources, looking for even low concentrations of contaminants that might signal a more serious problem down the road. Testing for 63 contaminants is conducted every three months. Pennsylvania-American also offers speakers to talk to civic organizations about water pollution and its prevention.

METERING

POLICY — Pennsylvania-American Water Company will universally meter all customer accounts, exclusive of public fire hydrants.

POLICY — Pennsylvania-American Water Company will utilize monthly reading and billing, and promote conservation information through that billing process.

DISCUSSION — Except for water used in fire protection, the Pennsylvania-American distribution system is a universally metered system with no unmetered customers. The company is also installing meters on sprinkler systems used for private fire protection. The purpose is to stop unauthorized use of water from such systems and to measure and charge for water used in testing of the systems.

MATERIALS AND ENGINEERING

POLICY - Pennsylvania-American Water Company will utilize high-quality materials in its distribution system to minimize leakage potential, and will include impacts of conservation in its engineering plans.

DISCUSSION - Pennsylvania-American has undertaken several efforts in the areas of materials and engineering that contribute to its general conservation plan.

The Company has gone almost exclusively to the use of ductile iron pipe in its mains. Though more costly than asbestos-cement, cast iron or plastic, its durability will cut down on leaks and maintenance costs for many years to come. The ductile iron pipe used by the Company is cement-lined to thwart internal corrosion and polyethylene wrapped to protect against external corrosion.

Pennsylvania-American does not accept newly constructed mains until leak testing has been done in agreement with standards set by the American Water Works Association. Also, in the last several years, the Company has covered and lined six of eight remaining open storage reservoirs, thus eliminating loss through evaporation and leaking.

Pennsylvania-American has installed water backwash turbidity monitors in its filtration plants. In the filtration process, solids removed in the filters cause the filters to become clogged. Periodically, these filters must be removed from service and backwashed in order to restore performance. Water that has been previously treated is used for backwash purposes. The use of these monitors provides plant personnel with a clear, instant indication of the cloudiness of the backwash water, helping to conserve process water used for backwash. The amount generally represents about 2 to 6 percent of total plant flow. The new monitors determine when the backwash operation may be terminated. Under the old method, backwash operations were conducted for a fixed time, regardless of the length of filter run. Use of the backwash turbidity monitors allows termination of the backwash cycle at a time when the filter is neither overwashed nor underwashed, resulting in optimum use of the water supply.

CONSERVATION CODES

POLICY — Pennsylvania-American Water Company will promote conservation-oriented ordinances in local municipalities where it provides service.

DISCUSSION — Pennsylvania-American in 1989 supplied all of its division managers with copies of a model water-conservation ordinance developed by the state Department of Environmental Resources. The ordinance sets water conservation standards for plumbing fixtures and fittings. Adoption by a municipality would mandate, in newly constructed or remodeled buildings, the installation of 1.6-gallon-per-flush toilets. Also required would be 1.5-gallon-per-flush urinals and showerheads with discharge rates not exceeding three gallons per minute. Division managers sent copies of this ordinance in November 1989 to all municipalities within their divisions. The Company's cover letter asked local officials to support the enactment of regulations mandating low-flow fixtures and fittings and offered the company's help. (See Appendix O for a sample cover letter and a copy of the model ordinance.)

EMERGENCY CONSERVATION PROCEDURES

POLICY — Pennsylvania-American Water Company will maintain a drought contingency plan in each of its operations.

DISCUSSION — Should a drought emergency arise, Pennsylvania-American has developed a series of steps to help its customers conserve water. In many instances, water allocation permits governing Pennsylvania-American's sources of supply specify certain steps when flows reach a pre-determined level (An outline of Pennsylvania-American's water conservation contingency plan and a list of water-saving suggestions developed for residential customers are included in Appendix E.)

RATES AND CONSERVATION

POLICY — Pennsylvania-American Water Company will promote rate and tariff changes that encourage conservation.

DISCUSSION — Pennsylvania-American recognizes that the rate and cost dynamics under which water utilities now operate are not conducive to promoting water conservation. This is because customers cannot save money in equal measure to the water they save, and further compounds the task of promoting conservation strictly as a matter of economic self-interest.

Over the years, investor-owned water utilities have been concerned that water conservation on a large scale would depress revenues without any offsetting reduction in costs. The National Regulatory Research Institute's (NRRI) Compendium on Water Supply, Drought, and Conservation confirms the sensitive link between conservation and revenues. "When conservation measures or water use prohibitions are in full force, absent an accompanying rate increase [emphasis added], utility revenues will be reduced," it says.

NRRI points out that, using typical demand elasticity estimates and a no-growth hypothetical model, a doubling of the price of water "results in a 32 percent reduction in demand but a 36 percent increase in revenue for the water utility. Without a price increase, the revenue loss caused by the same level of conservation would be about [32 percent]."

Due to the tremendous amount of fixed costs and the amount of investment per dollar of revenue, the largest part of the cost of providing water remains unchanged no matter how much water a customer may require. Costs do not go down proportionally if usage goes down. Once a plant and distribution system exist, the cost of that plant and system don't come down because people are conserving and drawing less water from the system. While similar economic results exist in other types of utilities, water companies are particularly sensitive to such results since the investment per dollar of revenue is much higher for water utilities than any other utility service.

Even designing a system with conservation in mind is difficult. Main size in the system is dictated by the capacity needed for fire fighting. A water system must be built to meet peak requirements rather than average requirements, which in turn mandates a higher front-end investment. Even though Pennsylvania-American is committed to conservation as part of its comprehensive planning process, the Company's construction expenditures over the next 15 years would not be affected by even the most successful conservation activities, since much of that construction is required to replace aging plants and meet water quality requirements. Operators and service people still have to be on hand, whether the amount used is 1 million gallons or 5 million gallons an any given day. Savings from conservation show up only in the reduced use of treatment chemicals and less energy used because less water is pumped.

The division of the water bill into two portions - a minimum charge and a volumetric charge - reflect the reality that the bulk of costs of providing water service are associated with the setup, the readiness to serve, rather than the amount of "product" used. This cost of service "difference" from the variabl cost dependence for energy utilities must be recognized in higher fixed service charges for water utilities. Now that Pennsylvania-American has eliminated the minimum allowance, a process authorized by the PUC, even greater emphasis can be placed on conservation by charging for all water use.

The paradox involved - that a consumer won't see a 10 percent savings on his or her bill after having used 10 percent less water - is, in fact, a public relations obstacle that must be solved in any water conservation program. Pennsylvania-American realizes that customers will save in other ways, such as reduced energy costs for heating water and reduced costs for sewage service. However, these savings do not show up at the only point at which the Company is involved - the water bill.

As the NRRI compendium points out, "The economic value of water lies not in the water itself but in the processes required to withdraw it from natural source and deliver it in sufficient quantities and of acceptable quality to the consumer." It also says, "Prices that accurately reflect costs send correct signals to consumers and discourage wasteful consumption."

APPENDIX A

CONSERVATION STATEMENT OF AMERICAN WATER WORKS COMPANY

A STATEMENT ON CONSERVATION

The theme of this Annual Report brings up an issue which merits separate comment. This issue is conservation and its applicability to water.

Conservation is defined in Webster's dictionary as "planned management of a natural resource to prevent exploitation, destruction and neglect."

Water is a natural resource. So are oil, gas and coal. There is, though, a very real distinction between water and other natural resources. Water is a renewable resource. The others are not.

We hear the terms "use" and "destruction" employed synonymously in discussions concerning the conservation of water. When this happens, the uniqueness of water as a resource is overlooked. Its "use" does not "destroy" it.

We have always supported and, in fact, pleaded for conservation of the natural resource water. Our commitment to this cause is to prevent exploitation and neglect. Its pollution and waste are shameful.

Water use by the customers of the American Water System does not exploit, destroy or neglect the resource. Our customers are not "consuming" water in the sense that what they use will no longer be available for those who follow them.

There is not now and, as far as we know, never will be a reduction in the volume of water on the earth. In fact, billions of gallons of fresh, usable water flow to the oceans every day.

On the other hand, certain areas of the world and parts of this country, including some of our service territories, have developed to a point where the water supply requires augmentation. This often mistakenly prompts a discussion of conservation. Consequently attention is distracted from the real issue, which is the management of the resource.

We hope by this statement to better focus the important decisions faced by those who must consider water supply augmentation.

A water system typically develops over time by utilizing the least costly source of supply first. As this supply is utilized to its fullest, the next least costly increment is developed.

The cost of development of these supplies function of the size and number of pipes, pum ters, dams, wells and all of the related equipme required to collect, treat and deliver water to consumers.

The decision whether or not to develop the least costly supply is basically a choice of how spend for water service. If consumers are willin the cost of development for the next increment water, then the answer is obvious: build the ne system.

If, on the other hand, those served are not to incur this cost, other steps are required. Thes include limiting community growth and develo restricting recreational or decorative water use trolling everyday household and business use

For those who confront the need to expand water supply, these questions are important an require very careful analysis. It must be recogn water supply limitations can cause economic d a community.

This kind of analysis has been a significant the business of the American Water System for years. We call it planning. In fact, no utility can without it.

We have augmented supplies when it was ent this was required. Consumers expected thi This may be changing.

Today, in certain service areas, people are tioning whether or not they are willing to pay f next supply increment. We respect this positio will work to help those communities consider alternatives.

On the other hand, we see no reason to co that a decision to expand the water supply wo late a conservation ethic.

We renew our plea: Do not exploit or neg water. Remember, it cannot be destroyed.

Use it wisely and enjoy it. It will continue us well.

FOREWARD

For years, the operators of water treatment and distribution systems have lived with the problems of unaccounted-for water. Although water has had and will always have a source of significance and value, in the past its economic value was taken for granted because of its abundance.

Today, water has taken on an economic significance it has never had. It is no longer over-abundant, especially in highly urbanized and industrialized areas. Many of our once plentiful sources are now polluted and unusable; many of our densely-populated areas require more supply than is locally available; and even in areas where there is sufficient supply to satisfy local needs, the regulatory climates in which we live require us to allocate the resource as though it were scarce.

For years, we have had a variety of programs which, when viewed broadly, were aimed at controlling water loss. However, we have never taken a comprehensive view of the unaccounted-for water situation. For instance, we annually allocate resources to large meter testing, residential meter change-outs, testing and correction of plant output meters, hydrant inspection programs, valve operating programs, and more recently, curb box sounding programs. But we have not taken a managerial approach and viewed these programs in the combined sense of being a Water Loss Audit Program.

In November, 1986, a meeting was held which assembled approximately 60 managerial employees of the Pennsylvania Region and a comprehensive water loss audit program was developed. The results of that four-day meeting are summarized in the following sections of this handbook.

INTRODUCTION

This handbook has been prepared to assist Pennsylvania-American Water Company

reduce water and revenue losses. It includes procedures for conducting a comprehensive systemwide water audit to assess the delivery efficiency of the water distribution system.

The water audit is a thorough examination of the accuracy of the company's records and system control equipment. The overall goal of the audit is to identify, quantify, and verify water and revenue losses. It also helps in prioritizing the allocation of money and manpower. The audit should be performed annually and should continue on an on-going basis as one of the company's top priorities.

The leak detection survey part of the water audit is a systematic method of using listening equipment to survey the distribution system, identify leak sounds, and pinpoint the exact locations of hidden underground leaks.

Water losses, whether attributed to leakage, theft, underbilling of customers, or faulty system controls, represent monetary losses to the company. This is water that the company has already paid to obtain, treat, and make available to the distribution system for sale to its customers. However, because it is lost, the water produces no revenue. Likewise, reduction of unaccounted-for water has the potential of not only improving fire protection capabilities, but also delaying capacity-oriented future construction.

Once the initial water audit is conducted, annual updates will provide data to assist the manager in deciding how to adjust his priorities and monitor progress on system maintenance. Equally important, the audit can identify new areas of system losses to establish new annual maintenance goals.

The company's water audit master plan will be a valuable planning tool which can be used to set priorities and schedule corrective actions to maintain the distribution system.

Since water conservation is of prime importance and the company desires to increase the efficiency of its operations, an ongoing water loss control program will continue to be a top priority of the company.

DEFINITION OF A WATER LOSS AUDIT

A water loss audit is a systematic, coordinated effort which analytically tests the integrity of the entire production, distribution and commercial systems of a water utility. The audit is a starting point. It is the foundation from which the whole picture can be viewed.

The term "audit" carries with it a financial connotation. In a simple accounting sense, a financial balance sheet of an organization must have its assets equal the sum of its liabilities and surplus.

From the viewpoint of water loss, the assets are the amount of water entering the system. The liabilities equal metered consumption, and the surplus is unaccounted-for water.

In the same manner that a financial auditor tests the validity of the assets and the validity of the liabilities such that he proves the surplus, the water loss auditor tests the validity of the metered measurement of water entering the distribution system and the validity of the metered sales such that he analytically confirms the amount of water that is lost.

In the same sense of a financial auditor's guidelines, this handbook does not necessarily instruct in the basics of water works operation (it assumes professional status already exists), but it does present check lists, guidelines, and signal points that should be reviewed by the auditor.

In the same sense that a company's financial balance sheet is viewed in its entirety, a water loss audit views the system in its entirety. There are five basic points in a water loss audit:

1. Confirmation of production station master meter registration
2. Confirmation of large meter registration
3. Confirmation of small meter registration
4. Review of unauthorized use, such as private fire service
5. Location of underground leakage

DATA COLLECTION

The following data should be collected, analyzed, and inserted in this section of the handbook:

1. Form 329 - annual and 12-month year-to-date ending for the audit period.
2. A listing of the largest customers.
3. An evaluation of the largest customers for proper meter sizing.
4. A listing of private fire service accounts to evaluate the following:
    a. Are they metered?
    b. Do they have detector checks?
    c. Are they unmetered and not detector-checked?
    d. Are they active and are they being billed?
    e. Have they been inspected annually?
5. The plant description and the elevation chart from the distribution map should be confirmed as still relevant.
6. Miles of main in the distribution system.
7. Number of customers and footage of main per customer.
8. Listing of the number of hydrants in the distribution system.
9. Area coding data.
10. The distribution map.
11. A distribution map marked for metered high service zones and booster zones.
12. A distribution map marked with the elevations of all hydrants.
13. A conversion of the gallons of unaccounted-for in the 12-month period analyzed to gallons per minute.
14. An anaylsis of leaks in the past year, listing number of main line leaks, hydrant leaks, and service leaks. Include size and type of pipe under main line leaks.
15. The meter aging report for the purpose of reviewing length of service change-outs.
16. A random sampling of 10 meters removed every month and tested at flows as follows: ¼, 2, 6, 15 gpm.

PROCEDURES FOR CARRYING OUT A COMPREHENSIVE WATER AUDIT

1. The company's production or pumping station output meters must be checked and verified for accuracy at least once a year. It may be necessary to verify these meters on a more frequent basis which will be left to the judgement of the operating district.
2. Testing of large commercial, industrial, and other meters measuring water sales to customers must be performed annually. The meters for the 10 largest customers of each operating unit must be verified annually. The testing of these meters ideally should be done in place with a fire-flow type of a meter.
3. All fire service lines should be identified and inspected on an annual basis to confirm that there is no theft of water via the fire service line. It may be necessary to undertake a program to install large full-flow meters on all fire lines at company expense and charge for fire service to the customer based upon size of connection in tariff and not meter size. This would apply to existing customers; however, all new customers desiring a fire service line should include a full-flow meter.
4. A leak detection survey should be undertaken initially by employees listening for sounds on all main line valves and fire hydrants. When distance between valves or hydrants is great, customer service lines or curb stops will have to be listened on in order to minimize the area covered, thus being able to sound out the complete area between the valves. Subsequent to listening on valves and hydrants, it may be necessary to listen on random, or even all, customer curb stops to assure the area is free of underground leaks.
5. Each operating district has its own characteristics; therefore, vehicle and equipment needs as well as the complement of employees assigned to perform the leak detection survey will vary.

The above items will be detailed under the sections in this handbook designated "Production, Distribution, and Commercial."

Once the accuracy of the plant output meter has been verified and system delivery restated based on recalibration of the output meter, a quick evaluation may be made. This phase of the audit will isolate generally where the largest portion of unaccounted-for water is.

There are two broad areas where water which is pumped but not billed may occur:

1. It may be missing due to underground leakage.
2. It may be unmeasured due to meter error, unmetered usage or improper meter setting conditions.

Each of the situations is correctable. The assessment formula as follows will help direct the strongest effort in salvaging unaccounted-for.

The formula has been developed over years of practical evaluation in the field. Its basis is to isolate all metered usage except residential from accurately-measured system delivery. Once commercial, industrial, and other usage has been subtracted from system delivery and divided by 365, the residual is daily residential usage and unaccounted-for. By dividing this amount by the population served (residential customers x per capita per residence) a usage + loss per capita is derived.

Normal ranges for this number is 50 to 70 gallons per capita per day. If the number is less than 50, chances are great that the largest portion of unaccounted-for is meter error. If greater than 70, the system is probably suffering most from underground leakage or unauthorized or unmetered usage.

QUICK ASSESSMENT FORMULA

Example

	Situation 1	Situation 2
1. Daily Metered Delivery	3,135,000	3,405,000
2. Daily Metered Ind., Comm., Other Usage	1,245,000	1,245,000
3. Metered Residential Sales and Unaccounted-for	1,890,000	2,160,000
4. Metered Residential Sales	1,215,000	1,620,000
5. 10,000 Customers x 2.7 Residents per home = population	27,000	27,000

Audit

$$\frac{\#4}{\#5} = \frac{1,215,000}{27,000} = 45 \qquad \frac{1,620,000}{27,000} = 60$$

less than 50

greater than 50, less than 70

$$\frac{\#3}{\#5} = \frac{1,890,000}{27,000} = 70 \qquad \frac{2,160,000}{27,000} = 80$$

equal or less than 70 metering problem; no appreciable leakage

greater than 70 leakage a problem; no appreciable meter error

WATER AUDIT CHECK LIST

This check list will enable the Company to institute an in-house water loss control program. This check list can be put into practice immediately with the existing complement of employees and can be utilized as a continuous program for water loss control.

1. Check production or station output meters for accuracy at least once a year.
2. Perform clearwell drawdown test as frequently as practical to confirm station output meters.
3. Clean and maintain venturi flow tubes as required or at least annually. Make arrangements to construct vault for venturi meter for easy access.
4. Test meters supplying large commercial and industrial customers annually.
5. Listen on valves, fire hydrants and curb stops.
6. Listen on mains, services and meters.
7. Check all stream crossings.
8. Inspect sewer manholes and catch basins.
9. Check for unmetered use.
10. Follow up on low pressure complaints from customers.
11. Investigate for large leak in system when daily station delivery suddenly increases or storage vessels are not refilling to proper levels.
12. Inspect all private fire services annually for unauthorized use.
13. Investigate the development of a new low pressure area in the distribution system.
14. Periodically check consumption recorded on 2" meters and larger for proper sizing and application.
15. Check altitude valves on tanks for overflow of water.

The term unaccounted-for water and its measurement have no meaning if the plant output meters do not accurately reflect the precise delivery of water into the distribution system. All calculations are based upon delivery to the system. Not only are unaccounted-for statistics based on the delivery meter, but budget decisions and future construction decisions are generated from this information as well.

1. There are three methods of metering production output:
   A. Sonic meters
   B. Turbine meters
   C. Venturi meters
2. The advantages and disadvantages of the three meters are:
   A. Sonic meters
      1. Advantages
         a. Measure to +/− 1% of rate of flow
         b. Little maintenance
      2. The disadvantage of sonic meters is that their accuracy is affected by solids in the water.
   B. Turbine meters
      1. Advantages
         a. Measure low flows well
         b. Parts replacement is easy via plug-in parts
         c. Low head loss
         d. Range of 20 - 1
         e. Accurate within ½% over the range
      2. The disadvantage is that the measurement is severely affected by turbulence and the setting is critical to accuracy
   C. Venturi meters
      1. Advantages
         a. No working parts
         b. Low head loss
         c. Ease of checking the primary element
         d. Accurate to ½% in the flow range
      2. Disadvantages
         a. Difficult to remove
         b. Need frequent checking
         c. Must specify accurately the delivery range

d. Overall testing is difficult
e. Test operator qualifications must be impeccable
f. Manometer readings must be precise to recalibrate accurately

3. There are three methods to verify the accuracy of plant output meters
   A. The easiest and least costly is the clearwell drop test. This procedure discontinues filtering and by determining volume pumped over specified time and comparing to metered recording, an accurate comparison can be made. This procedure should be used as often as practical.
   B. Another method of testing is to install a calibrated turbine meter at an appropriate distance downstream of the output meter and compare the readings.
   C. Pitometer measurement is the final and most common measurement. This method is normally accurate to within +/– 5% because of the necessity to have ideal and absolute known test conditions and the variance in reading the manometer.
4. Frequency of output meter testing
   A. Clearwell drop test - as often as is practical.
   B. Output meter verification by test meter - at least annually.
5. Accessibility of the output meter
   A. Every output meter should be accessible by occupying its own ventilated pit.
   B. Ideally, there should be a bypass setting arrangement wherein the bypass should be of known and controlled distance and diameter and have no conditions creating turbulence.
6. Other testing considerations
   A. All tests should be conducted over at least a 24-hour period.
   B. Each pumping configuration should be tested over a 24-hour period.
   C. The entire system, meter primary flow device, transmitter, recorder and totalizer should be tested as a system.
   D. The system should be retested following adjustment.
   E. Calibration adjustments should be recorded on meter records.
   F. Every meter should be evaluated no less than annually comparing the manufacturer's specifications and flow range to meter output conditions.
   G. Every output meter setting should be analyzed for compliance with manufacturer's recommendations regarding set location and exposure to turbulence.

H. Pressure lines and pressure taps should be routinely maintained.
I. Spare parts should be inventoried

7. Other production responsibilities
   A. Check system instrumentation, telemetering repeater systems and altitude valves to avoid overflowing tanks and reservoirs.
   B. Adjust treatment techniques to avoid corrosivity within the system and evaluate possible precipitates that will affect meter accuracy.
   C. Evaluate the location and the setting conditions to assure that conditions in the field are in strict compliance with the manufacturer's specification.
   D. Test the meter under laboratory conditions.
   E. Test the meter under all operational conditions for at least 24 hours.
   F. Review all plant production records including, but not limited to, results of previous tests, pump efficiency tests, and pump specifications.
   G. Require meter test certification for all new plant meters.
   H. It is recommended that individual flow meters be installed on each high service (Distributive) pumping unit whenever possible to facilitate tests for pump efficiency and station output meter accuracy.

COMMERCIAL DEPARTMENT

Accurate water measurements is the means by which our company produces revenue to cover expenses. Inaccurate water measurements contribute to unaccounted-for water. The following procedures are means of maintaining revenues and reducing unaccounted-for water.

1. Maintain compliance with Pennsylvania rules and regulations; i.e. Chapter 65, Testing of Meters, as well as Procedures contained in the American Water Works Service Operations Manual.
2. Review and continue to provide training to all outside commercial employees on an ongoing basis to insure that they have the proper knowledge to identify the following:
   A. To inspect and look for illegal connections.
   B. To insure that meters are properly installed, have not been tampered with and sealing devices are intact.
   C. To inspect meter if registration has not increased from prior reading. Run water to see if dial moves or meter is stuck.
3. Establish procedures for all outside commercial personnel to sound and investigate as follows as part of a water loss audit in performing this routine work:
   A. Sound service line for possible leak.
   B. Investigate wet spots in lawns.
   C. Sound fire hydrants if encountering or passing same while performing meter reading or service work.
   D. Sound outside hose bib where meter is a remote installation.
4. Inspect and test all meters 3" and larger annually with fire flow test meter to insure meter accuracy.
5. Inspect and test all battery settings of meters in line with comparison test meter.
6. Evaluate correct meter size by use of a meter master for all large customer accounts.
7. Review all Class 1 turbine meter installations for correct application.
8. Establish data base system and compare various data for identifying meter situations which need investigations.
9. Inspect all private fire services annually. When unauthorized use of water is suspected or found, Company will install properly-sized meter and vault at its expense, thus eliminating the unauthorized use.

(a) *Allowance Error.* No water meter which has an error in registration of more than 2.0% may be placed in service, nor may a water meter which has an error in registration of more than 4.0% be allowed to remain in service, when water is passing through it at approximately the following rates of flow:

Meter size (inches)	*Gallons per minute*
5/8	6
¾	10
1	20
1½	30
2	50
3	90
4	180
6	300

(b) *Periodic Tests.* No public utility furnishing metered water service may allow a water meter of 1 inch or less nor a water meter of more than 1 inch to remain in service for a period longer than 20 years and 8 years respectively without testing it for accuracy and readjusting it if it is found to be incorrect beyond the limits established in subsection (a).

Upon a customer's request the public utilities shall also perform a meter test without charge if a meter has been in service and has not been tested for a period greater than that specified in the following table:

Inch Meter	*Years*
5/8	10
¾	8
1	6
More than 1	4

(c) *Meter Test Records.*

Whenever a water meter is tested, the original test record should be kept indicating the information necessary for identifying the meter, the reason for making the test, the reading of the meter before being disturbed, and the accuracy of the meter together with data taken at the time of the test. This record shall be sufficiently complete to permit the convenient checking of the methods employed and the calculations made. A record shall also be kept, preferably numerically arranged, indicating the date of meter purchase, name of manufacturer, its size, its identification, its various places of installation with dates of installation and removal, and the dates and general results of all tests.

(d) *Installation and Removal of Meters.*

(1) *Installation of meters.* A water meter whenever installed shall be inspected by the public utility for proper connections, mechanical condition, and suitability of location within 60 days after installation. In the case of a new meter or a meter reconditioned by a manufacturer, the test results of the manufacturer may be accepted as the installation test if the utility has verified the manufacturer's reported test results by testing the greater of 10% or 10 meters of a shipment of meters. In case of emergency, a meter not meeting the requirements of this section may be installed temporarily.

(2) *Removal of Meters.* A water meter which is removed from service shall be tested within 30 days for accuracy to complete that meter's test history. When a meter is removed from service, it shall be properly sealed to secure registers and measuring devices until it can be properly tested for accuracy.

(e) *Facilities for Testing.* A public utility shall provide and keep available suitable and adequate facilities for testing its meters, and shall maintain these facilities in good condition and in correct adjustment so that they are capable of deterimining the accuracy of a service meter within 0.5%. A public utility not maintaining a standardizing laboratory may, upon written permission from the Commission, have its meters and instruments certified by a standardizing laboratory approved by the Commission. The accuracy of testing equipment will be established and checked annually by representatives of the Commission. After making final adjustments, the tester shall seal and date tag the testing facilities and furnish the public utility with a certificate of accuracy properly dated and signed.

(f) *Meters in Service without Test Records.* A water meter of a public utility which does not meet the requirements with respect to tests and records of tests shall be immediately removed from service by the public utility and may not again be placed in service until the requirements are met.

(g) *Request Test.* A public utility shall make a test of the accuracy of registration of a water meter upon written request of the customer for whom the meter is furnished, upon payment of the fee specified in § 1.43 (relating to schedule of fees payable to the Commission). If a customer desires personally or by a representative to witness the testing of a meter, he may require the seal of the meter to be broken in his presence or that of his representative. If the meter tested upon the request is found to be accurate within the limits specified in subsection (a), the fee shall be retained by the utility; but if not so found, the cost shall be borne by the utility and the fee paid by the customer shall be refunded. A report of the test shall be made to the customer.

(h) *Schedule of Fees for Testing Water Meters.* The schedule of fees for testing meters is as follows:

(1) For a water meter having an outlet not exceeding 1 inch—$10.

(2) For other water meters having an outlet not exceeding 2 inches—$20.

(3) Rates for testing other meters, including those which are so located that the cost is out of proportion to the fee specified, will be furnished by the Commission upon the receipt of complete specifications.

(i) *Fees for Testing Facilities of Public Utilities.* The Commission will charge and collect from utilities for the testing of their meter testing facilities and water meters the following fees:

(1) For testing meter testing facilities at the utility plant—$15.

(2) For a water meter tested at the Commission laboratory—$3.00

§65.9. Adjustments of bills for meter error.

(a) *Fast Meters.* If upon test of a meter, the meter is found to have an error of more than 4.0% fast, the public utility shall refund to the consumer the overcharge based upon what the meter would have registered had it not been fast or slow for a period equal to ½ the time elapsed since the last previous test but not to exceed 12 months. If the period of registration error is fixed with a reasonable degree of certainty, the overcharge shall be computed for the period. If the meter has not been tested under §65.8 (relating to meters), the period for which it has been in service beyond the regular test period shall be added to the 12 months in computing the refund.

(b) *Slow meters.* If upon test of a meter, the meter is found to have an error of more than 4.0% slow, the public utility may render a bill for the water consumed but not covered by previously rendered

bills equal to ½ of the time elapsed since the last previous test but not to exceed 12 months. If the period of registration error is fixed with a reasonable degree of certainty, the charge may be computed for the period. Payment of this previously unbilled consumption shall be under §56.83(5) (relating to unauthorized termination of service).

(c) *Nonregistering Meters.* If a meter is found not to have registered for a period or not to have fully measured the entire flow due to meter interference, the public utility shall compute the water used by taking the average of the water used for the nearest meter reading period immediately preceding and the meter reading period immediately following the date when the meter was found to be not registering or interfered with, which amount shall be assumed to be the amount of water used by the customer during the billing period in which the meter was found not to have registered. Exceptions may be made only if the facts clearly show that the stated method does not give the correct consumption for the period.

§65.8. Meters.

You may not place a meter into service if it has an error in registration of more than 2% (a meter which registers 98%-102% of consumption is considered accurate). Additionally, you may not allow a meter to remain in service if it has an error in registration of more than 4% (a meter which registers 96%-104% of consumption is considered accurate). The rates of flow are shown in the regulation on the preceding page. For example a 5/8" meter must be tested at 6 g.p.m. and a 2" meter at 50 g.p.m. These are the only tests you must conduct for these meters.

Meters measuring 1" and less must be tested once every 20 years. Meters measuring more than 1" must be tested once every 8 years.

For all new meters, you must verify the manufacturer's test results by testing 10% or 10 meters (whichever is greater) of each shipment.

Every meter removed from service must be out tested within 30 days following its removal. Again, you should conduct the test at the rates of flow shown in the regulation - 6 g.p.m. for 5/8" meters and 50 g.p.m. for 2"meters.

§65.9. Adjustment of bills for meter error.

If a meter is tested and found to have an error in registration of more than 4% fast, you must refund to the customer the overcharge. If you know the exact period of registration error, you compute the overcharge for that specific period. If you don't know the exact period, you compute the refund by determining what the meter would have registered had it not been running fast for the period

equal to ½ the time elapsed since the previous meter test. The period shall not exceed 12 months. However, if you have not tested the meter within the period of time prescribed by §65.8 (for example, a 5/8" meter in service over 20 years without being tested), the period for which the meter has remained in service beyond the regular test period shall be added to the 12 months in computing the refund.

If a meter is tested and found to have an error in registration of more than 4% slow, you may charge the customer for the unbilled water used during the period equal to ½ the time elapsed since the previous meter test. The period shall not exceed 12 months. Again, if you know the exact period of registration error, you compute the charge for that specified period. However, if the customer does not pay the bill, you may not terminate his/her service.

DISTRIBUTION DEPARTMENT

A leak detection survey is a process of elimination and discovery The goal is to eliminate the contact points where water sounds are not heard and discover the contact points where leaks can heard.

Prior to conducting a leak detection survey, you must review the specifications of your distribution system. The following information is important to review:

1. How much water is lost from the system in gallons as well as gallons per minute.
2. Types of pipelines in the system, ages, diameters, joints, installation methods, leak histories, and operating pressures.
3. Number and type of valves in the system, including location records and drawings, types of valves, open left or right, number of turns to exercise valves, and how often valves are exercised.
4. Hydrant records - types, sizes, locations, flushing frequencies, static pressure and residual flow.
5. Location of pressure-reducing valves, pressure-sustaining valves, pressure-relief valves and dates of inspections and maintenance of valves.
6. Location of blow-offs and air-release valves and records as to maintenance.
7. Accurate distribution system map.
8. Verify what is shown on map as to its accuracy, how current is the information, and how often is the information updated.

PROCEDURES FOR CONDUCTING A WATER LOSS AUDIT FOR DISTRIBUTION PERSONNEL

1. Formulate a plan to survey the distribution system taking into account the following:
   A. Determine number of miles to be surveyed.
   B. Need updated distribution maps for use in the survey along with current valve and hydrant records.
   C. Establish miles per day and length of time to conduct survey.
   D. Assign trained personnel to survey.
   E. Equipment necessary to conduct survey:
      1. Sonic Equipment
      2. Geophone
      3. Aquaphones
      4. Valve & curb keys
      5. Wrench & hand tools
      6. Pick, Shovel & Sledge
      7. Danger signs, cones, flags
      8. Marking Paint & Chalk
      9. Radio communications
      10. Valve Box & Curb Box
      11. Pipe locator
      12. Measuring(tape-wheel)
      13. Valve operator
      14. Vehicles
      15. Portable lighting outfit
      16. Flashers
      17. Arrow Board
      18. Altimeter

2. Segregation of Distribution System:
   A. Evaluate distribution system for problem areas using information from records on hand, leak cards, and computerized reports.
   B. Segregation of distribution system, if required, will be dependent upon number of miles to be surveyed.
   C. Divide distribution system into districts and further sub-divide sections into areas where known consumption can be determined, such as:
      1. Area coding
      2. Booster areas, etc.
   D. Install distribution system metering where feasible to isolate sections.

3. Procedures for conducting leak sounding survey:
   A. Sound all fire hydrants and verify static as per elevation and gradient.
   B. Sound main line valves, random curb boxes and meter pits. For complete audit, sound all curb boxes and meter pits.
   C. Investigate, inspect, and sound all fire services.

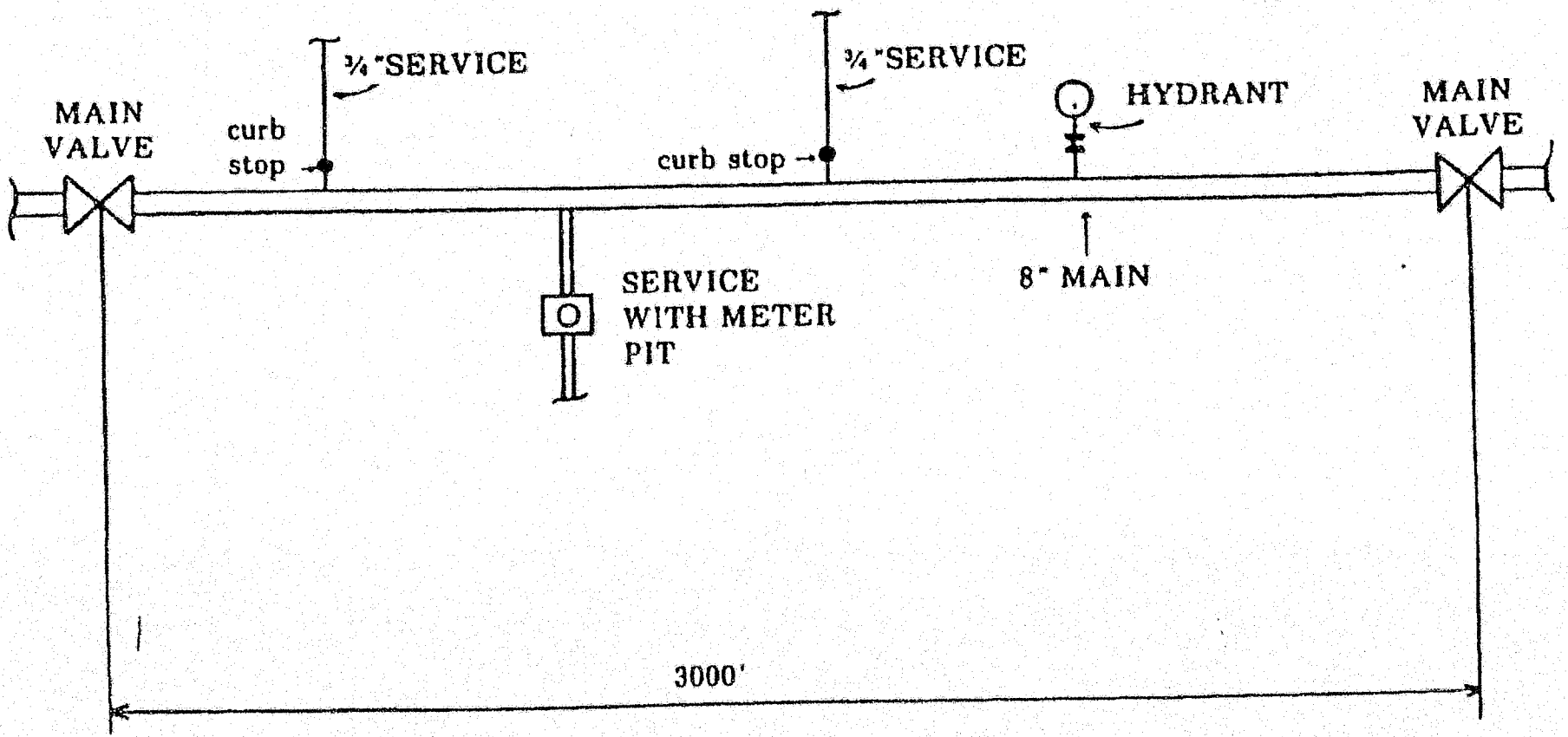
D. Investigate, inspect, and sound all large commercial and industrial services.
E. Sound blow offs and bleeders.
F. Inspect and sound exposed pipelines on bridges and railroad crossings.
G. Isolate and sound river crossings. A meter and bypass should be provided whenever possible.
H. Inspect and sound mains in easements. Line markers which provide sounding points should be installed whenever possible.

4. Perform Visual Inspection:
   A. Inspect manholes and catch basins for unusual flow of water.
   B. Inspect streams and springs in dry weather for unusual flow of water.
   C. Inspect and walk pipeline right-of-ways.
   D. Review and compare recording charts for changes in pressures and flows.
   E. Review Fire Department records for unreported usage after fire.
   F. Adopt and enforce a strong policy prohibiting the unauthorized use of fire hydrants for the following:
      1. Streets sweepers
      2. Sewer flushings
      3. Swimming pools
      4. Paving contractors
      5. Lawn care companies
      6. Exterminators
   G. Investigate wet spots or sunken areas in lawns and roads.
   H. Inspect tank and reservoir overflows and altitude valves.
   I. Service personnel should be alert for illegal connections before meters.

5. System for recording soundings on distribution maps via color-coded legend:
   A. Example:
      Blue dot – confirm sound was taken at specific location.
      Red dot – confirm leak sound located.
      Red X – leak location pinpointed.
      Green circle around red dot – indicates leak repaired.
      Brown circle around red dot – no sound on recheck.

6. Prioritize Repairs to Leaks:
   A. Leaks found should be scheduled for repairs as soon as possible depending on the flow and water supply affecting system and public health and welfare.
      1. Public Safety Priorities should be established on a case-by-case basis considering the following factors:
         a. Fire flows.
         b. Service to large customers: i.e. hospitals, schools, nursing homes, industry, etc.
         c. Streets, sidewalks, and property damage. Public safety - streets and sidewalks.
         d. Weather conditions.
         e. Property damage.
7. Data accumulation and analysis.
   A. Data obtained during leak surveys should be maintained in a computer data base per analysis.
   B. Twelve-month cumulative totals for system delivery volumes and percentages should be developed each month and depicted graphically to show trends.
   C. All data should be collected, maintained and presented in a standard format.

NOTE
SOUND ALL VALVES SERVICE, HYDRANT CURB STOPS



CONCLUSION

A Water Loss Audit as presented in this handbook is not an additional job. It is instead a coordination of effort and resources organized to view a water production and distribution network as an interrelated system. Unaccounted-for water does not occur because of leaks alone; it is not a single large main break; it is not only meter misregistration; it is not just unauthorized use. It is, however, a combination of all of these circumstances.

A water loss audit requires planning, organization, follow through and control, as well as the coordinated, dedicated and enthusiastic effort of every employee in every district. A well constructed audit will examine every source of loss to pinpoint leakage and lost revenue.

As a suggestion to focus effort and measure success, it is recommended that in the future, the M-Work Order process summarize the individual efforts into a single multi-section work authorization entitled "Water Loss Audit."

EXAMPLE
MAINTENANCE WORK ORDER

Water Company District
Name of Company

Maintenance
Work Order No

Total Estimated
Cost $ _____

DESCRIPTIVE TITLE:

Conduct a water loss audit of the Production, Distribution and Commercial system.

PURPOSE: The purpose of this program is to:

1. Test plant meters
2. Test large meters
3. Operate 20% of system valves
4. Operate all hydrants
5. Operate all curb boxes
6. Operate a leak van investigation of 50% of the pipe
7. Conduct a Pitometer survey of 33% of the system

The goal of the program in 1988 is to reduce unaccounted-for from 20% to 19% by December 31, 1988.

	LOCAL OFFICE		DIVISION OFFICE	
	INIT	DATE	INIT	DATE
W.O. INDEX				
BUDGET CONTROL				
COST SHEET				

MANAGER

APPROVALS | DATE

PRESIDENT OR VICE PRESIDENT

SUMMARY

Our mission is to manage water losses and misregistration throughout the system - from water origination through final consumer use. Our objective to view water loss via a coordinated audit procedure. Our goal is to reduce aggregate unaccounted-for to 15% of system delivery by the year 2003.

OCA

4

Pennsylvania-American Water Company

PAWC STATEMENT NO. 1
R-00016339

DIRECT TESTIMONY
OF
WILLIAM C. KELVINGTON

WITH REGARD TO SCOPE OF OPERATIONS, DESCRIPTION OF THE SYSTEM AND WATER CONSERVATION PLANNING

Q. Please state your name and business address.

A. William C. Kelvington, 800 West Hershey Park Drive, Hershey, PA 17033.

Q. By whom are you employed and in what capacity?

A. I am employed by Pennsylvania-American Water Company ("Pennsylvania-American," "PAWC" or the "Company") as Vice President of Operations.

Q. Will you please outline your business experience in the water utility industry?

A. I began my career in the water utility industry in 1971 with the Washington District of Western Pennsylvania Water Company ("WPW"), one of the corporate predecessors of PAWC. From 1971 to 1979, I held the positions of staff counting, assistant office manager, production supervisor, customer service superintendent and district manager in the Washington District. From July 1979 to August 1980, I was the Director of Budget Procedures for WPW. In August 1980, I became the Business Manager of the Washington District of WPW. I held that position until July 1981, when I became the Business Manager of WPW's Pittsburgh District. In March 1994, I became the Manager of the McMurray District PAWC, which encompasses all of the Company's operations in Western Pennsylvania outside the Pittsburgh District. In September 1998, I was promoted to Vice President of Operations (Western Pennsylvania). On April 16, 2001, I was promoted to my current position as Vice President of Operations for the entire PAWC system and transferred to the Company's corporate headquarters in Hershey, Pennsylvania.

Q. Do you belong to any professional or industry associations?

A. Yes, I am a member of the American Water Works Association ("AWWA") and served as the Chairman of the Education of the AWWA's Pennsylvania Chapter from 19- to 19-. I am also a member of the National Association of Water Companies ("NAWC") and serve on the Board of Directors of the Pennsylvania Chapter of the Consumer Affairs Committee. Additionally, I am a member of the Water Works Operations' Association of Pennsylvania.

Q. What is your education background?

A. I am a 1971 graduate of West Liberty State College where I received a Bachelor of Science Degree in Business Administration and Economics. I received my MBA in 1996 from the Indiana University of Pennsylvania.

Q. What is the nature of your duties with Pennsylvania-American?

A. As Vice President of Operations, I am responsible for providing technical assistance and supervision with regard to water quality, operations and maintenance to the Company's operating areas.

Q. What is the purpose of your testimony?

A. I will discuss two separate areas. First, I will explain the Company's scope of operations and provide a general description of its systems. In connection with this area, I will sponsor and explain Exhibit Nos 1-A and 1-B. Second, I will discuss the

Company's efforts to encourage cost-effective conservation, as summarized in Exhibit No. 1-C.

Q. **Please begin by explaining the Company's scope of operations and describing its system for producing, treating, pumping, storing and distributing water to customers.**

A. These explanations are set forth in Exhibit No. 1-A. Exhibit No. 1-A includes an explanation of the scope of operations of each of the four operating areas of the Company. Additionally, Exhibit No. 1-A contains a section captioned "Operational Overview of Pennsylvania-American Water Company," which sets forth a narrative description of corporate objectives and how the Company is organized to enable it to achieve these objectives. The narrative also provides a summary of the work the Company does and the functions of the Company that I supervise. Following the narrative are eleven pages of organizational charts showing the management structure of the Company at the corporate level for each operating area. The foregoing information is, in turn, supplemented by the detailed system maps which have been submitted with this filing as Exhibit 1-B. Those maps depict the major pipeline and storage facilities of the Company in relation to principal roads, highways and other geographic features.

Q. **Mr. Kelvington, focusing on the topic of conservation, are you aware that the Commission has issued regulations to be used to evaluate the performance of water utilities in encouraging cost-effective conservation by customers?**

A. Yes. The Company has reviewed those regulations and believes that it is meeting and, in some instances, exceeding the minimum standards established by the Commission. For example:

- The Company distributes conservation-related material to its customers at least twice a year.
- Sounds all hydrants for leaks every year during inspection and flushing of the distribution system via the hydrants.
- Employs eight state-of-the-art electronic leak detection vans to detect and locate fractured transmission and distribution mains. These vans are geographically dispersed throughout the state to provide maximum coverage.
- Provides and installs, free of charge, retrofit kits in the homes of customers meeting specific low-income and household consumption criteria. These kits include toilet dams, low flow shower heads, kitchen and bathroom faucet aerators and toilet leak-identifying dye tablets.
- Has incorporated into its tariff plumbing standards that require low water-use fixtures for new homes or significant remodeling projects.
- Has purchased and utilizes state-of-the art water-use monitoring equipment which allows the Company to properly size its larger meters to accurately measure water use.

Q. **Are you sponsoring any additional evidence regarding the Company's conservation efforts.**

A. Yes. The Company has filed Exhibit No. 1-C in this case, which is its current Water Resource Management Program. This document describes in detail the types of programs the Company either has in place or are under way, to promote the wise and efficient use of water. This document will be supplemented in the future as new programs are added to the Company's overall Water Resource Management Program, but stands now as clear evidence of the Company's commitment to this important environmental issue.

Q. Does this conclude your testimony?

A Yes, it does.

COPY 4

Pennsylvania-American Water Company

WATER RESOURCE MANAGEMENT PROGRAM

EXHIBIT 1-C

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INTRODUCTION

Water utilities, whether municipal or investor-owned, have viewed themselves over the years as guardians and protectors of the public water supply. Traditionally, they have taken the position that their job to make sure that there is enough water available and that it is safe for the public to use. What happens that water — how much is consumed and for what purpose — has been regarded as solely the province o the customer.

Water companies have the distinction of being the "original conservationists." Over the years, water companies have been in the forefront of seeking to protect the quality of water supplies. Water companie have gone to court to stop the dumping of pollutants. They have shown concern about chemical wastes, agricultural run-off, erosion and mine acid drainage, among other issues.

Water is a renewable resource and abundant on a global scale. However, the importance of water conservation as a policy question at all levels of government can only grow in the coming years. *The Global 2000 Report to the President*, as quoted in the National Regulatory Research Institute's recently published *Compendium on Water Supply, Drought, and Conservation*, points out that the world's supply of freshwater was 10 times greater than demand as of 1980, but predicts that by the year 2000, supply will b only 3.5 times greater than demand. Part of the challenge of the water supply industry and its regulators : the development of a conservation policy that addresses this problem, but which is fair to everybody.

As the largest investor-owned water company in the United States, Pennsylvania-American Water Com pany has accepted its responsibility for creating sound conservation programs. However, Pennsylvania-American realizes it must explain to its customers that their efforts, combined with those of the Company may have little initial impact on the Company's overall cost of service. The Company's current overall cos of service cannot be significantly reduced through conservation efforts even though some future costs may be delayed or avoided. Conservation efforts must focus on ways to reduce peak usage if new plant construction costs are to be avoided. Since many construction expenditures are to replace the aging infrastructure, it is not anticipated that overall costs will be significantly reduced.

Rate structures as they now exist make it virtually impossible for customers to translate less water use into savings, or peak usage as an increased cost. As an example: A 10 percent reduction in water use does not currently result in a 10 percent reduction in a customer's bill, nor does a 10 percent increase in usage on the maximum day result in a 10 percent increase in a customer's bill to discourage such usage.

As a matter of perspective it is worth noting water-use figures from the state Department of Environmental Resources that were quoted by Public Utility Commissioner Joseph Rhodes Jr. at the Great Lakes Conference of Public Utility Commissioners in July 1989. Of 75 billion gallons of water withdrawn per day in Pennsylvania, only 1.6 billion gallons are withdrawn for public needs. Seventy billion gallons are withdrawn for electrical generation; 3.4 billion gallons are used by industry. Of the 1.6 billion taken for public needs, only 500 million gallons per day are taken by investor-owned water companies under the jurisdiction of the Pennsylvania Public Utility Commission. Therefore, the task of this Company and the PUC to have an impact on the conservation of water use of the Commonwealth must extend beyond the responsibilities and procedures outlined in this document.

Of the 500 million-gallon daily withdrawal by investor-owned water companies referenced by Commissioner Rhodes, Pennsylvania-American accounts for about 184 million gallons withdrawn daily. Since Pennsylvania-American serves a population of about 2 million, the average per-capita use is 92 gallons per day. According to information published by the National Regulatory Research Institute (NRRI), the average per-capita use for the Commonwealth of Pennsylvania is 196 gallons per day.

The information published by NRRI further indicates the comparable per-capita use in New Jersey is 156 gallons; in Maryland, 216 gallons; in Ohio, 159 gallons; in New York, 180 gallons; in West Virginia, 115 gallons; and in Delaware, 151 gallons. This data only reflects withdraw of the natural resource and no the eventual use of finished water by the customer. However, it provides a clear indication of the beginnin point for Pennsylvania-American's increased conservation efforts.

As these statistics indicate, the Company's prior conservation efforts, universal metering and leak detec tion programs have already had a significant impact on the use of water resources in this state. Additional improvements realized from the program outlined herein may be difficult due to the low daily per-capita use Pennsylvania-American has already achieved.

Further evidence is reflected in the data related to the usage of that treated water. The average indoor and outdoor residential use by Pennsylvania-American's customers is 60 gallons per capita per day, or 6 gallons per day less than the average in Pennsylvania. Compare this usage with 103 gallons in Maryland, 92 in New York, 75 in New Jersey; 70 in Delaware; 62 in West Virginia and 52 in Ohio.

An additional consideration in any conservation discussion must be its impact on economic develop- ment. As noted in committee reports in Case No. 88-W-221 before the State of New York, Department o Public Service, a proceeding investigating conservation issues, "The committee recommends that any plan recognize the importance of maintaining a favorable business climate so as to retain existing businesses an encourage the entrance of new business in communities served by the suppliers." Pennsylvania-American shares this concern of protecting the economic base of its service areas, and has designed its water conser vation program to manage a natural resource and discourage wasteful uses. In this manner, potential businesses can see our concern for the environment and our management of the resource as an assurance of an adequate supply of water to meet their needs.

Water companies regulated by the PUC will have a minimal effect on the big picture. Policy linkage across a broad spectrum of interests and jurisdictions is necessary to accomplish the intended goals. The common tie among these diverse interests and jurisdictions will be a focus on the "wise use" principle. A explained by the National Regulatory Research Institute, this principle consists of three elements: wise management of resources, use of advancing technology and discouraging waste.

STRATEGIC PLANNING FOR CONSERVATION

POLICY — Pennsylvania-American will consider the cost and impact of its conservation program in all of its engineering and financial plans.

DISCUSSION — American Water Works Company, Inc., the corporate parent of Pennsylvania-American Water Company, recognizes the importance of conservation as a strong element in resource management. In its 1988 annual report, the American Water Works Company included "A Statement on Conservation." Among other things, that statement says:

"We have augmented supplies when it was apparent this was required. Consumers expected this of us. This may be changing."

The statement continues, "Today, in certain service areas, people are questioning whether or not they are willing to pay for the next supply increment. We respect this position and will work to help those communities consider their alternatives." (See Appendix A for the full text of the American Water Works statement.)

LEAK DETECTION

POLICY - Pennsylvania-American Water Company's Leak Detection Specialists will survey three or more miles of water distribution mains per day when they are not pinpointing known leaks.

POLICY - Operating personnel in each district will sound 100 percent of all hydrants, 20 percent of all system valves and 33 percent of all service line control valves for hidden leaks annually. These programs will be conducted in a fashion that ensures that all valves are sounded at least once every five years and all service line control valves are sounded at least once every three years.

DISCUSSION - Pennsylvania-American distribution employees have historically listened for leaks on valves and service line control valves as part of sound water works operating practices. However, due to new technology, this program was enhanced in 1981 by the addition of leak detection vans.

Pennsylvania-American's aggressive leak-detection program utilizes eight maintenance service employees, who specialize in leak detection, travel the state in specially equipped vans that contain more than $65,000 of sophisticated leak-detection equipment. These eight specialists cover a system composed of 32 different service districts and 7,589 miles of main.

The maintenance service employees who specialize in leak detection use electronic sounding devices and computerized correlators to find leaks. Upon arriving at a district, they collect information pointing to problem areas and initially concentrate in those areas. They begin by listening for leaks on hydrants and valves and then move on to small mains. A single specialist in a van can cover about three to five miles of distribution main per day.

As discussed earlier, in addition to these roving vans, employees in each of the Company's districts continue to conduct an active hydrant, valve, and service line control valve leak-detection program that has existed for years. This program is part of scheduled operations at the district level. All hydrants are inspected annually. All valves in each district are inspected at least once every five years. The Company's goal is to inspect all service line control valves at least once every three years.

PUBLIC EDUCATION

POLICY — Pennsylvania-American Water Company will distribute conservation-related information to all customers twice a year.

DISCUSSION — One of the most important elements in achieving conservation is public education. Providing reliable and persuasive information in an easy-to-understand manner can substantially influence customer attitudes and consumer practices.

All customers have received conservation-related informational pamphlets at least twice a year since 1982. In 1989, Pennsylvania-American created a colorful, fully illustrated, easy-to-read pamphlet filled with water-saving tips. (See Appendix B for a copy of this pamphlet.) The publication stresses how customers can benefit by practicing water conservation.

PROTECTION OF RESOURCES

POLICY — Pennsylvania-American Water Company will monitor its sources of supply on a regular scheduled basis and notify proper authorities of any degradation detected in quality or quantity of this natural resource.

DISCUSSION — Protection of existing resources is a significant component of conservation. Pennsylvania-American exercises that component through vigilance and up-to-date knowledge of activities in watershed areas. Water quality specialists of Pennsylvania-American oversee a vigorous monitoring program designed to protect the company's sources of supply.

In all, Pennsylvania-American operates 22 filter plants that draw from reservoirs, more than 60 operating wells, all of the state's major rivers, and a variety of small streams. Pennsylvania-American keeps records at these sites of all water discharged into the surface water which its water is drawn. The state Department of Environmental Resources (DER) regulates such discharge through permits issued under the National Pollution Discharge Elimination System.

Pennsylvania-American conducts daily monitoring of water sources so it can be aware of any change in water quality as soon as possible.

In 1981, for example, Pennsylvania-American called DER's attention to increased bacteriological counts in water downstream from a cheese processing factory along the Shenango River in New Castle. That action resulted in a DER order for upgraded treatment facilities at that factory so the processing facility could meet the discharge standards specified in its permit.

In another example, Pennsylvania-American in 1988 detected an unusual concentration of ammonia in water in the intake of its Pittsburgh plant. The Company notified DER and began treatment with extra chlorine. DER in turn identified the source of the ammonia as a licensed discharger who was exceeding permit limits. Additionally, the Company filed a notice of intent to sue U.S. Steel in 1985, under the Resource Conservation and Recovery Act (RCRA) for violation of regulations regarding benzene discharges.

Pennsylvania-American reviews The Pennsylvania Bulletin weekly for permit applications or re-applications. In instances where it feels concern is warranted, it will seek detailed data from DER and make its views known to the agency.

Once DER issues a permit, the permit holder must file monthly discharge reports with the agency. Pennsylvania-American routinely reviews such reports from its source areas at least once a year. If change in water quality are detected through its own testing, Pennsylvania-American immediately turns to these reports for clues as to the source of the change.

Pennsylvania-American maintains an information exchange network with upstream utilities to provide early warning should a spill occur. Pennsylvania-American maintains a close working relationship with DER and the Pennsylvania Fish Commission, and is prepared to work with an emergency response coordinator in each DER region and in each county within its various service territories.

Pennsylvania-American also monitors groundwater sources. Pollution in groundwater tends to linger longer and even small spills can cause serious contamination. Small amounts of volatile organic chemicals such as benzene, degreasers and paint thinners can percolate down into the water table. Eventually they work their way into the water supply, and it can then take decades for contaminants to pass through.

Pennsylvania-American performs quarterly analyses of its groundwater sources, looking for even low concentrations of contaminants that might signal a more serious problem down the road. Testing for 63 contaminants is conducted every three months. Pennsylvania-American also offers speakers to talk to civic organizations about water pollution and its prevention.

METERING

POLICY — Pennsylvania-American Water Company will universally meter all customer accounts, exclusive of public fire hydrants.

POLICY — Pennsylvania-American Water Company will utilize monthly reading and billing, and promote conservation information through that billing process.

DISCUSSION — Except for water used in fire protection, the Pennsylvania-American distribution system is a universally metered system with no unmetered customers. The company is also installing meters on sprinkler systems used for private fire protection. The purpose is to stop unauthorized use of water from such systems and to measure and charge for water used in testing of the systems.

MATERIALS AND ENGINEERING

POLICY - Pennsylvania-American Water Company will utilize high-quality materials in its distribution system to minimize leakage potential, and will include impacts of conservation in its engineering plans.

DISCUSSION - Pennsylvania-American has undertaken several efforts in the areas of materials and engineering that contribute to its general conservation plan.

The Company has gone almost exclusively to the use of ductile iron pipe in its mains. Though more costly than asbestos-cement, cast iron or plastic, its durability will cut down on leaks and maintenance costs for many years to come. The ductile iron pipe used by the Company is cement-lined to thwart internal corrosion and polyethylene wrapped to protect against external corrosion.

Pennsylvania-American does not accept newly constructed mains until leak testing has been done in agreement with standards set by the American Water Works Association. Also, in the last several years, the Company has covered and lined six of eight remaining open storage reservoirs, thus eliminating loss through evaporation and leaking.

Pennsylvania-American has installed water backwash turbidity monitors in its filtration plants. In the filtration process, solids removed in the filters cause the filters to become clogged. Periodically, these filters must be removed from service and backwashed in order to restore performance. Water that has been previously treated is used for backwash purposes. The use of these monitors provides plant personnel with a clear, instant indication of the cloudiness of the backwash water, helping to conserve process water used for backwash. The amount generally represents about 2 to 6 percent of total plant flow. The new monitors determine when the backwash operation may be terminated. Under the old method, backwash operations were conducted for a fixed time, regardless of the length of filter run. Use of the backwash turbidity monitors allows termination of the backwash cycle at a time when the filter is neither overwashed nor underwashed, resulting in optimum use of the water supply.

CONSERVATION CODES

POLICY — Pennsylvania-American Water Company will promote conservation-oriented ordinances in local municipalities where it provides service.

DISCUSSION — Pennsylvania-American in 1989 supplied all of its division managers with copies of a model water-conservation ordinance developed by the state Department of Environmental Resources. The ordinance sets water conservation standards for plumbing fixtures and fittings. Adoption by a municipality would mandate, in newly constructed or remodeled buildings, the installation of 1.6-gallon-per-flush toilets. Also required would be 1.5-gallon-per-flush urinals and showerheads with discharge rates not exceeding three gallons per minute. Division managers sent copies of this ordinance in November 1989 to all municipalities within their divisions. The Company's cover letter asked local officials to support the enactment of regulations mandating low-flow fixtures and fittings and offered the company's help. (See Appendix D for a sample cover letter and a copy of the model ordinance.)

EMERGENCY CONSERVATION PROCEDURES

POLICY — Pennsylvania-American Water Company will maintain a drought contingency plan in each of its operations.

DISCUSSION — Should a drought emergency arise, Pennsylvania-American has developed a series of steps to help its customers conserve water. In many instances, water allocation permits governing Pennsylvania-American's sources of supply specify certain steps when flows reach a pre-determined level. (An outline of Pennsylvania-American's water conservation contingency plan and a list of water-saving suggestions developed for residential customers are included in Appendix E.)

RATES AND CONSERVATION

POLICY — Pennsylvania-American Water Company will promote rate and tariff changes that encourage conservation.

DISCUSSION — Pennsylvania-American recognizes that the rate and cost dynamics under which water utilities now operate are not conducive to promoting water conservation. This is because customers cannot save money in equal measure to the water they save, and further compounds the task of promoting conservation strictly as a matter of economic self-interest.

Over the years, investor-owned water utilities have been concerned that water conservation on a large scale would depress revenues without any offsetting reduction in costs. The National Regulatory Research Institute's (NRRI) Compendium on Water Supply, Drought, and Conservation confirms the sensitive link between conservation and revenues. "When conservation measures or water use prohibitions are in full force, absent an accompanying rate increase [emphasis added], utility revenues will be reduced," it says.

NRRI points out that, using typical demand elasticity estimates and a no-growth hypothetical model, a doubling of the price of water "results in a 32 percent reduction in demand but a 36 percent increase in revenue for the water utility. Without a price increase, the revenue loss caused by the same level of conservation would be about [32 percent]."

Due to the tremendous amount of fixed costs and the amount of investment per dollar of revenue, the largest part of the cost of providing water remains unchanged no matter how much water a customer may require. Costs do not go down proportionally if usage goes down. Once a plant and distribution system exist, the cost of that plant and system don't come down because people are conserving and drawing less water from the system. While similar economic results exist in other types of utilities, water companies are particularly sensitive to such results since the investment per dollar of revenue is much higher for water utilities than any other utility service.

Even designing a system with conservation in mind is difficult. Main size in the system is dictated by the capacity needed for fire fighting. A water system must be built to meet peak requirements rather than average requirements, which in turn mandates a higher front-end investment. Even though Pennsylvania-American is committed to conservation as part of its comprehensive planning process, the Company's construction expenditures over the next 15 years would not be affected by even the most successful conservation activities, since much of that construction is required to replace aging plants and meet water quality requirements. Operators and service people still have to be on hand, whether the amount used is 1 million gallons or 5 million gallons an any given day. Savings from conservation show up only in the reduced use of treatment chemicals and less energy used because less water is pumped.

The division of the water bill into two portions - a minimum charge and a volumetric charge - reflects the reality that the bulk of costs of providing water service are associated with the setup, the readiness to serve, rather than the amount of "product" used. This cost of service "difference" from the variable cost dependence for energy utilities must be recognized in higher fixed service charges for water utilities. Now that Pennsylvania-American has eliminated the minimum allowance, a process authorized by the PUC, even greater emphasis can be placed on conservation by charging for all water use.

The paradox involved - that a consumer won't see a 10 percent savings on his or her bill after having used 10 percent less water - is, in fact, a public relations obstacle that must be solved in any water conservation program. Pennsylvania-American realizes that customers will save in other ways, such as reduced energy costs for heating water and reduced costs for sewage service. However, these savings do not show up at the only point at which the Company is involved - the water bill.

As the NRRI compendium points out, "The economic value of water lies not in the water itself but in the processes required to withdraw it from natural source and deliver it in sufficient quantities and of acceptable quality to the consumer." It also says, "Prices that accurately reflect costs send correct signals to consumers and discourage wasteful consumption."

APPENDIX A

CONSERVATION STATEMENT OF AMERICAN WATER WORKS COMPANY

A STATEMENT ON CONSERVATION

The theme of this Annual Report brings up an issue which merits separate comment. This issue is conservation and its applicability to water.

Conservation is defined in Webster's dictionary as "planned management of a natural resource to prevent exploitation, destruction and neglect."

Water is a natural resource. So are oil, gas and coal. There is, though, a very real distinction between water and other natural resources. Water is a renewable resource. The others are not.

We hear the terms "use" and "destruction" employed synonymously in discussions concerning the conservation of water. When this happens, the uniqueness of water as a resource is overlooked. Its "use" does not "destroy" it.

We have always supported and, in fact, pleaded for conservation of the natural resource water. Our commitment to this cause is to prevent exploitation and neglect. Its pollution and waste are shameful.

Water use by the customers of the American Water System does not exploit, destroy or neglect the resource. Our customers are not "consuming" water in the sense that what they use will no longer be available for those who follow them.

There is not now and, as far as we know, never will be a reduction in the volume of water on the earth. In fact, billions of gallons of fresh, usable water flow to the oceans every day.

On the other hand, certain areas of the world and parts of this country, including some of our service territories, have developed to a point where the water supply requires augmentation. This often mistakenly prompts a discussion of conservation. Consequently attention is distracted from the real issue, which is the management of the resource.

We hope by this statement to better focus the important decisions faced by those who must consider water supply augmentation.

A water system typically develops over time by utilizing the least costly source of supply first. As this supply is utilized to its fullest, the next least costly increment is developed.

The cost of development of these supplies : function of the size and number of pipes, pump ters, dams, wells and all of the related equipme required to collect, treat and deliver water to consumers.

The decision whether or not to develop the least costly supply is basically a choice of how r spend for water service. If consumers are willin the cost of development for the next increment water, then the answer is obvious: build the nev system.

If, on the other hand, those served are not to incur this cost, other steps are required. Thes include limiting community growth and develo restricting recreational or decorative water use . trolling everyday household and business use.

For those who confront the need to expan water supply, these questions are important an require very careful analysis. It must be recogn water supply limitations can cause economic d a community.

This kind of analysis has been a significant the business of the American Water System for years. We call it planning. In fact, no utility can without it.

We have augmented supplies when it was ent this was required. Consumers expected thi This may be changing.

Today, in certain service areas, people are tioning whether or not they are willing to pay f next supply increment. We respect this positio will work to help those communities consider alternatives.

On the other hand, we see no reason to cc that a decision to expand the water supply wo late a conservation ethic.

We renew our plea: Do not exploit or negl water. Remember, it cannot be destroyed.

Use it wisely and enjoy it. It will continue us well.

INTRODUCTION

This handbook has been prepared to assist Pennsylvania-American Water Company

reduce water and revenue losses. It includes procedures for conducting a comprehensive systemwide water audit to assess the delivery efficiency of the water distribution system.

The water audit is a thorough examination of the accuracy of the company's records and system control equipment. The overall goal of the audit is to identify, quantify, and verify water and revenue losses. It also helps in prioritizing the allocation of money and manpower. The audit should be performed annually and should continue on an on-going basis as one of the company's top priorities.

The leak detection survey part of the water audit is a systematic method of using listening equipment to survey the distribution system, identify leak sounds, and pinpoint the exact locations of hidden underground leaks.

Water losses, whether attributed to leakage, theft, underbilling of customers, or faulty system controls, represent monetary losses to the company. This is water that the company has already paid to obtain, treat, and make available to the distribution system for sale to its customers. However, because it is lost, the water produces no revenue. Likewise, reduction of unaccounted-for water has the potential of not only improving fire protection capabilities, but also delaying capacity-oriented future construction.

Once the initial water audit is conducted, annual updates will provide data to assist the manager in deciding how to adjust his priorities and monitor progress on system maintenance. Equally important, the audit can identify new areas of system losses to establish new annual maintenance goals.

The company's water audit master plan will be a valuable planning tool which can be used to set priorities and schedule corrective actions to maintain the distribution system.

Since water conservation is of prime importance and the company desires to increase the efficiency of its operations, an ongoing water loss control program will continue to be a top priority of the company.

DEFINITION OF A WATER LOSS AUDIT

A water loss audit is a systematic, coordinated effort which analytically tests the integrity of the entire production, distribution and commercial systems of a water utility. The audit is a starting point. It is the foundation from which the whole picture can be viewed.

The term "audit" carries with it a financial connotation. In a simple accounting sense, a financial balance sheet of an organization must have its assets equal the sum of its liabilities and surplus.

From the viewpoint of water loss, the assets are the amount of water entering the system. The liabilities equal metered consumption, and the surplus is unaccounted-for water.

In the same manner that a financial auditor tests the validity of the assets and the validity of the liabilities such that he proves the surplus, the water loss auditor tests the validity of the metered measurement of water entering the distribution system and the validity of the metered sales such that he analytically confirms the amount of water that is lost.

In the same sense of a financial auditor's guidelines, this handbook does not necessarily instruct in the basics of water works operation (it assumes professional status already exists), but it does present check lists, guidelines, and signal points that should be reviewed by the auditor.

In the same sense that a company's financial balance sheet is viewed in its entirety, a water loss audit views the system in its entirety. There are five basic points in a water loss audit:

1. Confirmation of production station master meter registration
2. Confirmation of large meter registration
3. Confirmation of small meter registration
4. Review of unauthorized use, such as private fire service
5. Location of underground leakage

DATA COLLECTION

The following data should be collected, analyzed, and inserted in this section of the handbook:

1. Form 329 - annual and 12-month year-to-date ending for the audit period.
2. A listing of the largest customers.
3. An evaluation of the largest customers for proper meter sizing.
4. A listing of private fire service accounts to evaluate the following:
    a. Are they metered?
    b. Do they have detector checks?
    c. Are they unmetered and not detector-checked?
    d. Are they active and are they being billed?
    e. Have they been inspected annually?
5. The plant description and the elevation chart from the distribution map should be confirmed as still relevant.
6. Miles of main in the distribution system.
7. Number of customers and footage of main per customer.
8. Listing of the number of hydrants in the distribution system.
9. Area coding data.
10. The distribution map.
11. A distribution map marked for metered high service zones and booster zones.
12. A distribution map marked with the elevations of all hydrants.
13. A conversion of the gallons of unaccounted-for in the 12-month period analyzed to gallons per minute.
14. An anaylsis of leaks in the past year, listing number of main line leaks, hydrant leaks, and service leaks. Include size and type of pipe under main line leaks.
15. The meter aging report for the purpose of reviewing length of service change-outs.
16. A random sampling of 10 meters removed every month and tested at flows as follows: ¼, 2, 6, 15 gpm.

PROCEDURES FOR CARRYING OUT A COMPREHENSIVE WATER AUDIT

1. The company's production or pumping station output meters must be checked and verified for accuracy at least once a year. It may be necessary to verify these meters on a more frequent basis which will be left to the judgement of the operating district.
2. Testing of large commercial, industrial, and other meters measuring water sales to customers must be performed annually. The meters for the 10 largest customers of each operating unit must be verified annually. The testing of these meters ideally should be done in place with a fire-flow type of a meter.
3. All fire service lines should be identified and inspected on an annual basis to confirm that there is no theft of water via the fire service line. It may be necessary to undertake a program to install large full-flow meters on all fire lines at company expense and charge for fire service to the customer based upon size of connection in tariff and not meter size. This would apply to existing customers; however, all new customers desiring a fire service line should include a full-flow meter.
4. A leak detection survey should be undertaken initially by employees listening for sounds on all main line valves and fire hydrants. When distance between valves or hydrants is great, customer service lines or curb stops will have to be listened on in order to minimize the area covered, thus being able to sound out the complete area between the valves. Subsequent to listening on valves and hydrants, it may be necessary to listen on random, or even all, customer curb stops to assure the area is free of underground leaks.
5. Each operating district has its own characteristics; therefore, vehicle and equipment needs as well as the complement of employees assigned to perform the leak detection survey will vary.

The above items will be detailed under the sections in this handbook designated "Production, Distribution, and Commercial."

QUICK ASSESSMENT FORMULA

Once the accuracy of the plant output meter has been verified and system delivery restated based on recalibration of the output meter, a quick evaluation may be made. This phase of the audit will isolate generally where the largest portion of unaccounted-for water is.

There are two broad areas where water which is pumped but not billed may occur:

1. It may be missing due to underground leakage.
2. It may be unmeasured due to meter error, unmetered usage or improper meter setting conditions.

Each of the situations is correctable. The assessment formula as follows will help direct the strongest effort in salvaging unaccounted-for.

The formula has been developed over years of practical evaluation in the field. Its basis is to isolate all metered usage except residential from accurately-measured system delivery. Once commercial, industrial, and other usage has been subtracted from system delivery and divided by 365, the residual is daily residential usage and unaccounted-for. By dividing this amount by the population served (residential customers x per capita per residence) a usage + loss per capita is derived.

Normal ranges for this number is 50 to 70 gallons per capita per day. If the number is less than 50, chances are great that the largest portion of unaccounted-for is meter error. If greater than 70, the system is probably suffering most from underground leakage or unauthorized or unmetered usage.

QUICK ASSESSMENT FORMULA

Example

	Situation 1	Situation 2
1. Daily Metered Delivery	3,135,000	3,405,000
2. Daily Metered Ind., Comm., Other Usage	1,245,000	1,245,000
3. Metered Residential Sales and Unaccounted-for	1,890,000	2,160,000
4. Metered Residential Sales	1,215,000	1,620,000
5. 10,000 Customers x 2.7 Residents per home = population	27,000	27,000

Audit

$$\frac{\#4}{\#5} = \frac{1,215,000}{27,000} = 45 \qquad \frac{1,620,000}{27,000} = 60$$

less than 50

greater than 50, less than 70

$$\frac{\#3}{\#5} = \frac{1,890,000}{27,000} = 70 \qquad \frac{2,160,000}{27,000} = 80$$

equal or less than 70
metering problem:
no appreciable leakage

greater than 70
leakage a problem;
no appreciable meter error

WATER AUDIT CHECK LIST

This check list will enable the Company to institute an in-house water loss control program. This check list can be put into practice immediately with the existing complement of employees and can be utilized as a continuous program for water loss control.

1. Check production or station output meters for accuracy at least once a year.
2. Perform clearwell drawdown test as frequently as practical to confirm station output meters.
3. Clean and maintain venturi flow tubes as required or at least annually. Make arrangements to construct vault for venturi meter for easy access.
4. Test meters supplying large commercial and industrial customers annually.
5. Listen on valves, fire hydrants and curb stops.
6. Listen on mains, services and meters.
7. Check all stream crossings.
8. Inspect sewer manholes and catch basins.
9. Check for unmetered use.
10. Follow up on low pressure complaints from customers.
11. Investigate for large leak in system when daily station delivery suddenly increases or storage vessels are not refilling to proper levels.
12. Inspect all private fire services annually for unauthorized use.
13. Investigate the development of a new low pressure area in the distribution system.
14. Periodically check consumption recorded on 2" meters and larger for proper sizing and application.
15. Check altitude valves on tanks for overflow of water.

The term unaccounted-for water and its measurement have no meaning if the plant output meters do not accurately reflect the precise delivery of water into the distribution system. All calculations are based upon delivery to the system. Not only are unaccounted-for statistics based on the delivery meter, but budget decisions and future construction decisions are generated from this information as well.

1. There are three methods of metering production output:
   - A. Sonic meters
   - B. Turbine meters
   - C. Venturi meters
2. The advantages and disadvantages of the three meters are:
   - A. Sonic meters
     1. Advantages
        - a. Measure to +/− 1% of rate of flow
        - b. Little maintenance
     2. The disadvantage of sonic meters is that their accuracy is affected by solids in the water.
   - B. Turbine meters
     1. Advantages
        - a. Measure low flows well
        - b. Parts replacement is easy via plug-in parts
        - c. Low head loss
        - d. Range of 20 - 1
        - e. Accurate within ½% over the range
     2. The disadvantage is that the measurement is severely affected by turbulence and the setting is critical to accuracy
   - C. Venturi meters
     1. Advantages
        - a. No working parts
        - b. Low head loss
        - c. Ease of checking the primary element
        - d. Accurate to ½% in the flow range
     2. Disadvantages
        - a. Difficult to remove
        - b. Need frequent checking
        - c. Must specify accurately the delivery range

d. Overall testing is difficult
e. Test operator qualifications must be impeccable
f. Manometer readings must be precise to recalibrate accurately

3. There are three methods to verify the accuracy of plant output meters
   A. The easiest and least costly is the clearwell drop test. This procedure discontinues filtering and by determining volume pumped over specified time and comparing to metered recording, an accurate comparison can be made. This procedure should be used as often as practical.
   B. Another method of testing is to install a calibrated turbine meter at an appropriate distance downstream of the output meter and compare the readings.
   C. Pitometer measurement is the final and most common measurement. This method is normally accurate to within +/— 5% because of the necessity to have ideal and absolute known test conditions and the variance in reading the manometer.
4. Frequency of output meter testing
   A. Clearwell drop test - as often as is practical.
   B. Output meter verification by test meter - at least annually.
5. Accessibility of the output meter
   A. Every output meter should be accessible by occupying its own ventilated pit.
   B. Ideally, there should be a bypass setting arrangement wherein the bypass should be of known and controlled distance and diameter and have no conditions creating turbulence.
6. Other testing considerations
   A. All tests should be conducted over at least a 24-hour period.
   B. Each pumping configuration should be tested over a 24-hour period.
   C. The entire system, meter primary flow device, transmitter, recorder and totalizer should be tested as a system.
   D. The system should be retested following adjustment.
   E. Calibration adjustments should be recorded on meter records.
   F. Every meter should be evaluated no less than annually comparing the manufacturer's specifications and flow range to meter output conditions.
   G. Every output meter setting should be analyzed for compliance with manufacturer's recommendations regarding set location and exposure to turbulence.

H. Pressure lines and pressure taps should be routinely maintained.
I. Spare parts should be inventoried

7. Other production responsibilities
   A. Check system instrumentation, telemetering repeater systems and altitude valves to avoid overflowing tanks and reservoirs.
   B. Adjust treatment techniques to avoid corrosivity within the system and evaluate possible precipitates that will affect meter accuracy.
   C. Evaluate the location and the setting conditions to assure that conditions in the field are in strict compliance with the manufacturer's specification.
   D. Test the meter under laboratory conditions.
   E. Test the meter under all operational conditions for at least 24 hours.
   F. Review all plant production records including, but not limited to, results of previous tests, pump efficiency tests, and pump specifications.
   G. Require meter test certification for all new plant meters.
   H. It is recommended that individual flow meters be installed on each high service (Distributive) pumping unit whenever possible to facilitate tests for pump efficiency and station output meter accuracy.

COMMERCIAL DEPARTMENT

Accurate water measurements is the means by which our company produces revenue to cover expenses. Inaccurate water measurements contribute to unaccounted-for water. The following procedures are means of maintaining revenues and reducing unaccounted-for water.

1. Maintain compliance with Pennsylvania rules and regulations: i.e. Chapter 65, Testing of Meters, as well as Procedures contained in the American Water Works Service Operations Manual.
2. Review and continue to provide training to all outside commercial employees on an ongoing basis to insure that they have the proper knowledge to identify the following:
   A. To inspect and look for illegal connections.
   B. To insure that meters are properly installed, have not been tampered with and sealing devices are intact.
   C. To inspect meter if registration has not increased from prior reading. Run water to see if dial moves or meter is stuck.
3. Establish procedures for all outside commercial personnel to sound and investigate as follows as part of a water loss audit in performing this routine work:
   A. Sound service line for possible leak.
   B. Investigate wet spots in lawns.
   C. Sound fire hydrants if encountering or passing same while performing meter reading or service work.
   D. Sound outside hose bib where meter is a remote installation.
4. Inspect and test all meters 3" and larger annually with fire flow test meter to insure meter accuracy.
5. Inspect and test all battery settings of meters in line with comparison test meter.
6. Evaluate correct meter size by use of a meter master for all large customer accounts.
7. Review all Class 1 turbine meter installations for correct application.
8. Establish data base system and compare various data for identifying meter situations which need investigations.
9. Inspect all private fire services annually. When unauthorized use of water is suspected or found, Company will install properly-sized meter and vault at its expense, thus eliminating the unauthorized use.

§65.8. Meters

(a) *Allowance Error.* No water meter which has an error in registration of more than 2.0% may be placed in service, nor may a water meter which has an error in registration of more than 4.0% be allowed to remain in service, when water is passing through it at approximately the following rates of flow:

Meter size (inches)	*Gallons per minute*
5/8	6
¾	10
1	20
1½	30
2	50
3	90
4	180
6	300

(b) *Periodic Tests.* No public utility furnishing metered water service may allow a water meter of 1 inch or less nor a water meter of more than 1 inch to remain in service for a period longer than 20 years and 8 years respectively without testing it for accuracy and readjusting it if it is found to be incorrect beyond the limits established in subsection (a).

Upon a customer's request the public utilities shall also perform a meter test without charge if a meter has been in service and has not been tested for a period greater than that specified in the following table:

Inch Meter	*Years*
5/8	10
¾	8
1	6
More than 1	4

(c) ***Meter Test Records.***

Whenever a water meter is tested, the original test record should be kept indicating the information necessary for identifying the meter, the reason for making the test, the reading of the meter before being disturbed, and the accuracy of the meter together with data taken at the time of the test. This record shall be sufficiently complete to permit the convenient checking of the methods employed and the calculations made. A record shall also be kept, preferably numerically arranged, indicating the date of meter purchase, name of manufacturer, its size, its identification, its various places of installation with dates of installation and removal, and the dates and general results of all tests.

(d) Installation and Removal of Meters.

(1) *Installation of meters.* A water meter whenever installed shall be inspected by the public utility for proper connections, mechanical condition, and suitability of location within 60 days after installation. In the case of a new meter or a meter reconditioned by a manufacturer, the test results of the manufacturer may be accepted as the installation test if the utility has verified the manufacturer's reported test results by testing the greater of 10% or 10 meters of a shipment of meters. In case of emergency, a meter not meeting the requirements of this section may be installed temporarily.

(2) *Removal of Meters.* A water meter which is removed from service shall be tested within 30 days for accuracy to complete that meter's test history. When a meter is removed from service, it shall be properly sealed to secure registers and measuring devices until it can be properly tested for accuracy.

(e) ***Facilities for Testing.*** A public utility shall provide and keep available suitable and adequate facilities for testing its meters, and shall maintain these facilities in good condition and in correct adjustment so that they are capable of deterimining the accuracy of a service meter within 0.5%. A public utility not maintaining a standardizing laboratory may, upon written permission from the Commission, have its meters and instruments certified by a standardizing laboratory approved by the Commission. The accuracy of testing equipment will be established and checked annually by representatives of the Commission. After making final adjustments, the tester shall seal and date tag the testing facilities and furnish the public utility with a certificate of accuracy properly dated and signed.

(f) ***Meters in Service without Test Records.*** A water meter of a public utility which does not meet the requirements with respect to tests and records of tests shall be immediately removed from service by the public utility and may not again be placed in service until the requirements are met.

(g) *Request Test.* A public utility shall make a test of the accuracy of registration of a water meter upon written request of the customer for whom the meter is furnished, upon payment of the fee specified in § 1.43 (relating to schedule of fees payable to the Commission). If a customer desires personally or by a representative to witness the testing of a meter, he may require the seal of the meter to be broken in his presence or that of his representative. If the meter tested upon the request is found to be accurate within the limits specified in subsection (a), the fee shall be retained by the utility; but if not so found, the cost shall be borne by the utility and the fee paid by the customer shall be refunded. A report of the test shall be made to the customer.

(h) *Schedule of Fees for Testing Water Meters.* The schedule of fees for testing meters is as follows:

(1) For a water meter having an outlet not exceeding 1 inch—$10.

(2) For other water meters having an outlet not exceeding 2 inches—$20.

(3) Rates for testing other meters, including those which are so located that the cost is out of proportion to the fee specified, will be furnished by the Commission upon the receipt of complete specifications.

(i) *Fees for Testing Facilities of Public Utilities.* The Commission will charge and collect from utilities for the testing of their meter testing facilities and water meters the following fees:

(1) For testing meter testing facilities at the utility plant—$15.

(2) For a water meter tested at the Commission laboratory—$3.00

§65.9. Adjustments of bills for meter error.

(a) *Fast Meters.* If upon test of a meter, the meter is found to have an error of more than 4.0% fast, the public utility shall refund to the consumer the overcharge based upon what the meter would have registered had it not been fast or slow for a period equal to ½ the time elapsed since the last previous test but not to exceed 12 months. If the period of registration error is fixed with a reasonable degree of certainty, the overcharge shall be computed for the period. If the meter has not been tested under §65.8 (relating to meters), the period for which it has been in service beyond the regular test period shall be added to the 12 months in computing the refund.

(b) *Slow meters.* If upon test of a meter, the meter is found to have an error of more than 4.0% slow, the public utility may render a bill for the water consumed but not covered by previously rendered

bills equal to ½ of the time elapsed since the last previous test but not to exceed 12 months. If the period of registration error is fixed with a reasonable degree of certainty, the charge may be computed for the period. Payment of this previously unbilled consumption shall be under §56.83(5) (relating to unauthorized termination of service).

(c) *Nonregistering Meters.* If a meter is found not to have registered for a period or not to have fully measured the entire flow due to meter interference, the public utility shall compute the water used by taking the average of the water used for the nearest meter reading period immediately preceding and the meter reading period immediately following the date when the meter was found to be not registering or interfered with, which amount shall be assumed to be the amount of water used by the customer during the billing period in which the meter was found not to have registered. Exceptions may be made only if the facts clearly show that the stated method does not give the correct consumption for the period.

§65.8. Meters.

You may not place a meter into service if it has an error in registration of more than 2% (a meter which registers 98%-102% of consumption is considered accurate). Additionally, you may not allow a meter to remain in service if it has an error in registration of more than 4% (a meter which registers 96%-104% of consumption is considered accurate). The rates of flow are shown in the regulation on the preceding page. For example a 5/8" meter must be tested at 6 g.p.m. and a 2" meter at 50 g.p.m. These are the only tests you must conduct for these meters.

Meters measuring 1" and less must be tested once every 20 years. Meters measuring more than 1" must be tested once every 8 years.

For all new meters, you must verify the manufacturer's test results by testing 10% or 10 meters (whichever is greater) of each shipment.

Every meter removed from service must be out tested within 30 days following its removal. Again, you should conduct the test at the rates of flow shown in the regulation - 6 g.p.m. for 5/8" meters and 50 g.p.m. for 2"meters.

§65.9. Adjustment of bills for meter error.

If a meter is tested and found to have an error in registration of more than 4% fast, you must refund to the customer the overcharge. If you know the exact period of registration error, you compute the overcharge for that specific period. If you don't know the exact period, you compute the refund by determining what the meter would have registered had it not been running fast for the period

equal to ½ the time elapsed since the previous meter test. The period shall not exceed 12 months. However, if you have not tested the meter within the period of time prescribed by §65.8 (for example, a 5/8" meter in service over 20 years without being tested), the period for which the meter has remained in service beyond the regular test period shall be added to the 12 months in computing the refund.

If a meter is tested and found to have an error in registration of more than 4% slow, you may charge the customer for the unbilled water used during the period equal to ½ the time elapsed since the previous meter test. The period shall not exceed 12 months. Again, if you know the exact period of registration error, you compute the charge for that specified period. However, if the customer does not pay the bill, you may not terminate his/her service.

A leak detection survey is a process of elimination and discovery. The goal is to eliminate the contact points where water sounds are not heard and discover the contact points where leaks can heard.

Prior to conducting a leak detection survey, you must review the specifications of your distribution system. The following information is important to review:

1. How much water is lost from the system in gallons as well as gallons per minute.
2. Types of pipelines in the system, ages, diameters, joints, installation methods, leak histories, and operating pressures.
3. Number and type of valves in the system, including location records and drawings, types of valves, open left or right, number of turns to exercise valves, and how often valves are exercised.
4. Hydrant records - types, sizes, locations, flushing frequencies, static pressure and residual flow.
5. Location of pressure-reducing valves, pressure-sustaining valves, pressure-relief valves and dates of inspections and maintenance of valves.
6. Location of blow-offs and air-release valves and records as to maintenance.
7. Accurate distribution system map.
8. Verify what is shown on map as to its accuracy, how current is the information, and how often is the information updated.

PROCEDURES FOR CONDUCTING A WATER LOSS AUDIT FOR DISTRIBUTION PERSONNEL

1. Formulate a plan to survey the distribution system taking into account the following:
   A. Determine number of miles to be surveyed.
   B. Need updated distribution maps for use in the survey along with current valve and hydrant records.
   C. Establish miles per day and length of time to conduct survey.
   D. Assign trained personnel to survey.
   E. Equipment necessary to conduct survey:
      1. Sonic Equipment
      2. Geophone
      3. Aquaphones
      4. Valve & curb keys
      5. Wrench & hand tools
      6. Pick, Shovel & Sledge
      7. Danger signs, cones, flags
      8. Marking Paint & Chalk
      9. Radio communications
      10. Valve Box & Curb Box
      11. Pipe locator
      12. Measuring(tape-wheel)
      13. Valve operator
      14. Vehicles
      15. Portable lighting outfit
      16. Flashers
      17. Arrow Board
      18. Altimeter

2. Segregation of Distribution System:
   A. Evaluate distribution system for problem areas using information from records on hand, leak cards, and computerized reports.
   B. Segregation of distribution system, if required, will be dependent upon number of miles to be surveyed.
   C. Divide distribution system into districts and further sub-divide sections into areas where known consumption can be determined, such as:
      1. Area coding
      2. Booster areas, etc.
   D. Install distribution system metering where feasible to isolate sections.

3. Procedures for conducting leak sounding survey:
   A. Sound all fire hydrants and verify static as per elevation and gradient.
   B. Sound main line valves, random curb boxes and meter pits. For complete audit, sound all curb boxes and meter pits.
   C. Investigate, inspect, and sound all fire services.

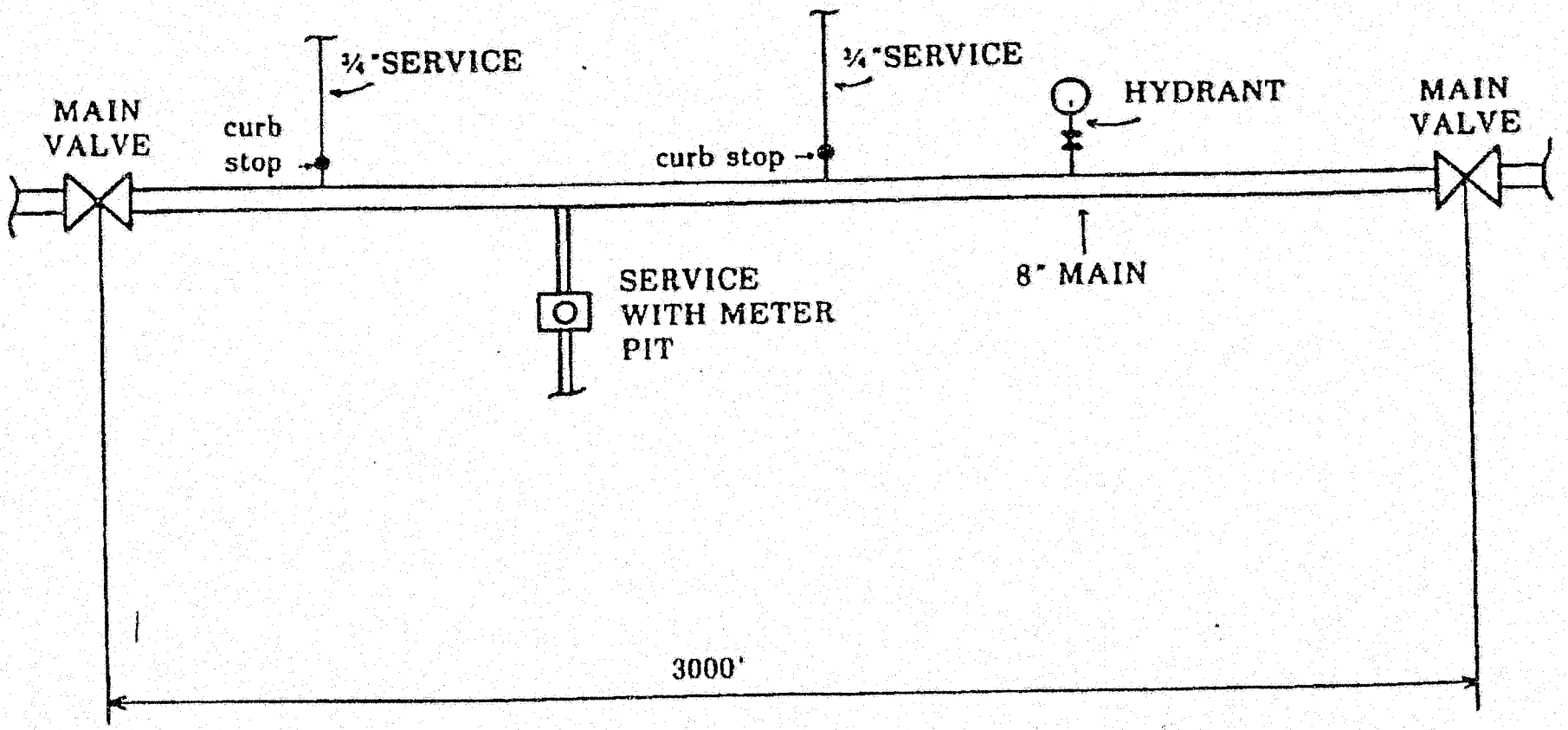
D. Investigate, inspect, and sound all large commercial and industrial services.
E. Sound blow offs and bleeders.
F. Inspect and sound exposed pipelines on bridges and railroad crossings.
G. Isolate and sound river crossings. A meter and bypass should be provided whenever possible.
H. Inspect and sound mains in easements. Line markers which provide sounding points should be installed whenever possible.

4. Perform Visual Inspection:
   A. Inspect manholes and catch basins for unusual flow of water.
   B. Inspect streams and springs in dry weather for unusual flow of water.
   C. Inspect and walk pipeline right-of-ways.
   D. Review and compare recording charts for changes in pressures and flows.
   E. Review Fire Department records for unreported usage after fire.
   F. Adopt and enforce a strong policy prohibiting the unauthorized use of fire hydrants for the following:
      1. Streets sweepers
      2. Sewer flushings
      3. Swimming pools
      4. Paving contractors
      5. Lawn care companies
      6. Exterminators
   G. Investigate wet spots or sunken areas in lawns and roads.
   H. Inspect tank and reservoir overflows and altitude valves.
   I. Service personnel should be alert for illegal connections before meters.

5. System for recording soundings on distribution maps via color-coded legend:
   A. Example:
      Blue dot – confirm sound was taken at specific location.
      Red dot – confirm leak sound located.
      Red X – leak location pinpointed.
      Green circle around red dot – indicates leak repaired.
      Brown circle around red dot – no sound on recheck.

6. Prioritize Repairs to Leaks:
   A. Leaks found should be scheduled for repairs as soon as possible depending on the flow and water supply affecting system and public health and welfare.
      1. Public Safety Priorities should be established on a case-by-case basis considering the following factors:
         a. Fire flows.
         b. Service to large customers: i.e. hospitals, schools, nursing homes, industry, etc.
         c. Streets, sidewalks, and property damage. Public safety - streets and sidewalks.
         d. Weather conditions.
         e. Property damage.
7. Data accumulation and analysis.
   A. Data obtained during leak surveys should be maintained in a computer data base per analysis.
   B. Twelve-month cumulative totals for system delivery volumes and percentages should be developed each month and depicted graphically to show trends.
   C. All data should be collected, maintained and presented in a standard format.

NOTE
SOUND ALL VALVES SERVICE, HYDRANT CURB STOPS



CONCLUSION

A Water Loss Audit as presented in this handbook is not an additional job. It is instead a coordination of effort and resources organized to view a water production and distribution network as an interrelated system. Unaccounted-for water does not occur because of leaks alone; it is not a single large main break; it is not only meter misregistration; it is not just unauthorized use. It is, however, a combination of all of these circumstances.

A water loss audit requires planning, organization, follow through and control, as well as the coordinated, dedicated and enthusiastic effort of every employee in every district. A well constructed audit will examine every source of loss to pinpoint leakage and lost revenue.

As a suggestion to focus effort and measure success, it is recommended that in the future, the M-Work Order process summarize the individual efforts into a single multi-section work authorization entitled "Water Loss Audit."

EXAMPLE
MAINTENANCE WORK ORDER

Water Company District
Name of Company

Maintenance
Work Order No .

Total Estimated
Cost $ _____

DESCRIPTIVE TITLE:

Conduct a water loss audit of the Production, Distribution and Commercial system.

PURPOSE: The purpose of this program is to:

1. Test plant meters
2. Test large meters
3. Operate 20% of system valves
4. Operate all hydrants
5. Operate all curb boxes
6. Operate a leak van investigation of 50% of the pipe
7. Conduct a Pitometer survey of 33% of the system

The goal of the program in 1988 is to reduce unaccounted-for from 20% to 19% by December 31, 1988.

	LOCAL OFFICE		DIVISION OFFICE	
	INIT	DATE	INIT	DATE
W.O. INDEX				
BUDGET CONTROL				
COST SHEET				

MANAGER

APPROVALS	DATE
PRESIDENT OR VICE PRESIDENT	

SUMMARY

Our mission is to manage water losses and misregistration throughout the system - from water origination through final consumer use. Our objective to view water loss via a coordinated audit procedure. Our goal is to reduce aggregate unaccounted-for to 15% of system delivery by the year 2003.

CITIZENS UTILITIES WATER COMPANY OF PENNSYLVANIA

APPENDIX E

STATEMENT OF WATER CONSERVATION POLICY

CITIZENS UTILITIES WATER COMPANY OF PENNSYLVANIA

CONSERVATION PROGRAM

The following statement is submitted by Citizens Utilities Water Company of Pennsylvania ("Penn Water") on behalf of the consolidated service districts in compliance with the Pennsylvania Public Utility Commission's ("Commission") Policy Statement on Water Utility Conservation Measures. The Policy Statement was published at 18 Pa. Bulletin No. 28, page 3071 (July 9, 1988). The Policy statement was adopted pursuant to Section 523 (b) of the Public Utility code, 66 Pa. C.S. 523(b), by the Commission in the order at Docket No. L-880040 on February 16, 1989. The order was published at 19 Pa. Bulletin No. 14, pages 1575-1577 (April 8, 1989).

A detailed conservation program has been adopted by Penn Water. It addresses the following issues: source meters, service meters, leak detection and repair, water conservation performance standards for plumbing fixtures and fittings, customer education, retail water pricing, and the establishment of a mandatory conservation plan should one be required. Attached is an outline and summary of the conservation program.

Penn Water believes that lost and unaccounted for water is minimal within each of its service districts because each district has an on-going leak detection program. Leaks that are detected are repaired immediately to minimize lost water.

Penn Water periodically sends to its customers pamphlets prepared by the Pennsylvania Department of Environmental Resources or the American Water Works Association, explaining conservation measures that customers can put to use in their homes. Such measures include

explanations of inexpensive water-saving plumbing devices and procedures for washing clothes, cars, and dishes using less water.

Penn Water has amended its tariff to include a conservation contingency plan as explained in the Commission's regulations at 52 Pa. Code Paragraph 65.11. In addition, Penn Water has adopted additional tariff rules and regulations requiring customers to use water wisely.

Penn Water will continue to review its water conservation program and make such modifications in the future that can be reasonably expected to make the program more effective.

CONSERVATION PROGRAM SUMMARY

A. SOURCE METERS

Meters are installed at each source of supply and are maintained by Citizens Utilities Water Company of Pennsylvania (Penn Water) service personnel or outside service contractors as required. The source meters are read and recorded daily by Penn Water service personnel and the meters are tested and/or calibrated every two to three years, or as needed.

B. SERVICE METERS

The majority of service meters within each service district are 5/8" X 3/4" Sensus or Schlumberger residential meters. Meters throughout the districts range in size from 5/8" X 3/4" to 10". Non-residential meters consist of 5.21% of the total meters installed; 100% of all customers are metered.

Residential meters are replaced every 15 to 20 years, or as needed. Meters removed from service are tested for accuracy prior to repairs or scrapping. Large meters (larger than 1") are tested on an average of every five (5) years. All meters are read, at a minimum, every three months. Many of the larger meters (commercial and industrial customers) are read on a monthly basis.

C. LEAK DETECTION AND REPAIR

Each of the service districts of Penn Water has an on-going leak detection and repair program. Service personnel monitor daily production of each source of supply for indicators of possible leakage in each pressure zone.

Service personnel use aquascopes and ear phones to survey for leakage by sounding fire hydrants, valves, and curb stops. A professional leak detection consultant is utilized to perform a system-wide survey every three to five years, or as necessary depending upon unaccounted-for water. Monthly meter reading of many commercial and industrial customers was implemented in 1994 to assist in monitoring for leakage on customer service lines.

All leaks that are detected are immediately repaired and a log is maintained on all repairs. Unaccounted-for water averaged 11.50% for 1994 for the consolidated service districts.

Each service district maintains a distribution system map, which is updated annually, noting the location of fire hydrants, valves, blow-offs, etc. to assist in locating and isolating leaks for repair.

D. WATER CONSERVATION PERFORMANCE STANDARDS FOR PLUMBING FIXTURES AND FITTINGS

New homes constructed by developers/builders are required to comply with the provisions of Resolution No. 88-2, as revised, (water conserving plumbing fixtures and fittings). This requirement is a provision of the Water Facilities Line Extension Agreement, executed by each developer/builder and Penn Water. Water conservation is also promoted by ordinances adopted by each municipality within each of Penn Water's service districts.

E. CUSTOMER EDUCATION

Water conservation is promoted through the annual distribution of a bill-stuffer to all customers. New customers are provided the same bill-stuffer/pamphlet ("Be a Leak Seaker" or "25 Things You Can do to Prevent Water Waste") when initially making application for service. A message is also imprinted on the customer's bill which states "Conserve, use water wisely."

Penn Water developed in 1993 a water education program for the local school districts of its service areas. The program is presented annually at the elementary schools with the primary topic focusing on water conservation in the home.

Refer to Section G, Mandatory Conservation Plan, for additional customer education initiatives.

F. RETAIL WATER PRICING

It is Penn Water's intent to implement a water conserving pricing structure that reflects the Pennsylvania Public Utility Commission's judgement with regard to avoiding unfair burdens on groups of customers during the implementation period consistent with ratemaking principles of gradualism.

Penn Water proposes to work towards a single commodity rate structure that is also a water conserving pricing structure and meets the defined requirements of resolution No. 92-2 amending the Comprehensive Plan and Water Code of the Delaware River Basin.

G. MANDATORY CONSERVATION PLAN

A necessary part of any conservation plan is a provision to initiate a stringent rationing plan requiring a certain percentage reduction in consumption along with appropriate penalties. The severity of the rationing would be determined at such time as it is required. Prior to initiating a mandatory rationing plan, additional customer education will have been undertaken which would include one or more of the following:

1. Appropriate notices will be posted in local offices regarding current laws and penalties for misuse of water, and a description of non-essential uses as recognized by governing bodies.

2. Advise consumers of all available conservation devices that are available such as flow control devices for shower heads and aerators.

3. Issue appropriate press releases to local news media relating to conservation when warranted.

MANAGEMENT AND OPERATIONS AUDIT OF THE CITIZENS UTILITIES WATER COMPANIES OF PENNSYLVANIA

PREPARED BY THE

PENNSYLVANIA PUBLIC UTILITY COMMISSION

BUREAU OF AUDITS

MANAGEMENT AUDIT DIVISION

JUNE 1994

CITIZENS' UTILITIES WATER COMPANY
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IV. OPERATIONS

A. SYSTEM PLANNING

Background

The system planning function for the local properties is a shared responsibility between CUC and the local properties' engineering staff. Planning studies for specific projects as a result of the Pennsylvania Safe Drinking Water Act (SDWA) requirements are the responsibility of the Senior Project Manager at the Stamford Administrative Office (SAO). Routine and comprehensive system or master planning studies that identify long term capital improvements for each of the local properties are the responsibility of the Project Manager at the SAO. The first of two recent studies conducted in May of 1990 concerned the expansion and modification of the HOME treatment plant. The second study conducted in March of 1992 concerned the construction of the BLUE filtration plants. In both cases, the local properties' engineering staff assisted in developing the planning documents by supplying data through field measurements, computer hydraulic program simulations, etc.

The HOME treatment plant study was conducted to compare the cost to expand the existing treatment plant versus the cost to construct a new plant at a different location. The results of the study indicate that expansion of the existing plant is the most cost effective alternative. Expansion of the plant is scheduled to be conducted in phases as warranted by system demand. The first planned expansion will increase plant capacity to meet system demands until the year 2005.

The study conducted for BLUE evaluated four alternatives in order to comply with the Surface Water Treatment Rule of the Pennsylvania SDWA. The four alternatives are:

- construct a filtration system to treat surface water
- connect to another water supply system
- construct groundwater facilities as the source of supply
- any other alternative not using an unfiltered surface water source

Based on technical feasibility and total cost, the study recommended that filtration systems be constructed for the Stoney Garden and Pen Argyl sources at BLUE.

Short term planning within the next budget year will be conducted by the local properties' engineering and management staff with approval received from SAO. Items of this nature would include distribution system mapping, water purchase agreements, main replacements, pump replacements, etc.

Findings and Conclusions

Our examination of the system planning function for the local properties included a review of assigned responsibilities, system planning tools, policies and procedures, etc. We found these areas satisfactory except as follows:

1. System planning studies are not conducted for the local properties on a routine basis.

As a result of the SDWA regulations, planning studies were conducted in May of 1990 for the expansion and modification of the HOME filtration plant and in March of 1992 for the construction of the BLUE filtration plant. No planning study documents are available prior to the 1990 and 1992 studies. Furthermore, no planning studies exist for the other local properties and none are scheduled to be conducted in the near future.

The local properties should have a comprehensive system planning study which identifies both short and long term engineering projects and acts as a road map to follow in operating, upgrading, and maintaining the distribution systems. It should also include supply and demand forecasts which recognize variances among different geographic and demographic regions within a service territory. The projects identified in the system planning study should be prioritized to ensure that the most critical or cost effective projects are completed first and are included in the budget. The prioritization process should be based on the necessity and relative benefit of the project to the distribution system and not solely on available budget funds.

While the responsibility to initiate and conduct all system planning studies clearly rests with the CUC engineering staff, it remains unclear why these studies have not been conducted on a routine basis for the local properties. By conducting such studies on a routine basis, management would be better able to accurately predict the timing of system improvements in relation to financial funding, regulatory requirements, capacity needs, etc., thereby establishing a foundation for current decisions affecting future projects.

2. The local properties have not adopted a formalized long-term main replacement program.

Main replacements are currently scheduled on a case-by-case basis at the discretion of the local properties respective

Superintendent. These informal reviews are conducted during the annual capital budget process in which main failure reports and customer complaint logs are utilized in the decision-making process.

A long-term main replacement program should be incorporated into the recommended system planning studies (see Finding & Conclusion #1 in this section) and the local properties' proposed five-year capital budget. This program would identify and prioritize affected mains based on the following criteria:

- historical repair costs
- number of service interruptions
- water quality problems
- number of customers affected
- age and condition of mains
- current vs. future planned capacity

Due to the current one-year budgeting process imposed by CUC, long-term planning has been conducted on a limited basis which inhibits the development and utilization of such tools as a long-term main replacement program.

The introduction of a formalized program would provide a systematic and logical approach to budgeting and planning main replacements on a long-term basis, thus ensuring system reliability as water mains age.

Recommendations

1. Conduct and document system planning studies on a routine basis for the local properties.

2. Develop and implement a formalized long-term main replacement program.

B. ENGINEERING AND CONSTRUCTION

Background

Currently, the Engineering and Construction department is in transition with the recent hiring of the Manager Engineering and Construction, who is a professionally licensed engineer, in October of 1991. The Manager Engineering and Construction has yet to assume all of the position responsibilities due to project management responsibilities for the design and construction of the filtration systems at BLUE and HOME. Prior to the inception of this position, the Manager Operations was responsible for both engineering and construction, and distribution functions.

The Manager Engineering and Construction, who reports directly to the General Manager, PA Operating Companies, has a support staff consisting of two engineers. Additional support can also be obtained from the CUC engineering staff for matters that require technical expertise. The responsibilities of the local properties' Engineering and Construction department are to inspect construction projects to assure design and contract compliance, assist property superintendents on various water system projects and designs, evaluate distribution systems using computer hydraulic modeling programs, develop master plans for expansion and/or replacement of plant in service, design and implement construction standards, provide input into the annual construction budget, and coordinate consulting engineering service. Because of the extraordinary growth and potential for continued growth, a staff engineer is permanently assigned to HOME. All other department personnel are located at PENN and dedicate their time to the remaining local properties.

New mains and service lines are installed utilizing contractors with projects awarded on a lump sum competitive bid process. For developer funded line extension agreements, the developer is required to furnish all materials and supplies based on engineering department specifications. Annual contractor labor and equipment rate schedules are maintained for each of the respective local properties. These schedules are utilized to acquire contractor labor and/or equipment for emergency repair work as well as scaled down projects such as minor main replacements, fire hydrant installations, etc.

Major construction activities in the recent past or near future throughout the local properties include the design and construction of filtration systems at BLUE, treatment plant upgrade at HOME, Second Avenue and Mennonite Road booster station construction at HOME, and air stripping towers at PENN.

Findings and Conclusions

Our examination of the engineering and construction function included a review of assigned responsibilities, policies and procedures, contractor usage, project scheduling, etc. We found these areas to be satisfactory except as follows:

1. A cost comparison study has not been conducted that evaluates the utilization of contractor versus in-house crews at HOME and PENN.

Currently, contractors are primarily utilized for main extension and replacement projects in addition to providing support equipment for main repair and service line installation work without conducting cost comparison studies. Based on internally projected forecasts, customer growth at HOME and PENN is expected to increase 74% and 34%, respectively, over the period 1991 to 1995. Steady long-term growth and the probable corresponding increase in contractor usage are factors that support the basis for performing cost comparison studies.

A cost comparison study should be conducted that evaluates the cost of crews, supervision, tools, equipment and training for contractor versus in-house crews. The study should identify and compare only those costs to perform continuously available work with contractor usage reserved for peak workload conditions.

Management contends that current contractor usage practices are cost effective based on an informal review.

However, without conducting a cost comparison study, management cannot adequately support their contention and may not be operating in the most cost effective manner.

2. Post construction follow-up reviews and analyses of project variances are not documented by the local property engineers.

The staff engineers located at PENN and HOME are currently responsible for developing estimates for in-house projects. In developing an estimate, the engineers utilize data from the most recently completed developer and in-house projects to serve as a basis for determining current labor and material unit costs. During the construction phase, informal reviews of the projects are conducted between the Superintendents and the Engineers to report any unusual occurrences that may affect the scheduled completion or overall cost of a particular project. Management has stated that projects with reported variances based on an informal variance limit policy of ± 10% are reviewed to determine causal factors. But during the course of our field work, budget to actual history detail with a variance analysis could not be provided for in-house projects.

As part of the project estimating process, project costs exceeding the estimate should be investigated as established by a variance limit policy (for example ± 10 percent) to determine causal factors which can be identified as either controllable or non-controllable factors.

Because a formal limit policy has not been established, the engineers are not held accountable for internally developed project estimates.

Without specifically identifying and documenting causal factors as either controllable or non-controllable, management limits their ability to analyze and trend variances on a historical basis and therefore lacks the information to take corrective action with regard to estimating units and/or operating practices.

Recommendations

1. Conduct a periodic cost comparison study that evaluates the utilization of contractors versus in-house crews at HOME and PENN.

2. Enhance the project estimating process for in-house projects by establishing a formal variance limit policy and conducting post-construction follow-up reviews to analyze project variances.

C. SOURCE OF SUPPLY

Background

The sources of supply and production yields for each of the respective local properties for 1990 are listed below.

BLUE:

Surface Water Supplies
- Ross Common Stream
- Pen Argyl Stream
- Cherry Valley Stream
- Stoney Garden Reservoir (capacity 12 MG)

Groundwater Supplies	Yield(gpd)
• Ross Common Well 1A	432,000
• Ross Common Well 2	360,000
• Ross Common Well 3	259,000
• Ross Common Well 4	331,000
• Ross Common Well 5	432,000
• Ross Common Well 6	374,000
• Douglassville Well	720,000
• Dietz Well	245,000

The Stoney Garden Reservoir located at the headwaters of the Ross Common Stream is the primary source of supply for the BLUE distribution system. During periods of low stream flow, the Cherry Valley stream and groundwater wells provide additional capacity. Under the DER water allocation permit, BLUE may withdraw a maximum total of 3.0 million gallons (MG) per day from the Cherry Valley, Stoney Garden and Pen Argyl stream sources.

BLUE owns approximately 3,900 acres of watershed land in its service territory, the majority of which is forested. Annual inspections of the watershed are conducted in order to monitor for any potential source contamination and unauthorized personnel.

HOME:

Surface Water Supplies
- Schuylkill River

Groundwater Supplies	Yield(gpd)
• Well 1	216,000
• Well 3	305,000
• Well 4	578,000
• Well EP-1	32,000

The primary source of supply for HOME is the Schuylkill River with a maximum allowable withdraw rate of 2.0 MG per day. Groundwater wells are utilized to supplement the surface water supply as system demand requires. As a result of the tremendous growth experienced in the service territory over the past several years, the Company has been forced to purchase water from surrounding systems in greater quantities. From 1987 to 1991 the quantity of purchased water increased at a compound annual growth rate of 48%. In an effort to reduce this level as well as meet future system demand, the Company has applied for an additional 3.0 MGD withdraw permit to coincide with the planned treatment plant capacity upgrade. Also, a second plant operator shift has been added to increase daily production. With the implementation of these measures, the Company has targeted a sixty percent reduction for purchased water in 1993.

PENN:

Groundwater Supplies	Yield(gpd)
• Well 2	237,000
• Well 11	158,000
• Well 12	540,000
• Well 13	309,000
• Well 16	454,000
• Well 17A	576,000
• Well 18A	583,000
• Well 19	590,000
• Well 20	576,000
• Well 21	468,000
• Well 23	360,000

Since 1990, the Company has been required to purchase water because of contaminated groundwater from Well #'s 17A and 19. Currently the Company is constructing air stripping towers to remove the contaminants and restore the wells to service.

GLEN:

Groundwater Supplies	Yield(gpd)
• Glen Alsace Well 1	60,000
• Glen Alsace Well 2	79,000
• Glen Alsace Well 3	capped
• Glen Alsace Well 4	68,000
• Glen Alsace Well 5	90,000
• Glen Alsace Well 6	52,000
• Glen Alsace Well 7	120,000
• Glen Alsace Well 8	450,000
• Glen Alsace Well 9	750,000
• Linstead Well 1	43,000
• Linstead Well 2	500,000
• Exeter Artesian Well 1	0
• Exeter Artesian Well 2	51,000

• Exeter Artesian Well 3	830
• Exeter Artesian Well 4	3,600
• Exeter Artesian Well 5	830
• Exeter Artesian Well 6	23,500

Three groundwater sources currently under evaluation may be surface influenced and therefore require filtration or abandonment pending a decision by the Pennsylvania Department of Environmental Resources.

LAKE:

Groundwater Supplies	Yield(gpd)
• Well 1	180,000
• Well 2A	180,000

Finding and Conclusion

Our examination of the Source of Supply functional area included a review of assigned responsibilities, policies and procedures, contingency plans, regulatory compliance, purchased water agreements, etc. We found these areas to be satisfactory except as follows:

1. A fire protection plan has not been developed for the BLUE watershed.

The 3,900 acre property-owned portion of the watershed surrounding the Stoney Garden reservoir is primarily forested land which is not covered by a fire protection plan. Several access roads have been constructed in order for property personnel to gain entry into the area to conduct daily operations rather than to serve as fire trails for fire protection.

A fire protection plan should consist of maps and charts, equipment and manpower availability, and the steps to be taken should a fire start. Additional planning should include:

- measures to either reduce or eliminate hazardous fuels on the watershed
- maintenance of firebreaks and access roads throughout the watershed that would aid in the suppression of fires
- maintenance of a Company trained contingency crew equipped to respond, control and extinguish small fires
- coordination with state agencies (Bureau of Forestry) and local fire departments for large fires

Property management maintains that discussions with local fire departments have been conducted with regard to providing fire suppression support in the event of any fire outbreaks in the watershed property. Although discussions of this type are essential to developing a fire protection plan, additional steps as outlined above need to be addressed in the planning process.

While historical records reflect a low fire incident rate for Northhampton County (9 fires from 1989-1992) and the watershed property (1 fire on record), a potential risk is present due to the mixed oak forest stand indigenous to the area, and the Appalachian trail that is in close proximity to the watershed. Detrimental effects of a large scale fire that could impact the watershed include damage to the timber stand, lower vegetation, forest microclimate and soil leading to potential problems regarding tree and plant regeneration and raw water quality.

Recommendation

1. Develop a fire protection plan for the BLUE watershed. The extent of the plan should be influenced by the known fire danger rating for the area, the commitment of outside sources, and the accessibility of the watershed area, as well as a cost/benefit analysis of implementation.

D. PUMPING, PURIFICATION AND STORAGE

Background

In this section, we discuss the production and storage of the finished water at each of the respective local property distribution systems.

BLUE:

The Stoney Garden Reservoir with a 12 MG capacity collects and impounds the runoff from the 3,900 acre watershed behind the Stoney Garden Dam. The reservoir, which is the highest point in the system, delivers water by gravity to all service areas. Two transmission mains, 10 and 14 inches, interconnect the reservoir to the chlorination building. A single 20-inch main extends from here to an adjoining building where a venturi meter and the lime feed equipment are located. From this point, the finished water enters the distribution system through one 12-inch main, two 10-inch mains and one 8-inch main.

The Ross Common Wells are located in close proximity to Ross Common Creek which is southwest of Stoney Garden Dam. The water which is chlorinated at each of the well houses is collected at the Ross Common Reservoir which has a capacity of 1.3 MG. The finished water is then boosted by a 1,000 gallon per minute pump to the distribution system.

The Pen Argyl Reservoir with a 1.3 MG capacity collects water from the Pen Argyl stream which originates from springs on the southern slope of Blue Mountain. Before entering the reservoir water passes through a slow sand filtration system where chlorine and lime are added to the effluent. Due to the condition and age of the open reservoir, management plans to construct storage tanks in 1993 to replace the existing reservoir.

The Nazareth Reservoir is an open finished water reservoir with a capacity of 1.3 MG supplied by the Stoney Garden Reservoir through transmission mains. Additional supply is available from the Douglassville Well if required. Because of the relatively good condition of this reservoir, management intends to construct a cover for the reservoir in order to meet Pennsylvania DER regulatory requirements.

Chapter 109 of the Pennsylvania SDWA requires that all surface water and surface water influenced sources be filtered by year-end 1995. Accordingly, plans for the design and construction of filtration systems at BLUE are under development. A conventional system will be constructed to filtrate the Stoney Garden Reservoir and Ross Common Well water supplies. Because the well water supplies via the Ross Common Reservoir are surface water influenced

and enter the system at the chlorination building below the Stoney Garden Reservoir, the water supply can no longer be considered as part of the finished water storage supply. Therefore, storage tanks must be constructed downstream of the filter plant to hold finished water. The slow sand filtration system currently used at Pen Argyl does not meet DER standards for treating surface water; therefore, the Company tentatively plans to use diatomaceous earth (DE) filters to treat the Pen Argyl supply.

HOME:

Two low lift pumps with a combined capacity of 3.7 mgd draw water from the Schuylkill River. At this point, alum and occasionally clay are added to induce the coagulation process. Other additives include potassium permanganate for the removal of iron and unpleasant tastes/odors as well as chlorine for disinfection. Raw water turbidity is checked manually with chemical dosing adjusted accordingly.

Water entering the filter plant is received into two flocculation basins each with a mechanical mixer. Just prior to entering the flocculation basins, lime is injected to further aid the coagulation process. The total detention time is approximately 20 minutes at a flow rate of 2.0 mgd.

The water then flows into settling tanks where the coagulated matter settles to the bottom. The accumulated sludge is removed periodically by a contractor and disposed of at one of several approved wastewater treatment plants in the area.

From the settling tanks, water passes through four multi-media filters having a rated capacity of 2.0 mgd. Filter backwash rates are approximately every 50 hours under current operating conditions. The finished water from each of the filters is monitored for turbidity levels and discharged into a clearwell for distribution to the open reservoir.

In order to comply with DER regulations, storage tanks will be constructed to replace the existing 1.3 MG open reservoir as part of the overall plant expansion and upgrade. Other improvements include expanding the capacity of the flocculation/sedimentation units to increase maximum daily production from 2.0 mgd to 3.4 mgd.

The responsibility to operate and maintain the filter plant rests with two full-time operators who perform the required analysis and testing of water samples.

PENN, GLEN, LAKE:

Each of these local properties are supplied entirely by groundwater wells which are chlorinated and treated with a chemical

compound referred to as Shan-no-corr for anti-corrosion purposes. Water is pumped based on system demand and directed to storage tanks to maintain adequate water supplies and pressures.

Findings and Conclusions

Our examination of the pumping, purification and storage facilities at the local properties included a review of water storage capacities, filter processes, assigned personnel, regulatory requirements, etc. We found these areas to be satisfactory except as follows:

1. A power cost study has not been conducted for each of the local properties.

In order to assess present pumping conditions versus the original design, a power cost study was conducted at HOME in 1992 which identified capital improvements that would result in a power cost savings of $68,000 per year with a payback period of two and one-half years. A second study has been targeted for PENN in 1993, but studies for the remaining properties have not been conducted or scheduled.

The power cost study analyzes methods to reduce costs associated with pumping. Each pumping facility is evaluated with respect to pumping capacity, total dynamic head (TDH) and current field data in order to recommend any capital improvements (replace oversized pumps, line voltage limiters, power factor controllers, etc.) that would increase overall pump efficiencies. Additional issues that would be addressed in the study are electric curtailment agreements and off-peak pumping arrangements that may represent other cost saving opportunities.

Management recognizes the need and intends to conduct studies for the remaining local properties but, as of our field work, had not developed a schedule for completion. By conducting studies in a timely manner, cost saving opportunities as evidenced by the HOME study may be implemented with expedience thereby reducing operating expenses.

2. Adequate planning has not been undertaken with regard to filter plant operator certification training.

Currently, two filter plant operators are assigned to the filtration plant at HOME under the supervision of the Service Supervisor who presently is the only certified filter plant operator for the local properties. A filter plant operator has been budgeted for both BLUE and GLEN in 1993 and 1994, respectively, as well as a third shift operator for HOME in 1995. To date, planning has not been formally conducted to address training for certification.

Chapter 109, section 704 of the Safe Drinking Water Rules and Regulations issued by the Pennsylvania Department of Environmental Resources (DER) states:

> "Community water systems, except bottled water and bulk water hauling systems, shall have personnel certified under the Sewage Treatment Plant and Waterworks Operators' Certification Act and qualified by experience and education to operate and maintain a public water system."

In view of the planned construction of filtration plants at both BLUE and GLEN in the near future, management should develop action plans that outline and quantify specific training objectives within a designated timeframe.

Management has stated that the distant location and length of the certification training programs have effectively precluded the operators from attending these programs and thus obtaining certification. However, through early planning, management would have the necessary lead time required to budget resources to conduct either in-house training certification, schedule correspondence course certification or hire experienced operators with the desired certification.

Recommendations

1. Conduct power cost studies for the remaining local properties.

2. Develop action plans to train current and future filter plant operators for required certification.

E. DISTRIBUTION

Background

In this section, we discuss the distribution function organization and responsibilities for each of the local properties.

BLUE:

The Superintendent, who reports directly to the Operations Manager, has a support staff consisting of a Service Supervisor, five Servicemen, an Assistant Maintenance person and a Plant Operator. Functional responsibilities of distribution include plant construction, preventive and general maintenance, system water quality treatment and monitoring, leak detection, meter reading and customer service work.

Responsibilities of the Superintendent include daily supervision of operations, investigation and response to customer inquiries regarding service and construction, inspection of construction projects, preparation and submission of periodic management and regulatory reports and overall responsibility for the productive operation of the local property.

The Service Supervisor, who reports daily to the Superintendent, provides direct supervision over the Assistant Maintenance person and Servicemen. Responsibilities of this position include inventory control of materials and supplies, daily inspection of contractor crews, investigation and response to customer inquiries regarding quality of product or service, providing on-going safety and skills training programs and scheduling daily field work assignments for the servicemen.

Responsibilities of the Assistant Maintenance person include performing maintenance on pumps, wells, basins and reservoirs. Other distribution maintenance duties include facility repairs/ replacements, system flushing, leak surveys and maintaining chemical feed equipment. Additionally, in the absence of the Service Supervisor, the Assistant Maintenance person would assume responsibilities of this position.

The Servicemen, who work independently or in crews depending on the assigned task, are responsible for the installation of water meters, fire hydrants, service lines, and the maintenance and repair of water mains using contractor equipment. Other duties may include meter reading and customer service related field work.

The Plant Operator reports directly to the Superintendent and is responsible for the operation, maintenance and repair of the water treatment plant facilities. Additional duties include performing the required analysis and testing of water samples,

monitoring river conditions and maintaining accurate logs regarding testing and operations.

The distribution system consists of a gravity feed and boosted pressure network. Facilities within the system consist of three booster stations, eight well houses, and three finished water reservoirs.

HOME:

The distribution function's organizational structure at HOME consists of a Superintendent with a support staff that includes a Service Supervisor, three Servicemen and two Filter Plant Operators. Functional and positional responsibilities as outlined in the preceding discussion for BLUE are similar for HOME except as noted below.

Because the Service Supervisor is a certified filter plant operator, responsibilities of this position extend to providing daily oversight for the unlicensed filter plant operators. Unlike the slow sand filtration system currently in use at BLUE, the conventional filtration system at HOME requires at least the supervision of a certified filter plant operator according to Department of Environmental Resources regulations.

HOME'S distribution system is primarily a repumped network which consists of four booster stations, four well houses, one finished water reservoir and six storage tanks.

PENN, GLEN, LAKE:

Due to service territory proximities, the distribution function was structured to operate and maintain PENN, GLEN and LAKE. The Superintendent with a support staff of two Service Supervisors is responsible for the overall operation of all three local properties. Of the two Service Supervisors, one is responsible for PENN and LAKE and has a support staff consisting of four Servicemen and an Assistant Maintenance person. The other Service Supervisor is responsible for GLEN and has a support staff of three Servicemen. Functional and positional responsibilities are similar to those outlined in preceding discussions of BLUE and HOME.

The distribution system for each of the three properties are repumped networks and consist of the following:

PENN

- 3 booster stations
- 11 well houses
- 6 storage tanks

GLEN

- 3 booster stations
- 17 well houses
- 6 storage tanks

LAKE

- 2 well houses
- 1 storage tank

Findings and Conclusions

Our review of the Distribution function included a review of assigned responsibilities, policies and procedures, preventive maintenance practices, expense trends, unaccounted-for-water, contractor utilization, etc. We found these areas to be satisfactory except as follows:

1. A comprehensive cross-connection control program has not been established for the local properties.

Under Chapter 109.709 of the Safe Drinking Water Rules and Regulations issued by the Pennsylvania Department of Environmental Resources, the customer is responsible for eliminating cross-connections or providing backflow devices to prevent contamination of the distribution system from both back siphonage and backpressure. Further, the local properties' tariffs state:

> "that an approved check-valve shall be installed by residential customers for new and replacement service lines, and backflow prevention devices shall be installed by all commercial and industrial customers."

However, as shown in Exhibit IVE-1, the number of check valves or backflow prevention devices installed by customers of each respective local property illustrates a need to commit greater resources to achieve compliance with regulatory and tariff requirements.

The local properties should have a cross-connection control program which addresses the following:

- description of the methods and procedures to be used
- implementation schedule
- annual re-inspection of previously installed backflow prevention devices for commercial and industrial customers
- public education program for residential customers
- description of the methods and devices which will be used to protect the water system
- provisions for discontinuance of water service, after reasonable notice, to any premises where devices have not been installed.

CITIZENS UTILITIES WATER COMPANIES
BACKFLOW PREVENTION DEVICE INSTALLATIONS

Local Property	Residential Check Valves		Backflow Prevention Devices			
			Commercial		Industrial	
	Service lines*	Installed**	Service lines*	Installed**	Service lines*	Installed**
BLUE	6377	30	423	96	112	17
PENN	7307	NA	278	NA	33	NA
HOME	4315	158	191	59	45	8
GLEN	3627	NA	93	NA	3	NA
LAKE	555	NA	4	NA	0	NA

* Service line count as of 12/91
** Installation count as of 9/92

N/A = not available

Source: Company data, auditor analysis

Exhibit IVE-1

Program development and administration should be a centralized function at PENN for all of the local properties. Installation of backflow prevention devices should be prioritized based on such criteria as industrial users, high hazard risk, low pressure areas, and line size.

Management contends that current regulations do not provide the enforcement powers necessary to effectively implement a cross-connection control program. However, Chapter 109 regulations state that "if the customer fails to comply within a reasonable period of time to fulfill the Company's request, the water supplier shall terminate service after reasonable notice has been given to the customer."

Implementation of a cross-connection control program would allow management to enforce the local properties' tariffs and minimize any threat of contamination of the potable water supply especially from high risk users such as industrial customers.

2. A cost/benefit analysis was not conducted prior to the purchase of the Supervisory Control and Data Acquisition (SCADA) system for HOME.

With expansion of the HOME service territory and the distances involved between production facilities, management targeted HOME for implementation of a SCADA system in the Spring of 1993 at a cost of approximately $120,000. This system would be used to remotely monitor facilities throughout the service territory and alert plant operators to impending or incurred system failures thus reducing the manpower necessary in order to physically inspect each production facility. The only analysis conducted by management prior to the purchase in May of 1991 was a cost comparison study that evaluated four different SCADA system equipment manufacturers. Evaluative criteria utilized in the decision making process were hardware quality and integrity, software user friendliness, and customer service support.

As part of the planning process, a cost/benefit analysis should be conducted in order to support decisions concerning capital intensive projects. The study should attempt to quantify the man-hour savings, the productivity efficiency gains, workload factors, total project costs, the associated cost savings, expected payback period, etc,.

Because the SCADA system offers obvious manhour savings through the elimination of overtime, reduction in travel time and remote system monitoring, management believed that a SCADA system purchase was adequately justified. However, without a detailed analysis of the project costs and benefits, HOME may be implementing an automated operations system which is not cost effective.

3. Workforce management techniques and practices are not formally employed by the local properties.

As part of their responsibility, local property management personnel assign, schedule, and evaluate field work personnel by reviewing time sheets and comparing those reported times against informal standards. The informal standards are based on the experience of the Superintendent and/or Service Supervisor and may vary slightly among the local properties.

Development of simple time standards, a fundamental workforce management technique based on historical data, should be undertaken and utilized by the local properties for highly repetitive and routine tasks in order to measure and track individual performance. On a broader scale, distribution workload should be tracked and measured with respect to the following items:

- service line installations
- service line repairs
- service line disconnects or removals
- meter sets, exchanges, removals, leaks, tests, repairs
- backflow prevention device installations, repairs, inspections
- fire hydrant inspections, repairs, flushes
- valve and box inspections, repairs
- facility locates for contractors

Due to the relatively small size of each local property workforce and the extensive use of contractors, management feels that adequate control is maintained over the workforce.

By tracking individual and crew performance based on simple productivity standards, a historical database would be created to enhance the informal manpower planning process, make comparisons among the local properties, identify and correct potential deficiencies, and improve overall efficiency.

4. Operations and Maintenance (O&M) manuals have not been developed for the local properties.

Currently, operating practices and/or maintenance schedules are conducted at the discretion of the respective local property Superintendents with some variations based on the unique

characteristics of the respective properties rather than propagated from a detailed operations and maintenance manual.

At a minimum, the O&M manual should include the following:

- standardized operating practices
- prescribed maintenance tasks
- respective schedules to accomplish the designated tasks

Furthermore, the O&M manual should contain manufacturer design specifications and drawings for filter plant valve operations, flow metering devices, turbidity meters, pumps, communication equipment, etc.

The Manager Operations has acknowledged the need to develop O&M manuals for each of the local properties which is reflected in the 1993 Individual Goals and Objectives for this position. By developing the O&M manuals, management will provide the necessary reference documents to promote greater efficiency by establishing uniform operating practices where applicable. Thus standardizing practices will improve management's ability to budget manpower and resources accordingly.

5. Management failed to conduct a manpower planning analysis for the additional staff budgeted for GLEN and HOME.

The 1993 local properties' business plan indicates that an additional serviceman is budgeted for GLEN in 1993 and HOME in 1994. Currently, one of the Serviceman positions at GLEN spends approximately 40% of total available time in the metershop. Due to a projected increase in meter testing and repair workload, this position will be dedicated entirely to the meter shop. This, in addition to customer growth, will necessitate an additional serviceman. The Serviceman at HOME is budgeted for 1994 based on projected customer growth of 350 to 400 new customers per year.

Personnel increases for production oriented positions such as servicemen should be demonstrated through a manpower planning analysis. The analysis should quantify present and projected workload in terms of manhours and how additional staffing would impact the workload.

Because management does not track the data necessary to develop a manpower planning analysis (see: Finding and Conclusion #3), the need to increase servicemen staffing levels must be based on broad parameters such as annual customer growth.

Without conducting a manpower planning analysis, management lacks the ability to properly demonstrate that additional servicemen will be gainfully employed.

6. Outside contractor services for LAKE are not obtained through a competitive bid process.

Because of the small service area and the distance from PENN, a contractor is used to operate and maintain the distribution system with overall direction provided by management. From 1983 to mid-1991, the Company renewed the contract annually with the same contractor without soliciting competitive bids. Midway through 1991, a new contractor was awarded a one year contract again without obtaining competitive bids.

Prior to awarding contracts for engineering and construction services, management should seek competitive bids or quotes from at least three contractors.

For the most recent agreement, management stated that an informal review of several contractors was conducted. Based on this review, management felt that adequate measures were taken in selecting the most economical contractor. However, without actively seeking competitive rates prior to contract renewal time, management cannot be assured that services are being purchased at the most competitive rate.

Recommendations

1. Develop and implement a cross-connection control program for the local properties.

2. Conduct a post implementation cost/benefit analysis of the SCADA system at HOME. Prior to future implementation of SCADA systems at the remaining local properties conduct a cost/benefit analysis as part of the planning process.

3. Create a more formal Workforce Management system that consists of simple time standards, distribution workload activity logs, etc.

4. Develop an O&M manual for the individual local properties.

5. Conduct a manpower planning analysis for the additional servicemen budgeted for GLEN in 1993, and HOME in 1994.

6. Obtain contractor services for LAKE through a competitive bid process prior to renewal of the annual contract.

CITIZENS UTILITIES WATER COMPANY OF PENNSYLVANIA

MANAGEMENT EFFICIENCY INVESTIGATION EVALUATING THE IMPLEMENTATION OF SELECTED RECOMMENDATIONS IN THE AREAS OF COMPANY MANAGEMENT, OPERATIONS, FINANCIAL OPERATIONS, ADMINISTRATIVE AND SUPPORT FUNCTIONS, AND OTHER SPECIFIC ISSUES

PREPARED BY THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION
BUREAU OF AUDITS
MANAGEMENT AUDIT DIVISION

ISSUED DECEMBER 1997

CITIZENS UTILITIES WATER COMPANY OF PENNSYLVANIA

MANAGEMENT EFFICIENCY INVESTIGATION

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IV. OPERATIONS

A. SYSTEM PLANNING

PRIOR RECOMMENDATION - Conduct and document system planning studies on a routine basis for the local properties.

PRIOR SITUATION - The responsibility of the system planning function for the former Pennsylvania local properties (now referred to as service districts) was shared between the engineering staff at Wyomissing, and the Senior Project Manager at the Stamford Administrative Office (SAO). The Audit Staff found that only two engineering studies existed which identified long term capital improvements for each of the properties The first of these studies was conducted in May of 1990 to compare the cost of expanding the existing HOME treatment plant versus constructing a new plant at a different location. The second study, in March of 1992, was a feasibility study which eventually lead to the construction of the Stony Garden and Pen Argyl filtration plants. No additional studies were expected for the other local properties subsequent to the management Audit.

FOLLOW-UP FINDING AND CONCLUSION NO. 2 - **The Company has prepared a number of engineering studies and maintained a revolving three-year capital budgeting process; however, there is no document which consolidates the Company's long-term system planning process.**

The system planning function remains the shared responsibility of both SAO and CWC's engineering staff. Since the June 1994 Management Audit, the Company has continued to update its library of engineering studies which document their efforts to identify and investigate potential opportunities in each district. In addition, a revolving three-year plan is used by the Manager of Engineering and Construction to anticipate opportunities and make preparations for their development. All projects relating to a particular opportunity are reflected in the Company's annual capital budget, which is approved by SAO. Each of these projects are then managed by CWC's engineering staff.

Although the Company possesses several elements of a system plan, they are not consolidated into one formal document for system planning and regulatory purposes. An ideal system plan should contain the following information:

- prioritized short (less than five years), intermediate (5-10 years), and long (over 10 years) range goals and objectives;
- demand forecasts and facilities planning reports; and

- approved and estimated capital budgets

As CWC's customer base grows, more long-term planning steps will be required to identify and address the demands of their system. A prioritized long-term system plan would provide the Company with a better means of preparing for tomorrow's challenges, especially in areas such as: main replacement, utilizing new water sources, acquiring existing systems, and constructing plant facilities. It would also facilitate a timely identification of long range funding needs.

STAFF'S RECOMMENDATION - Develop and maintain a prioritized, long-term system plan.

B. ENGINEERING AND CONSTRUCTION

PRIOR RECOMMENDATION - Enhance the project estimating process for in-house projects by establishing a formal variance limit policy and conducting post-construction follow-up reviews to analyze project variances.

PRIOR SITUATION - The Company's staff engineers and district Superintendents developed estimates for all Company-funded capital projects. They performed this function by utilizing data from previously completed projects to calculate labor and material cost estimates. During the construction phase, the Staff engineers, Superintendents, and the Manager of Engineering and Construction conducted informal project reviews on those variances which had an affect on the scheduled completion date and on cost overruns. CWC claimed to have an informal project variance policy (±10%) requiring identification of causal factors. However, the Company could not provide the Audit Staff with any documented budget variance information. In addition, the Company did not perform post-construction follow-up reviews.

FOLLOW-UP FINDING AND CONCLUSION NO. 3 - **The Company established a formal variance policy along with post-construction follow-up review procedures to track and enhance its estimating process for Company-funded capital projects.**

CWC's combined 1995 and 1996 completed capital projects had an overall variance of 14.7%. In December 1996, the Company established a formal budget variance policy for individual capital project variances greater than 10% or $20,000.

Also in December 1996, the Manager of Budgeting and Accounting began providing each Work Order Requestor with a monthly construction report which includes summary information of SAO and CWC costs for each of the capital projects in progress. Using this report, the Work Order Requestor then reviews the projects which exceed the variance policy's threshold of either 10% or $20,000 to identify causal factors.

The Manager of Engineering and Construction receives written explanations for all variances which exceed the policy. Some of the more common causal factors attributing to CWC's variances are:

- the pre-set 7% of material costs standard for engineering and inspection services; and
- material and supply additions and/or changes.

The Company's engineering staff has observed that the standard estimate of 7% of material cost for engineering and inspection services is less than the appropriate amount for projects with little material costs. For example, a project with $500 of material costs would provide only a budget of $35 for engineering and inspection work. The Audit Staff believes this standard could be affecting larger projects as well, which may be causing unnecessary budget variances.

Since CWC has only recently (December 1996) developed a formal budget variance policy and reports for monitoring budgets, improvement to the capital projects budgeting process has just begun. Management should continue to identify and document any causal factors that may create a large dollar variance in subsequent budgets. Such practices will provide better estimates for future capital budgets and enable the Company to control construction costs more effectively.

STAFF'S RECOMMENDATION - Continue to identify and document the causal variance factors in the capital budgeting process.

C. SOURCE OF SUPPLY

PRIOR RECOMMENDATION - Develop a fire protection plan for the BLUE watershed. The extent of the plan should be influenced by the known fire danger rating for the area, the commitment of outside sources, and the accessibility of the watershed area, as well as a cost/benefit analysis of implementation.

PRIOR SITUATION - The Company's BLUE service district had 3,900 acres of forest land which was never covered by a fire protection plan. This included both the Stony Garden and Pen Argyl Reservoir watershed areas. The Audit Staff found that nine forest fires occurred between 1989 and 1992 in Northampton County, and one was on BLUE's property. The Audit Staff concluded that these fires and the presence of the Appalachian Trail through BLUE's property possessed a potential risk to CWC. In particular, the Audit Staff was concerned that damage to the timber stand, lower vegetation, forest microclimate, and soil could negatively affect raw water quality at both reservoir sites.

FOLLOW-UP FINDING AND CONCLUSION NO. 4 - The Company has not completed a fire protection plan for the forested property which surrounds the Stony Garden and Pen Argyl Reservoirs.

Since the June 1994 Management Audit, CWC has been slow to develop a fire protection plan for its Stony Garden and Pen Argyl facilities. Originally, during the early stages of its field work, the Audit Staff was informed that it was management's intent to delay work on such a plan until after Pennsylvania Emergency Management Agency (PEMA) or the Monroe County Emergency Management (MCEM) had developed their plans. However, later on, the Audit Staff discovered that BLUE's Superintendent had prepared a draft fire protection plan for the Stony Garden facilities in anticipation of receiving a reference guide developed by the Pennsylvania Department of Conservation and Natural Resources (DCNR), PEMA and the Office of the State Fire Commissioner. This document provides property owners with guidelines for developing a fire protection plan.

Aware of some the criteria in the reference guide, BLUE's Superintendent prepared a draft plan which:

- designates an individual to coordinate fire protection efforts with key agencies and local fire departments;
- establishes a Fire Plan Descriptive Map to provide a means of locating and tracking fires in the Stony Garden area, as well as identifying all available access roads to engage a fire; and

- outlines a Preparedness Plan which. (1) requires annual meetings with local fire departments to discuss, plan, and familiarize department personnel with facilities and the potential contamination of BLUE's water supply, (2) provides an "on-site" fire hydrant at a location approved by local fire department officials, and (3) familiarizes all BLUE employees with the plan, procedure, and method of coordinating a major fire event.

While this document is a good start, it does not address such areas as training and exercises, plan maintenance (i.e., updates), administration and logistics, potential hazard areas, or fire prevention, which are critical in a fire protection plan. Completion of the final plan should involve such participants as the local Emergency Management Coordinator, the Bureau of Forestry and local emergency services to insure that it is comprehensive and reliable.

STAFF'S RECOMMENDATION - Complete and periodically update a fire protection plan for the Stony Garden and Pen Argyl Reservoir watersheds, and facilities.

D. PUMPING, PURIFICATION, AND STORAGE

PRIOR RECOMMENDATION - Conduct power cost studies for the remaining local properties.

PRIOR SITUATION - In 1991, a study of the HOME water system was performed by the Company's engineering staff to identify capital improvements that eventually resulted in power cost savings at each of its facilities. Shortly afterwards, the Company made plans to conduct a similar study in 1993 at PENN that would achieve the same results. According to the previous Audit, management recognized the need for such studies, but at the time did not have a defined schedule for their completion.

FOLLOW-UP FINDING AND CONCLUSION NO. 5 - Although power cost studies have been conducted for the HOME, GLEN, and LAKE districts with some success, other studies and updates of prior studies are required.

CWC has continued its study of each service district's power costs. The Company has completed the following studies (see Table IV D-1) and realized annual savings of $22,942.

Table IV D-1
Completed Power Cost Studies
(as of April 30, 1997)

Power Cost Study	Date Completed	Projected Power Savings	Realized Power Savings
HOME*	September 1991	$56,225 / year	Not Calculated
GLEN	May 1993	$3,648 / year	$1,390 / year
GLEN (Douglasville)	January 1995	$19,980 / year	$21,552 / year
LAKE	October 1996	$2,760 / year	Not Calculated
HOME (Wells 1 & 3)	November 1996	$11,446 / year	Not Calculated

Source: Company Data (Data Request PS-1); Auditor Analysis
* Estimated a payback period of 2.5 years

In light of these savings, CWC's engineering staff plans to conduct a power cost study of BLUE in late 1997 and update the HOME district study. Also, a power cost study of PENN is planned for 1998. CWC is currently reviewing a proposal by a local engineering firm to

study PENN's No. 18 and 21 wells. If pleased with the results, the Company plans to outsource future power cost studies.

The Company should continue to update each study as changes occur, calculate the payback period which to-date has only been done for the HOME study, and attempt to quantify all savings realized. Along with the Company's existing power cost studies, the Audit Staff believes additional savings opportunities can be identified by reviewing heating and lighting costs at each facility. Such efforts will demonstrate CWC's efforts to provide the most cost-effective service to the ratepayer and the best available return to the stockholder.

STAFF'S RECOMMENDATION - **Conduct power cost studies for the remaining districts, identify estimated savings and the payback periods, and document actual savings realized.**

PRIOR RECOMMENDATION - Develop action plans to train current and future filter plant operators for required certification.

PRIOR SITUATION - The Audit Staff found that only the HOME Service Supervisor and the BLUE Superintendent had the correct certification to operate water treatment and filtration plants. A Water Treatment Filter Plant Operator's position had been budgeted for BLUE in 1993 and another one for HOME in 1995. However, the Audit Staff found that the Company did not formally plan for the training and certification of Water Treatment Plant Operators

FOLLOW-UP FINDING AND CONCLUSION NO. 6 - **Although training of the Water Treatment Plant Operators is now an ongoing process, the BLUE service district still does not have the proper complement of certified personnel.**

Since 1994, a number of CWC's Water Treatment Plant Operators attended training courses to qualify for the Waterworks Operator Certificate. As shown in Table IV D-2, several operators at HOME and BLUE have either acquired or upgraded their proficiency.

Table IV D-2
Certification of Plant Operators

District	Minimum Certification	Certifications as of April 1994	Certifications as of April 1997
HOME	B-1	A-1, C-1	A-1, A-1, A-1, C-1, D-1
BLUE	B-1	B-1, A-3, A-3, B-3	B-1, A-3, A-3, A-3, B-3

Source: Company Data (Data Request No. PS-2); Auditor Analysis

As stated in 25 PA Code § 305 regarding the number of operators required at a water treatment plant, "owners or purveyors of sewage treatment plants, water treatment plants and distribution systems shall have a minimum of two certified operators of the required classification." Therefore, based on a capacity of 3 7 and 3.2 million gallons per day for the HOME and BLUE filtration and treatment plants (see Table IV D-3), at least two operators with at least a B-1 Waterworks Operators Certificate are required at both districts.

Table IV D-3
Classes and Types of Water Treatment Plants for Regular Certificates
Classified by Authorized Plant Design Capacity (maximum level in gallons per day)

Classes	1 Plants Utilizing Filtration & Including Chemical Treatment	2 Plants Not Utilizing Filtration But With Chemical Treatment	3 Plants With Disinfection Only
A	Unlimited Capacity	Unlimited Capacity	Unlimited Capacity
B	5,000,000	10,000,000	10,000,000
C	1,000,000	5,000,000	5,000,000
D	Covers distribution systems only		

Source: 25 PA Code § 305, State Board for Certification of Sewage Treatment and Waterworks Operators

Since 1993, HOME has gained a total of three certified operators to handle its newly upgraded treatment and filtration plant. This more than meets the required levels for the plant's daily operations and provides better coverage in the event that one or two of its operators are unavailable.

However, at BLUE, only the District Superintendent is presently certified to operate the treatment and filtration facilities at Stony Garden and Pen Argyl. The Company expects that one of its plant operators will receive a B-1 certificate in late 1997, which will bring the number of operators up to the minimum requirement.

According to management, training is now an ongoing process. Operators are compensated for the training, travel and examination expenses (first attempt only) associated with preparing and testing for the Waterworks Operator Certificate. As an incentive for acquiring this certificate, each operator is awarded a one-time amount of $50 to $100. With the exception of a salary increase when promoted, Water Treatment Plant Operators-I are not

generally awarded step increases after obtaining their certificate (see Chapter VI, Section A, Follow-up Finding and Conclusion No. 17).

The training of operators is an important process which has been established to insure that customers are provided with a safe and reliable source of drinking water. Although the Company has taken steps to train its filter plant operators for certification, the process is not complete. The Company needs to certify at least one more Water Treatment Plant Operator at BLUE to comply with Pennsylvania Code and regulations by the Department of Environmental Protection (DEP).

STAFF'S RECOMMENDATION - **Expedite the training and certification of at least one more Water Treatment Plant Operator at BLUE.**

E. DISTRIBUTION

PRIOR RECOMMENDATION - Develop an operations and maintenance (O&M) manual for the individual local properties.

PRIOR SITUATION - The Company allowed routine O&M to be performed at the discretion of the Superintendents. A documented O&M manual was not maintained. Although the Manager of Operations had acknowledged the need for O&M manuals at each service district, no effort was put into their development.

FOLLOW-UP FINDING AND CONCLUSION NO. 7 - **O&M manuals have been developed for all Company facilities.**

CWC has compiled on-site O&M manuals for each service district facility. These manuals comprise items such as:

- standardized operating practices and procedures,
- prescribed maintenance tasks and schedules, and
- specified manufacturer designs and drawings.

Some of these documents, although kept at their respective facility, may not always be found in the O&M manual. For example, the HOME district has prescribed maintenance tasks and schedules which are tracked on separate cards and located on each major component part (i.e., pumps, chemical feeders, etc.) of a given facility. At all other districts, this information has been consolidated into one notebook and kept on-site at each facility. In both instances, the information contained in each district's manuals is consistent with the criteria specified in the June 1994 Management Audit.

Management should update the information provided in each manual as facility and equipment modifications occur. These manuals will provide the Company with a means of ensuring uniform operating practices, coordinating maintenance efforts, and improving its ability to budget resources.

STAFF'S RECOMMENDATION - None.

PRIOR RECOMMENDATION - Obtain contractor services for LAKE through a competitive bid process prior to renewal of the annual contract.

PRIOR SITUATION - Because of LAKE's small customer base (located near Gettysburg, Pennsylvania) and its distance from other company service districts, a local contractor instead of CWC personnel was used to operate and maintain its distribution system. The Audit Staff found that from 1983 to mid-1991, the Company had awarded a service contract annually to the same contractor without soliciting competitive bids. From 1991 to 1993 this contract was annually awarded to a different contractor, again without obtaining competitive bids.

FOLLOW-UP FINDING AND CONCLUSION NO. 8 - Although the Company has acquired competitive bids for the LAKE service contract, management did not bid the current contract nor document its prior efforts.

The selection of an O&M contractor for LAKE continues to be the responsibility of the district Superintendent, who is also responsible for PENN and GLEN. Each year, the Superintendent solicits bids from as many qualified contractors as possible in the Gettysburg area, and makes a selection based solely on cost. This decision is later approved by the Manager of Operations before an agreement is signed.

Since 1994, the Company's attempts to acquire the most qualified vendor based on a competitive rate has been unsuccessful because of a limited availability of contractors in LAKE's service territory. Also, for what ever reason, many contractors do not respond to the Company's request for proposal. As a result, LAKE's Superintendent began using two-year service agreements rather than the typical one-year contract. This practice went into effect on July 15, 1996, with a contract that expires July 15, 1998. Due to the fact that only one contractor bid in 1995, the 1996 agreement was not competitively bid.

Table IV E-1 (next page) represents the number of contractors contacted by the Company, as well as the number of bids received for the 1994, 1995, and 1996 contracts. The Company was not able to provide documentation, in the form of follow-up correspondence and/or records of telephone conversations with the contractors, to support its contractor selection for 1994, or the lack of competing contractors in 1995 and 1996.

During the bidding process, CWC should record information pertinent to the selection of a contractor. Even in the case of LAKE's contract, when only a few contractors were available to bid, CWC should document its follow-up inquiries with contractors who declined to bid. This could provide the Company with important information as to the contractors' reasons for not bidding, as well as their interest in bidding for future work. Management can use the information to support its decision and structure future requests for proposals.

Table IV E-1 Annual Bids for LAKE's Contracted Services		
Contract Year	Number of Solicitations	Number of Bids Received
1994	5	2
1995	3	1
1996	0	0

Source: Company Data (Data Request No DT-2 and DT-5); Auditor Analysis

STAFF'S RECOMMENDATION - Attempt to obtain competitive bids for the LAKE contract and document the contractor selection process for future decision-making purposes.

FOCUSED MANAGEMENT AND OPERATIONS AUDIT OF PENNSYLVANIA-AMERICAN WATER COMPANY

PREPARED BY THE
PENNSYLVANIA UTILITY COMMISSION
BUREAU OF AUDITS
MANAGEMENT AUDIT DIVISION

Issued August 2000

PENNSYLVANIA-AMERICAN WATER COMPANY
FOCUSED MANAGEMENT AND OPERATIONS AUDIT
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V. UNACCOUNTED-FOR-WATER

Background

The Company's unaccounted-for-water (UFW) program, formally developed in 1987, is modeled after the American Water Works Association's (AWWA) water audit loss program. This program is designed to identify, quantify, and verify water and revenue losses as well as prioritize the allocation of funds and manpower on an annual basis. As part of its UFW program, the Company maintains a group of eight employees dedicated full-time to leak detection efforts. These employees, referred to as leak detection specialists, survey approximately three miles of main on a daily basis as well as pinpoint known leaks. Over the past three years (1996-1998), the number of miles of main surveyed has gradually increased from 4,081 miles in 1996 to 4,783 miles in 1998. This 1998 survey level reflects approximately 63% of the total system mileage.

Supporting the Company's UFW program is an active main replacement program. Management personnel in their respective service districts review data continuously regarding the number of main breaks, the type pipe installed, age of the mains, water quality complaints, number of service disruptions, and liability claims in order to identify and prioritize main replacement candidates. Recent main replacement expenditures have ranged from $14,951,000 in 1996 to $20,400,000 in 1998 with budgeted expenditures of $22,500,000 for the year 2000. These main replacement expenditures equate to approximately 36 to 47 miles of main replaced annually from 1996 through 1998, or an approximate 0.6% annual replacement of the miles of main in-service.

Table V-1 indicates that the Company reduced system-wide UFW percentages from a high of 27.1% in 1996 to a low of 20.7% in 1998. Through the twelve-month period ending July 1999, the Company further reduced unaccounted-for-water to 18.6%. Table V-1 shows that the greatest reduction occurred in the Northeast Region, or in the former Pennsylvania Gas and Water Company territory that PAWC acquired in 1996 (see Chapter X). The Company has established a future system-wide UFW goal of 15%, to be achieved by holding management employees accountable in their annual performance appraisals for achieving their respective Operating and District goals.

Table V-1
UFW percentages by Operation Region

Region	1996	1997	1998	1999*	% variance
Pittsburgh	26.5%	24.6%	23.4%	23.5%	-3.0%
West	17.3%	15.7%	12.7%	11.0%	-6.3%
East	13.5%	13.1%	13.6%	9.4%	-4.1%
Northeast	45.3%	36.1%	26.6%	22.5%	-22.8%
Total	27.4%	23.3%	20.7%	18.6%	-8.8%

*Twelve months ended July 31, 1999
Source: data request UFW-2

Findings and Conclusions

Our examination of unaccounted-for-water included a review of the Company's UFW trends, policies and procedures, water audit loss program, main replacement program, annual goals and objectives, etc. We found these areas to be satisfactory except as follows:

1. A system-wide leak survey and repair database has not been developed.

Currently, monthly leak detection summary reports are generated on a operating region basis detailing the number of leaks located and repaired on mains, hydrants, services, valves, and meters. Additionally, daily leak location reports are generated by district which provide more specific data including locations surveyed, municipality/distribution map coordinates, pipe size and type, type of service area, sounding access points, sound recorded, and location of leak detected as well as any associated leak repair data including size of leak (gallons per minute), date repaired, type of leak, and estimated repair cost. Daily leak sounding reports by district also provide data regarding the number of valves, hydrants, curb stops, and street location as well as noise and/or leaks detected. As mentioned previously, the district operating personnel review this data on an annual basis in order to identify and prioritize main replacement candidates. However, the reports being reviewed are generated manually with no systematic means available for compiling and analyzing system-wide leak survey and repair data.

An electronic leak survey and repair database should be developed on a common platform in order to compile and analyze data on a district and system-wide basis. Network terminals residing in the district offices could then be utilized to input weekly data on a real-time basis. The data fields (i.e., number of leaks, number of breaks, water quality complaints, main size, cost of repairs, etc.)

could then be quickly compiled and utilized as input into the recommended main replacement prioritization model (see Finding and Conclusion No. V-2) to effectively identify main replacement candidates.

Company Management believes that maintaining the leak survey and repair data on a decentralized basis only is the appropriate procedure as it allows the local district personnel to identify and prioritize their main replacement candidates. However, the Audit Staff believes that compiling a Company-wide electronic database will provide for more efficient and standardized reporting of data and allow more effective statewide main replacement decision-making to be performed.

2. A formal main replacement prioritization procedure needs to be developed.

Main replacement expenditures have increased from $14.9 million in 1996 to a projected $22.5 million by year-end 2000, or at an annual compound growth rate of 10.8%. As shown in Table V-2, this main replacement expenditure trend represents a 30% increase in the number of miles of main replaced from 1996 to 1998.

Table V-2
Main Replacement Statistics

	1996	1997	1998	% change
System Miles of Main	7,345	7,465	7,589	3.3%
Annual Miles Retired/Replaced	36	42	47	30.0%
% of System Miles Retired Annually	0.49%	0.56%	0.62%	0.13%

Source: data request UFW-9

Expressed as a percent of miles retired/replaced to total system miles in-service, the Company has increased its replacement efforts from 0.49% to 0.62%. PAWC's retired/replaced percentages compare favorably to a water utility industry 1995 regional average of 0.5%, and are in-line with a water utility industry 1995 national average of 0.6%.

Although local district personnel consider factors such as number of leaks, age of mains, type of main material, water quality complaints, number of service disruptions, liability claims, and the timing of municipality street repaving programs in order to identify main replacement candidates, PAWC lacks a uniform and standardized documented approach to incorporating these factors into the decision-making process. The Company should develop a formal state-wide

main replacement prioritization procedure that incorporates the evaluation of main replacement candidates based on a weighted factor formula. Each factor should be assigned a weighted point value and aggregated in order to identify and effectively prioritize main replacement candidates. The factors to be considered should include, but not be limited to, the following elements: water quality, repair history, number of leaks and breaks, number of customers affected, age of the main, type of main material, customer complaints, etc.

The Company's position is that its existing informal main replacement selection process adequately considers the necessary factors to identify main replacement candidates. Additionally, the Company is concerned that a formula-based approach may continually direct main replacement funds to specific districts, thereby creating a negative perception of the Company in its districts receiving reduced investment.

However, the Audit Staff believes that implementation of a formal state-wide main replacement prioritization procedure would enhance the Company's ability to systematically and effectively identify mains in the most need of repair/replacement. Additionally, the implementation of a more formal state-wide main replacement prioritization procedure may reverse the current negative main break trend as shown in Table V-3.

Table V-3
Main Break Statistics

	1996	1997	1998	July-1999	% Change
No. of Main Breaks	2,450	2,801	3,015	1,954 (3,349)*	37.0%
Miles of System Main	7,345	7,465	7,589	7,589**	3.3%
# Miles per Main Break	2.99	2.66	2.51	2.26	-24.4%

*annualized
**year-ending/mid-year 1999 data was not available
Source: data request UFW-10

The number of miles per main break performance ratio, as indicated in Table V-3, has decreased by 24.4% from 1996 to 1999 (as projected). This ratio compares unfavorably to the latest available (1995) regional average of 3.25 miles per main break as well as to the trend of another major Pennsylvania water utility that achieved improving ratios of 3.11, 3.08, and 4.54 during 1996, 1997, 1998, respectively.

3. The Company has not conducted a cost/benefit study to determine the appropriate mix of contractor and in-house crews to be used to perform annual leak surveys.

The Company currently conducts its annual leak survey program utilizing only in-house personnel. Eight Leak Detection Specialists are dedicated full-time to performing leak surveys covering 32 service districts and 7,589 miles of main system-wide. Each Leak Detection Specialist is assigned a specially equipped van that contains more than $65,000 of equipment such as correlators, sonic equipment, and aqua log sensors (which are unmanned nighttime sensors deployed on valve boxes in the middle of the night in order to gather data in normally high traffic areas). Over the past three years (1996-1998), the number of miles of main surveyed has gradually increased resulting in approximately 63% of the total system being surveyed annually. Annual company-wide leak detection operating activity goals include sounding 100 percent of all hydrants, 20 percent of system valves, and 33 percent of all service line control valves. Additionally, meter readers and servicemen as part of normal operating duties supplement the leak detection specialists in their leak surveying work.

While current leak detection activities have resulted in lower UFW levels, management has not conducted a cost/benefit study to support its current operating practices. A study should be conducted periodically to compare the costs and benefits of using contractors versus Company personnel to perform this work throughout the year. The study should also examine the potential benefits of using contractors seasonally to supplement or reduce the existing internal staffing. Factors to consider in the cost/benefit study would include, but not be limited to, the following factors: labor costs, equipment and associated maintenance/repair costs, vehicle and associated maintenance/repair costs, supervision costs, training costs, overhead costs, insurance and liability costs, and fuel costs necessary to conduct annual leak surveys.

PAWC expressed a belief that the use of contractors to perform leak surveys would be more costly than the current use of Company personnel. However, as contractors have not been used by PAWC for many years, the Company was unable to provide any support for its contention. By performing periodic studies regarding the appropriate extent of the annual leak surveying and the costs and benefits of using contractors rather than Company personnel to perform all or portions of this work, management would ensure that it is operating in the most cost-effective and efficient manner.

Recommendations

1. Develop an automated company-wide leak survey and repair database to be utilized with the recommended main replacement prioritization procedure.

2. Develop a formalized main replacement procedure based on weighted factors in order to systematically prioritize main replacement candidates on a state-wide basis.

3. Conduct a cost/benefit study on a periodic basis to determine the appropriate mix of contractors and in-house personnel to perform annual leak survey work.

PENNSYLVANIA AMERICAN WATER COMPANY

MANAGEMENT EFFICIENCY INVESTIGATION EVALUATING THE IMPLEMENTATION OF SELECTED MANAGEMENT AUDIT RECOMMENDATIONS FROM THE 2000 MANAGEMENT AUDIT

PREPARED BY THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION
BUREAU OF AUDITS
MANAGEMENT AUDIT DIVISION
ISSUED NOVEMBER 2004

PENNSYLVANIA AMERICAN WATER COMPANY
MANAGEMENT EFFICIENCY INVESTIGATION

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V. UNACCOUNTED-FOR-WATER

Prior Recommendation – Develop an automated company-wide leak survey and repair database to be utilized with the recommended main replacement prioritization procedure.

Prior Situation – On a monthly basis each regional Operations Office manually produced a leak detection summary report detailing the number of leaks located and repaired on mains, hydrants, services, valves, and meters within its service area. In addition, each regional office manually produced a daily leak location report and a daily leak sounding report. This data was reviewed by the Regional Manager and appropriate staff on an annual basis in order to identify and prioritize main replacement candidates. However, because these reports were manually produced, PAWC's Operations Department was unable to systematically compile and analyze regional and state-wide leak survey and repair data.

It was recommended that an electronic leak survey and repair database be developed on a common electronic platform in order to facilitate the compilation and analysis of data on a regional and state-wide basis. The Audit Staff believed that compiling a state-wide electronic database would provide for more efficient and standardized reporting of data, and facilitate more effective state-wide main replacement decision-making. The Audit Staff also believed that the regional office network computer terminals could be utilized to input weekly data on a real-time basis. The data fields (i.e., number of leaks, number of breaks, water quality complaints, main size, cost of repairs, etc.) could then be quickly compiled and utilized as input to effectively implement the recommendation to develop a main replacement prioritization model (see Follow-Up Finding and Conclusion No. 6).

Follow-up Finding and Conclusion No. 5 – PAWC has not developed an automated regional and state-wide leak survey and repair database.

A number of circumstances at AWC and PAWC have delayed implementation of the prior management audit recommendations related to reductions in unaccounted-for-water (UFW) via improvements in its main replacement prioritization process. As recent as its November 2002 implementation plan update, PAWC had reported plans to implement a Company-wide leak survey and repair database and new main replacement prioritization procedures by April 1, 2003.

The initial delays resulted when the Company's Information Technology (IT) staff determined that the database applications should reside on the mainframe computer and not functionally operate from personal desktop computers. However, around this same time, PAWC's IT staff was transferred into AWWSC's IT Department. AWWSC in turn established its national Information Technology (IT) headquarters in the available office

space at PAWC's Hershey building. Project priority and scheduling adjustments continued as the IT Department centralized its computer operations personnel during 2003.

By the Spring of 2003, IT established new procedures that had a direct impact on all mainframe IT projects. One procedural change was the establishment of a ten-member IT Steering Committee. As of mid-2003, the IT Steering Committee had held only one meeting. This was followed by AWWSC establishing a Project Management Office (PMO) to manage all IT projects approved by the IT Steering Committee. At the time of our audit, the PMO was not yet fully operational.

As a result, AWWSC's IT department had not yet devoted resources to completing the prior management audit recommendations. However, according to AWWSC's on-site IT Manager, the Commission's recommendations are considered "regulatory" requests and, therefore, the Steering Committee should assign them a "High" priority with a projected one to two-year completion date. The IT staff will first review other similar computer applications already running for other AWC subsidiaries. If similar parameters are identified, only small modifications may be necessary, which would shorten the time schedule for completion, and result in a lower cost to PAWC.

It should be noted that PAWC has been able to reduce its total Unaccounted-For-Water (UFW) percentage by more than 12% from 1999 to 2002 despite the delays in developing an automated state-wide leak survey and repair database. During this time period, PAWC's percentage of system-wide sales to total gallons distributed increased by over 7.5 percent. This is significant given that total system-gallons distributed decreased for the same time period by almost 5% (see Exhibits V-1 and V-2). The Company was unable to provide UFW data for year-to-date 2003 because a real time on-line system was not developed.

Staff's Follow-up Recommendation – Develop an automated state-wide leak survey and repair database and link the IT project with the management audit recommendation to automate the main replacement prioritization process.

Exhibit V-1
Pennsylvania American Water Company
Unaccounted-For-Water Percentages by Operational Region
For Years Ending 1999-2002

Region	1999	2000	2001	2002	% Change '99 - '02
Western	15.07%	14.99%	14.93%	15.95%	0.88%
Pittsburgh	21.65%	18.49%	16.20%	15.53%	-6.12%
Central	9.75%	11.49%	14.29%	15.24%	56.31%
Eastern	17.21%	15.33%	18.31%	16.05%	-0.67%
Northeastern	20.13%	19.82%	16.66%	14.31%	-28.91%
Coatesville	-	-	48.33%	38.05%	-21.27%
Reading		-	-	18.46%	-
Total System	**20.10%**	**18.78%**	**18.08%**	**17.63%**	**-12.29%**

Note: Coatesville Water Authority was added in March 2001 and the Reading region (former Citizens Water of PA) was added in January 2002. Beginning in 2003, PAWC combined Coatesville and Reading and established the Southeastern Region. Also the regional percentages do not reflect any inter and intra-regional transmission sales and distributions. Furthermore, the Central Region's significant increase in the UFW percentage is primarily the result of sizable declines in system throughput resulting from the loss of a large industrial customer.

Source: Data Request UFW-1; Auditor Analysis

Exhibit V-2
Pennsylvania American Water Company
Total System-Wide Gallons (in thousands)
For Years Ending 1999-2002

	1999	2000	2001	2002	% Change '99 - '02
Sales	51,712,136	50,245,034	50,711,239	52,965,049	2.42%
Non-Revenue[1]	4,834,681	3,222,687	3,300,898	2,534,516	-47.58%
UFW[2]	14,227,791	12,366,303	11,918,387	11,877,222	-16.52%
Total System	**70,774,608**	**65,834,024**	**65,930,524**	**67,376,787**	**-4.80%**
% of Sales to Total System	**73.07%**	**76.32%**	**76.92%**	**78.61%**	**7.58%**

[1] Non-Revenue = Estimated gallons used or lost related to leaks, street cleaning, flushing, testing, firefighting, and etc.
[2] UFW = Total System Sales less Non-Revenue volumes.

Source: Data Request UFW -1; Auditor Analysis.

Prior Recommendation – Develop a formalized main replacement procedure based on weighted factors in order to systematically prioritize main replacement candidates on a state-wide basis.

Prior Situation – PAWC's main replacement expenditures had increased from $14.9 million in 1996 to a projected $22.5 million by year-end 2000, or at an annual compound growth rate of 10.8 percent. This reflected a 30% increase in the number of miles of main replaced from 36 miles in 1996 to 47 miles in 1998, and an increase in main replacements from .49% of total system miles in 1996 to .62% of total system miles in 1998. Further, PAWC's retired/replaced percentages compared favorably to a 1995 water utility industry regional average of 0.5% and national average of 0.6 percent. However, while PAWC's local district personnel considered factors such as the number of leaks, age of mains, type of main material, water quality complaints, number of service disruptions, liability claims, and the timing of municipality street repaving programs in order to identify main replacement candidates, the Company lacked a uniform, standardized approach to incorporating these factors in its decision-making process.

The Audit Staff recommended that PAWC develop a formal state-wide main replacement prioritization procedure that incorporates the evaluation of main replacement candidates based on a weighted-factor formula. The factors were to include, at a minimum: water quality, repair history, number of leaks and breaks, number of customers affected, age of the main, type of main material, and number of customer complaints. The Audit Staff believed that implementation of the recommendation would enhance the Company's ability to systematically and effectively identify mains that were in the most need of repair or replacement. Automating such a formal state-wide replacement prioritization procedure could help the Company reverse the negative trend in main breaks which had increased from 2,450 main breaks in 1996 to an estimated 3,350 in 1999.

Follow-up Finding and Conclusion No. 6 – PAWC has not developed an automated and formalized state-wide replacement procedure based on weighted factors that systematically prioritize main replacement candidates.

As noted in Follow-Up Finding and Conclusion No. 5, a number of AWWC's national and local organizational and management changes negatively impacted the implementation efforts related to the prior management audit's two UFW recommendations. PAWC's local district personnel still consider such factors as number of leaks, age of mains, type of main material, water quality complaints, number of service disruptions, liability claims, and the timing of municipal street repaving programs in order to identify main replacement candidates. However, we found that PAWC has not documented a uniform approach that incorporates these factors into a standardized decision-making process. As of mid-2003 it was unclear when implementation of the previous two UFW recommendations would be completed because AWWSC's IT

Steering Committee had not yet prioritized projects and devoted adequate resources for their completion.

Notwithstanding the above, PAWC did develop a separate Excel-based prioritization process which was being tested by a few districts within the Central and Northeastern Regions. Management has been reluctant to implement the system state-wide because AWWSC's IT department soon might develop a mainframe-based system. As of July 2003, the Audit Staff was informed that the IT Department had begun investigating the system currently used by New Jersey-American as a standard template to meet the needs of PAWC.

Even though PAWC's main replacement process has not been automated or standardized, the data shown in Exhibit V-3 reflects a reduction in main breaks over previous years. The data also indicates an increase in PAWC's main replacement expenditures from $16,893,037 in 1999 to a budgeted $24,739,000 in 2003, or a 46.5% increase. Prospectively, PAWC planned to spend $26,619,520 for main replacements in 2004. This would represent a 57.6% increase in annual main replacement expenditures from 1999 levels.

Exhibit V-3
Pennsylvania American Water Company
Water Main Break and Replacement Statistics
1999-2002

	1999	2000	2001	2002	2003 (budgeted)	Actual % Change 1999-2002
Replacement Expenditures[1]	$16,893,037	$19,421,209	$22,525,467	$15,953,485	$24,739,000	-5.6%
System Miles of Main	7,704	7,758	8,040	8,852	8,921	14.9%
Annual Miles of Main Replaced/Retired	66	46	50	36	62	-45.5%
% of System Miles of Main Replaced/Retired Annually	0.86%	0.59%	0.62%	0.41%	0.69%	-52.3%
Number of Main Breaks	3,762	3,708	3,339	3,619	--	-3.8%
Number of Miles per Main Break	2.05	2.09	2.41	2.45	--	19.5%

[1] Does not reflect specific expenses associated with values, hydrants, vaults, etc.

Source: Data Requests UFW-4, 5 and 6, Auditor Analysis.

While Exhibit V-3 shows a 52.3% decrease in main retirements/replacements from .86% of system miles in 1999 to .41% of system miles in 2002, PAWC projects that its percentage of main replacements will recover during years 2003 and 2004, to .69% of system miles and .72% of system miles, respectively. Although the data shows some improvement in the number of main breaks, the Audit Staff could not determine how this compared to industry trends because national average data was not readily available.

Staff's Follow-up Recommendation – Develop a mainframe-based fully-automated main replacement process that is based on standardized weighted factors that prioritize main replacement candidates on a state-wide basis and is linked to an automated PAWC state-wide leak survey and repair database.

Pennsylvania American Water

Implementation Plan in Response to the Public Utility Commission's Management Efficiency Investigation

December 1, 2004

Pennsylvania American Water
IMPLEMENTATION PLAN

UNACCOUNTED-FOR WATER

Follow-Up Recommendation No. 5

Develop an automated state-wide leak survey and repair database and link the IT project with the management audit recommendation to automate the main replacement prioritization process.

Company Acceptance

The Company accepts this recommendation.

Discussion

Pennsylvania American Water recognizes the significance of non-revenue water (NRW) loss and, in an effort to better address this complex issue and minimize unbilled losses, established a NRW Department during a reorganization process that occurred early in 2004. The department is charged with tracking and documenting water loss wherever it occurs and implementing preventative strategies to minimize the loss. There are 8 regional management employees dedicated to this function, including 5 who monitor PAW districts.

An American Water information technology (IT) initiative that will include development of leak repair and asset management databases residing on the Company's mainframe computer is in the planning stages. This initiative will include all of American Water's regulated companies across the country. The anticipated completion date for the asset management portion of the project is year-end 2006. The leak survey and repair database will be completed by late 2007.

The recently-established NRW Department is charged with tracking and documenting leaks surveyed and repaired. Until American's leak repair and asset databases are developed and available, the NRW team is maintaining a leak survey and repair log which is entered at the district level and combined into state and regional reports. The log not only tracks leak repairs but identifies areas which require monitoring on a regular basis to minimize water loss. District/ regional non-revenue water teams are currently being established to review data being collected and develop action plans using a regional template in order to

focus employees in all functional departments on the same objectives/goals. Regular team meetings report and monitor progress. These reports will be used by management to prioritize main replacements and monitor progress in minimizing water loss. Once American's standardized asset and leak databases are established, the regional logs will be converted to the new mainframe databases.

Implementation Date

The Company anticipates fully-implementing this recommendation by year-end 2007.

Personnel Responsible

Managing Director
Regional Director Service Delivery
Regional Manager NRW

Pennsylvania American Water
IMPLEMENTATION PLAN

UNACCOUNTED-FOR WATER

Follow-Up Recommendation No. 6

Develop a mainframe-based, fully-automated main replacement process that is based on standardized weighted factors that prioritize main replacement candidates on a state-wide basis and is linked to an automated PAWC state-wide leak survey and repair database.

Company Acceptance

The Company accepts this recommendation.

Discussion

The Company developed an Excel-based main replacement prioritization schedule that will serve as the conceptual basis for a future mainframe-based program to prioritize main replacement candidates. However, the mainframe program will not be available until an American Water information technology (IT) initiative that includes development of leak repair and asset management databases residing on the Company's mainframe computer is completed. This initiative will include all of American Water's regulated companies across the country. The anticipated completion date for the asset management portion of the project is year-end 2006. The leak survey and repair database will be completed by late 2007. Until the mainframe program is established, PAW will use the Excel-based schedule to help prioritize main replacement projects.

Implementation Date

The Company anticipates fully-implementing this recommendation by year-end 2007.

Personnel Responsible

Managing Director
Regional Director Service Delivery
Regional Manager NRW

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

Spring Township v. Pennsylvania American Water Company	:	Docket No. C-20054746
Neil R Rahn and David Singerling, et al. v. Pennsylvania-American Water Company	: : :	Docket No. C-20054919
Wilson School District v. Pennsylvania American Water Company	: : :	Docket No. C-20055371

OCA EXHIBIT C

DATED: JUNE 27, 2006

PENNSYLVANIA AMERICAN WATER COMPANY
CHECK LIST - WATER

BALANCE SHEET	REFERENCE TAB	AMOUNT	REFERENCE TAB	AMOUNT	DIFFERENCE	
Utility Plant in Service	200	2,258,687,650	201	2,258,687,650	(0)	
Utility Plant Leased To Others	200	0	202	0	0	
Property Held for Future Use	200	1,314,870	203	1,314,869	1	
Construction Work in Progress	200	54,128,214	204	54,128,214	(0)	
Utility Plant in Service	200	479,882,961	205	479,882,961	0	
Utility Plant Leased to Others	200	0	205	0	0	
Property Held for Future Use	200	0	205	0	0	
Utility Plant Acquisition Adjustments	200	18,348,511	206 Attach	20,335,014	(0)	Combined
Accumulated Amortization of Utility Plant Acquisition Adjustments	200	1,986,503	206			
Pending Reclass of Utility Plant	200	0	205	0	0	
Other Investments	200	38,591,012	210	38,591,012	0	
Other Investments	200	1,459,573	210	1,459,573	0	
Other Accounts Receivable	200-1	2,336,709	211	2,336,709	0	
Accounts Receivable from Affiliated Company	200-1	77,602	213	77,602	0	
Notes Receivable from Affiliated Company	200-1	0	212	0	0	
Plant Materials and Supplies	200-1	3,002,252	214	3,002,252	0	
Prepayments	200-1	1,469,480	215	1,469,480	0	
Miscellaneous Current & Accrued Assets	200-1	4,045,452	216	4,045,452	0	
Unamortized Debt Discount and Expense	200-1	16,760,720	217	16,760,720	(0)	
Extraordinary Property Losses	200-1	0	218	0	0	
Preliminary Survey and Investigation Charges	200-1	6,115,150	219	6,115,150	(0)	
Clearing Accounts	200-1	2,044	220	2,044	0	
Deferred Rate Case Expense	200-1	75,521	221	75,521	0	
Other Deferred Debits	200-1	43,187,357	222	43,187,357	(0)	
Accumulated Deferred Federal Income Taxes	200-1	0	419-420		0	
Accumulated Deferred State Income Taxes	200-1	0	419-420		0	
Appropriated Retained Earnings	200-2	707,530	223	707,530	0	
Unappropriated Retained Earnings	200-2	234,600,521	223	234,600,521	0	
Bonds	200-2	857,536,482	224	857,536,482	0	0
Reacquired Bonds	200-2	0	224	0	0	
Notes Payable	200-3	0	225	0	0	
Accounts Payable to Affiliated Companies	200-3	1,087,489	226	1,087,489	0	
Notes Payable to Affiliated Companies	200-3	22,612,968	227	22,612,968	0	
Accrued Taxes, Taxes Other Than Income	200-3	(117,268)	418B	(117,267)	(1)	
Accrued Taxes, Income Taxes	200-3	29,089,810	418B	29,089,810	0	
Accrued Taxes, Other Income & Deductions	200-3	(597,447)	418B	(597,447)	0	
Miscellaneous Current and Accrued Liabilities	200-3	23,866,034	228	23,866,034	0	
Advances for Construction	200-3	82,277,604	229	82,277,604	(0)	
Other Deferred Credits	200-3	36,286,720	230	36,286,721	(1)	

PENNSYLVANIA AMERICAN WATER COMPANY
CHECK LIST - WATER

INCOME STATEMENT	REFERENCE TAB	AMOUNT	REFERENCE TAB	AMOUNT	DIFFERENCE	REFERENCE TAB	AMOUNT	DIFFERENCE
Operating Revenues	400	394,359,698	401	394,359,697	1			
Operating Expenses	400	168,103,087	407	168,103,087	0			
Amortization of Utility Plant Acquisition Adjustment	400	601,636	417	601,636	0			
Amortization of Limited Term Plant	400	63,024	417	63,024	0			
Amortization of Property Losses	400	0	417	0	0			
Amortization of Other Utility Plant	400	0	417	0	0			
Taxes Other Than Income	400	12,301,541	419	12,301,541	0			
Federal Income Taxes, Utility Operating Income	400	28,474,322	419	28,474,322	0			
State Income Taxes, Utility Operating Income	400	6,923,658	419	6,923,658	0			
Federal	400	9,420,434	419	9,420,434	0			
State	400	2,094,886	419	2,094,886	0			
Taxes Other Than Income, Other Income and Deductions	400	(187,996)	419	(187,996)	0			
Income Taxes, Other Income and Deductions	400	(883,339)	419	(883,339)	0			
					0			
Sales for Resale	401	2,085,419	405	2,085,419	0			
Other Water Revenues	401	163,078	406	163,078	0			
					0			
					0			
Employees	407	34,053,974	409	34,053,974	0	410		#VALUE!
Officers, Directors and Majority Stockholders	407	0	409	0	0			
Employee Pensions and Benefits	407	15,335,613	409-A	15,335,613	0			
Purchased Water	407	3,108,259	408	3,108,259	(0)			
Engineering	407	296,594	411-A	296,594	0			
Accounting	407	269,095	411-A	269,095	0			
Legal	407	507,529	411-A	507,529	0			
Management Fees	407	32,456,502	411-B	32,456,502	0			
Testing	407	79,310	411-B	79,310	0			
Other - Maintenance	407	12,264,782	411-B	12,264,782	0			
Advertising Expense - Other than Conservation	407	260,807	412	260,807	0			
Miscellaneous Other	407	12,411,372	413	12,411,372	0			
Travel	407	0	416	0	0			

CLASS "A" AND "B" WATER COMPANY
PUC ANNUAL REPORT
OF

Utility Code
212285

Company:

Pennsylvania American Water

Address:

800 West Hershey Park Dr. Hershey, PA 17033
Address City State Zip

TO THE
PENNSYLVANIA
PUBLIC UTILITY COMMISSION

For the Year Ended December 31, 2005

Telephone Number 717-533-5000

Fax Number 717-531-3235

E-Mail christopher.buls@amwater.com

Web Site Address www.pawc.com

Officer to whom correspondence
concerning this report should be addressed:

Christopher C. Buls
First Name Last Name

Treasurer & Comptroller
Title

800 West Hershey Park Drive Hershey, PA 17033
Address City State Zip

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GENERAL INSTRUCTIONS

1. Two copies of this report shall be prepared by each water utility. One copy should be mailed to the Pennsylvania Public Utility Commission, P.O. Box 3265, Harrisburg, PA 17105-3265 by April 30 of the year following the calendar year. The other copy should be retained by the Company for reference. Companies may file this report in an electronic format supplied by the Commission along with a hard copy. All water utilities are required by statute to complete and file this annual report.

2. Pencil entries will not be permitted on hard copy.

3. All accounting terms and phrases used in this report are to be interpreted in accordance with the effective applicable Uniform System of Accounts prescribed by this Commission, as set forth in 52 Pa. Code §65.16. The Uniform System of Accounts defines Class A companies as those with annual revenues of $750,000 or more.

4. Standard accounting procedures shall apply in determining the nature of any entry (e.g. entries of a reverse or contrary character shall be indicated by a parentheses around the number).

5. The report shall be filed consisting of data relative to a calendar year basis.

6. If this report is made for a period less than the calendar year, the period covered must be clearly stated on the front cover and elsewhere throughout the report where the period covered is shown. When operations cease during the year because of the disposition of property, the balance sheet and supporting schedules should consist of balances and items immediately prior to transfer (for accounting purposes).

7. All instructions shall be followed and each question shall be answered fully and accurately. Sufficient answers shall appear to show that no question or schedule has been overlooked. The expression "none" or "not applicable" shall be given as the answer to any particular inquiry or schedule where it truly and completely states the fact. Unless otherwise indicated, no information will be accepted which incorporates by reference information from another document or report. Where information called for herein is not given, state fully the reason for its omission.

8. Dates, when called for, should include the day, month and year. Customary abbreviations may be used in stating dates.

GENERAL INSTRUCTIONS
(Continued)

9. Whenever schedules call for comparison of figures of a previous year, the figures reported must be based upon those shown by the annual report of the previous year or an appropriate explanation given why different figures were used.

10. One copy of the respondent's latest annual report, if issued, should be submitted with this report. If respondent is a member of a group, both parent and subsidiary's annual report should be submitted.

11. Throughout this report money items will be rounded off to the nearest dollar.

12. In the space provided at the top of each page insert the name of the utility and the year to which this report relates.

EXCERPT FROM TITLE 66, THE PUBLIC UTILITY CODE, APPROVED JULY 1, 1978

SECTION 504. Reports by Public Utilities

The Commission may require any public utility to file periodical reports at such times, and in such form, and of such content, as the Commission may prescribe; and special reports concerning any matter whatsoever about which the Commission is authorized to inquire, or to keep itself informed, or which it is required to enforce. The Commission may require any public utility to file with it a copy of any report filed by such public utility with any Federal department or regulatory body. All reports shall be completed under oath or affirmation when required by the Commission.

SECTION 3301. Civil Penalties for Violations

(a) General rule. -- If any public utility,...shall fail, omit, neglect, or refuse to perform any duty enjoined upon it by this part; or shall fail, omit, neglect or refuse to obey, observe, and comply with any regulation or final direction, requirement, determination or order made by the Commission,.. such public utility, person or corporation for such violation, omission, failure, neglect, or refusal, shall forfeit and pay to the Commonwealth a sum not exceeding $1,000, to be recovered by an action of assumpsit instituted in the name of the of Commonwealth. In construing and enforcing the provisions of this section, the violation, omission, failure, neglect, or refusal of any officer, agent, or employee acting for, or employed by, any such public utility, person or corporation shall, in every case be deemed to be in violation, omission, failure, neglect, or refusal of such public utility, person or corporation.

(b) Continuing offenses. -- Each and every day's continuance in the violation of any regulation or final direction, requirement, determination, or order of the Commission,...shall be a separate and distinct offense ...

GENERAL INFORMATION

1. Name and title of officer having custody of the general books of account and address of the office where such books are kept.

Christopher C. Buls, Treasurer and Comptroller
Pennsylvania American Water
800 West Hershey Park Drive
Hershey, PA 17033

2. Name of State under the laws of which respondent is incorporated and the date of incorporation. If incorporated under a special law, give reference to such law. If not incorporated, state that fact and give the type of organization and date organized.

Pennsylvania - July 15, 1904

3. If at any time during the year the property of respondent was held by a receiver or trustee, give: (a) name of receiver or trustee, (b) date such receiver or trustee took possession, (c) the authority by which the receivership or trusteeship was created and, (d) date when possession by receiver or trustee ceased.

Not Applicable

4. State the classes of utility and other services furnished by respondent during the year in each state that the respondent operated.

Water and Wastewater only - Pennsylvania only
This report does not include results pertaining to wastewater operations.

IMPORTANT CHANGES DURING THE YEAR

Provide on the following page written responses for each of the items listed below. Make the written statements explicit and precise, and number each statement in accordance with the inquiries. Each inquiry must be answered. However, if the word "none" states the fact, it may be used in answering any inquiry, or if information is given elsewhere in the report which answers any inquiry, reference to such other schedule will be sufficient.

1. Changes in, and additions to franchise rights, describing (a) the actual consideration given therefore, and (b) fro whom acquired. If acquired without payment of any consideration, state that fact.

2. Acquisition of other companies, reorganization, merger or consolidation with other companies; give names of companies involved, particulars concerning the transactions, and reference to Commission authorization, including docket numbers.

3. Purchase or sale of operating units, such as sources, treatment and storage facilities, transmission and distribution systems, etc., specify items, parties, effective dates and also reference to Commission authorization, including docket numbers.

4. Important leaseholds acquired, given, assigned, or surrendered, effective dates, lengths of terms, names of parties, rents, Commission authorization, (docket numbers), if any, and other conditions.

5. Important extensions of service territories, including Commission authorization (docket numbers), giving location of the new service territory covered by distribution system, and dates of beginning operations. Give the number of customers by class, and for each class of customers the estimated annual revenues relating to the new territories.

6. Estimated increase or decrease in annual revenues due to important rate changes, (docket numbers), and the approximate extent to which such increase or decrease is reflected in revenues for the reporting year.

7. Important wage scale changes, showing dates of changes, effect on operating expenses for the year, and estimated annual effect of such wage scale changes on operating expenses.

8. Obligations incurred or assumed by respondent as guarantor for the performance by another of any agreement or obligation, excluding ordinary commercial paper maturing on demand or not later than one year after date of issue, and giving Commission authorization, (docket number), if any.

9. Changes in articles of incorporation or amendments to charters, explain the nature and purpose of such changes or amendments. Note any filing with the Commission.

10. Other important changes not provided for elsewhere.

WRITTEN RESPONSES FOR IMPORTANT CHANGES DURING THE YEAR

Provide written responses for each of the items listed on the previous page.

1. See #5

2. See #3

3. Purchase Snowshoe Condominium Association's water system and the right to offer water service in additional portions of Mount Pocono Borough, Monroe County
Docket # a-212285F 0117 February 24, 2005
Docket No. A-212285F0089

Purchase Shippenville Borough and/or Shippenville Municipal Authority's water system and the right to offer water service in Shippenville Borough and a portion of Elk Township, Clarion County
Docket # A-212285F 0092 March 31, 2005

Purchase Blue Mountain Lakes Associates, L.P.'s water system and the right to offer water service in Blue Mountain Lake Associates, L.P. certificated service territory (Portions of Stroud & Smithfield Townships, Monroe County) and additional portions of the Township.
Docket A-212285F 0123 October 31, 2005

Purchase the water system of the Township of East Fallowfield and the right to offer water services in additional areas of East Fallowfield Township, Chester County
Docket A-212285F 0115 December 22, 2005

4. None

5. Right to furnish water service to the public in portions of Franklin Township, Butler County
Docket # A-212285F 0120 June 6, 2005

Right to furnish water service to the public in additional portions of West Cain Township, Chester Co
Docket # A-212285F 0118 June 27, 2005

Right to furnish water service to the public in additional portions of Nottingham & Somerset Townships Washington County
Docket # A-212285F 0119 June 27, 2005

Right to furnish water service to the public in additional portions of Lehman Township, Pike County
Docket # A212285F 0121 June 27, 2005

Right to furnish water service to the public in additional portions of Lehman Township, Pike County
Docket # A212285F 0124 July 18, 2005

Right to furnish water service to the public in additional portions of New Beaver Borough, Lawrence County, and Big Beaver County, Beaver County
Docket # A-212285F 0125 August 15, 2005

6. None

7. None

8. None

9. None

10. None

DEFINITIONS

"Accounts" means the accounts prescribed in the NARUC System of Accounts.

"Amortization" means the gradual extinguishment of an amount in an account by distributing such amount over a fixed period, which may be over the life of the asset or liability to which it applies, or over the period during which it is anticipated the benefit will be realized.

"Book Cost" means the amount at which property is recorded in the applicable account without deduction of related provisions for accrued depreciation, amortization, or for other purposes.

"Control" (including the terms; "controlling," "controlled by," and "under common control with") means the possession, directly or indirectly, of the power to direct or cause the direction of the management and policies of a company, whether such power is exercised through one or more intermediary companies, or alone, or in conjunction with, or pursuant to an agreement, and whether such power is established through a majority or minority ownership or voting of securities, common directors, officers, or stockholders, voting trusts, holding trusts, affiliated companies, contract or any other direct or indirect means.

"Cost" means the amount of money actually paid for property or service. When the consideration given is other than cash, the value of such consideration shall be determined on a cash basis.

"Debt Expense" means all expenses in connection with the issuance and initial sale of evidences of debt, such as fees for drafting mortgages and trust deeds; fees and taxes for issuing or recording evidences of debt; cost of engraving and printing bonds and certificates of indebtedness; fees paid trustees; specific costs of obtaining governmental authority, fees for legal services; fees and commissions paid underwriters, brokers, and salesmen or marketing such evidences of debt; fees and expenses of listing on exchanges; and other like costs.

"Depreciation", as applied to depreciable utility plant, means the loss in service value not restored by current maintenance, incurred in connection with the consumption or prospective retirement of the utility plant in the course of providing service. This includes causes which are known to be in current operation and against which the utility is not protected by insurance. Among the causes to be given consideration are wear and tear, decay, action of the elements, inadequacy, obsolescence, changes in the art, changes in demand, and requirements of regulatory bodies.

"Distribution Mains" mean any pipes whose primary purpose is to distribute treated water throughout a community, and whose components include arterial or primary feeders, secondary feeders, and the distribution grid works.

DEFINITIONS
(Continued)

"Investment Advances" means advances, represented by notes or by book accounts only, with respect to which it is mutually agreed or intended between the creditor and debtor that they shall be settled by the issuance of securities or shall not be subject to current settlement.

"Minor Items of Property" means the associated parts or items of which retirement units are composed.

"Net Salvage Value" means the salvage value of property retired less the cost of removal.

"Nominally Issued", as applied to securities issued or assumed by the utility means those which have been signed, certified, or otherwise executed, and placed with the proper officer for sale and delivery, or pledged, or otherwise placed in some special fund of the utility, but which have not been sold, or issued directly to trustees of sinking funds in accordance with contractual requirements.

"Original Cost", as applied to utility plant, means the cost of such property to the person first devoting it to public service.

"Property Retired", as applied to utility plant, means property which has been removed, sold, abandoned, destroyed, or which for any cause has been permanently withdrawn from service.

"Replacing or Replacement", when not otherwise indicated in the context, means the construction or installation of utility plant in place of property retired, together with the removal of the property retired.

"Retained Earnings" means the accumulated net income of the utility less distributions to stockholders and transfers to other capital accounts, and other adjustments.

"Salvage Value" means the amount received for property retired, less any expenses incurred in connection with the sale or in preparing the property for sale, or, if retained, the amount at which the material recoverable is chargeable to materials and supplies, or other appropriate account.

"Straight-Line Remaining Life Method", as applied to depreciation accounting, means the plan under which the service value of property is charged to operating expenses (and to clearing accounts if used), and credited to the accumulated depreciation account through equal annual changes during its service life. "Remaining Life" implies that estimates of the future life and salvage shall be reexamined periodically and that depreciation rates will be corrected to reflect any changes in these estimates.

DEFINITIONS
(Continued)

"Supply Main" means any main, pipe, or aqueduct or canal whose primary purpose is to convey raw untreated water from one unit to another unit in the source of supply and pumping plant, and to the water treatment equipment.

"Transmission Main" means any pipes whose primary purpose is to convey treated water from the water treatment equipment or pumping station to the distribution system serving a community and generally provides no service connections with customers.

"Utility" as used herein and when not otherwise indicated in the context, means any public utility to which the uniform system of accounts is applicable

100. VOTING POWERS and ELECTIONS

This schedule is to be completed only by publicly held Corporations. Subsidiaries who are 100% owned by others should not complete this schedule.

1. Has each share of stock the right to one vote? Yes/No

2. Are voting rights attached only to stock? Yes/No (If the answer to either query 1 or 2 is "No," give particulars.)

3. Give date of the latest closing of the stock book prior to end of year and state the purpose of such closing

4. Is cumulative voting permitted? Yes/No

5. State the total number of Board or Directors meetings held during year

6. State the date and place of the latest general meeting held prior to the end of the year for the election of directors

7. State the total number of votes cast at the latest general meeting and the total number cast by proxy

8. State the total number of voting security holders and the total of all voting securities as of December 31

9. If any security has preferences, special privileges, or restrictions in the election of directors, trustees or managers, or in the determination of any corporate action, give details

10. State the number of votes controlled by management, other than officers of the Corporation

101. SECURITY HOLDER INFORMATION AND VOTING POWERS

1 Report the requested information for each holder of one percent or more of the voting securities or, if there are fewer than ten such holders, the ten who hold the highest voting powers. Data should be the latest available at the end of the year. When the holder of record is a trustee, or other intermediate agency (except a corporation), the data should be reported opposite the names of the beneficial owners, designated as such, under a general heading identifying the trustee or other agency. Securities with contingent voting rights may be disregarded.

2 Attach hereto a certified copy of every effective voting trust established and a certified copy of every other agreement (trustee or otherwise) under which voting securities are held for beneficial owners. If any such agreement has been filed with a previous report, reference to the earlier report will be sufficient, provided that changes or modification since previous filing are shown.

Line No	Name of Security Holder (a)	(b)	Street Address (c)	City (d)	State (e)	Zip (f)	Voting Securities Number of votes as of December 31, 2005 Total Votes (g)	Common Stock (h)	Preferred Stock (i)	Other (j)	Nonvoting Securities (See Instruction #2) Principal, Par Value, or Stated Value (Specify issue - omit cents) (k)
1	RWE		1025 Laurel Oak Road	Voorhees	NJ	08043	3,910,343	3,910,343			
2											
3											
4	4 1/2% - 88 shareholders (ChaseMellon										
5	Shareholder Service)						17,202		17,202		
6											
7	8.40% Cuss & Co						120,000		120,000		
8											
9	9.35%-Nationwide Mutual Fire Insurance Co						2,735		2,735		
10											
11	9.75% - Nationwide Mutual Insurance C0.						1,780		1,780		
12											
13											
14											
15											
16	Total votes of all voting securities	4,052,060									
17	Total number of security holders	92									
18	Total votes of security holders listed above	3,910,343									

102. COMPANIES CONTROLLED BY RESPONDENT

Shew below the names of all corporations, business trusts, and similar organizations, controlled directly or indirectly by respondent at any time during the year

1. If control ceased prior to end of the year, give particulars in a footnote
2. If control was by other means than a direct holding of voting rights, state in a footnote the manner in which control was held, naming any intermediates involved.
3. If control was held jointly with one or more other interests, state the fact in a footnote and name the other interests.

Line No	Name of Company Controlled (a)	Kind of Business (b)	Street Address (c)	City (d)	State (e)	Zip (f)	Voting % of Stock (g)	Footnote Ref. (h)
1	None							
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								

FOOTNOTES:

1. Direct control is that which is exercised without interposition of an intermediary.
2. Indirect control is that which is exercised without interposition of an intermediary which exercises direct control. Control may exist by mutual agreement or understanding between two or more parties who together have control within the meaning of the definition of control in the NARUC System of Accounts, regardless of the relative voting rights of each party
3. Joint control is that in which neither interest can effectively control or direct action without the consent of the other, as where the voting control is equally divided between two holders, or each party holds a veto power over the other. Joint control may exist by mutual agreement or understanding between two or more parties who together have control within the meaning of the definition of control in the NARUC System of Accounts, regardless of the relative voting rights of each party.

103. DIRECTORS

1. Provide the following information on each director of the respondent who held office at any time during the year. Include in column (a) abbreviated titles of the directors who are officers of respondent.
2. Designate by an asterisk names of members of Executive Committee, and by double asterisk the Chairman of the Executive Committee.

Line No.	Directors Name and Title (a)	Principal Business Address					Term Began (g)	Term Expires (h)	Meetings Attended (i)	Fees Paid (j)
		Street Address (b)	City (c)	State (d)	Zip (e)	Telephone (f)				
1	Daniel Warnock - President (2)	800 W. Hershey Park Dr.	Hershey	PA	17033		Apr-05	May-06	2	
2	Daniel L. Kelleher	1025 Laurel Oak Road	Voorhees	NJ	08043		May-05	May-06	2	
3	John D. McCarthy, Sr. (3)	340 Kidder St. PO Box 1125	Wilkes-Barre	PA	18703		May-05	May-06	1	14,500
4	James D. McGiveen (1)	1025 Laurel Oak Road	Voorhees	NJ	08043		May-05	May-06	2	
5	Ronald W. Simms (3)	454 South Main St. PO Box 454	Wilkes-Barre	PA	18703		May-05	May-06	2	15,000
6	John R. Bigelow (1)	1025 Laurel Oak Road	Voorhees	NJ	08043		May-05	May-06	3	
7	Christopher C. Buls	800 W. Hershey Park Dr.	Hershey	PA	17033		May-05	May-06	3	
8	William C. Kelvington	800 W. Hershey Park Dr.	Hershey	PA	17033				1	
9	Nick O. Rowe	800 W. Hershey Park Dr.	Hershey	PA	17033		Jul-05	May-06	1	
10	Robert M. Ross	1614 Nottingham Drive	Hummelstown	PA	17036		May-05	May-06	3	46,000
11	George McKenzie (4)	360 High Ridge Road	Chadds Ford	PA	19317		Apr-05	May-06	3	17,250
12	Accrual Adjustment									(1,750)
13										
14										
15										$ 91,000

1- Executive Committee
2 - Chairman of Executive Committee
3 - Audit Committee
4 - Chairman of Audit Committee

104. OFFICERS

Line No	Official Title & Name (a)	Principal Business Address						
		Street Address (b)	City (c)	State (d)	Zip (e)	Telephone (f)	Fax (g)	Email (h)
1	President - Daniel Warnock (2)	800 West Hershey Park Drive	Hershey	PA	17033	717-531-3200	717-531-3252	
2	President - Robert M. Ross (3)	800 West Hershey Park Drive	Hershey					
3	Vice-Presidents							
4	W. C. Kelvington - Resigned 7/22/05	800 West Hershey Park Drive	Hershey	PA	17033			
5	N. O. Rowe - Elected 7/22/05	800 West Hershey Park Drive	Hershey	PA	17033	717-531-3370	717-531-3252	
6	V. A. Redmond-Gen Counsel & Sec	800 West Hershey Park Drive	Hershey	PA	17033	717-531-3210	717-531-3252	
7	Treasurer & Comptroller- C. C. Buls	800 West Hershey Park Drive	Hershey	PA	17033	717-531-3225	717-531-3235	
8	Assistant Treasurer - P. T. Diskin	800 West Hershey Park Drive	Hershey	PA	17033	717-531-3253	717-531-3235	
9	Assistant Secretary							
10	S. Simms-March	800 West Hershey Park Drive	Hershey	PA	17033	717-531-3208	717-531-3252	
11	E. T. Hicks	800 West Hershey Park Drive	Hershey	PA	17033	717-531-3211	717-531-3252	
12	Asst. Comptrollers:							
13	C. A. Gilbert	800 West Hershey Park Drive	Hershey	PA	17033	717-531-3221	717-531-3235	
14	B. L. Carmack	800 West Hershey Park Drive	Hershey	PA	17033	717-531-3226	717-531-3235	
15	J. G. Easlick (1)	131 Woodcrest Road	Cherry Hill	NJ	08003	856-310-5999	856-672-2878	
16	B. J. Tartaglia, Jr. (1)	131 Woodcrest Road	Cherry Hill	NJ	08003	856-310-5999	856-672-2878	
17								
18								
19								
20								
21								
22								
23								
24								
25								

200. COMPARATIVE BALANCE SHEET
ASSETS AND OTHER DEBITS

Balances at Beginning of Year must be consistent with balances at end of previous year

Line No	Account Number and Title (a)	Schedule No. (b)	Balance Beginning of Year (c)	Balance End of Year (d)	Increase/ Decrease (e)
1	**UTILITY PLANT**		xxx	xxx	xxx
2	101.0 Utility Plant in Service	201	2,163,995,747	2,258,687,650	94,691,903
3	102.0 Utility Plant Leased To Others	202			
4	103.0 Property Held for Future Use	203	239,200	1,314,870	1,075,670
5	104.0 Utility Plant Purchased or Sold		199,566	2,024,147	1,824,581
6	105.0 Construction Work in Progress	204	35,598,934	54,128,214	18,529,280
7	106.0 Completed Construction Not Classified			(833,782)	(833,782)
8	**Total Utility Plant**		2,200,033,447	2,315,321,099	115,287,652
9	**ACCUMULATED DEPRECIATION**		xxx	xxx	xxx
10	108.1 Utility Plant in Service	205	442,456,770	479,882,961	37,426,191
11	108.2 Utility Plant Leased to Others	205			
12	108.3 Property Held for Future Use	205			
13	**Total Accumulated Depreciation**		442,456,770	479,882,961	37,426,191
14	**ACCUMULATED AMORTIZATION**		xxx	xxx	xxx
15	110.1 Utility Plant In Service				
16	110.2 Utility Plant Leased to Others				
17	**Total Accumulated Amortization**				
18	**UTILITY PLANT ADJUSTMENTS**		xxx	xxx	xxx
19	114.0 Utility Plant Acquisition Adjustments	206	18,330,479	18,348,511	18,032
20	115.0 Accumulated Amortization of Utility Plant Acquisition Adjustments		1,921,433	1,986,503	65,070
21	116.0 Other Utility Plant Adjustments				
22	**Total Utility Plant Adjustments**		20,251,912	20,335,014	83,102
23	117.0 Pending Reclass of Utility Plant	205			
24	**TOTAL NET UTILITY PLANT**		1,777,828,588	1,855,773,152	77,944,564
25	**OTHER PROPERTY AND INVESTMENTS**		xxx	xxx	xxx
26	**OTHER PROPERTY**		xxx	xxx	xxx
27	121.0 Non-Utility Property		562,955	355,806	(207,149)
28	122.0 Accumulated Depreciation & Amortization of Non-Utility Property		(26,384)	(69,461)	(43,077)
29	**Total Other Property**		536,572	286,345	(250,227)
30	**INVESTMENTS**		xxx	xxx	xxx
31	123.0 Investments in Affiliated Companies	210			
32	123.1 Other Investments	210	38,591,012	38,591,012	
33	123.2 Sinking Funds	210			
34	123.3 Other Special Funds	210			
35	124.0 Utility Investments	210			
36	125.0 Other Investments	210	1,594,547	1,459,573	(134,974)
37	126.0 Sinking Funds				
38	127.0 Other Special Funds				
39	**Total Investments**		40,185,560	40,050,585	(134,974)
40	**TOTAL OTHER PROPERTY AND INVESTMENTS**		40,722,131	40,336,930	(385,201)

* The assets do not equal the liabilities due to this balance sheet containg water only information

200. COMPARATIVE BALANCE SHEET
CURRENT ASSETS AND OTHER DEBITS

Balances at Beginning of Year must be consistent with balances at end of previous year

Line No	Account Number and Title (a)	Schedule No (b)	Balance Beginning of Year (c)	Balance End of Year (d)	Increase Decrease (e)
1	CURRENT AND ACCRUED ASSETS		XXX	XXX	XXX
2	131.1 Cash on Hand				
3	131.2 Cash in Bank		8,699,784	4,163,200	(4,536,584)
4	132.0 Special Deposits - Interest and Dividends				
5	133.0 Other Special Deposits		104,022	76,422	(27,600)
6	134.0 Working Funds		3,425	3,325	(100)
7	135.0 Temporary Cash Investments	210			
8	141.0 Customers Accounts Receivable		38,580,812	33,933,722	(4,647,090)
9	142.0 Other Accounts Receivable	211	15,061,706	2,336,709	(12,724,997)
10	143.0 Accumulated Provision for Uncollectible Accounts-Credit		(2,535,246)	(4,244,241)	(1,708,995)
11	144.0 Notes Receivable	211			
12	145.0 Accounts Receivable from Affiliated Company	213	0	77,602	77,602
13	146.0 Notes Receivable from Affiliated Company	212			
14	151.0 Plant Materials and Supplies	214	3,571,816	3,002,252	(569,564)
15	152.0 Merchandise				
16	153.0 Other Materials and Supplies				
17	161.0 Stores Expense				
18	162.0 Prepayments	215-218	1,646,689	1,469,480	(177,209)
19	171.0 Accrued Interest & Dividends Receivable		13,067	12,260	(807)
20	172.0 Rents Receivable				
21	173.0 Accrued Utility Revenues		41,635,377	42,325,198	689,821
22	174.0 Miscellaneous Current & Accrued Assets	216	3,139,384	4,045,452	906,068
23	TOTAL CURRENT & ACCRUED ASSETS		109,920,837	87,201,381	(22,719,456)
24	DEFERRED DEBITS		XXX	XXX	XXX
25	181.0 Unamortized Debt Discount and Expense	217	18,479,679	16,760,720	(1,718,959)
26	182.0 Extraordinary Property Losses	218			
27	183.0 Preliminary Survey and Investigation Charges	219	7,128,916	6,115,150	(1,013,766)
28	184.0 Clearing Accounts	220	88,896	2,044	(86,852)
29	185.0 Temporary Facilities				
30	186.1 Deferred Rate Case Expense	221	690,391	75,521	(614,870)
31	186.2 Other Deferred Debits	222	72,693,718	43,187,357	(29,506,361)
32	186.3 Regulatory Assets		106,261,704	107,187,962	926,258
33	187.0 Research & Development Expenditures				
34	190.1 Accumulated Deferred Federal Income Taxes	419-420			
35	190.2 Accumulated Deferred State Income Taxes	419-420			
36	TOTAL DEFERRED DEBITS		205,343,304	173,328,754	
37	TOTAL ASSETS & OTHER DEBITS		2,133,814,861	2,156,640,217	22,825,357

200. COMPARATIVE BALANCE SHEET
LIABILITIES AND OTHER CREDITS

Balances at Beginning of Year must be consistent with balances at end of previous year

Line No	Account Number and Title (a)	Schedule No. (b)	Balance Beginning of Year (c)	Balance End of Year (d)	Increase/ (Decrease) (e)
1	EQUITY CAPITAL & LIABILITIES		XXX	XXX	XXX
2	EQUITY CAPITAL		XXX	XXX	XXX
3	201.0 Common Stock Issued		21,506,887	21,506,887	
4	202.0 Common Stock Subscribed				
5	203.0 Common Stock Liability for Conversion				
6	204.0 Preferred Stock Issued		14,171,700	14,171,700	
7	205.0 Preferred Stock Subscribed				
8	206.0 Preferred Stock Liability for Conversion				
9	207.0 Premium on Capital Stock		86,702,612	86,702,612	
10	209.0 Reduction in Par or Stated Value of Capital Stock				
11	210.0 Gain on Resale or Cancellation of Reacquired Capital Stock		200,199	200,809	610
12	211.0 Other Paid-In Capital		341,079,582	371,079,582	30,000,000
13	212.0 Discount on Capital Stock				
14	213.0 Capital Stock Expense				
15	214.0 Appropriated Retained Earnings	223	707,530	707,530	
16	215.0 Unappropriated Retained Earnings	223	225,027,546	234,600,521	9,572,975
17	216.0 Reacquired Capital Stock				
18	218.0 Proprietary Capital (For proprietorships & partnerships)				
19	TOTAL EQUITY CAPITAL		689,396,056	728,969,641	39,573,585
20	LONG-TERM DEBT		XXX	XXX	XXX
21	221.0 Bonds	224	909,816,009	857,536,482	(52,279,527)
22	222.0 Reacquired Bonds	224			
23	223.0 Advances from Affiliated Companies				
24	224.0 Other Long-term Debt	224			
25	TOTAL LONG-TERM DEBT		909,816,009	857,536,482	(52,279,527)

200. COMPARATIVE BALANCE SHEET
LIABILITIES AND OTHER CREDITS

Balances at Beginning of Year must be consistent with balances at end of previous year

Line No.	Account Number and Title (a)	Schedule No. (b)	Balance Beginning of Year (c)	Balance End of Year (d)	Increase Decrease (e)
1	CURRENT AND ACCRUED LIABILITIES		XXX	XXX	XXX
2	231.00 Accounts Payable		26,835,618	26,833,253	(2,365)
3	232.00 Notes Payable	225			
4	233.00 Accounts Payable to Affiliated Companies	226	6,821,019	1,087,489	(5,733,530)
5	234.00 Notes Payable to Affiliated Companies	227	25,665,263	22,612,968	(3,052,295)
6	235.00 Customers' Deposits-Billing				
7	236.11 Accrued Taxes, Taxes Other Than Income	418	(133,993)	(117,268)	16,725
8	236.12 Accrued Taxes, Income Taxes	419-420	13,283,641	29,089,810	15,806,169
9	236.20 Accrued Taxes, Other Income & Deductions	419-20	(597,447)	(597,447)	
10	237.10 Accrued Interest on Long-term Debt		11,683,375	11,482,459	(197,916)
11	237.20 Accrued Interest on Other Liabilities				
12	238.00 Accrued Dividends				
13	239.00 Matured Long-term Debt				
14	240.00 Matured Interest				
15	241.00 Miscellaneous Current and Accrued Liabilities	228	23,301,268	23,866,034	564,766
16	TOTAL CURRENT AND ACCRUED LIABILITIES		106,855,745	114,257,298	7,401,553
17	DEFERRED CREDITS		XXX	XXX	XXX
18	251.00 Unamortized Premium on Debt	217			
19	252.00 Advances for Construction	229	77,708,251	82,277,604	4,569,353
20	252.10 Accumulated Amortization of Advances for Construction				
21	253.00 Other Deferred Credits	230	32,843,649	36,286,720	3,443,071
22	255.10 Accumulated Deferred Investment Tax Credit (Utility Operations)				
23	255.20 Accumulated Deferred Investment Tax Credit (Non-Utility Operations)		7,942,084	7,708,492	(233,592)
24	TOTAL DEFERRED CREDITS		118,493,984	126,272,816	7,778,832
25	OPERATING RESERVES		XXX	XXX	XXX
26	261.00 Property Insurance Reserve				
27	262.00 Injuries & Damages Reserve				
28	263.00 Pensions & Benefits Reserve				
29	265.00 Miscellaneous Operating Reserve				
30	TOTAL OPERATING RESERVES				
31	CONTRIBUTIONS IN AID OF CONSTRUCTION (CIAC)		XXX	XXX	XXX
32	271.10 Customer Contributions		80,764,591	90,419,741	9,655,150
33	271.20 Developer Contributions				
34	271.30 Grant(s) in Aid				
35	271.40 Other				
36	272.00 Accumulated Amortization		(21,194,869)	(23,033,189)	(1,838,320)
37	TOTAL NET (CIAC)		59,569,722	67,386,552	7,816,830
38	ACCUMULATED DEFERRED INCOME TAXES				XXX
39	281.00 Accelerated Amortization				
40	282.00 Liberalized Depreciation		274,133,296	287,774,826	13,641,530
41	283.00 Other				
41	TOTAL ACCUMULATED DEFERRED INCOME TAXES		274,133,296	287,774,826	13,641,530
42	TOTAL LIABILITIES & OTHER CREDITS		2,158,264,813	2,182,197,615	23,932,803

* The assets do not equal the liabilites due to this balance sheet containg water only information

201. UTILITY PLANT IN SERVICE - Account No. 101.0

1 Report by prescribed accounts the original cost of utility plant in service and the additions and retirements of such plant during the year
2 Do not include as adjustments, corrections to additions and retirements for the current or preceding year. Such items should be included in appropriate Column (c) or (d).
3 Credit adjustments in Column (e) should be shown in red, or in black enclosed in parentheses. State in a footnote the general character of any adjustments in Column (e).
4 Submit, in a footnote, an explanation of amounts included in Columns (c) and/or (f). Line 34, for lowering or changing the location of mains

Line No	Account Number and Title (a)	Balance Previous Year (b)	Additions (c)	Retirements (d)	Adjustments +/- (e)	Balance End of Year (f)
1	.1 INTANGIBLE PLANT	XXX	XXX	XXX	XXX	XXX
2	301.10 Organization	588,931				588,931
3	302.10 Franchises	2,400,958				2,400,958
4	339.10 Other Plant and Miscellaneous Equipment	4,299,861	10,275		(2,834)	4,307,302
5	Total Intangible Plant	7,289,751	10,275		(2,834)	7,297,191
6	.2 SOURCE OF SUPPLY AND PUMPING PLANT	XXX	XXX	XXX	XXX	XXX
7	303.20 Land and Land Rights	4,251,613	48,032	10,797		4,288,848
8	304.20 Structures and Improvements	11,109,158	2,186,467	4,829		13,290,796
9	305.20 Collection and Impounding Reservoirs	29,710,431		7,293		29,703,138
10	306.20 Lake, Rivers and Other Intakes	17,790,576	48,578	86,025		17,753,129
11	307.20 Wells and Springs	7,324,976	202,411	42,233		7,485,154
12	308.20 Infiltration Galleries and Tunnels	81,294				81,294
13	309.20 Supply Mains	2,957,548		588		2,956,960
14	310.20 Power Generation Equipment	2,597,462	506,735			3,104,197
15	311.20 Pumping Equipment	718,141	567,740	21,343	21,343	1,285,881
16	339.20 Other Plant and Miscellaneous Equipment					
17	Total Source of Supply and Pumping Plant	76,541,200	3,559,963	173,109	21,343	79,949,397
18	.3 WATER TREATMENT EQUIPMENT	XXX	XXX	XXX	XXX	XXX
19	303.30 Land and Land Rights	2,462,607	2,134	49,981		2,414,759
20	304.30 Structures and Improvements	180,060,118	1,859,125	543,375	(65,680)	181,310,188
21	310.30 Power Generation Equipment					
22	311.30 Pumping Equipment	56,933,836	336,430	527,282		56,742,984
23	320.30 Water Treatment Equipment	214,659,683	3,582,673	2,307,855	76,660	216,011,161
24	339.30 Other Plant and Miscellaneous Equipment	12,149	10,960		(12,149)	
25	349.30 Instrumentation					
26	350.30 Wastewater Treatment Equipment					
27	Total Water Treatment Equipment	454,128,393	5,791,321	3,428,493	(1,169)	456,490,052
28	.4 TRANSMISSION AND DISTRIBUTION PLANT	XXX	XXX	XXX	XXX	XXX
29	303.40 Land and Land Rights	6,978,543	157,812	126,483		7,009,872
30	304.40 Structures and Improvements	9,502,445	827,325	9,938	1,169	10,321,001
31	310.30 Power Generation Equipment					
32	311.40 Pumping Equipment	1,836,820	154,243	38,930		1,952,133
33	330.40 Distribution Reservoirs and Standpipes	85,453,832	4,444,753	1,010,764	(21,343)	88,866,478
34	331.40 Transmission and Distribution Mains	1,011,119,211	60,793,538	1,782,348	760,665	1,070,891,067
35	333.40 Services	270,212,120	19,775,619	783,923		289,203,817
36	334.40 Meters and Meter Installations	92,256,122	4,163,570	7,170,704		88,248,989
37	335.40 Hydrants	39,716,723	2,425,841	82,669		42,059,895
38	336.40 Backflow Prevention Devices					
39	339.40 Other Plant and Miscellaneous Equipment					
40	Total Transmission and Distribution Plant	1,516,075,817	92,742,702	11,005,758	740,491	1,598,553,251
41	.5 GENERAL PLANT	XXX	XXX	XXX	XXX	XXX
42	303.50 Land and Land Rights	2,489,792		26,231	(23,587)	2,439,974
43	304.50 Structures and Improvements	22,381,726	687,314	150,615	26,422	22,944,846
44	340.50 Office Furniture and Equipment	49,016,749	2,522,928	56,922		51,482,755
45	341.50 Transportation Equipment	518,543	1,514	144,832		375,225
46	342.50 Stores Equipment	340,858	4,433	1,013		344,258
47	343.50 Tools, Shop and Garage Equipment	7,132,616	532,300	116,282		7,548,634
48	344.50 Laboratory Furniture & Equipment	3,450,426	25,298	54,072		3,421,655
49	345.50 Power Operated Equipment	3,129,684	87,625	40,010		3,177,300
50	346.50 Communication Equipment	5,226,259	951,220	21,443		6,156,036
51	347.50 Miscellaneous Equipment	9,306,379	2,278,251	45,228		11,539,502
52	348.50 Other Tangible Plant	26,322				26,322
53	Total General Plant	103,019,337	7,090,983	656,648	2,834	109,456,507
54	TOTAL WATER PLANT-IN-SERVICE	2,157,054,497	109,195,244	15,264,008	760,665	2,251,746,398
	Regulatory Asset - AFUDC Debt	6,941,252				6,941,252
		2,163,995,749				2,258,687,650

202. UTILITY PLANT LEASED TO OTHERS SUPPORTING SCHEDULE Account No. 102.0

This schedule should include a breakdown of the accounts that constitute the ending balance in Account No. 102.0 - Utility Plant Leased to Others.

Line No.	Name of Lessee (a)	Balance Previous Year (b)	Additions (c)	Retirements (d)	Adjustments (e)	Balance at End of Year (f)
1						
2	None					
3						
4						
5						
6						
7	TOTALS					

203. PROPERTY HELD FOR FUTURE USE SUPPORTING SCHEDULE Account No. 103.0

Insert in Column (a) the titles of the applicable primary accounts for Plant in Service and the details regarding Account No. 103.0 - Property Held For Future Use

Line No.	Item (a)	Anticipated in Service Date (b)	Balance at Beginning of Year (c)	Additions During Year (d)	Transfers to Plant in Service (e)	Balance at End of Year (f)
1	SS Land-Susquehanna River		61,588			61,588
2	SS Land - Kane Wells					
3	#4 & #5		21,814			21,814
4	Dist. Tower Land-New Castle		45,115			45,115
5	T & D Land-Pittsburgh		26,975			26,975
6	Pennhurst Property		46,716			46,716
7	Citizens Acquisition		36,991			36,991
8	108 Acres Steigerwalt Hollow Rd			1,075,670		1,075,670

204. CONSTRUCTION WORK IN PROGRESS - Account No. 105.0

1. Describe the particulars concerning utility plant in process of construction but not ready for service at end of Calendar Year.
2. Describe separately each work order that exceeds an estimated expenditure of $250,000 or 1%, whichever is lesser, of the book cost of utility plant at the beginning of the year. All minor work orders may be grouped by nature of project.

Line No.		Description of Work	Balance End of Year	Estimate Total Cost of Construction	Projected In-Service Date
		(a)	(b)	(c)	(d)
1	50012338	LAKE SCRANTON TUNNEL REHAB	191,883	300,000	2010
2	50014506	Harkins Farm - Water	3,661	250,000	2006
3	50014509	Mendenhall Property - Water	3,487	250,000	2006
4	50028592	WA*RES DAM	535,063	600,226	2006
5	50030855	Crane Tract - Water	5,280	1,500,000	2008
6	50039980	WSRIP	34,610,922	29,899,325	2006
7	50055909	Reading Int Treatment System	274,430	400,000	2006
8	50059482	ST DC Replace Wtr Ln No 22	304,330	12,150,000	2006
9	50062391	INS ONE BOOSTER STATION	439,079	440,000	2006
10	50068002	Booster Station State Hill Tnk	391,770	2423300	2006
11	50070149	APX 900-36" DR U CECELIA ST	85,200	353,557	2007
12	50076792	INS 11945 LF 12" Kimberton Est	8,756	1,121,327	2007
13	50079086	Scott Farm - Water	26,684	250,000	2008
14	50079101	INS 3610 LF 12" MAIN LNA	18,569	327,611	2007
15	50081978	Hampton Twp Tank	4,605,067	5,261,955	2006
16	50085308	HUNTERS RIDGE/MANCHESTER FARMS	194,629	269,000	2006
17	50085313	W 36058" 12" ALAMAE LAKES PROJ	938,345	1,705,014	2006
18	50085315	W 68208" ALAMAE LAKES PROJ	2,216	335,892	2006
19	50085679	W 16000 12" RT 231	363,547	1,034,992	2006
20	50086419	CHURCH RD MOR TAINTOP 4800 LF"	198,131	278,000	2006
21	50086623	INS 13065 LF 8" DIP	1,012	629,000	2006
22	50088141	INS 2360 LF 12" DIP	3,223	334,670	2006
23	50088906	DENICO BODY KUTZ	1,560	1,071,500	2007
24	50089925	Annis Toilet Interconnect	1,736,575	3,994,275	2007
25					
26					
27					
28	3040	Land & Water Rights	1,139		
29	3034	T & D Land	16,495		
30	304	Chemical Feed	322,391		
31	3042	Source of Supply Structures	6,281		
32	3043	Water Treatment Structures	608,603		
33	3044	T & D Structures	29		
34	3045	Misc. Structures	36,925		
35	3070	Wells & Springs	951,393		
36	3110	Pumping Equipment	306,817		
37	3200	Water Treatment Equipment	596,083		
38	3300	Distribution Lyers	219,360		
39	3310	Water Mains	2,230,344		
40	3330	Services	3,840		
41	3340	Meters	65,698		
42	3350	Hydrants	53,314		
43	3390	Comprehensive Planning Studs	11,678		
44	3402	Computer Equipment	92,133		
45	3403	Computer Software	2,076,872		
46	3460	Communication Equipment	9,967		
47	3473	Miscellaneous Equipment	183,915		
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58		TOTALS	554,128,214	563,310,345	

205. ACCUMULATED DEPRECIATION OF UTILITY PLANT - Account Nos. 180.1, 180.2, 180.3 and 117.0

1 Report below an analysis of the changes in accumulated depreciation during the year and the amounts applicable to prescribed functional classifications.
2 Explain and give particulars of important adjustments during the year.

Line No	Item (a)	Account No. Total (b)	108.1 Utility Plant In Service (c)	108.2 Utility Plant Leased to Others (d)	108.3 Property Held for Future Use (e)	117.0 Operating Plant Pending Reclassification (f)
1	**Balance Beginning of Year**	442,673,224	442,673,224			
2	Credits During Year:	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX
3	Depreciation Provisions charged to:	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX
4	403. Depreciation	56,853,848	56,853,848			
5	413. Income from Utility Plant Leased to Others					
6	Properties Acquired					
7						
8						
9						
10	**Total Depreciation Provisions**	56,853,848	56,853,848			
11	Recoveries from Insurance					
12	Salvage Realized from Retirements	127,532	127,532			
13	Other Credits (Describe)					
14	Sale of Scrap	27,780	27,780			
15	Accumulated Depreciation on acquired property					
16	Depreciation charged to contributed property	1,838,319	1,838,319			
17						
18	**Total Credits During Year**	2,043,631	2,043,631			
19	**Total Credits**	58,897,479	58,897,479			
20	Debits During Year	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX
21	Retirement of Utility Plant	15,006,021	15,006,021			
22	Cost of Removal	6,511,125	6,511,125			
23	Other Debits (Describe)					
24	Adjust between water and sewer	170,596	170,596			
25						
26						
27						
28	**Total Debits During Year**	21,687,742	21,687,742			
29	**Balance at End of Year**	479,882,961	479,882,961			

Describe the basis upon which depreciation provisions for the year were determined and attach worksheets showing the computations made in arriving at the annual provisions.

206. UTILITY PLANT ACQUISITIONS ADJUSTMENTS - Account No. 114.0

Line No.	Item (a)	Project No. 1 Amount (b)	Project No. 2 Amount (c)	Project No. 3 Amount (d)	Project No. 4 Amount (e)	Totals (f)
1	Book Plant - Net					
2	PUC Difference (Ratemaking)	See				
3	Less Contributions (Net)	Attached				
4	Net Utility Plant Acquired	for Detail				
5	Purchase Price					
6	Acquisition Adjustment					
7						
8						

PENNSYLVANIA AMERICAN WATER
AMORTIZATION OF UTILITY PLANT ACQUISITION ADJUSTMENT

WORK ORDER	DIVISION	SUB LEDGER	YEAR ACQ	114100 A/C 114	PRIOR YEARS AMORT	CURRENT YEAR AMORT	BALANCE AS OF 12/31/2003
	WEST						
	Summit Township	AQ240020	1993	($344,205.75)	$344,205.75	0.00	$0.00
A-6050	Penn Florence Acq	AQ240012	1994	-88,570.21	88,570.23	(0.02)	$0.00
A-7089	Clarion Twp Assets	AQ240052	1998	(569,800.83)	388,363.77	56,980.06	($123,456.80)
A-7450	Franklin Manor Utilities Acq	AQ240059	1998	(111,184.42)	70,416.82	11,118.42	($29,649.18)
A-7701	Taylor Twp Acq	AQ240060	1998	(715,996.05)	435,564.24	71,599.63	($208,832.18)
20205&20206	Applewold Boro Water System Acq	AQ240062	1999	129,182.52	(75,356.46)	(12,918.26)	$40,907.80
20160	Cedar Grove Water Assoc Acq	AQ240063	1999	(10,607.69)	5,834.25	1,060.75	($3,712.69)
23819	Center Twp Acquisition	AQ240065	1999	(1,368,110.60)	879,490.15	141,378.21	($547,244.24)
20159	Independence Twp Water Auth Acq	AQ240064	1999	(372,853.14)	205,069.23	37,285.31	($130,498.60)
23702	Koppel Water System Acquisition	AQ240066	1999	144,032.40	(72,016.20)	(14,403.24)	$57,612.96
	Franklin Twp Acquisition	AQ240069	2000	(452,722.83)	199,952.58	45,272.29	($207,497.96)
26382	Statlerville Acq	AQ240068	2000	107,936.77	(51,269.94)	(10,793.70)	$45,873.13
	Butler Twp Acquisition	AQ240072	2004	(205,368.07)	77,013.02	20,536.81	($107,818.24)
	Conneaueessing Boro	AQ240081	2004	210,446.26	(28,059.51)	(21,044.62)	$161,342.13
AQ240071	T O W Acquisition	AQ240071	2001	(435,268.86)	170,450.30	43,526.89	($221,291.67)
AQ240011	Smith Township	AQ240011	1990	(93,057.82)	93,057.82	0.00	$0.00
	Shippenville	AQ240080		(2,689.23)		201.69	($2,487.54)
	Sligo	AQ240079	2004	(130,772.74)		17,436.37	($113,336.37)
	Total West			(4,309,610.09)	2,532,316.05	387,234.58	(1,390,059.46)
	EAST						
A-3032M	Country Place	AQ240029	1995	(598,070.65)	571,234.07	24,836.58	0.00
A-3066	Hickory Water Co Acq	AQ240027	1995	(431,480.38)	384,678.00	38,802.38	0.00
A-3067	Pocono Farms East Acq	AQ240030	1995	(503,166.82)	456,948.72	46,118.10	0.00
A-3068	Sewer Water Co. Acq. (Mechanicsburg)	AQ240028	1995	(180,611.43)	164,055.42	16,556.01	0.00
A-4424	Skyline Water Company (Milton)	AQ240036	1993	(4,492.53)	4,492.53	0.00	0.00
A-2411	Gregg	AQ240041	1994	2,200.87	(2,200.87)	0.00	0.00
A-2740	Morris Township	AQ240042	1996	(309,023.38)	349,145.42	39,902.38	(9,975.58)
A-4785	Westford Acquisition	AQ240037	1996	27,087.10	(22,798.34)	(2,708.68)	1,580.08
A-5452 & 20380	Evansburg Acquisition	AQ240061	1998	(440,405.47)	260,573.27	44,040.51	(135,791.69)
	Fox Knoll Acquisition	AQ240073	2004	51,756.36	(19,408.61)	(5,175.86)	27,172.09
	Sandy Ridge Acquisition	AQ240077	2004	(161,188.98)	21,491.86	16,118.90	(123,578.22)
	Abington Twp	AQ240025	1990	(5,368.98)	(5,368.98)	0.00	0.00
	West Decatur Acquisition	AQ240076	2003	(85,239.23)	15,623.85	8,527.27	(61,088.11)
	Total East			(2,685,205.54)	2,158,506.34	225,017.77	(301,681.43)
	NORTHEAST						
	PG & W Acq(Shickshinny & Mocanaqua)	AQ240044	1996	287,912.51	(287,912.51)	0.00	0.00
	PG & W Acq(Ocean City Acq)	AQ240045	1996	(357,033.72)	64,712.38	8,925.84	(283,395.52)
	PG & W Acq (1994 Merger)	AQ240046	1996	29,691.34	(5,381.58)	(742.26)	23,567.50
	PG & W Acquisition (PG&W 1950)	AQ240047	1996	14,583,383.31	(2,645,050.71)	(364,834.60)	11,583,498.00
	PG & W Acquisition (PAWC)	AQ240048	1996	3,408,361.80	(617,765.55)	(85,259.07)	2,705,387.18
A-4364	Pocono Mtn Industrial Park	AQ240049	1998	(833,712.18)	555,808.11	83,371.23	(194,532.84)
A-4365	Fairview Water Co	AQ240050	1998	(1,113,747.44)	742,498.29	111,374.75	(259,874.40)
A-4366	NUI Pocono Acq	AQ240051	1998	105,544.13	(70,362.72)	(10,554.45)	24,626.96
A-5350	Greene Valley Water Co Acq	AQ240053	1998	(5,858.00)	3,758.58	585.80	(1,513.32)
A-5013	Tobyhanna fire protection system Acq	AQ240054	1998	360.00	(228.00)	(36.00)	96.00

25909	Elk Forest Acquisition	AG240058	2003	(68,084.19)	27,801.04	8,808.42	33,474.73)
	Skytop	AG240078	2003	3,687.87	(49[illegible]2)	(278.59)	2,919.56
	Rustic Acres	AG24-0082	2003	24,321.99	(3,242.93)	(2,229.52	18,849.54
	Total Northeast			18,054,827.42	(2,215,857.04)	(257,815.43)	13,586,153.95
	POCONO						
50007788	MID-MONROE		Aug-02	(12,578.11)	2,830.07	1,257.82	(8,490.22)
	Total Pocono			(12,578.11)	2,830.07	1,257.82	(8,490.22)
	COATESVILLE						
	Coatesville Water Co. Acquisition	114650	2001	438,746.25	(164,529.84)	(43,874.63)	230,341.78
	Total Coatesville			438,746.25	(164,529.84)	(43,874.63)	230,341.78
	LEHMAN PIKE						
24025587	LEHMAN PIKE WATER		May-02	537,365.12	(134,341.28)	(53,736.51)	349,287.33
	Total Lehman Pike			537,365.12	(134,341.28)	(53,736.51)	349,287.33
	CITIZENS'						
	Citizens Water Utilities	AG240070	2002	1,959,598.00	(312,872.84)	(37,624.29)	1,609,100.87
	Citizens Water Utilities			6,365,368.52	(145,230.67)	(159,776.33)	6,060,361.28
	Total Citizens'			8,324,966.52	(458,103.51)	(197,400.62)	7,669,462.15
	TOTAL PA AMERICAN WATER			$18,348,511.67	$1,920,820.55	$65,681.97	120,335,014.09

210. INVESTMENTS - Account Nos. 123.0, 124.0, 125.0, and 135.0

1. Report below investments in Account No. 123.0, Investments in Affiliated Companies, Account No. 124.0, Utility Investments; Account No. 125.0, Other Investments; and Account No. 135.0, Temporary Cash Investments.
2. Provide a subheading for each account and list thereunder the information called for, observing the instructions below.
3. Investments in Securities - List and describe each security owned, giving name of issuer. For bonds give also principal amount, date of issue, maturity, and interest rate. For capital stock state number of shares, class and series of stock. Minor investments may be grouped by classes.
4. Investment Advances - Report separately for each person or company the amounts of loans or investment advances which are subject to repayment but which are not subject to current settlement. With respect to each advance show whether the advance is a note or open account. Each note should be listed giving date of issuance, maturity date, and specifying whether note is a renewal. Designate any advances due from officers, directors, stockholders, or employees.
5. For any securities, notes, or accounts that were pledged, designate such securities, notes, or accounts and in a footnote state the name of pledgee and purpose of the pledge.
6. If Commission approval was required for any advance made or security acquired, designate such fact and in a footnote give date of authorization and case or docket number.
7. Interest and dividend revenues from investments should be reported in Column (g), including such revenues from securities disposed of during the year.
8. In Column (h) report for each investment disposed of during the year, the gain or loss represented by the difference between cost of the investment (or the other amount at which carried in the books of account if different from cost) and the selling price thereof, not including any dividend or interest adjustment included in Column (g).

Line No	Description of Investment (a)	Date Acquired (b)	Date of Maturity (c)	Book Costs* Beginning of Year (d)	Principal Amount or No. of Shares (e)	Book Cost End of Year (f)	Revenues For Year (g)	Gain or (Loss) From Invest. Disposed of (h)
1								
2	Coatesville Acquisition							
3	Parksburgh #1 Sewer Revenue Bond	3/22/2001		12,068				
4	Parksburgh #2 Sewer Revenue Bond	3/22/2001		1,456,300		1,359,400		
5	Sadsbury Township Note	3/22/2001		126,179		100,173		
6								
7								
8								
9	Sub Total			1,594,547		1,459,573		
10								
11	Citizen's Acquisition							
12	Goodwill	1/1/5/02		26,191,012		26,191,012		
13	Intangibles with indefinite life	1/1/5/02		12,400,000		12,400,000		
14								
15	SUB-TOTAL			38,591,012		38,591,012		
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26	TOTALS			40,185,559		40,050,585		

* If book cost is different from cost to Utility, give cost to Utility in a footnote and explain difference.

211. NOTES AND OTHER ACCOUNTS RECEIVABLE - Account Nos. 142.0 and 144.0

If interest was derived during year from notes liquidated before the end of the year, include such interest revenue in Column (d).

Line No.	Item (a)	Notes Receivable			Accounts Receivables	
		Beginning 1/1/____ (b)	Ending 12/31/____ (c)	Interest Revenue (d)	Beginning 1/1/05 (e)	Ending 12/31/05 (f)
1	Misc A/R Customer Related				1,153,475	1,271,494
2	Misc A/R Manual				1,401,894	481,626
3	Misc A/R Collections by Others				(6,980)	
4	Misc A/R uncollectible					(18,400)
5	FIT Refund Receivable				12,442,415	106,080
6	SIT Refund Receivable				70902	495,909
7	TOTALS				15,061,706	2,336,709

212. NOTES RECEIVABLE FROM AFFILIATED COMPANIES - Account No. 146.0

1. Furnish below the particulars indicated concerning notes receivable from affiliated companies at end of year.
2. If any note was received in satisfaction of an open account indebtedness, state the period covered by such open account.
3. Include in Column (f) the amount of any interest revenue during the year on notes that were paid off before the end of the year.
4. Give particulars of any notes pledged or discounted.

Line No.	Name of Affiliated Company (a)	Date of Issue (b)	Date of Maturity (c)	Amount at End of Year (d)	Interest Rate (e)	Amount (f)
1						
2	None					
3						
4						
5						
6						
7						
8	TOTALS					

213. ACCOUNTS RECEIVABLE FROM AFFILIATED COMPANIES - Account No. 145.0

1. Furnish below the particulars called for concerning each Account Receivable from Affiliated Companies.
2. The term "Services Received" set forth on Line 22 of this schedule means the Management, Construction, Engineering, Purchasing, Legal, Accounting or other similar service which has been rendered to Utility under written, oral or implied contract.
3. The term "Joint Expenses Transferred" set forth on Line 23 means Central office and/or other expenses continuously assessed against respondent covering all locations of common operating costs
4. This schedule shall include all transactions during the year with each affiliated interest affecting Account No. 145.0 and Account No. 234.0. If the latter is offset against Account No. 145.0, even though there were no outstanding balances at the beginning and end of year, and regardless of whether or not the transactions were recorded in Account Nos. 145.0 or 234.0.

Line No.	Item (a)	Total (b)	Name Of Affiliate (c)	(d)	(e)	(f)
1	**Balance at Beginning of Year**					
2	**Debits During Year**	XXX	XXX	XXX	XXX	XXX
3	Cash Dispensed	256,635	256635			
4	Materials and Supplies Sold					
5	Services Rendered					
6	Joint Expense Transferred					
7	Interest and Dividends Receivable					
8	Rents Receivable					
9	Securities Sold					
10	Other Debits (Specify)					
11	Travel and Entertainment Costs					
12						
13						
14	**Total Debits During Year**	256,635	256,635			
15	**Total Debits**	256,635	256,635			
16						
17	**Credits During Year**					
18	Cash Received	179,033	179,033			
19	Water Purchased					
20	Fuel Purchased					
21	Materials and Supplies Purchased					
22	Services Received					
23	Joint Expense Transferred					
24	Interest and Dividends Payable					
25	Rents Payable					
26	Securities Purchased					
27	Transferred to Account 145					
28	Other Credits (Specify)					
29						
30						
31						
32	**Total Credits During Year**	179,033	179,033			
33	**Balance at End of Year**	$ 77,602	$ 77,602			

214. PLANT MATERIALS AND SUPPLIES - Account No. 151.0

ummarize below by character (such as chemicals, fuel oil, valves, pipe, etc.) of materials and supplies, the balance Account No. 151.0 at the beginning and end of the year.

2. Important inventory adjustments during the year of materials and supplies account shall be explained, showing the class of materials affected and the various classes of accounts (operating expenses, clearing accounts, plant accounts) debited or credited.

Line No.	Classification of Materials And Supplies (a)	Balance Beginning of Year (b)	Balance End of Year (c)	Increase (Decrease) (d)
1	Stock C - Chemicals	586,915	729,609	142,694
2	Stock D - Fuel	36,152	45,991	9,839
3	Stock E - Materials & Supplies	2,948,750	2,226,652	(722,098)
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30	Total	3,571,817	3,002,252	(569,565)

215. PREPAYMENTS SUPPORTING SCHEDULE - Account No. 162.0

This schedule should include a breakdown of the accounts that constitute the ending balance in Account No. 162.0 - Prepayments.

Line No.	Account No. (a)	Balance Beg. of Year (b)	Additions (c)	Reductions or Deletions (d)	Adjustments (e)	Balance End of Year (f)
1	Taxes - 165100	1,269,070	4,502,697	(4,608,472)		1,163,295
2	Insurance - 165200		9,861,456	(9,860,206)		1,250
3	Lotus Notes		31,982	(19,602)		12,380
4	AWW Dues		120,769	(83,176)		37,593
5	Clarion Bond	100,000			(100,000)	
6	Sales tax-backhoe	3,900	7,585	(11,485)		
7	Oracle		132,693	(34,351)		98,342
8	JDE Software	88,649	44,325	(132,974)		
9	Microsoft	41,983	115,860	(131,542)		26,301
10	Dell	2,388	89,900	(92,288)		
11	PWC Fees		260,810	(310,072)		(49,262)
12	IBM	23,413	183,010	(192,253)		14,170
13	NAWC Dues	101,191	215,885	(155,935)		161,141
	Stafford Real Estate		25,624	(21,354)		4,270
14	IBM	16,095		-16,095		
15	TOTALS	1,646,689	15,592,596	(15,669,805)	(100,000)	1,469,480

216. MISCELLANEOUS CURRENT AND ACCRUED ASSETS SUPPORTING SCHEDULE - Account No. 174.0

This Account should include a breakdown of the accounts that constitute the ending balance in Account No. 174.0 - Miscellaneous Current and Accrued Assets.

Line No.	Account No. (a)	Balance Beg. of Year (b)	Additions (c)	Reductions or Deletions (d)	Adjustments (e)	Balance End of Year (f)
1	Deferred Vacation Pay	3,139,384	1,985,703	(2,272,242)		2,852,845
2	Deferred Tax -Curr Fed		905,475			905,475
3	Deferred Tax - Curr State		287,132			287,132
4						
5						
6						
7						
8	TOTALS	$3,139,384	$3,178,310	($2,272,242)		$4,045,452

217. UNAMORTIZED DISCOUNT AND EXPENSE - Account No. 181.0 and UNAMORTIZED PREMIUM ON DEBT - Account No. 251.0

1. Report under separate subheadings for Unamortized Debt Discount and Unamortized Premium on debt securities issued or assumed and unamortized debt expense and premium on reacquired debt.
2. Show premium amounts in red or enclose in parentheses.
3. In column (b) show the principal amount of bonds or other long-term debt originally issued.
4. In column (c) show the discount and expense or premium with respect to the original issue of bonds or other long-term debt originally issued.
5. Furnish particulars regarding the treatment of unamortized debt discount and expense or premium associated with debt issues redeemed during the year. Also give the date of the Commission authorization.
6. Do not report each individual amount applicable to issues which have been redeemed, although these amounts must be written off during the current year. If Any facility fees have been capitalized, show the amount and period of amortization.
7. Explain any debits and credits other than debits to Account No. 428, Amortization of Debt Discount and Expense, or credits to Account No. 429, Amortization of Premium on Debt.

Line No.	Designation of Long-Term Debt		Date of Issue or Assumption of Securities to Which Discount, Premium, Expense or Premium Relates	Date of Maturity	Amortization Period		Balance Beginning of Year	Debits During Year	Credits During Year	Balance at End of Year
	(a)		(b)	(c)	From (d)	To (e)	(f)	(g)	(h)	(i)
1	7.8	General Mortgage Bond	150,000,000	2009-05	1999	2009	1,089,552		89,347	1,451,205
2										
3	7.38	General Mortgage Bond	3,000,000	5/31/07	1997	2007	34,167		17,083	102,498
4										
5	0.00	General Mortgage Bond	20,000,000	1/4/2003	1999	2013	301,449	0	1,896	45,732
6										
7	8.51	General Mortgage Bond	2,200,000	12/1/2006	1997	2006	7,115		6,115	1,000
8	8.82	General Mortgage Bond	10,000,000	12/1/2009	1999	2009	83,654		5,000	51,655
9	9.38	General Mortgage Bond	19,000,000	10/1/2009	1999	2009	59,583		8,518	59,166
10	9.71	General Mortgage Bond	15,000,000	6/1/2010	1990	2010	82,857		5,512	75,339
11										
12	8.56	General Mortgage Bond	12,000,000	5/31/2011	1991	2011				
13	6.28	General Mortgage Bond	6,000,000	12/1/2013	1993	2013	39,144		5,158	130,339
14	7.57	General Mortgage Bond	3,000,000	5/1/2015	1995	2015	4,421		4,421	
15	8.35	General Mortgage Bond	15,000,000	8/1/2016	1996	2016	4,308		2,180	92,355
16										
17										
18										
19										
20	1.62	Premium	999,999.99	10/2/2002	1992	2002	24,825		2,916	47,117
21	1.336	Premium	999,999.99	10/1/2003	1993	2003	50,534		4,888	46,655
22	1.453	Premium	999,999.99	10/1/2004	1994	2004	32,204		686	31,528
23	1.54	Premium	999,999.99	10/1/2005	1995	2005	34,770		2,332	32,447
24	1	Premium	2,000,000	3/1/2006	1996	2006	89,078		5,603	83,504
25	1	Premium	250,000	2/1/2007	1997	2007	10,840		1,165	9,675
26	0.00	Unamortized Debt	25,000,000	1/1/2008	1998	2008	147,994		61,817	85,177
27	8.39	Unamortized Debt					31,875		4,250	6,500
28	0.00	Unamortized Debt					1,922			1,922
29	0.00	Unamortized Debt					1,241			1,241
30	6.82	American Capital	42,000,000	12/1/2023	1993	2023	2,414,318		97,865	108,143
31	6.93	American Capital	35,000,000	12/1/2028	1998	2028	35,000		4,118	30,882
32	6.93	American Capital	6,500,543		1998	2028	6,500,543		6,514	6,494,029
33	variable	HDRB Bond	10,700,000		2003	2033	762,210		29,893	762,184
34	variable	HDRB Bond	350,000		2003	2033	24,978		10,978	14,000
35	variable	HDRB Bond	7,955,000		2003	2033	567,596		6,515	547,362
36										
37	1.62	Premium	999,999.99	10/2/2002	1992	2002	24,825		1,103	23,838
38	1.62	Premium	999,999.99	10/1/2003	1993	2003	33,975		344	33,631
39	1.39	Premium	2,000,000	10/1/2004	2004	2004	0	5,000	149	4,851
40	1	Premium	5,000,000	3/1/2006	2006	2006		20,000	760	98,559
41	5.6		40,000,000	2/1/2034	2004	2034	4,931,855	67,456	232,931	4,866,850
42	5.1		5,000,000	2/1/2034	2004	2034	1,000,000	5,000	29,896	975,104
43	7.67	Premium	5,000,000	2/1/2034	2004	2034	5,000		520	5,000
44	1.39	Premium	5,000,000	2/1/2034	2004	2034	13,000		676	12,838
45	1.39	Premium	5,000,000	2/1/2034	2004	2034	7,000		400	7,000
46	4.5		40,000,000	2/1/2034	2004	2034	2,000,000	32,000	53,389	1,978,000
47	3.95		10,000,000	2/1/2034	2004	2034	1,000,000	6,000	15,693	1,000,000
48	5.1		15,000,000	2/1/2034	2004	2034	975,000	5,000	17,583	1,968,000
		Total	621,255,000	6,134,000			8,470,078	238,456	963,885	10,760,727

218. EXTRAORDINARY PROPERTY LOSSES - Account No. 182.0

1. Report below the information called for concerning extraordinary property losses.
2. Include in the description of the property loss the date of Commission authorization.

Line No.	Description of Property Loss and Damage	Commission Order Docket No.	Authorization for Period (Years) From	To	Total Amount of Charge	Previously Written off	Written off During Year Account Charged	Amount	Balance At End of Year
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
1	None								
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15	TOTAL								

219. PRELIMINARY SURVEY AND INVESTIGATION CHARGES SUPPORTING SCHEDULE - Account No. 183.0

Please provide particulars regarding activity associated with the ending balance in Account No. 183.0 - Preliminary Survey and Investigation Charges.

Line No.	Project/ Account No. (a)	Balance at Beg. of Year (b)	Additions (c)	Reductions or Deletions (d)	Adjustments (e)	Balance at End of Year (f)
1	Business Development					
2	Project	7,048,354		(983,490)		6,064,864
3	Citizens	80,561		(30,275)		50,286
4						
5						
6						
7						
8	TOTALS	$7,128,915		($1,013,765)		$6,115,150

220. CLEARING ACCOUNTS SUPPORTING SCHEDULE - Account No. 184.0

This Schedule should include a breakdown of the accounts that constitute the ending balance in Account No. 184.0 - Clearing Accounts.

Line No.	Account No. (a)	Balance at Beg. of Year (b)	Additions (c)	Reductions or Deletions (d)	Adjustments (e)	Balance at End of Year (f)
1						
2	Capital Labor Clearing	38,930	7,377,409	(7,416,339)		
3	Backhoe Clearing	49,966	930,193	(980,159)		
4	Mngmt Study - AMR		27,335	(25,411)		1,924
5	Ingmt Study - Pipe Assmnt		2,459	(2,339)		120
6						
7						
8	TOTALS	88,896	8,337,396	(8,424,248)		2,044

221. DEFERRED RATE CASE EXPENSE SUPPORTING SCHEDULE
Account No. 186.1

Please provide particulars regarding activity associated with the ending balance in Account No. 186.1 - Deferred Rate Case Expense.

Line No.	Rate Case Docket No. (a)	Total Amount Claimed (b)	Total Amount Allowed (c)	Normalize Period (d)	Annual Expense (e)	Unamortized Ending Balance (f)
1						
2	R-38304	1,213,909	1,213,909	24 mos.	642,912	54,161
3	R-2006					21,360
4						
5						
6						
7						
8	TOTALS	$1,213,909	$1,213,909		$642,912	$75,521

222. OTHER DEFERRED DEBITS SUPPORTING SCHEDULE
Account No. 186.2

This Account should include a breakdown of the accounts that constitute the ending balance in Account No. 186.2 - Other Deferred Debits.

Line No.	Account No (a)	Balance at Beg. of Year (b)	Additions (c)	Reductions (d)	Adjustments (e)	Balance at End of Year (f)
1						
2	Preliminary Financing Exp.	59,329	3,334,921	(3,330,568)		73,682
3	Defered Pension	22,020,369	9,406,373	(4,911,726)		26,515,016
4	Preliminary Cost Property Sale	174,550	25,184	(177,189)		22,545
5	Deferred Water Billings	253,436		(233,940)		19,496
6	Deferred Customer Awareness	7,811		(7,811)		0
7	Deferred Treatment Plt Costs	1,322,633		(480,957)		841,676
8	Deferred IMO Costs	2,867,131		(2,867,131)		0
9	Deferred Acquisition Costs		4,694,450	(4,341,485)		352,965
10	Def Insurance Other Than Group	-642,908		(387,143)		(1,030,051)
11	Retirement Work In Progress	1,043,129	11,978,601	(12,948,711)		73,019
12	Merchandise & Jobbing WIP	8,168	83,120	(91,288)		(0)
13	Management Contracts		687,332	(594,288)		93,044
14	Deferred Security Costs	15,115,348		(1,664,076)		13,451,272
15	Undistributed Items	-3,004,266	6,907,269	(3,903,003)		0
16	Leased Office Alterations	627,068		(627,068)		(0)
17	I/C-Rec-Pay-Clearing	-453,760	21,271,733	(22,185,484)		(1,367,511)
18	Funds Restricted for Construction	33,285,681	460,725	(29,604,201)		4,142,205
19	Other Deferred					
20	TOTALS	72,693,718	58,849,708	(88,356,069)		43,187,357

223. STATEMENT OF RETAINED EARNINGS SUPPORTING SCHEDULE
Account Nos. 214.0 and 215.0

1. Dividends should be shown for each class and series of capital stock. Show amounts of dividends per share.
2. Show separately the state and federal income tax effect of items shown in Account No. 409.0.

Line No	Item (a)	Amounts (b)
1	**Unappropriated Retained Earnings Account No. 215.0:**	XXXXX
2	Balance Beginning of Year	225,027,546
3	Changes to Account:	XXXXX
4	Adjustments to Retained Earnings *	
5	Credits	
6	Debits dividends - common & preferred	
7	Balance Transferred From Income	9,572,975
8	Total Unappropriated Retained Earnings	234,600,521
9		
10	**Appropriated Retained Earnings Account No. 214.0:**	XXXXX
11	Total Appropriations of Retained Earnings	707,530
12	Dividends Declared:	XXXXX
13	Preferred Stock Dividends Declared	
14	Common Stock Dividend Declared	
15	Total Dividends Declared	
16	Total Appropriated Retained Earnings	707,530
17	**Total Retained Earnings**	235,308,051

* Requires Commission approval prior to use.

Notes to Retained Earnings:

224. LONG-TERM DEBT - Account Nos. 221.0, 222.0, and 224.0

(Excluding Advances from Affiliated Companies)

1. Enter below the particulars indicated of the long-term debt at end of year represented by unmatured obligations issued or assumed by the respondent, exclusive of advances from affiliated companies.
2. Group entries according to accounts and show the total for each account.
3. For obligations assumed by the respondent, show in Column (a) the name of the issuing company and the class and series of such obligations.
4. For Receivers' Certificates, show the name of the court and date of court order under which such certificates were issued.
5. If respondent has pledged any of its long-term debt securities, give particulars in a footnote, including name of the pledgee and purpose of pledge.
6. If interest expense was incurred during the year on any obligations retired or reacquired before end of year, include such interest expense in Column (g).
7. If interest has accrued but is unpaid on any obligations, state in a footnote the class, series and principal amount of such obligations and the amount of interest accrued thereon.

Line No.	Class and Series of Obligation	Nominal Date of Issue	Date of Maturity	Principal Amount Authorized	Outstanding Per Balance Sheet*	Interest For Year		Held By Respondent	
						Rate	Amount	As Reacquired Long-Term Debt	In Sinking & Other Funds
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
1	Obligations Other Than PENNVEST	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX
2	General Mortgage Bond GMBX08	12-__-97	12-1-2007	37,900,000	37,900,000	8.58%	3,251,820		
3	General Mortgage Bond GMBx78	11-__-91	11-1-2031	58,000,000	58,000,000	6.75%	3,526,480		
4	General Mortgage Bond GMBO26	9-1-96	9-1-2026	150,000,000	150,000,000	7.80%	11,700,000		
5	General Mortgage Bond GMBx208	11-__-97	11-1-2017	33,000,000	33,000,000	7.05%	2,326,400		
6	General Mortgage Bond GMBN81	11-__-91	11-1-2006	11,800,000	2,300,000	8.51%	71,832		1,100,000
7	General Mortgage Bond GMBN82	11-__-91	11-1-2031	30,000,000	30,000,000	8.83%	883,000		
8	General Mortgage Bond GMBO82	8-1-95	8-1-2005	14,000,000		7.82%	642,719		
9	General Mortgage Bond GMBO35	8-1-95	8-1-2025	30,000,000	30,000,000	8.15%	815,000		
10	General Mortgage Bond GMBO97	8-22-89	8-1-2019	15,500,000	15,500,000	9.71%	1,505,050		
11	General Mortgage Bond GMBO09	2-15-91	6-15-2021	20,000,000	20,000,000	9.69%	1,938,000		
12	General Mortgage Bond GMBO35	6-15-88	6-1-2008	29,400,000	14,700,000	9.35%	1,488,988		4,900,000
13	General Mortgage Bond GMBC58	11-__-86	12-1-2007	700,000	700,000	5.75%	1,433		350,000
14									
15									
16	Tax Exempt Bond N58	6-1-99	6-1-2039	24,000,000	23,865,000	5.05%	1,205,183		
17	AWC Loan AN2*	4-1-2001	3-30-2011	47,000,000	29,000,000	6.12%	1,085,156		
18	AWC Loan 4.92%	11-1-01	11-1-2006	73,000,000	73,000,000	4.92%	3,591,608		73,000,000
19	AWWC Loan 4.92%*	11-08-01	12-01-2006	61,619,549	61,619,549	4.92%	3,031,003		61,619,549
20	AWWC Loan variable	05-15-96	5-1-2026	6,700,000	6,700,000	var.	437,988		
21	Clarion County H34	12-10-04	12-1-09	3,165,000	3,165,000	3.60%	121,440		
22	VWWC Loan variable	09-30-91	08-15-2019	7,950,000	7,950,000	var.	466,925		
23	AWWC Loan variable	09-01-88	9-1-2018	18,250,000	18,250,000	var.	427,801		
24									
25	Luzerne County Industrial Development Authority	3-__-04	3-1-2014	80,000,000	80,000,000	4.75	3,800,000		
26	Luzerne County Refinancing	12-__-02	12-1-09	80,000,000	80,000,000	3.6%	2,880,000		
27	Luzerne County Industrial Development Authority	9-1-03	9-1-34	30,000,000	30,000,000	5.10%	1,530,000		
28	Luzerne County Industrial Development Authority	9-1-03	9-1-33	19,000,000	19,000,000	4.95%	940,500		
29	Cumberland County PLOFA	9-1-04	9-1-34	10,000,000	10,000,000	4.8%	1,921,000		
30									
31	Total Obligations Other Than PENNVEST			909,524,549	830,769,549		53,130,297		140,679,549
32	PENNVEST Obligations	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX
33	Loan # 30042	3-1-89	3-1-2009	4,000,000	958,414	4.19%	40,194		369,991
34	Loan # 00861	3-1-89	3-1-2009	3,000,000	710,533	4.19%	34,330		199,962
35	Loan # 35028	12-3-93	12-1-2013	2,500,000	1,191,518	5.45%	43,935		149,253
36	Loan # 35067	5-2-96	4-1-2011	715,221	91,332	1.00%	1,003		16,596
37	Loan # 30017	8-25-89	8-1-2009	649,000	180,022	3.25%	6,656		45,561
38	Loan # 800-1	1-8-98	1-1-2018	1,335,238	964,935	1.40%	35,699		67,261
39	Loan # 80039	4-1-2000	5-1-2018	6,600,000	4,332,833	1.00%	63,916		359,961
40	Loan # 80049	2-1-2000	3-1-2019	3,350,000	2,069,667	1.45%	67,439		114,495
41	Loan # 80078	10-1-2000	10-1-2019	1,810,000	1,527,835	1.41%	43,353		102,399
42	Loan # 80093	4-1-2000	5-1-2022	3,069,432	2,809,305	1.62%	45,801		47,858
43	Loan # 35017	10-01-2001	5-1-2033	3,757,200	2,763,594	3.00%	82,966		203,084
44	Loan # 80101	9-30-2000	9-30-2022	3,760,814	3,023,436	1.619%	50,366		141,132
45	Loan # 80109	8-30-2000	9-30-2022	4,645,458	3,641,351	1.619%	60,816		196,923
46	Loan #80133	9-01-2003	10-01-2024	1,979,330	1,937,610	1.670%	41,420		203,420
47	Loan #80134	10-1-2003	8-01-2024	4,514,950	4,361,377	1.39%	69,214		266,813
48	Loan #880038	12-11-03	8-01-26	2,594,239	2,594,196	1.39%	32,664		87,966
49	Loan #80141	10-04	2-2024	1,451,364	1,255,630	1.39%	18,459		129,917
50	Loan #84180	5-1-05	11-01-25	949,688	635,068	1%	4,983		182,964
51	Total PENNVEST Obligations			53,568,134	36,766,933		691,138		2,785,111
52	TOTAL OBLIGATIONS			963,092,683	867,536,482		53,821,435		143,464,660

* Total amount outstanding without reduction for amount held by respondent.

225. NOTES PAYABLE SUPPORTING SCHEDULE - Account No. 232.0

This schedule should include a breakdown of the accounts that constitute the ending balance in Account No. 232.0 - Notes Payable.

Line No.	Name of Creditor (a)	Description of Transaction (b)	Date of Issue (c)	Date of Maturity (d)	Amount at End of Year (e)	Interest Rate Per Annum (f)
1	None					
2						
3						
4						
5						
6						
7						
8				TOTAL		

226. ACCOUNTS PAYABLE TO AFFILIATED COMPANIES SUPPORTING SCHEDULE - Account No. 233.0

This schedule should include a breakdown of the accounts that constitute the ending balance in Account No 233.0 - Accounts Payable to Affiliated Companies

Line No.	Name of Affiliated Company (a)	Description of Transaction (b)	Date of Issue (c)	Date of Maturity (d)	Amount at End of Year (e)	Interest Rate Per Annum (f)
1						N/A
2						N/A
3	American Water Works Serv. Co	Service Co. Bill			1,087,489	N/A
4						N/A
5						N/A
6						N/A
7						N/A
8				TOTAL	1,087,489	

227. NOTES PAYABLE TO AFFILIATED COMPANIES SUPPORTING SCHEDULE - Account No. 234.0

This schedule should include a breakdown of the accounts that constitute the ending balance in Account No. 234.0 - Notes Payable to Affiliated Companies.

Line No.	Name of Affiliated Company (a)	Description of Transaction (b)	Date of Issue (c)	Date of Maturity (d)	Amount at End of Year (e)	Interest Rate Per Annum (f)
1	American Water Capital Corp	Line of Credit	Daily	Daily	22,612,968	
2						
3						
4						
5						
6						
7						
8				TOTAL	22,612,968	

228. MISCELLANEOUS CURRENT AND ACCRUED LIABILITIES SUPPORTING SCHEDULE - Account No. 241.0

This schedule should include a breakdown of the accounts that constitute the ending balance in Account No. 241.0 - Miscellaneous and Accrued Liabilities.

Line No.	Account (a)	Balance at Beginning of Year (b)	Additions (c)	Reductions or Deletions (d)	Adjustments (e)	Balance at End of Yr (f)
1	Vacation Pay	3,139,383	1,985,704	2,272,241		2,852,846
2	Water Purchases	180,449	4,194,667	4,059,633		315,483
3	Power	541,000	49,000			590,000
4						
5	Wages	3,094,648	75,582,365	75,927,906		2,658,807
6	Union Dues	(40)	211,913	211,913		(40)
7	Savings Bonds	2,405	30,775	29,300		3,880
8	Misc. Payroll	(19,405)	61,546	42,354		(213)
9	Flexible Spending Acct.	(1,356)	27,850	27,541		(1,047)
10	Payroll Taxes	660,678	12,818,735	12,775,247		704,166
11	Construction Costs Payable	6,614,157	15,172,639	5,718,349		6,068,447
12	Unclaimed Credits	75,762	18,157	2,245		91,674
13	Outstanding Checks	872				872
14	Unclaimed Extension Deposits	16,206				16,206
15	ESOP Contribution	134,568	473,768	504,164		104,172
16	Withheld/Matched 401K Contribution	212,383	4,448,867	4,440,439		220,811
17	Accts. Payable Check Clearing	4,910,584	142,645,309	141,457,020		6,098,873
18	Other Bank Obligations	1,154,488	31,930,964	31,607,192		1,478,260
19	CFO Management Contracts	619,803	81,283,844	80,763,132		1,140,515
20	Waste Disposal-Sewer	108,249	5,101,182	5,136,431		73,000
21	accrued safety incentive			18,439		(18,439)
22	Customer Deposit Refund Payable	(2,480)				(2,480)
23	Other Curr Liab Analyzed	3,212	62,681	62,985		2,908
24	Unbilled	1,654,352	24,906,740	25,406,417		1,154,675
25	PFD Div Requirement	291,350	1,305,054	1,305,087		291,317
26	Accrued Insurance	0	1,504,619	1,483,279		21,340
27	TOTALS	$23,301,268	$403,816,079	$403,251,314		$23,866,334

229. ADVANCES FOR CONSTRUCTION SUPPORTING SCHEDULE - Account No. 252.0

This schedule should include a breakdown of the accounts that constitute the ending balance in Account No. 252.0 - Advances for Construction.

Line No.	Account (a)	Balance at Beg of Year (b)	Additions (c)	Reductions or Deletions (d)	Adjustments (e)	Balance at End of Year (f)
1	Non-Taxable Extension Dep.	43,713,677	35,532,711	27,639,881		51,606,507
2	Non-Taxable Services	322,077	1,222,645	106,315		1,438,407
3	Non-Taxable Hydrants	75,916	664,944	97,206		643,654
4	Non-Taxable Work In Progres	19,132,907	15,795,234	14,489,407		20,438,734
5	Non-Taxable Other	1,387,552	18,333	2,667		1,403,218
6	Taxable Extension Deposits	11,243,710	8,728,306	14,988,172		4,983,844
7	Taxable Work In Progress	1,832,412	84,323	153,495		1,763,240
8	TOTALS	77,708,251	62,046,496	57,477,143		82,277,604

230. OTHER DEFERRED CREDITS SUPPORTING SCHEDULE - Account No. 253.0

This schedule should include a breakdown of the accounts that constitute the ending balance in Account No. 253.0 - Other Deferred Credits.

Line No	Account (a)	Balance at Beg of Year (b)	Additions (c)	Reductions or Deletions (d)	Adjustments (e)	Balance at End of Year (f)
1	Regulatory Liabilities	7,579,655	30,312	258,852		7,351,115
2	Pensions	22,025,968	9,406,373	4,911,724		26,520,617
3	Insurance Other Than Group	(642,912)	17,711	404,857		(1,030,058)
4	OPEB	2,713,130	7,559,744	7,559,745		2,713,129
5	Extension Deposits in Suspens	(29,551)	924,776	902,400		(7,175)
6	Timber Sales	11,000	67,007	66,007		12,000
7	Advance Payment & Deposits	9,100	3,139	2,989		9,250
8	Post Employment Benefits	36,883				36,883
9	Deferred Compensation Costs	235,627				235,627
10	Incentive Plan	133,837		133,837		
11	Cash Annual	768,782	658,862	984,441		443,203
12	Plan stock	2,130				2,130
13	TOTALS	32,843,649	18,667,924	15,224,852		36,286,721

400. COMPARATIVE INCOME STATEMENT REVENUES AND EXPENSES

Line No.	Account Number and Title (a)	Schedule No (c)	Balance End of Year (d)	Balance Previous Year (e)	Increase/ Decrease (f)
1	400.0 Operating Revenues	401	394 359,698	378,624 769	15,734 929
2					
3	UTILITY OPERATING EXPENSES		XXX	XXX	XXX
4	401.0 Operating Expenses		168,103,087	159,301,082	8,802 005
5	403.0 Depreciation Expense		56,853,847	54,355,290	2 498,557
6	406.0 Amortization of Utility Plant Acquisition Adjustment	417	601,636	533,600	68,036
7	407.1 Amortization of Limited Term Plant	417	63,024	101,976	(38,952)
8	407.2 Amortization of Property Losses	417			
9	407.3 Amortization of Other Utility Plant	417			
10	407.4 Amortization of Regulatory Assets		648,237	480,967	167,270
11	408.0 Taxes Other Than Income	418	12,361,541	12,469,029	(107,488)
12	409.10 Federal Income Taxes, Utility Operating Income	419	28,474,322	3,384,860	25,089,462
13	409.11 State Income Taxes, Utility Operating Income	419	6 923,658	9,969 186	(3,045,528)
14	409.12 Local Income Taxes, Utility Operating Income				
15	410.0 Deferred Income Tax	420			
16	410.10 Federal	420	9,420,434	31,010,634	(21,590,200)
17	410.11 State	420	2,094,886	(1,754 727)	3,849,613
18	Total Deferred Income Tax	420	11,515,320	29,255,907	(17,740,587)
19	411.1 Provision for Deferred Income Taxes - Credit, Utility Operating Income	42			
20	Tax Credits				
21	412.1 Investment Tax Credit Deferred to Future Periods, Utility Operating Income		(233,592)	(233,592)	
22	412.2 Investment Tax Credits Restored to Operating Income, Utility Operating Income				
23	Total Tax Credits		(233,592)	(233,592)	
24	TOTAL UTILITY OPERATING EXPENSES		285,251,080	269,618,304	15,632,776
25					
26	NET UTILITY OPERATING INCOME (LOSS)		109,108,618	109,006,465	102,153
27					
28	OTHER OPERATING INCOME (LOSS)		XXX	XXX	XXX
29	413.0 Income from Utility Plant Leased to Others				
30	414.0 Gains (Losses) from Disposition of Utility Property		1,088,030	794,867	293,163
31	TOTAL OTHER OPERATING INCOME (LOSS)		1,088,030	794,867	293,163
32					
33	NON-OPERATING INCOME		XXX	XXX	XXX
34	415.0 Revenues from Merchandising, Jobbing and Contract Work		185,958	288,817	(102,859)
35	419.0 Interest & Dividend Income		77,655	78,101	(446)
36	420.0 Allowance for Funds Used During Construction (AFUDC)		1,075,117	235,535	839,582
37	421.0 Non-Utility Income			55	(55)
38	TOTAL NON-OPERATING INCOME		1,338,730	602,508	736,222
39					
40	NON-OPERATING DEDUCTIONS		XXX	XXX	XXX
41	408.2 Taxes Other Than Income, Other Income and Deductions		(187,990)	(311,994)	123,998
42	409.2 Income Taxes, Other Income and Deductions		(883,339)	(366,602)	516,737
43	416.0 Costs & Expenses of Merchandising, Jobbing and Contract Work		(139,862)	(334,688)	194,826
44	426.1 Miscellaneous Non-Utility Expenses		939,627	1750,667	(1,690,294
45	TOTAL NON-OPERATING INCOME & DEDUCTIONS		1,067,160	(1,161,443)	2,228,603
46					
47	INTEREST EXPENSE		XXX	XXX	XXX
48	427.0 Interest Expense		50,377,957	48,918,686	1,459,271
49	428.0 Amortization of Debt Discount & Expenses		997,886	727,221	270,665
50	429.0 Amortization of Premium on Debt				
51	TOTAL INTEREST EXPENSE		52,375,843	49,645,907	2,729,937
52					
53	EXTRAORDINARY ITEMS		XXX	XXX	XXX
54	433.0 Income				
55	434.0 Deductions				
56	409.3 Income Taxes				
57	409.4 Other				
58	TOTAL EXTRAORDINARY ITEMS				
59	NET INCOME (LOSS)		58,887,965	58,993,983	(106,018)

401. OPERATING REVENUES SUPPORTING SCHEDULE - Account No. 400.0

This schedule should include a breakdown of the accounts that constitute the ending balance in Account No. 400.0 - Operating Revenues

Line No.	Account Number and Title (a)	Schedule No. (b)	Balance End of Year (c)	Balance Previous Year (d)	Increase/ Decrease (e)
1	WATER SALES REVENUE		XXX	XXX	XXX
2	460.0 Unmetered Water Revenue		XXX	XXX	XXX
3	460.1 Residential		292,075	324,269	(32,194)
4	460.2 Commercial				
5	460.3 Industrial				
6	460.4 Public				
7	460.5 Other				
8					
9	Total Unmetered Water Revenue		292,075	324,269	(32,194)
10					
11	461.0 Metered Water Revenue		XXX	XXX	XXX
12	461.1 Residential		256,933,360	246,009,519	10,923,841
13	461.2 Commercial		81,202,971	78,722,592	2,480,379
14	461.3 Industrial		21,232,097	20,684,995	547,102
15	461.4 Public		15,574,261	14,133,775	1,440,486
16	461.5 Multiple Family Dwellings				
17	461.6 Other				
18					
19	Total Metered Water Revenue		374,942,689	359,550,881	15,391,808
20					
21	462.1 Public Fire Protection		7,261,466	7,362,343	-100,877
22	462.2 Private Fire Protection		3,013,041	3,798,228	-785,187
23	464.0 Other Sales to Public (Special Contracts)	404			
24	466.0 Sales for Resale	405	2,085,419	1,535,296	550,123
25	467.0 Interdepartmental Sales				
26	468.0 Other				
27					
28	TOTAL WATER SALES		387,594,690	372,571,018	15,023,672
29					
30	OTHER WATER REVENUES		XXX	XXX	XXX
31	470.0 Forfeited Discounts		1,407,429	1,415,591	-8,162
32	471.0 Miscellaneous Service Revenues		4,019,766	3,551,009	468,757
33	472.0 Rents from Water Property		1,174,734	966,276	208,458
34	473.0 Interdepartmental Rents				
35	474.0 Other Water Revenues	406	163,078	120,876	42,202
36					
37	TOTAL OTHER WATER REVENUES		6,765,007	6,053,752	711,255
38					
39	TOTAL WATER SALES & OTHER REVENUES		394,359,697	378,624,769	15,734,928

402. OPERATING REVENUES SUPPORTING SCHEDULE - CUSTOMER DATA

Customers should be reported on the basis of number of meters, (except where multiple customers have one meter) plus number of flat rate accounts. Where separate meter readings are added for billing purposes, one customer shall be counted for each group of meters so added.

Line No.	Customer Classes (a)	Customers End of Current Year (b)	Customers End of Previous Year (c)
1	Unmetered Sales	XXX	XXX
2	Residential	6	19
3	Commercial		
4	Industrial		
5	Public		
6	Other		
7	Public Fire		
8	Private Fire		
9	Total Unmetered Sales	6	19
10			
11	Metered Sales	XXX	XXX
12	Residential	569,472	565,271
13	Commercial	42,463	42,569
14	Industrial	882	899
15	Public	2,298	2,361
16	Multiple Family Dwellings		
17	Other		
18	Private Fire	2,835	2,859
19	Public Fire	382	376
20	Sales for Resale	24	23
21	Total Metered Sales	618,356	614,289

403. OPERATING REVENUES SUPPORTING SCHEDULE - GALLONS SOLD

1. Report below the gallons sold for the current year and the previous year for each customer class.
2. How the quantities of water sold to unmetered flat-rate customers were determined should be explained in a footnote.

Line No	Account (a)	Gallons Sold Current Year (000 omitted) (b)	Gallons Sold Previous Year (000 omitted) (c)
1			
2	Unmetered Sales	XXX	XXX
3	Residential		
4	Commercial		
5	Industrial		
6	Public		
7	Other		
8	Public Fire		
9	Private Fire		
10	Total Unmetered Sales		
11			
12	Metered Sales	XXX	XXX
13	Residential	30,716,981	30,136,851
14	Commercial	13,233,437	12,916,806
15	Industrial	5,161,026	5,095,556
16	Public	2,660,505	2,551,684
17	Multiple Family Dwellings		
18	Other		
19	Public Fire		
20	Private Fire		
21	Sales for Resale	748,755	554,658
22	Total Metered Sales	52,520,704	51,255,555
23			
24	Interdepartmental Sales		
25			
26	Total Water Sales	52,520,704	51,255,555

404. OTHER SALES TO PUBLIC WATER UTILITIES SUPPORTING SCHEDULE - Account No. 464.0

1. Designate by asterisk in Column (a) purchases which are affiliated with respondent.
2. The entries on Lines 1 to 8 under Columns (b) to (s) must correspond to the entries on the same lines under Columns (a) to (g). The totals of Columns (h) to (s), inclusive, must agree with respective quantities reported in Column (e).

Line No.	Name of Purchaser (a)	Point of Delivery (b)	Service* Capacity (c)	Pressure @ Point of Delivery (d)	Quantity of Water Sold (1,000-Gal.) (e)	Revenues (f)	Revenue Per (1,000-Gal.) (g)
1	None						
2							
3							
4							
5							
6							
7							
8				TOTALS			

* Size of meter from which delivery is made

MONTHLY SALES IN 1,000-GAL BY PURCHASER

Line No.	January (h)	February (i)	March (j)	April (k)	May (l)	June (m)	July (n)	August (o)	September (p)	October (q)	November (r)	December (s)
1												
2												
3												
4												
5												
6												
7												
8												
TOTALS												

MONTHLY SALES IN 1,000-GAL BY PURCHASER

Line No	January	February	March	April	May	June	July	August	September	October	November	December
1	1,457	(1,191)	266	1,999	266	267	854	266	266	1,165	266	174
2												
3	2,324	2,028	2,997	2,740		5,615		6,922	3,551	3,164	1,677	
4												
5	130	47	86	256	185							
6												
7	89,086	23,715	26,198	22,216	3,224	30,914	31,209	16,377	36,546	19,469	26,152	9,623
8	911			64	(126)	131	130	102	129	156	129	131
9												
10		6,932	5,749	7,554	7,802	7,801	7,069	7,858	13,602	9,335	13,909	
11	8,073	3,672	4,003	2,930	3,657	4,547	3,701	4,025	5,505	2,900	4,310	
12												
13	491	343	817		174	8		5	10			
14	1,180	999	1,084	1,343	853	1,198	1,157	1,437	1,078	1,032	1,174	1,338
15								1,219	1,525	2,478	1,351	
16	7	10	10	6	9	7	9	10	5	6	6	9
17												
18	3,819	4,281	4,644	3,709	3,486	3,626	4,397	3,904	5,698	2,617	3,489	4,958
19	706	575	680	606	620	753	722	843	759	791	805	826
20	4,927	4,784	5,786	3,964	3,737	3,395	3,333	3,567	3,308	3,401	3,415	3,543
21												
22	14	48	58		38	82		87	31	2	164	4
23												
24	1,053	569	2,275		910	1,648		981	879	1,157	1,015	1,052
25	271	192	571		1,183	327		2,280	175	295	138	
26	1,021	858	1,917			(32)	120,461	(117,002)	6,168	1,466	1,059	1,110
27	348	314	481		402	1,112		715	958	1,176	483	739
28		(32)	417	(56)			(24)	10	33,940			
29												
30												
31												
32												
33												
34												
35												
36												
37												
Totals	113,565	58,213	57,269	47,261	54,410	61,529	173,088	(67,294)	114,095	50,570	62,542	23,507

406. OTHER WATER REVENUES SUPPORTING SCHEDULE - Account No. 474.0

Provide a breakdown of Other Water Revenues - Account No. 474.0 not shown in any other revenue account.

Line No.	Description (a)	Amounts (b)
1	Timber Sales	$62,007
2	Outside Maintenance Services	$79,755
3	Leak Detection	$3,620
4	Tank Antenna Application Fee	$1,000
5	Outside Water Quality Services	$9,942
6	Center Co. Commissioners circuit rider program	-$2,400
7	Gas Royalities	$8,251
8	Scrap Meters	$441
9	Miscellaneous	$462
10		
11		
12		
13		
14		
15		
16		
17	TOTALS	$163,078

407. WATER OPERATION AND MAINTENANCE EXPENSE ACCOUNTS

Line No.	Account Number and Title	Schedule No.	Amount of Operating Expenses		
	(a)	(b)	Current Year (c)	Previous Year (d)	Increase (Decrease) (e)
1	Salaries and Wages		XXX	XXX	XXX
2	6010 Employees	409	34,053,974	37,787,001	-3733027
3	6030 Officers, Directors and Majority Stockholders	409		877,439	-877439
4	Total Salaries and Wages		34,053,974	38,664,440	-4610466
5	6040 Employee Pensions and Benefits	409-A	15,335,613	14,724,139	611474
6	6050 Purchased Water	408	3,106,259	2,779,592	326667
7	6150 Purchased Power		11,890,629	11,463,870	426759
8	6160 Fuel for Power Production		285	757	-472
9	6180 Chemicals		5,066,937	4,395,984	670953
10	6200 Materials and Supplies		2,873,392	1,732,103	1141289
11	Contractual Services		XXX	XXX	XXX
12	6310 Engineering	411-A	296,594	249,459	47135
13	6320 Accounting	411-A	269,095	213,888	55207
14	6330 Legal	411-A	507,529	995,950	-488421
15	6340 Management Fees	411-B	32,456,502	29,538,308	2918194
16	6350 Testing	411-B	79,310	146,083	-66773
17	6360 Other - Maintenance	411-B	12,264,782	13,167,948	-903166
18	Total Contractual Services		45,873,812	44,311,635	1562177
19	6410 Rental of Building/Real Property		1,529,470	815,501	713969
20	6420 Rental of Equipment		658,065	618,828	39237
21	6500 Transportation Expenses		5,098,936	5,443,491	-344555
22	Insurance		XXX	XXX	XXX
23	6560 Vehicle		342,770	493,796	-151026
24	6570 General Liability		7,148,658	7,516,460	-367802
25	6580 Workman's Compensation		1,337,376	1,322,446	214930
26	6590 Other		882,403	782,687	99716
27	Total Insurance		9,711,207	10,115,388	-20418
28	6601 Advertising Expense - Other than Conservation	412	290,807	909,760	-648953
29	6665 Regulatory Commission Expenses-Amort. of Rate Case Expense		642,912	592,274	50638
30	6670 Regulatory Commission Expenses-Other		237,068	91,489	145579
31	6675 Water Resource Conservation Expense				
32	6700 Bad Debt Expense		9,521,774	7,308,698	2213076
33	Miscellaneous Expenses		XXX	XXX	XXX
34	6710 Miscellaneous Other	413	12,411,372	5,907,448	6503924
35	6720 Membership Dues		370,361	418,205	-47844
36	6732 Registration Fees for Conventions & Meetings of Industry	414	44,633	22,952	21681
37	6735 Communication Services		2,509,432	2,647,234	-137802
38	6754 Trustee Fees and Bank Charges		1,148,948	627,183	521765
39	6755 Stockholders Expenses				
40	6756 Office Expenses and Utilities		3,067,130	2,953,490	113640
41	6757 Uniforms		120,478	183,877	-63399
42	6758 Directors Fees and Expenses		91,005	11,023	79982
43	6759 Mailing		2,276,885	2,562,837	-285949
44	6760 Subscriptions				
45	6761 Write off of expenditures for preliminary surveys, plans investigations etc., included in Account 1830 - Preliminary Surveys and Investigation Charges, relative to projects which have been abandoned				
46	6762 Travel	416			
47	6763 Education	415			
48	6764 Charitable Contributions			182	-182
49	Total Miscellaneous Expenses		27,039,447	15,334,131	6,705,816
50	Total Water Operation and Maintenance Expense Accounts		168,103,087	159,301,082	8,802,005

MONTHLY PURCHASES IN 1,000-GAL FROM VENDER

Line No	January (h)	February (i)	March (j)	April (k)	May (l)	June (m)	July (n)	August (o)	September (p)	October (q)	November (r)	December (s)
1			11			10			9			10
2	45	54	48	45	55	48	59	55	59	52	45	43
3	1,384	1,765	545	705	935	839	281	1,454	775	709	667	696
4	492	296	350	33	306	372	359	608	543	451	409	471
5	26,250	30,652	38,824	19,600	26,153	26,791	29,289	39,970	46,274	39,270	32,359	33,934
6	3,245	4,430	2,380	2,455	2,139	2,030	110	770	268	153	53	16
7												
8				1	117	35	20	8	8	30		
9			801									
10	5,047	8,095	7,615	7,968	7,101	8,136	9,921	11,121	8,559	6,565	8,168	558
11	27,365	32,533	24,707	27,120	24,215	29,416	30,403	31,237	25,342	28,305	27,991	21,006
12	758	902	671	764	638	875	963	1,077	797	872	366	1,216
13	109	120	127	123	85	85	99	83	92	81	93	68
14		67			65			64			68	
15	643	687	598	551	607	565	612	621	563	532	336	341
16	289	1,633	1,750	1,030	1,143	998	869	2,039	1,925	1,588	767	1,627
17	238	461	589	617	654	640	1,535	2,644	2,058	2,109	2,240	1,062
18	5	2	4	4	3	8	9	8	7	10	9	11
19	139	118	140	157	142	127	149	194	222	188	173	130
20	55	55	1,360					235			255	50
21			20	68	1,172	233						
22	2,215	1,787	2,603	3,853	3,722	3,835	4,281	2,959	3,270	3,816	3,232	4,689
23	4,470	3,870	4,130	3,500	4,860	5,210	5,960	2,172	3,620	3,940	3,260	2,500
24	120	10		10	10	80	290	860	1,350	1,580	1,370	1,120
25	2,030	2,658	2,336	2,541	5,704	4,110	10,053	5,662	12,238	8,287	3,700	903
26	6,097	3,590	12,595			5,504	5,504	5,504	5,504	5,504	36,684	5,504
27	2			60	2	6	9	26	98	40	94	112
28											340	
29	21,405	2,782	6,880	20,146	17,887	5,885	10,335	7,141	8,645	10,959	9,356	9,358
30	333,217	311,026	329,729	316,083	340,515	361,525	360,544	363,206	347,503	334,789	309,057	323,590
31	82,553	75,514	82,544	80,787	102,655	114,595	107,868	113,606	113,590	96,485	90,430	85,430
32	13,276	13,909	4,408		10,490	2,425	1,652	726	410			
33	69,388	62,673	68,931	64,596	70,476	63,179	38,224	38,949	40,003	1,073	11,449	9,764
34	64,810	65,160	74,650	75,750	76,940	86,200	81,500	87,270	89,500	75,420	66,880	65,900
35												
TOTALS	668,751	643,858	668,351	631,177	699,186	720,072	701,606	720,155	713,030	622,828	609,850	576,148

MONTHLY WATER OBTAINED IN 1,000 GAL FROM OWN SOURCE(S)

Line No	January (v)	February (w)	March (x)	April (w)	May (x)	June (y)	July (z)	August (aa)	September (ab)	October (ac)	November (ad)	December (ae)
1	8,288,509	5,437,849	6,813,894	5,415,156	5,233,472	7,168,096	5,897,544	5,960,412	7,113,238	5,311,463	5,146,001	3,803,163
2												
3												
4												
5												
6												
7												
8												
TOTALS	8,288,509	5,437,849	6,813,894	5,415,156	5,233,472	7,168,096	5,897,544	5,960,412	7,113,238	5,311,463	5,146,001	3,803,163

409. WATER OPERATION AND MAINTENANCE EXPENSE ACCOUNTS (ALLOCATION)

Line No	Account Number and Title (a)	Total from Schedule 307 (b)	Sources of Supply And Expenses - Operations (c)	Sources of Supply And Expenses - Maintenance (d)	Water Treatment Expenses Operations (e)	Water Treatment Expenses Maintenance (f)	Transmission And Distribution Operations (g)	Transmission And Distribution Maintenance (h)	Customer Accounts Expenses (i)	Administrative And General Expenses (j)
1	Salaries and Wages	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
2	601.0 Employees	34,053,974	136,756	48,109	8,174,264	2,227,252	5,104,001	9,145,519	6,091,830	3,156,243
3	603.0 Officers, Directors, and Majority Stockholders									
4	Total Salaries and Wages *	34,053,974	136,756	48,109	8,174,264	2,227,252	5,104,001	9,145,519	6,091,830	3,156,243
5	Contractual Service	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
6	631.0 Engineering **	296,591	16,513		18,010		195,622			66,449
7	632.0 Accounting **	269,095								269,095
8	633.0 Legal **	507,529			(37,500)				301	544,728
9	634.0 Management Fees **	32,456,502								32,456,502
10	635.0 Contract Services Testing	79,310			102,594					(23,284)
11	636.0 Other - Maintenance **	12,264,782	469,322	415,042	2,581,174	545,382	650,854	3,549,509	712,939	3,340,560
12	Total Contractual Service	45,873,812	485,835	415,042	2,664,278	545,382	846,476	3,549,509	713,240	36,654,950
13	Miscellaneous Expense	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
14	675.3 Communications Service	2,509,432	19,629		431,573		346,377		254,445	1,447,408
15	675.12 Travel***									
16										
17										
18	Total Miscellaneous Expenses	2,509,432	19,629		431,573		346,377		254,445	1,447,408
19	TOTALS	82,437,218	642,220	463,151	11,280,115	2,772,634	6,296,854	12,695,028	7,059,515	41,257,701

* For breakdown see Schedule 410

** For breakdowns see Schedules 411-A and 411-B

*** For breakdown see Schedule 416

409-A. EMPLOYEE PENSIONS AND BENEFITS SUPPORTING SCHEDULE
Account No. 604.0

This schedule should include a breakdown of the accounts that constitute the ending balance in Account No. 604.0 - Employee Pensions and Benefits.

Line No.	Benefit Type (a)	Employees (c)	Total Expenses for	
			Current Year (d)	Prior Year (e)
1	Pension		2,311,365	1,667,795
2	Life Insurance			
3	Health Insurance*		5,831,995	6,009,531
4	Dental			
5	Eye Care			
6	Prescriptions			
7	Employee Recognition		47,520	101,455
8	Physicals		21,223	20,986
9	Tuition Assistance		45,117	99,341
10	Death Benefits		39,212	3,679
11	Other Post Employee Benefits		6,321,019	5,676,408
12	401K		581,152	676,632
13	Employee Stock Option Program		137,010	468,312
14	Others (Specify)			
15	TOTALS		15,335,613	14,724,139

* Health Insurance includes life insurance, dental and prescriptions. PA-American Water Company does not offer eye care.

410. EMPLOYEE AND PAYROLL STATISTICS

1. Show hereunder the details called for concerning the number of officers and employees at the beginning and end of the year, and the aggregate salaries and wages for the year.
2. The data shall be itemized according to the department payroll classification maintained by Respondent at the end of the year (such as, for example, executive, accounting, treasury, engineering, etc)

Line No	Payroll Classification (a)	Number Beginning of Year (b)	Number End of Year (c)	Aggregate Salaries and Wages for the Year (d)
1	Production	201	197	$ 10,644,528
2	Field Services	446	433	20,547,102
3	Administration & General	177	197	2,862,344
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
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32				
33				
34				
35				
36				
37				
38				
39				
40		824	827	$ 34,053,974

411-A. CONTRACTUAL SERVICES SUPPORTING SCHEDULE
Account Nos. 631.0, 632.0 and 633.0

Provide a breakdown of **Engineering Expense** - Account No. 631.0.

Line No.	Description of Project (a)	Expense (b)
1	Source of Supply	16,513
2	Water Treatment	18,010
3	Transmission & Distribution	195,622
4	Administrative and General	66,449
5		
6		
7	TOTAL	296,594

Provide a breakdown of **Accounting Expense** - Account No. 632.0.

Line No.	Type of Service (a)	Expense (b)
1	PriceWaterHouse Coopers	269,095
2		
3		
4		
5		
6		
7	TOTAL	269,095

Provide a breakdown of **Legal Expense** - Account No. 633.0

Line No.	Description of Service (a)	Expense (b)
1	Customer Accounting	301
2	Administrative and General	544,728
3	Source of Supply	
4	Water Treatment	-37,500
5		
6		
7	TOTAL	507,529

411-B. CONTRACTUAL SERVICES SUPPORTING SCHEDULE
Account Nos. 634.0, 635.0 and 636.0

Provide a breakdown of **Management Fees** - Account No. 634.0.

Line No	Description of Management Fee (a)	Expense (b)
1	American Water Works Service Co.-Water Treatmem	
2	American Water Works Service Co.-Customer Accounting	
3	American Water Works Service Co.-Administration & General	32,456,502
4		
5		
6		
7	TOTAL	32,456,502

Provide a breakdown of **Testing Expense** - Account No. 635.0.

Line No	Type of Testing Services (a)	Expense (b)
1	American Water Works - Lab Testing	102,594
2	Outside lab Testing	(23,284)
3		
4		
5		
6		
7	TOTAL	79,310

Provide a breakdown of **Other - Maintenance Expense** - Account No. 636.0.

Line No	Description of Maintenance (a)	Expense (b)
1	SS Operating Contract Services - Ground Care	71,912
2	SS Operating Contract Services - Other	113,520
3	SS Maintenance Contract Services - Other	415,042
4	SS Operating Contract Services - Security	283,890
5	WT Operating Contract Service - Waste Disposal	1,723,455
6	WT Operating Contract Service - Other	248,158
7	WT Operating Contract Service - Ground Care	294,684
8	WT Operating Contract Service - Janitor	90,280
9	WT Operating Contract Service - Security	224,597
10	WT Maintenance Contract Service - Other	545,382
11	TD Operating Contract - Other	94,374
12	TD Operating Contract Service - Temporary Agency	70,609
13	TD Operating Contract Service - Ground Care	253,435
14	TD Operating Contract Service - Janitor	104,911
15	TD Operating Contract Service - Security	128,125
16	TD Maintenance Contract Service - Other	890,695
17	TD Maintenance Contract Service - Distribution System	2,658,814
18	CA Contract Services - Other	211,306
19	CA Contract Services - Temporary Agency	501,409
20	CA Contract Services - Janitor	424
21	A & G Contract Services - Other	605,812
22	A & G Contract Services - Temporary Agency	673,309
23	A & G Contract Services - Ground Care	148,596
24	A & G Contract Services - Janitor	185,591
25	A & G Contract Services - Security	1,718,239
26	A & G Maintenance Contract Services - Other	9,013
27		
28		
29	TOTAL	12,264,782

412. ADVERTISING EXPENSES SUPPORTING SCHEDULE - Account No. 660.0

Provide a breakdown of Advertising Expense - Account No. 660.0 by type i.e. Radio, TV, Newspaper, Bill Insert, etc.

Line No.	Type of Advertising Expense (a)	Purpose of Expense (b)	Expenses ($)
1	Customer Information		37,463
2	Public Awareness		221,590
3	Employment Opportunity		1,754
4			
5			
6			
7			
8			
9			
10			
11		TOTAL	260,807

Provide a breakdown of Miscellaneous Other Expense - Account No. 675.0

Line No.	Description (a)	Expenses ($)
1	Rentals	23,053
2	Employee Expenses	115,607
3	Employee Meals	18,364
4	Employee Relocation	20,897
5	Injuries/Damages	72,650
6		
7	Business Reorganization Project	6,913,275
8		
9	Community Organizations	41,842
10	Lobbying	2,535
11		
12	Source of Supply Maintenance Agreements	40,237
13	Water Treatment Maintenance Agreements	313,567
14	Transmission & Distribution Maintenance Agreements	1,389,453
15	Administration & General Maintenance Agreements	683,526
16	Misc. Other	1,121,574
17	Water Treatment Other	496,808
18	Transmission & Distribution Other	320,181
19	Customer Accounting Other	85,110
20	Administration & General Other	350,069
21	Penalties	8,436
22	Purchased Supply Other	139,409
23	Software Licenses and support	57,907
24		
25		
26		
27		
28		
29		
30		
31		
32	TOTAL	12,413,372

415. TRAVEL EXPENSE SUPPORTING SCHEDULE - Account No. 675.12

Provide a breakdown of Travel Expense - Account No. 675.12

Line No.	Event (a)	Travel Expenses (b)	Lodging Expenses (c)	Meal Expenses (d)	Entertainment Expenses (e)	Total Expense (f)
1	None					
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16	TOTALS					

417. AMORTIZATION EXPENSES SUPPORTING SCHEDULE - Account Nos. 406.0, 407.1, 407.2 and 407.3

Amortization of Utility Plant Acquisition Adjustment - Account No. 406.0

Line No	Year Incurred Date (a)	Name of Company Acquired (b)	Total Acquisition Adjustment (c)	Yearly Amortization (d)
1	1996	P.C.& W. Acquisition	10,023,519	441,856
2		Citizen's Acquisition	8,324,967	59,276
3				
4				
5				
6				
7		TOTALS	18,348,512	601,132

Amortization of Property Losses - Account No. 407.2

Line No	Year Incurred Date (a)	Identify Each Item (b)	Total Adjustment (c)	Yearly Amortization (d)
1		None		
2				
3				
4				
5				
6				
7		TOTALS		

Line No	Year Incurred Date (a)	Description of Plant (b)	Total Adjustment (c)	Yearly Amortization (d)
1	993	Regulatory Asset - AFUDC	6,941,255	63,024
2				
3				
4				
5				
6				
7		TOTALS		363,024

Line No	Year Incurred Date (a)	Plant Item Amortized (b)	Total Adjustment (c)	Yearly Amortization (d)
1		None		
2				
3				
4				
5				
6				
7		TOTALS		

TAXES ACCRUED AND PREPAID DURING YEAR
Account Nos. 236 and 162

1. Give particulars (details) of the combined prepaid and accrued tax accounts and show the total taxes charged to operations and other accounts during the year. Do not include gasoline and other sales taxes which have been charged which the taxed material was charged. If the actual or estimated amounts of such taxes are known, show footnote and designate whether estimated or actual amounts.

2. Include on this page, taxes paid during the year and charged directly to final accounts, (not charged to prepaid or accrued taxes).

3. Include in column (c) taxes charged during the year, taxes charged to operations and other accounts through (a) accruals credited to taxes accrued, (b) amounts credited to proportions of prepaid taxes chargeable to the current year, and (c) taxes paid and charged directly to operations or accounts other than accrued and prepaid tax accounts.

4. List the aggregate of each kind of tax in such a manner that the total tax can be readily ascertained.

		ACCRUED AND PREPAID TAXES DURING YEAR						
Line	Kind of Tax	BALANCE AT BEGINNING OF (b)	BY DEBIT OR CREDIT TO	BY DEBIT OR CREDIT TO OTHER ACCOUNTS ACCT NO	AMOUNT	ACCT NO.	AMOUNT	TOTAL ACCRUALS AND AMORTIZATIONS
2	TAXES ACCRUED (Account 236)							
3	Federal Income Tax On Income	(453,605)						
4	Federal Excess Profits Tax							
5	Federal Capital Stock Tax							
6	Federal Tax on Revenue	13,125,876	(13,199,641)			409		
7	Federal Pensions Tax	129,611	(3,296,807)			408		
8	Federal Unemployment Relief	8,692	(48,675)			408		
9	State Unemployment Relief	(16,587)	(311,448)			408		
10	State Capital Stock Tax	(285,709)	(3,552,399)			408		
11	State Gross Receipts Tax							
12	Gen Assessment - Pub Util Comm		(2,283,742)			408		
13	Local Gross Receipts Tax							
14	Pole Taxes							
15	State Corporate Loan Tax							
16	Foreign State Taxes On Income	(143,843)				410		
17	Mercantile Taxes							
18	Local Real Estate Tax							
19	PA Realty Tax					408		
20	Consumer Advocate Assessment							
21	Other Taxes (specify)							
22	State Tax on Revenue	157,765	(6,624,618)			409		
23			(19,959)			Var		
24	TOTAL TAXES ACCRUED	12,552,201						
25								
26								
27								
28		1,325,422	(3,754,645)	408	3,591,918	408.10		
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42	TOTAL PREPAYMENTS	1,325,422						
43								

TAXES ACCRUED AND PREPAID DURING YEAR

5. Report in column (j) through (n) only the amounts charged to Accounts 408.1 and 409.1 pertaining to water operations. Report in column (m) the amounts charged to Accounts 408.1 and 409.1 pertaining to other utility departments and amounts charged to Accounts 408.2 and 409.2. Also show in column (n) the taxes charged to utility plant or other balance sheet accounts.

6. For any tax apportioned to more than one utility department or account, state in a footnote the basis (necessity) of apportioning such tax.

Line No.	Balance at End of Year		Distribution of Taxes Charged			
			WATER ACCT 408.1	WATER 409.1	OTHER UTILITIES ACCTS 408.1 - 409.1	UTILITY PLANT AND OTHER BAL. SHEET ACCOUNTS
1	(i)	(j)	(k)	(l)	(m)	(n)
2						
3		152,605)				
4						
5						
6		39,087,751		28,474,322	887,164	
7		232,720	2,741,970			657,946
8		9,324	35,907			
9		22,655)	241,598			
10		(16,706)	3,491,602			
11						
12			2,383,342			
13						
14						
15						
16		2,842				
17						
18						
19						
20						
21						
22		3,659				
23		19,926)				
24		2,378,606				
25						
26						
27						
28	1,163,295		3,403,422		187,996	
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42	1,163,295		12,301,541	[illegible]	071,335	732,128
43						

TAXES OTHER THAN INCOME, INCOME TAXES AND DEFERRED TAXES DURING YEAR
Accounts Nos. 408, 409, 410, 411 and 412

1. Taxes Other Than Income shall include the amount of gross revenue or gross receipts taxes, regulatory agency general assessment for purposes of public utility regulation, state unemployment insurance, franchise taxes, federal excise taxes, social security taxes and all other taxes assessed by federal, state, county, municipal, or other local government authorities except income taxes. These accounts shall be charged in each accounting period with the amount of taxes which are applicable thereto, with concurrent credits to account 236 - Accrued Taxes or account 165 - Prepayments, as appropriate.

2. Income Taxes shall include the amounts of local, state, and federal income taxes on income properly accruable during the period covered by the income statement to meet the actual liability for such taxes. Concurrent credits for the tax accruals shall be made to account 236 - Accrued Taxes, and as the exact amount of taxes become known, the current amount shall be adjusted by charges or credits to these accounts unless such adjustments are properly included in account 439 - Adjustments to Retained Earnings.

3. The charges to these accounts shall be made or supported so as to show the amount of each tax and the basis upon which each charge is made. In the case of a utility rendering more than one utility service, taxes of the kind includible in these accounts shall be assigned directly to the utility department the operation of which gave rise in so far as practicable. Where the tax is not attributable to a specific utility department, it shall be distributed among the utility departments of nonutility operations on an equitable basis.

		OTHER THAN INCOME AND INCOME TAXES DURING YEAR						
		BALANCE AT	BY DEBIT OR	BY DEBIT OR CREDIT TO OTHER ACCOUNTS				TOTAL ACCRUALS,
Line No.	Name of Tax (See Instruction 5)	BEGINNING OF YEAR	CREDIT TO ACCOUNT	ACCT NO.	AMOUNT DEBIT	ACCT NO.	AMOUNT CREDIT	AMORTIZATIONS AND DEFERRALS
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
2	Taxes Other Than Income Accounts (409.1)							
3	Utility Reg. Assessment Taxes (Acct 408.10)		2,383,742				-	2,383,742
4	Property Taxes (Acct 408.11)		3,805,922	409.2	187,866		-	3,591,918
5	Payroll Taxes (Acct 408.12)		2,622,603	181			232,256	2,390,347
6	Other Taxes (Acct 408.13)		3,491,402				-	3,491,402
	Other Taxes (Acct 408.13)							-
8								
9								-
10	Total Taxes Other Than Income		12,303,669					11,757,409
11								
12	Income Taxes (Acct 409.1)							
13	Total Federal Income Taxes (Acct 409.1)		28,474,322					28,474,322
14	State Income Taxes (Acct 409.1)		6,923,658				-	6,923,658
15	Total State Income Taxes (Acct 409.1)							-
16	Other Taxes (Acct 409.1)		883,339				-	883,339
17	Other Taxes (Acct 409.1)							-
18	Other Taxes (Acct 409.1)							-
19								-
20	Total Income Taxes		36,281,319					36,281,319
21								
22	Deferred Income Taxes (Acct 410.1)							
23	Deferred Taxes (Acct 410.1)		9,420,434				-	9,420,434
24	Deferred Taxes (Acct 410.1)		2,094,886				-	2,094,886
25	Deferred Taxes (Acct 410.1)							-
26	Other Deferred Taxes (Acct 410.1)							-
27								-
28	Total Deferred Income Taxes		11,515,320					11,515,320
29								
30	Deferred Tax Taxes Credited (Acct 411.1)							
31								-
32								-
33								-
34	Total Deferred Taxes Credited (Acct 411.1)		(233,592)				-	(233,592)
35								-
36								-
37								-

TAXES OTHER THAN INCOME, INCOME TAXES AND DEFERRED TAXES DURING YEAR

4. If any tax (exclude Federal and State income taxes) covers more than one year, show the required information separately for each tax year, identifying the year in column (b).

5. Enter all adjustments of the Other Than Income, Income and Deferred tax accounts in column (c) and explain each adjustment in a footnote. Designate debit adjustments by parentheses.

6. Do not include on this page entries with respect to taxes collected through payroll deduction or otherwise pending transmittal of such taxes to the taxing authority.

7. Report in columns (k) through (n) only the amounts charged to Accounts 408.1 and 409.1 pertaining to water operations. Report in column (m) the amounts charged to Accounts 408.1 and 409.1 pertaining to other utility departments and amounts charged to Accounts 408.2 and 409.2. Also show in column (m) the taxes charged to utility plant or other balance sheet accounts.

8. For any tax apportioned to more than one utility department or account, state in a footnote the basis (necessity) of apportioning such tax.

Line No	Balance at Beg of Year		Distribution of Taxes Charged			
			WATER ACCT 408.1	WATER ACCT 409.1	OTHER UTILITIES ACCTS 408.1 - 409.1	UTILITY PLANT AND OTHER BAL SHEET ACCOUNTS
1	(a)	(b)	(k)	(l)	(m)	(n)
2						
3	2,065,741		2,383,734			
4	359,353		543,922		184,569	
5	2,298,347		3,022,475			322,128
6	3,491,402		3,491,402			
7						
8						
9						
10	1,755,260		12,305,734			
11						
12						
13	28,471,327			29,471,922		
14	6,923,855			7,407,424		
15						
16	503,330				503,330	
17						
18						
19						
20	36,284,459					
21						
22						
23		2,383,734				
24		2,905,656				
25						
26						
27						
28		5,289,390				
29						
30						
31						
32						
33						
34						
35						
36						

422. RECONCILIATION OF NET INCOME SHOWN ON SCHEDULE 400 WITH FEDERAL NORMAL TAX NET INCOME

INSTRUCTIONS

1. Report in the form provided a reconciliation of (a) net income for the year as shown by the Income Statement (Schedule 400) with (b) Federal normal tax net income as shown in return filed with the Federal government for the calendar or other fiscal year covered by Respondent's PUC Annual Report. The reconciliation is to be furnished even if there is no net income on which Federal taxed on income are payable for the year.

2. If the Respondent is a member of a group which files a consolidated tax return, the net income reported to the Commission in Schedule 400 should be reconciled with the net income which would be subject to Federal normal income tax if a separate tax return were filed by the Respondent. In a supplementary schedule there should be shown (a) names of the companies in the consolidated group, (b) the taxes for the consolidated group, determined from the consolidated tax return, according to the kinds of taxes, (c) the taxes of the Respondent if a separate return were filed, and (d) the amount allocated and method of allocation to Respondent or a portion of the consolidated taxes.
   a. See Attached List b. The taxes for the consolidated group are not available until Sept.15, 2006
   c. $26,715,788 d. Taxes are not allocated
3. If the tax situation of the Respondent with respect to the year's income is such as to permit of the filing of a claim for refund of taxes of a prior year, or the carrying forward of a credit against taxable income of a future year, explain the circumstances and state the amount of tax refund which may be claimed or the credit available against future taxable income.
   Not Applicable
4. Furnish particulars of any additional taxed paid or refunds received during the year with respect to Federal taxes on income of a previous year, and adjustments of Accrued Taxes for under or over accrual of taxes of previous years.
   Not Applicable
5. State below the latest year with respect to which the tax returns have been received by the Federal government and the year's income closed as to assessment of additional Federal taxed on income or recovery of a tax refund.
   Returns have been received by the IRS through the tax year ending 2004 and all years income closed through 2002. American Water Works is currently under IRS audit for years 2003 and 2004.

6. State below the date Respondent's tax returns for the year were filed and the Collector's office to which sent. If a consolidated tax return was filed state that fact also and name of the parent company which filed the return
   The consolidated tax return for American Water Works Co., Inc. for 2005 will be filed on or before September 15, 2006 in Philadelphia, PA.

7. State below the Federal taxes on income for the year as shown by returns filed with the Federal government of the calendar or other established fiscal year covered by Respondent's PUC Annual Report and the taxes shown in Respondent's annual report to the Commission.

	Per Tax Returns	Per PUC Annual Report
Normal Tax Surtax		
Total		

8. If the taxes per tax returns differ from amounts shown by the PUC Annual Report, furnish a statement showing allocation of the taxes per tax return to the departmental tax expense accounts and other accounts to which applicable, and an explanation of the basis of allocation

422. RECONCILIATION OF NET INCOME SHOWN ON SCHEDULE 400 WITH FEDERAL NORMAL TAX NET INCOME (Continued)

Line No.	Particulars (a)	Amount (b)
1	**Net Income for the year per Schedule 400**	58,887,965
2	Adjustments made to determine taxable income*	
3	Income attributable to Wastewater**	3,166,956
4	Federal income tax	38,348,358
5	Deferred State taxes	9,214,689
6	**Permanent Differences**	
7	Book over tax travel & entertainment	70,495
8	Nondeductible penalties	8,439
9	Nondeductible dues	37,669
10	Lobbying expense	2,535
11	Luxury auto - Lease limit	3,118
12	Amort Of preferred stock expense	
13		
14	**Temporary Differences**	
15	Change in taxable contributions and advances	6,167,395
16	Book over tax depreciation	-16,543,906
17	Uncollectable accounts	2,319,150
18	Interest capitalized for taxes over AFUDC	591,297
19	Merger expenses	521,037
20	Taxable advances	-6,332,409
21	Miscellaneous deferred expense	577,664
22	Rate case expense	667,862
23	Amortization of Premature Property Loss	
24	Amortization of regulatory asset	71,522
25	Amortization of UPAA	-478,921
26	Gains and losses	-903,932
27	Regulatory Pension	-1,393,443
28	AFUDC over interest capitalized for taxes	-114,795
29	Accrued vacation pay expense	59,080
30	Abandonment losses	-9,068,676
31	Cost of Removal	-938,763
32	Incentive pay expense	-729,244
33	Miscellaneous deferred expenses	-1,569,156
34	Deferred Security Costs	1,802,748
35	State Income Tax deduction	-8,114,518
36	Preferred pate dividend credit	
37		
38	**Net additions to or deductions from amount shown on Line 1**	17,442,857
39		
40	**Federal surtax net income** (surtax $ at applicable rate of tax of %)	76,330,822

* List additional income items first, followed by additional deductions.

** Wastewater net income must be added in to calculate taxes due to taxes being calculated on a total company basis

		35.00%
		26,715,788
	Provision adjustment	
	Federal Income Tax Expense	26,715,788

500. WATER DELIVERED INTO SYSTEM DURING YEAR

Other Authorized Unmetered Usage

Office Use	3,718
Meter Shop Use	13,201
Draining Storage	999,154
Street Cleaning/Sewer Flushing/Fire Usage	108,376
	1,124,449

501. IMPORTANT PHYSICAL CHANGES DURING the YEAR

Submit information separately for each of the six functional groups listed below with respect to major physical changes to plant-in-service costing more than $250,000 during the year involving either additions to or improvements of, or retirements or replacements of plant. Information provided shall include Work Order Number, a Description of the Project, and the District Served. Attach additional sheets as necessary.

1. Source of Supply 2. Power and Pumping 3. Purification 4. Distribution 5. General 6. Other Tangible

1. Source of Supply

See Attachment

2. Power and Pumping

See Attachment

3. Purification

See Attachment

4. Distribution

See Attachment

5. General

See Attachment

6. Other Tangible

No major physical changes

502. PA-DEP ANNUAL WATER SUPPLY REPORTS

Attach copies of the Annual Water Supply Reports submitted to PA-DEP for the calendar year. Each stand alone water system is required to file a separate report. Below separately list the Names of each District, Division or System for which reports are attached and the number of pages including all attachments thereto.

	PAGES

The information requested will be sent as soon as available.

Company

610. Territory Served

Report below the number of customers at the end of the year in respondent's distribution system in which service is furnished, setting forth by counties the number of customers and average number of customers during the year.

County Code	Name of Pennsylvania County	Number Of Customers At End Of Year	Average Number Of Customers During Year
(a)	(b)	(c)	(d)
01	Adams This information is not available at this time.		
02	Allegheny		
03	Armstrong		
04	Beaver		
05	Bedford		
06	Berks		
07	Blair		
08	Bradford		
09	Bucks		
10	Butler		
11	Cambria		
12	Cameron		
13	Carbon		
14	Centre		
15	Chester		
16	Clarion		
17	Clearfield		
18	Clinton		
19	Columbia		
20	Crawford		
21	Cumberland		
22	Dauphin		
23	Delaware		
24	Elk		
25	Erie		
26	Fayette		
27	Forest		
28	Franklin		
29	Fulton		
30	Greene		
31	Huntingdon		
32	Indiana		
33	Jefferson		
34	Juniata		
35	Lackawanna		
36	Lancaster		
37	Lawrence		
38	Lebanon		
39	Lehigh		
40	Luzerne		
41	Lycoming		
42	McKean		
43	Mercer		
44	Mifflin		
45	Monroe		
46	Montgomery		
47	Montour		
48	Northampton		
49	Northumberland		
50	Perry		
51	Philadelphia		
52	Pike		
53	Potter		
54	Schuylkill		
55	Snyder		
56	Somerset		
57	Sullivan		
58	Susquehanna		
59	Tioga		
60	Union		
61	Venango		
62	Warren		
63	Washington		
64	Wayne		
65	Westmoreland		
66	Wyoming		
67	York		
Totals			0
Total Population of Territory Served (Estimated)			

VERIFICATION

OATH

(To be made by the officer having control of the accounting of the respondent)

State of _Pennsylvania ___ as

County of __ Dauphin

_Christopher C. Bulz ___ (Name of affiant) makes oath and says that he she is _Treasurer & Comptroller (Official title of affiant)

of _Pennsylvania American Water (Exact legal title or name of the respondent)

The signed officer has reviewed the report

Based on the officer's knowledge, the report does not contain any untrue statements of a material fact or omit to state a material fact necessary in order to make the statements made, in light of the circumstances under which such statements were made, not misleading

Based on such officer's knowledge, the financial statements, and other financial information included in the report, fairly present in all material respects the financial condition and results of operations of the issuer as of, and for, the periods presented in the report

He/she believes that all other statements contained in the said report are true, and that the said report is a correct and complete statement of the business and affairs of the above-named respondent during the period of time from and including _January 1, 2005 to and including ___December 31, 2005 .

Subscribed and sworn to and before me, a

in and for the State and County above-named, this ___ day of ___.

(Signature of affiant)

My commission expires

(Signature of officer authorized to administer oaths)

SUPPLEMENTAL OATH

(By the president or other chief officer of the respondent)

State of ___ Pennsylvania as

County of _Dauphin

_ Daniel W. Warnock (Name of affiant) makes oath and says that he/she is _President (Official title of affiant)

of ___Pennsylvania American Water (Exact legal title or name of the respondent)

that he/she has carefully examined the foregoing report; that he/she believes that all statements of fact contained in the said report are true, and that the said report is a correct and complete statement of the business and affairs of the above named respondent during the period of time from and including ___January 1, 2005 , to and including __December 31, 2005

Subscribed and sworn to before me, a

in and for the State and County above-named, this ___ day of ___

(Signature of affiant)

My commission expires

(Signature of officer authorized to administer oaths)

COMPANY	YEAREND	COUNTYCO	SERVES	COUNTYNAME	CUSTOMERSEOY	CUSTOMERSAVE
	0 YEAR ENDED DECEMBER 31, 200	01	0	Adams	0	0
	0 YEAR ENDED DECEMBER 31, 200	02	0	Allegheny	0	0
	0 YEAR ENDED DECEMBER 31, 200	03	0	Armstrong	0	0
	0 YEAR ENDED DECEMBER 31, 200	04	0	Beaver	0	0
	0 YEAR ENDED DECEMBER 31, 200	05	0	Bedford	0	0
	0 YEAR ENDED DECEMBER 31, 200	06	0	Berks	0	0
	0 YEAR ENDED DECEMBER 31, 200	07	0	Blair	0	0
	0 YEAR ENDED DECEMBER 31, 200	08	0	Bradford	0	0
	0 YEAR ENDED DECEMBER 31, 200	09	0	Bucks	0	0
	0 YEAR ENDED DECEMBER 31, 200	10	0	Butler	0	0
	0 YEAR ENDED DECEMBER 31, 200	11	0	Cambria	0	0
	0 YEAR ENDED DECEMBER 31, 200	12	0	Cameron	0	0
	0 YEAR ENDED DECEMBER 31, 200	13	0	Carbon	0	0
	0 YEAR ENDED DECEMBER 31, 200	14	0	Centre	0	0
	0 YEAR ENDED DECEMBER 31, 200	15	0	Chester	0	0
	0 YEAR ENDED DECEMBER 31, 200	16	0	Clarion	0	0
	0 YEAR ENDED DECEMBER 31, 200	17	0	Clearfield	0	0
	0 YEAR ENDED DECEMBER 31, 200	18	0	Clinton	0	0
	0 YEAR ENDED DECEMBER 31, 200	19	0	Columbia	0	0
	0 YEAR ENDED DECEMBER 31, 200	20	0	Crawford	0	0
	0 YEAR ENDED DECEMBER 31, 200	21	0	Cumberland	0	0
	0 YEAR ENDED DECEMBER 31, 200	22	0	Dauphin	0	0
	0 YEAR ENDED DECEMBER 31, 200	23	0	Delaware	0	0
	0 YEAR ENDED DECEMBER 31, 200	24	0	Elk	0	0
	0 YEAR ENDED DECEMBER 31, 200	25	0	Erie	0	0
	0 YEAR ENDED DECEMBER 31, 200	26	0	Fayette	0	0
	0 YEAR ENDED DECEMBER 31, 200	27	0	Forest	0	0
	0 YEAR ENDED DECEMBER 31, 200	28	0	Franklin	0	0
	0 YEAR ENDED DECEMBER 31, 200	29	0	Fulton	0	0
	0 YEAR ENDED DECEMBER 31, 200	30	0	Greene	0	0
	0 YEAR ENDED DECEMBER 31, 200	31	0	Huntingdon	0	0
	0 YEAR ENDED DECEMBER 31, 200	32	0	Indiana	0	0
	0 YEAR ENDED DECEMBER 31, 200	33	0	Jefferson	0	0
	0 YEAR ENDED DECEMBER 31, 200	34	0	Juniata	0	0
	0 YEAR ENDED DECEMBER 31, 200	35	0	Lackawanna	0	0
	0 YEAR ENDED DECEMBER 31, 200	36	0	Lancaster	0	0
	0 YEAR ENDED DECEMBER 31, 200	37	0	Lawrence	0	0
	0 YEAR ENDED DECEMBER 31, 200	38	0	Lebanon	0	0
	0 YEAR ENDED DECEMBER 31, 200	39	0	Lehigh	0	0
	0 YEAR ENDED DECEMBER 31, 200	40	0	Luzerne	0	0
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	0 YEAR ENDED DECEMBER 31, 200	42	0	McKean	0	0
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	0 YEAR ENDED DECEMBER 31, 200	44	0	Mifflin	0	0
	0 YEAR ENDED DECEMBER 31, 200	45	0	Monroe	0	0
	0 YEAR ENDED DECEMBER 31, 200	46	0	Montgomery	0	0
	0 YEAR ENDED DECEMBER 31, 200	47	0	Montour	0	0
	0 YEAR ENDED DECEMBER 31, 200	48	0	Northampton	0	0
	0 YEAR ENDED DECEMBER 31, 200	49	0	Northumberland	0	0
	0 YEAR ENDED DECEMBER 31, 200	50	0	Perry	0	0
	0 YEAR ENDED DECEMBER 31, 200	51	0	Philadelphia	0	0
	0 YEAR ENDED DECEMBER 31, 200	52	0	Pike	0	0
	0 YEAR ENDED DECEMBER 31, 200	53	0	Potter	0	0
	0 YEAR ENDED DECEMBER 31, 200	54	0	Schuylkill	0	0
	0 YEAR ENDED DECEMBER 31, 200	55	0	Snyder	0	0
	0 YEAR ENDED DECEMBER 31, 200	56	0	Somerset	0	0
	0 YEAR ENDED DECEMBER 31, 200	57	0	Sullivan	0	0
	0 YEAR ENDED DECEMBER 31, 200	58	0	Susquehanna	0	0
	0 YEAR ENDED DECEMBER 31, 200	59	0	Tioga	0	0
	0 YEAR ENDED DECEMBER 31, 200	60	0	Union	0	0
	0 YEAR ENDED DECEMBER 31, 200	61	0	Venango	0	0
	0 YEAR ENDED DECEMBER 31, 200	62	0	Warren	0	0
	0 YEAR ENDED DECEMBER 31, 200	63	0	Washington	0	0
	0 YEAR ENDED DECEMBER 31, 200	64	0	Wayne	0	0
	0 YEAR ENDED DECEMBER 31, 200	65	0	Westmoreland	0	0
	0 YEAR ENDED DECEMBER 31, 200	66	0	Wyoming	0	0
	0 YEAR ENDED DECEMBER 31, 200	67	0	York	0	0

PCL&P STATEMENT NO. 2

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

COUNTY OF PIKE, ET AL.	:	
	:	
COMPLAINANTS,	:	
	:	
V.	:	DOCKET NO.: C-20065942, et al. (Consolidated)
	:	
PIKE COUNTY LIGHT & POWER COMPANY	:	
	:	
RESPONDENT.	:	

DOCUMENT FOLDER

REBUTTAL TESTIMONY

OF

ANGELO M. REGAN

ON BEHALF OF

RESPONDENT

PIKE COUNTY LIGHT & POWER COMPANY

DECEMBER 11, 2006

2006 DEC 13 AM 8:50

PCL&P COUNTY LIGHT & POWER COMPANY
REBUTTAL TESTIMONY OF
ANGELO M. REGAN

Q. **Please state your name and business address.**

A. Angelo M. Regan, 390 West Route 59, Spring Valley, New York 10977.

Q. **By whom are you employed and in what capacity?**

A. I am employed by Orange and Rockland Utilities, Inc. ("Orange and Rockland"), the corporate parent of Pike County Light & Power Company ("PCL&P" or the "Company"), as Director of Electrical Engineering.

Q. **Please briefly describe your educational and business experience.**

A. I received a Bachelor of Science degree in Electrical Engineering in 1985, and a Masters of Science degree in Industrial Engineering Management Science in 1987, both from Fairleigh Dickinson University, in Teaneck, New Jersey. I am a registered professional engineer in the State of New York. I was employed by Central Hudson Gas and Electric Corporation as an overhead distribution systems engineer from 1985 to 1987. Since then, I have worked for Orange and Rockland as an overhead and underground Systems Engineer, as Manager of the Distribution Engineering Department, and then as Chief Distribution Engineer, prior to assuming my present position as Director of Electrical Engineering.

Q. **What is the purpose of your testimony in this proceeding?**

A. The purpose of my testimony is to discuss the possible interconnection of PCL&P to PPL Electric Utilities, Inc. ("PPL"), Metropolitan Edison Company ("MetEd"), and/or Sussex Rural Electric Cooperative ("Sussex"), and the Company's electric service reliability. I also will address certain issues raised by witnesses during the public input hearings in this proceeding, as well as by formal complainants during

the evidentiary hearing held before Administrative Law Judge Jandebeur on November 6, 2006 in Scranton, Pennsylvania.

Q. Has PCL&P completed an interconnection study?

A. Yes. PCL&P has completed an interconnection study ("Interconnection Study") exploring the costs and benefits of interconnecting its service territory with PJM. A copy of the Interconnection Study was attached as Appendix B to the Report on Competitive Market Conditions Regarding the Pike County Light & Power Company dated June 1, 2006 prepared by the Pennsylvania Public Utility Commission's ("PAPUC") Law Bureau ("Law Bureau Report").

Q. Please describe why the Interconnection Study focused solely on a 69kV transmission line extension option from PP&L or MetEd?

A. The 69kV transmission line extension that PCL&P proposed and examined in the Interconnection Study is the proper solution both to improve reliability and to allow for future load growth. PCL&P has serious concerns with proposals, such as those advanced by Office of Consumer Advocate ("OCA") witness Mr. Lanzalotta, utilizing lower voltage systems that offer significant line exposure, and thus added reliability risk, and do not meet the load deliverability requirements of PJM. While alternatives that involve interconnecting the existing area 34.5kV systems may be a short-term solution, the eventual connection to, and service from, the area 69kV transmission systems is the correct long-term solution. At present, as described in the Interconnection Study, the nearest 69kV transmission system is PP&L's 69kV line into the Twin Lakes Substation. However, by the end of 2008, Orange and Rockland will have three 69kV lines

terminating at its Port Jervis Substation, which will also be upgraded in 2008 to provide significantly improved reliability to the 13.2kV and 34.5kV systems that it serves. This extremely strong source will be providing substantially improved system reliability to the PCL&P system and its customers from just a quarter mile away from Pike County. The eventual tying of the Orange and Rockland and PP&L 69kV systems is what PCL&P envisions as the ultimate and correct long-term solution to improving reliability for all of the customers in this area of Pennsylvania.

Q. **At pages 5 and 6 of his testimony, Mr. Lanzalotta describes additional possible alternatives, with their associated costs, for interconnecting with PP&L and MetEd. Do you agree with his assessment and conclusions?**

A. No, I do not. First I will address Mr. Lanzalotta's assessment that new distribution circuits could be extended from PP&L's Twin Lakes Substation to supply PCL&P's service area and load. From a field investigation, and in the absence of having actual system information from PP&L, it appears that the Twin Lakes substation has lower voltage distribution circuits serving local area load, probably at 12kV. Even if the Twin Lakes Substation transformer had the capacity to serve an additional 12kV distribution circuit that could be extended to PCL&P, this distribution would not have the capacity to serve PCL&P's present peak load, let alone its projected load growth. There would certainly be adequacy of service and voltage quality issues with serving load centers between eight and 14 miles away from the source. Put simply, Mr. Lanzalotta's proposal does not constitute good utility design or practice. I would note that his proposal would

more than double the line exposure of the system that PCL&P presently utilizes to serve its customers. All of the line transformers in PCL&P would have to be changed as well to accommodate the 12kV distribution voltage. With the addition of MetEd's new 34.5kV circuit along Route 6, this corridor, which would remain the most viable one to extend additional circuits towards Milford, is becoming increasingly congested. Any new circuits either would have to be double or triple circuited as overhead construction, or extended for a considerable distance as underground construction. This will significantly raise the difficulty and cost of extending additional circuits in this direction on limited pubic roads. Moreover, there are other substantial unknown factors which could require significant upgrades and increase costs; namely the actual available capacity of the Twin Lakes Substation transformer, and PP&L's 69kV radial transmission line that presently serves the load at both the Twin Lakes Substation and MetEd's Walker Substation.

Q. Please go on.

With respect to MetEd's Walker Substation, it is apparent that the Walker Substation has an open position where a transformer can be connected to provide an independent 34.5kV source to interconnect with the PCL&P's 34.5kV system. At first glance, this solution appears more viable than the Twin Lakes distribution proposal from the perspective of similar system voltage and more available capacity. Many of the issues and cost concerns that I raised for the non-viability of the Twin Lakes distribution alternative, however, apply to this alternative as well. These include the increased length of exposure to PCL&P's load centers, the

corridor congestion along Route 6 to extend this circuit, and PP&L's available transmission line capacity. There certainly could be adequacy of service and voltage quality issues with serving load centers between eight and 14 miles away from the source. Should the MetEd system have to feed the PCL&P service territory radially from the Walker Substation, it would more than double the line exposure (i.e., from the Walker Substation to Matamoras) of the system that PCL&P presently utilizes to serve its customers. In proposing that PCL&P interconnect at the Walker Substation, Mr. Lanzalotta has failed to address whether MetEd has any future plans for the Walker Substation, and what additional cost and/or operating implications there would be to utilize this space and capacity. It appears that Mr. Lanzalotta has not spoken with representatives of MetEd regarding his interconnection proposal. Indeed, Mr. Lanzalotta has failed to provide any evidence that MetEd would even entertain accommodating PCL&P as an additional tenant in their substation. This is far from an academic question, since PCL&P's interconnection at the Walker Substation would have limited benefit to MetEd.

Q. Do you have any concerns regarding the cost estimates Mr. Lanzalotta uses for interconnection at the Walker Substation?

A. While it is true that just the substation costs to increase capacity at the Walker Substation would be less expensive than constructing a completely new substation in PCL&P's service territory, I do not agree with Mr. Lanzalotta's assessment (page 6, line 6) that the addition of a 20 to 25 MVA substation transformer would cost from $500,000 to $600,000. PCL&P has considerable recent experience in

estimating the costs for, and constructing similar projects. PCL&P projects that the fully installed cost of this facility would be approximately $1.45 million, with the estimated cost of the transformer to be $600,000 alone. The substation improvements provided for in this estimate would include the 25 MVA transformer, high and low side breaker protection and protective relay systems, control and SCADA systems, foundations and conduits, and design and construction labor. This cost projection does not include certain other costs, which upon closer inspection could be required, such as any additional costs to modify the PP&L and MetEd systems, or provide any upgrades to the Walker Substation to accommodate an additional tenant.

Q. Do you agree with the size of the transformer that Mr. Lanzalotta recommends?

A. No. I do not agree with Mr. Lanzalotta's recommendation that PCL&P install a substation transformer of from 20 to 25 MVA. With PCL&P's recent 2006 peak load of 19 MVA, and utilizing its present weather normalized system load growth of 3% for annual future projections, a 25 MVA transformer would exceed its base rating in less than 10 years. A more appropriate size transformer to install would be one with a base rating of 35 MVA. This may provide a 20-year solution, and would increase the cost by an additional $150k above the $1.45 million estimate (or to a total cost of $1.6 million). Additional costs would be required for the 34.5kV circuits, including upgrades to PCL&P's Line 7 mainline facilities, the installation of distribution automation and sectionalizing schemes, and voltage support. The Route 6 corridor congestion likely would require undergrounding or

double circuiting, or a combination of both, for a portion of the new 34.5kV line where there are presently facilities on both sides of the road. PCL&P is estimating that the extension of this line from the Walker Substation to Milford would cost $1.6 million, upgrades to the PCL&P 34.5kV system to interconnect with the new line would cost $300,000, voltage support costs are estimated at $300,000, and automation monitoring and control to cost an additional $200,000. In total, the line costs associated with interconnecting to the Walker Substation would be approximately $2.4 million.

Q. Has Mr. Lanzalotta adequately considered the electrical characteristics of MetEd's and PCL&P's 34.5kV systems?

A. No. Even accounting for the lack of detail in Mr. Lanzalotta's proposal, it would appear that he has not considered the electrical characteristics of the 34.5kV systems in question. PCL&P believes there is a 30-degree phase shift between the MetEd and PCL&P 34.5kV systems that would require the installation of a special transformer to correct. This phase shift could be corrected with the new transformer installation discussed above, however, it should be noted that this new circuit would be 30-degrees out of phase with the existing MetEd 34.5kV circuit presently extending along Route 6, precluding close transition ties.

Q. Do you have any concerns with Mr. Lanzalotta's assessment at page 6, lines 2-3, which states that the PCL&P load could potentially be served out of the MetEd Walker Substation over the existing 34.5kV line?

A. Yes. The utilization of the existing MetEd 34.5kV circuit as a stand-alone solution would be even less viable than the second transformer and new 34.5kV line

alternative discussed above, due to capacity issues and the requirement to install a transformer station to correct the phasing problem discussed above. The cost for this transformer station would exceed the projected costs of the station additions at the Walker Substation described above. In order to satisfy PJM deliverability requirements and PCL&P system load growth, as well as the growth on MetEd's own system, likely upgrades would be required to the existing Walker Substation transformer and the existing 34.5kV circuit that would make this alternative even more expensive than the new transformer and line alternative discussed above.

Q. Do you have any other concerns with Mr. Lanzalotta's proposal?

A. Yes. As noted above, PCL&P has numerous serious concerns regarding Mr. Lanzalotta's proposal given the speculative and undocumented nature of many of its components. At a minimum, a detailed engineering investigation, local area study and load flow studies would need to be performed to determine conclusively the sizing of facilities and system equipment needs, or even if such an interconnection would be viable from engineering and system operating perspectives. PCL&P estimates that the known costs for a possible interconnection with the MetEd 34.5kV system at the Walker Substation are $4 million at minimum, without any payments to the hosting utility (i.e., MetEd) for upgrades and any other associated fees that may be required as a result. There are still too many unknown variables and costs, many of which could be significant, to determine at present if this is even possible, let alone a cost-effective alternative. As noted above, however, regardless of cost, Mr. Lanzalotta's 34.5kV proposal suffers from the fact that it is not as reliable as, and does not

offer the long-term deliverability and system operating requirements that are inherent with, the 69kV alternative.

Q. At page 6, Line 20 of Mr. Lanzalotta's testimony, he discusses PCL&P's possible interconnection with Sussex. Do you agree with his assessment and conclusions?

A. I must preface my response to this question by noting that to date I have been provided no system maps or other relevant information on the Sussex electric delivery system. Accordingly, my response is based on limited field observations. Mr. Lanzalotta suggests that Sussex has a 34.5kV circuit with the capacity to serve the PCL&P load, by extending this circuit between 3 and 13 miles, at a cost of $1 to $2 million. He has broken this down to three major components; the costs to connect the Sussex 34.5kV line to PCL&P, the Delaware River crossing, and costs to reconfigure the PCL&P system to prepare it to be fed from the Sussex system. I will address these components in the same order.

Q. Please discuss the first component of Mr. Lanzalotta's Sussex interconnection proposal.

A. With respect to the first component, Mr. Lanzalotta has not identified the location of the Sussex sources, or the path of interconnection and the facilities that would need to be upgraded to interconnect with the PCL&P 34.5kV system. The nearest 34.5kV sources that PCL&P could locate within the Sussex territory are approximately 12 to 14 miles in straight-line distance from PCL&P's facilities; those being at the Sussex Substations located off of Meyer Road and Cemetery Road. In order to reach the PCL&P service territory, the most logical route that

this line would have to traverse would be through New Jersey State parkland, and then proceed through Jersey Central Power and Light's ("JCP&L") service territory. The distance from these sources to PCL&P along roadways is closer to 21 miles. Assuming that all of the ROW, parkland, environmental and franchise approvals could be obtained, and some combination of ROW and roadway is utilized for the route, this line extension could be lessened to 17 miles. Mr. Lanzalotta has also utilized a cost of $115,000 per mile for 34.5kV construction, as provided by Sussex. While this cost is not entirely out of line for just the base 34.5kV line construction, PCL&P is not sure if these costs contain other ancillary costs that can typically be part of the overall cost, such as vegetation management, rock holes, flagging or other contingency costs. PCL&P has seen these factors escalate the costs to approach $150,000 per mile or higher. Assuming there will be stretches of straightforward, as well as more difficult construction, PCL&P estimates that $130,000 per mile is more representative for this type of construction. Based on this estimate, the cost for this portion of the interconnection would be at least $2.2 million. This does not include any additional costs that may be required to, among other things, secure ROW, obtain permits, and complete environmental studies.

Q. Please discuss the second component of Mr. Lanzalotta's Sussex interconnection proposal.

A. The second major component is to cross the Delaware River. Mr. Lanzalotta utilized the cost that PCL&P incurred over 15 years ago, updated to present day dollars, to cross the Delaware River between Port Jervis and Matamoras. The

costs, that were requested of and supplied by PCL&P, were updated costs to re-construct an existing aerial crossing, not to install a completely new crossing. PCL&P believes that utilizing this cost to be representative of what will be required to cross the Delaware River, particularly if it is near or adjacent to the Route 206 Bridge in south Milford, is inaccurate and most probably understated. A straightforward increase just to correct to present day dollars would not properly account for increases in materials that have escalated at a higher rate than inflation, such as steel, or for factors such as rock removal that certainly could be prevalent near a river bed. If it is permitted to span the Delaware River as overhead construction, the cost to complete this will depend on the location and distance of the crossing. PCL&P is estimating that this cost could exceed $400,000. However, issues relating to permitting and approvals, including the time required to secure them, could substantially raise this cost. This crossing will be in the Delaware Water Gap National Recreation Area, and the permitting agencies may require the line to be attached to an existing structure, such as the Route 206 Bridge, or installed under the river. More investigation needs to be competed before a reasonable cost estimate can provided. If this section is required to be attached to an existing structure or installed under the river. PCL&P's preliminary observations indicate that the costs to complete this section of the line extension will be extremely expensive, and could be double or more of PCL&P's estimated overhead cost to complete this crossing.

Q. **Please discuss the third component of Mr. Lanzalotta's Sussex interconnection proposal.**

A. The third major component is to reconfigure the PCL&P system to prepare it to be fed from the Sussex system. As with the MetEd alternative discussed above, this component would include at a minimum upgrades to PCL&P's Line 7 mainline facilities, the installation of distribution automation and control/monitoring schemes, and voltage support. Upgrades to the PCL&P 34.5kV system to interconnect with the new line are estimated to cost $350,000, voltage support costs are estimated at $450,000, and automation monitoring and control are estimated to cost $200,000. Together, these line upgrade requirements are estimated to cost $1 million.

Q. Are there any other costs that Mr. Lanzalotta should have considered with this Sussex alternative?

A. Yes. A fourth major cost component that Mr. Lanzalotta seems to have overlooked is the source costs for this new Sussex 34.5kV line. As with the MetEd alternative discussed above, in order to meet full PJM deliverability requirements and PCL&P system load growth, it is anticipated that a new express feeder, with a 477 AAC conductor and a capacity of 35 MVA at minimum, would need to be installed As such, and at a minimum, substation upgrade costs would be required to provide a new feeder position, breaker and relay protection, SCADA, and other associated costs. In addition, as noted above, PCL&P believes that there is a 30-degree phase shift between the Sussex and PCL&P 34.5kV systems that would require the installation of a special transformer to correct this phasing problem. Similar to the MetEd alternative, PCL&P estimates that the cost of these substation upgrades would be approximately $1.6 million. Additionally,

the Sussex sources in this area are fed from 34.5kV lines, and with the proposed load addition of the PCL&P load and projected PCL&P system growth to the Sussex system, it is likely that the Sussex source feeders will need to be upgraded in the short-term. These costs can be substantial and should be identified and accounted for in any cost analysis.

Q. Do you have any other concerns regarding Mr. Lanzalotta's Sussex interconnection proposal?

A. Yes. PCL&P also has serious concerns regarding adequacy of service and voltage quality issues associated with this alternative. This alternative proposes to serve PCL&P's load centers that are located between 17 to 23 miles away, from the sources I have described above, with a single radial 34.5kV line. As noted previously, this constitutes neither good utility design nor practice. Should this Sussex line have to feed the PCL&P service territory radially from the proposed Sussex source, it would more than triple the line exposure of the system that PCL&P presently utilizes to serve its customers. A detailed engineering investigation, local area study and load flow studies would need to be performed to determine the sizing of facilities and system equipment needs, or even if such an interconnection would be viable from engineering and system operating perspectives. PCL&P estimates that the known costs for this alternative are $5.2 million, and could easily exceed $6 million depending on the construction required to cross the Delaware River. There are still too many unknown variables and costs, many of which could be significant, to determine at present if this is a viable and cost-effective alternative. Depending on the resolution of these

outstanding issues and unknown costs, while this alternative could seem less expensive than the 69kV alternative that PCL&P originally proposed, it is not nearly as reliable, nor does it offer the long-term deliverability and system operating requirements that are inherent with the 69kV alternative. In conclusion, PCL&P questions the overall adequacy of Mr. Lanzalotta's Sussex proposal, and further contends that this will not be a more reliable solution to the system that presently serves PCL&P customers.

Q. **At Page 7, lines 24-27, Mr. Lanzalotta describes the need for PCL&P to remain interconnected to maintain the reliability of this interconnection. Does PCL&P agree that it should maintain this interconnection should its service territory be taken over by Sussex?**

A. In the event that PCL&P is forced to sell and relinquish its service territory to Sussex or any another entity, it would be under no obligation to remain interconnected with its present facilities in Pennsylvania from its New York based sources. PCL&P will provide no guaranties that it will remain so interconnected. Additionally, it is quite possible that if PCL&P remained interconnected with free-flowing ties to Sussex, in the scenario that Mr. Lanzalotta describes, that PCL&P's significantly stronger source in Port Jervis would not only continue to serve all of PCL&P's current load, but it could end up serving some of the Sussex system load. This would put more demand requirements on Orange and Rockland's Port Jervis substation and the sources feeding it, with no benefits to PCL&P's parent company, Orange and Rockland. Such a free rider scenario is neither attractive nor acceptable to Orange and Rockland. At a minimum, that

interconnection would be subject to rules and regulations of both PJM and the NYISO and require proper payment and accounting of the energy flows.

Q. Is PCL&P presently aware of, or investigating any other possible interconnections with, PJM Companies?

A. PCL&P has initiated preliminary discussions with JCP&L and MetEd, and will investigate if any opportunities exist to interconnect with its existing electric delivery systems that could improve reliability, while satisfying PJM deliverability requirements.

Q. Please discuss Mr. Lanzalotta's contention that the reliability performance of the PCL&P electric system has deteriorated since the merger of Orange and Rockland, PCL&P's parent company, with Consolidated Edison, Inc. ("CEI").

A. Mr. Lanzalotta states that electric system reliability performance, as reflected in the Company's reliability data, reflects a substantial degradation in the Company's electric service reliability performance since 1999, the year of the Orange and Rockland and CEI merger. He also contends that this is somehow related to the timing of the merger between Orange and Rockland and CEI . Mr. Lanzalotta's contentions are not justified for the following three reasons. First, Mr. Lanzalotta failed to account for the entire set of data the Company provided in response to the OCA's interrogatories. Mr. Lanzalotta's selective use of this data presents an inaccurate view of the Company's service reliability performance. Second, Mr. Lanzalotta failed to adjust for weather-related outages

or other outages beyond the control of the Company. A utility has virtually no control over the number of these incidents, nor their location, and therefore has little control over their impact on reliability performance. Third, Mr. Lanzalotta failed to account properly for the two major factors that contributed to the customer hours of interruption in 2004 and 2005.

Q. Please discuss the first factor.

A. The first factor involved customer outages related to the construction and energization of the new Matamoras Substation. Prior to the completion of the Matamoras Substation, the majority of the customers in the Matamoras area were fed from 34.5kV stepdown transformers at 2.4kV. Prior to the completion of the Matamoras Substation, the local distribution facilities were upgraded and made ready for conversion from the existing antiquated 2.4kV delta system to a modern 13.2kV grounded wye connected system that provides a higher level of safety for the general public. All of this construction and make ready work for the new distribution system was performed under live line conditions and had minimal effect on customer service. At page 14, lines 7-12, Mr. Lanzalotta implies that the planned outages associated with the upgrade of the Matamoras substation were somehow avoidable. Mr. Lanzalotta should be aware that system conversion work, that requires taking customer outages to "cut-over" to the new distribution voltage, is unavoidable and is an industry-accepted practice. Planned outages were necessary to complete the upgrade and modernization of this system. The Company took proper measures to minimize the extent of such outages, and followed appropriate procedures and steps to notify customers in advance of

scheduled outages. Please refer to the rebuttal testimony of Company witness James O'Brien for a detailed description of these procedures. Even though there was some inconvenience to customers during the scheduled outages associated with this system upgrade, it is undeniable that the completion of the new Matamoras Substation, and the upgrade to a new, more reliable 13.2kV system, provides substantially improved reliability to the customers that are now served from the new Matamoras Substation (i.e., approximately 35% of all PCL&P customers).

Q. Please discuss the second factor.

A. The second major factor contributing to customer hours of interruption in 2004-05, were those due to tree contacts. PCL&P acknowledges that interruptions and customers affected were significantly increased during this period due to tree contacts. PCL&P was at the very end of its four-year trimming cycle for the distribution lines that serve PCL&P during this timeframe. Significant vegetation management was performed and the reliability performance with respect to tree incidents has improved in 2006. In recognition of these effects, in the summer of 2006, PCL&P committed to improving its vegetation management cycle on its PCL&P distribution system to a three-year program. Therefore, because of the outage anomalies associated with the Matamoras Substation conversions, and in recognition of the proposed improvements that will be gained by improvements to the vegetation management program, the data from the 2004-2005 period should not be used for trending analysis.

Q. Do you have any other observations on Mr. Lanzalotta's analysis?

A. Yes I do. Notwithstanding the above objections to this analysis, Mr. Lanzalotta's testimony is misleading because the six years (1994-1999) that were used as a basis for this analysis are insufficient to determine a trend because of the volatility of PCL&P's system performance. Inclusion of the 1981-1999 data in the analysis will provide a more complete and objective view of the overall historical reliability performance of the PCL&P system (Refer to Exhibit 1 for the complete PCL&P reliability statistics from 1981 – 2005). During this period, the variability of the interruption data is clearly evident. The mean SAIFI (i.e., System Average Frequency Index, or the frequency of electric service outages) for that nineteen-year period is 2.98, with a standard deviation of 1.69, or 57%. For the years 2000-2003, SAIFI was below the mean twice, and was within one standard deviation above the mean for the other two years. CAIDI (i.e., Customer Average Interruption Duration Index, or the average customer restoration time for electric service outages) and SAIDI (which is calculated by multiplying SAIFI times CAIDI) are within one standard deviation for each of the four years. These results do not indicate a substantial degradation. However, even this analysis may not produce statistically valid results due to the relatively small number of incidents, the variability in the number of customers affected by individual incidents, and the type of incidents that have occurred. It must be noted that the extreme variability in PCL&P's reporting statistics, particularly those that have been reported with major events excluded, is due largely to the fact that its electric delivery system is exceptionally small (i.e., during most of this reporting period, PCL&P had two distribution circuits and approximately 4,400 customers).

As such, all outages in excess of approximately 440 customers qualified as a major event that is excludable from the reporting statistics that generate SAIFI. Therefore, typical interruptions for a larger utility that would never qualify as a major event, such as a tree contact or equipment failure that might trip an entire distribution circuit, or even half of the customers on a circuit with a midpoint recloser, do get excluded for PCL&P, as long as they meet the 10% criteria. This only allows smaller outages, with the associated lower number of customers affected, to count towards the reportable indices, which in turn results in SAIFI indices that are considerably lower than those of a utility with a substantial customer base. This effect of reflecting relatively low SAIFI numbers has the inverse effect of reflecting higher CAIDI numbers, as the remaining outages that do count towards the reportable statistics are smaller and with more localized damage that requires longer time to restore. Additionally, because of PCL&P's small size and customer base, the number of interruptions that are experienced each year is extremely low as compared to many of the other Pennsylvania utilities, both with and without major events.

Q. Please discuss PCL&P's statistical volatility.

A. The problem that exists for PCL&P is that of significant statistical volatility since the standards are based on an extremely small number of incidents that can vary widely year to year. This volatility in the statistics makes it difficult to put a tight bracket on expected performance, without accounting for proper measures to address this volatility. For example and referring to PCL&P's statistics without major events, from 1994 through 2005 the average annual number of interruptions

for PCL&P was 50 with the low being 32 and the high being 90. This equates to a volatility of 36% below and 80% above the 12-year mean. Further adding to the volatility is the number of customers affected by an interruption. From 1994-2005, the average number of customers affected per incident was 47, with the low being 24 and the high being 90. This equates to a volatility of 48% below to 92% above the 12-year mean. Due to the combination of these factors during the period 1994 to 2005, the customers affected each year varied from 850 to 8,123, with 2,527 being the arithmetic mean. Thus the volatility ranged from 66% below the mean to 221% above the mean. Since the number of customers affected each year is directly proportional to SAIFI, SAIFI is directly affected by the volatility of the number of interruptions and the number of customers affected by those interruptions. Likewise for CAIDI, because of the small number of interruptions, CAIDI also exhibits extreme volatility. From 1994–2005 the average annual customer minutes was 448,179 with the high being 997,007 and the low being 176,719. This equates to a volatility of 61% below the mean and 122% above the mean.

Q. Has the Company's electric service reliability shown any indications of improvement in 2006?

A. Yes. Based on 12-month rolling data through November 2006, SAIFI was 1.77, which is below the 2000-05 and 1981-99 means (i.e., 3.97 and 2.98 respectively); CAIDI was 196 minutes which is within one standard deviation of the 2000-05 mean and above the 1981-99 mean (i.e., 162 and 111 respectively); and, SAIDI was 347 minutes which is below the 2000-05 mean and within one standard

deviation of the 1981-99 mean (i.e , 617 and 317 respectively). These values directly contradict Mr. Lanzalotta's assertion, at page 8, line 23, that the "reliability data reflects a substantial degradation in the Company's electric service reliability". Customers' perception of reliability is driven predominately by the frequency of service interruptions (as measured by SAIFI), as opposed to the duration of outages (as measured by CAIDI). The Company's 2006 SAIFI performance indicates better reliability than either the pre- and post-merger average reliability performance. Additionally, the 2006 data includes a major event that significantly impacted these statistics. On February 19, 2006 a tree fell from outside of PCL&P's right-of-way, in a relatively inaccessible location, on to PCL&P's facilities causing an outage. Without this incident, SAIFI would improve to 1.19, CAIDI would improve to 128 minutes, and SAIDI would improve to 153 minutes. Again, this demonstrates the type of variability that exists for PCL&P's system performance, in that a single incident can have an inordinate impact on each of the performance measurements. It also demonstrates the inequity of including outages that are beyond the control of the utility in this analysis. Additionally, through November 2006, PCL&P's reliability is better than the rolling 12-month criteria set by the PAPUC. The rolling 12-month Frequency (SAIFI) of 1.18 is better than the target of 1.31. The rolling 12-month Restoration (CAIDI) of 108 minutes is significantly better than the target of 215 minutes. The rolling 12-month Duration (SAIDI) of 127 minutes is significantly better than the target of 282 minutes. Contrary to Mr. Lanzalotta's comments, this data supports

the fact that PCL&P's reliability in 2006 is not degrading, but is improving and exceeding the PAPUC's criteria.

Q. Please describe the validity of comparing PCL&P's reliability data with that of Sussex?

A. PCL&P does not believe that any meaningful comparisons can be made with the Sussex electric system reliability data contained in Mr. Lanzalotta's testimony. Sussex is not required by the New Jersey Board of Public Utilities to report its data with any substantial regulatory oversight. Accordingly, any data that is provided as part of interrogatories or testimony must be thoroughly evaluated as to its definitions and completeness, to the extent that this can even be determined. PCL&P has a sophisticated Outage Management System that captures each and every electric service interruption, and all interruption data is rigorously reviewed prior to its inclusion as part of the Company's reliability database. PCL&P cannot be sure that Sussex reliability data is as strenuously accounted for and scrutinized as those utilities that are subject to regulatory oversight and consequences. As discussed above, Mr. Lanzalotta's Sussex interconnection proposal will result in less reliable service for the customers in Pike County. To assume that any reliability level that has been experienced by Sussex would be maintained, after the addition of a 51 square mile area that would be located and fed from a single radial line at the end of their distribution system, is both unrealistic and incorrect.

Q. On page 15, lines 18 – 24, Mr. Lanzalotta asserts that the annexation of the PCL&P system onto the Sussex System will have an immediate impact on

reducing the duration of electric service outages on the PCL&P system. Do you agree with this assertion?

A. No, I do not. Mr. Lanzalotta has made this assertion based solely on an extremely limited comparison and analysis of outage statistics, to which for reasons as stated above, PCL&P lends little credence. Additionally, Mr. Lanzalotta has not provided any other key and critical information that would be required to make such comparisons, such as the number of resources that Sussex devotes in responding to system outages, the location that they respond from, and how this may differ for normal work hours, off schedule work hours (such as weeknights, weekends and holidays), and for storm conditions, both expected and unexpected. It must be noted that the nearest facility from which PCL&P staffs its crews from is the Port Jervis facility, located just one quarter mile away from Matamoras. During normal working hours of Monday through Friday 8:00AM - 4:30PM, the Port Jervis facility is staffed with two crews. When additional projects are scheduled in the area, staffing is increased to a range of three to five crews. Currently our staffing in the facility is five crews due to capital improvement work being done on both Line 7 and circuit 5-10-34, which are the two sources serving the PCL&P load. This level is expected to remain in effect through June 2007, and possibly beyond. During other times of the day, or for weekends and holidays, crews can be dispatched from Orange and Rockland's Middletown, New York facilities, which are approximately 18 miles away from Pike County and is quickly accessible to Pike County via Interstate highway Route 84. In addition, in June 2004, Orange and Rockland modified and enhanced the Troubleshooter

classification to include the Northern Division, which includes the area that provides service to PCL&P. The troubleshooter classification included two-person crewing who are scheduled on the 1600 to 2400 hour period during the normal workweek, and on the Saturday 0800 to 1600 hour period, with out the call out process required. This enhancement was implemented in September 2004 to help reduce response time to the PCL&P area and other areas served by the division. Absent having been provided with any details regarding the Sussex facilities and crew reporting locations, PCL&P was able to locate the main headquarters for Sussex across from the Sussex airport on NJ local Route 639. It appears that the most direct driving route, from this location to the nearest point on the PCL&P system in Milford, Pennsylvania, is approximately 16 miles along single lane roads. I would note that this distance is not substantially closer to where PCL&P crews respond from during off-hour periods, and significantly farther away from its Port Jervis facility during normal working hours. With the additional information that I have provided above, combined with the lack of key Sussex information and supportable statistics, one cannot assume that, under Sussex, system restoration and customer hours of interruption will show immediate improvement. In fact, it is just as likely that customer hours of interruption may deteriorate, particularly when accounting for the significant radial line exposure concerns inherent with the Sussex option.

Q. Does the nature of the PCL&P service territory affect the service reliability that the Company's customer's experience?

A. Most definitely. The type of outages that PCL&P customers experience and the resultant hours of interruption, are directly related to geography, customer density, vegetation density, system design, and other system and operating specific parameters. The nature of the PCL&P service territory, where many customers are fed from radial lines in heavily treed areas at the very end of the Company's service territory, explains why, as discussed above, customers are particularly susceptible to tree related interruptions and longer duration outages. Given the more rural characteristics of PCL&P's service territory, it is simply unrealistic for many of the Company's customers to expect that they will experience the same levels of high service reliability as customers who reside in predominately urban or suburban environments, where the electric delivery infrastructure is considerably more developed with higher levels of redundancy available. I would note further that the characteristics of the Company's service territory, and their impact on service reliability, would remain regardless if service were provided by PCL&P, Sussex, or another utility. I must conclude by noting that PCL&P has changed, or is in the process of changing certain of its system design, maintenance and operating parameters to improve system performance and restoration. PCL&P is committed to improving service reliability for its customers.

Q. **Please discuss the outages experienced over the past few years by the Municipal Authority of the Borough of Milford ("Municipal Authority"), and the Delaware Valley School District ("DVS").**

A. Previously in this proceeding both the Municipal Authority and DVS provided PCL&P with data regarding the service interruptions that they had experienced during the period from August 2004 through February 2006. PCL&P analyzed this data against its records and substantiated that there were nine of the listed outages that affected service to the Municipal Authority and DVS. Of those outages, three were from stormy weather, one was due to a non-Company accident, and two were from the failure of the customer's underground facilities/equipment that supply the school. Two incidents were due to tree contacts, one of which was a tree from well outside of the ROW that fell into Line 7 and disrupted service to all of the customers served from Line 7. The remaining incident was a pre-scheduled outage to relocate a pole. Therefore, with respect to these nine outages, seven were due to extenuating circumstances or incidents over which PCL&P has little control. Aside from tree contacts, which PCL&P has addressed with the proposed improvements to its vegetation management program, these outages are not indicative of recurring problems.

Q. Do you have any observations regarding the service interruptions experienced by Mr. Peter Kenny?

A. During cross-examination on November 6, 2006, Mr. Kenny testified that he has suffered from many service outages over the past few years. PCL&P performed a review of the recent service interruptions experienced by Mr. Kenny. Mr. Kenny's residence is located in Milford, Pennsylvania, near the end of a long heavily treed road that is served by a step-down transformer and a long radial line off of the radial portion of Line 7. The Company's analysis substantiated that

there were 16 outages that affected this customer in the January 2005 to November 2006 timeframe. The make-up of interruptions are broken down as follows: one storm related, three non-Company accidents, one scheduled, one animal contact, one overloaded fuse, four equipment failures, one of which was the DVS riser pole failure, and five tree contacts, one of which was a tree from well outside of the ROW that fell into Line 7 and disrupted service to all of the customers served from Line 7. PCL&P would note that seven of these sixteen outages were due to extenuating circumstances or incidents over which PCL&P has little control PCL&P anticipates that its vegetation management program improvements will address the tree conditions. The overload condition occurred from a blown fuse on Cummins Hill Road, and, as a result, the Company upgraded the fuse size. PCL&P acknowledges that this customer has experienced a higher than average number of interruptions. It must be noted, however, that this customer is located near the end of a long heavily treed single-phase spur that is fed from a stepdown transformer, off of a radial feeder at the end of the Company's service territory. While PCL&P has taken action to improve his service reliability, given his location, and the exacerbated radial nature of the system that serves him, Mr. Kenny likely will continue to be more susceptible to outages than the average PCL&P customer.

Q. Have you come to any conclusions regarding the service interruptions that occurred in PCL&P's service territory?

A. Yes. The Company's analysis of outages that have occurred over the past six years reveals that increases in the number of interruptions, the number of

customers affected, and the customer-hours of interruption predominantly occurred in 2004 and 2005. The reasons for this were primarily due to the following:

- Pre-scheduled outages associated with the constructing and energizing the Matamoras Substation.
- Tree contacts towards the end of the Company's four-year vegetation management program. Significant vegetation management has been completed, and improvements have been made regarding reliability performance with respect to tree outages in 2006. Additional improvements are expected as a result of improving the vegetation management plan to a three-year program.
- An increase in non-Company accidents that resulted in outages. It is expected that this increase is a statistical anomaly, could certainly be related to growth and increasing customer density in Pike County, and is not related to any deficiency in PCL&P's system or work practices.

As discussed earlier in my testimony, in analyzing the reliability of the PCL&P system, it should be noted that the service area is rural, and is primarily a radial system, resulting in reliability performance that is somewhat lower than more urban locations that are serviced by loop systems and multiple sources. The relatively small size of the service area and its topology, also contribute to volatility in reliability performance. PCL&P operates and maintains this system in a manner that is consistent with regulations and industry standards. The Company makes necessary improvements to the system, and adjusts its practices

when appropriate. The implementation of the Matamoras Substation and improved vegetation management will contribute to improved system reliability. As evidenced by Exhibit 2, PCL&P interruption data, year-to-date through November, has improved as compared to the 2004 – 2005 statistics. The number of customers affected and the customer hours of interruption are the lowest since 2001 through November of each year.

Q. Does this conclude your rebuttal testimony?

A. Yes, it does.

Angelo M. Regan
Exhibit 1

Year	All Outages			Excluding Pre-Arranged, Storms and Major Events		
	SAIFI	CAIDI	SAIDI	SAIFI	CAIDI	SAIDI
1981	6.52	127	828			
1982	3.67	98	361			
1983	1.81	59	107			
1984	2.69	77	206			
1985	0.88	58	51			
1986	3.49	99	347			
1987	1.61	225	361			
1988	5.72	79	453			
1989	4.26	53	227			
1990	4.36	108	471			
1991	4.43	120	533			
1992	4.85	108	525			
1993	2.13	193	410			
1994	3.25	84	274	0.44	114	50
1995	1.58	142	224	0.38	179	67
1996	1.64	115	189	0.22	208	45
1997	1.15	112	129	0.47	140	67
1998	1.33	132	176	0.42	247	103
1999	1.18	121	143	0.51	161	83
2000	2.61	140	366	0.51	357	183
2001	2.58	145	376	0.35	200	69
2002	4.09	115	471	1.05	224	234
2003	3.74	112	420	0.52	184	96
2004	3.04	318	965	0.52	172	90
2005	7.79	141	1102	1.85	109	202