October 2021

Morgan County Water District

West Liberty, Kentucky

Corrective Action Plan

nesbitt engineering, inc.
227 N Upper Street
Lexington, KY 40507
www.nei-ky.com
859-233-3111

ERRATA

CHAPTER 2, PAGE 2-1

The last line of the next to the last paragraph should be changed to read:

The first water lines were installed in the decade of 1990. These lines were located along and off of KY 191.

Table 2-1 on page 2-1 of Chapter 2 should be revised as shown.

Table 2-1 Water Lines by Decade Installed

Decade Constructed	Linear Feet of Pipe	% of Total Linear Feet
1990	643,703	34
2000	1,183,102	63
2010	55,627	3
Totals	1,882,432	100

Table 2-2 on page 2-4 and 2-5 of Chapter 2 should be revised as shown;

Table 2-2 Water Lines by Material Installed Existing System Pipes (Sorted by Decade Installed)

Size (inches)	Material	Decade Installed *	Length	LF by Decade Installed	% of Total System
Up to 2	PVC	1990	11,582		
3	PVC	1990	30,706		
4	PVC	1990	134,639		
4	Ductile Iron	1990	41,087		
6	PVC	1990	302,230		
8	PVC	1990	121,459		
Total per Decade Installed				643,703	34%
Up to 2	PVC	2000	18,341		
3	PVC	2000	103,451		
4	PVC	2000	493,164		
6	PVC	2000	567,000		
8	PVC	1990	1,146		
Total per Decade Installed				1,183,102	63%
Up to 2	PVC	2010	511		
3	PVC	2010	39,029		
8	DUCTILE IRON	2010	5,694		
8	PVC	2010	10,393		
Total per Decade Installed				55627	3%
Total Linear Feet in Distribution System			1,882,432	1,882,432	100%
Total Miles in Distribution System			356.5		

District began in 1989, so totals shown in 1070 and 1980 in the WRIS system are included in the 1990 totals. WRIS indicates 10,208 feet of Asbestos Cement (AC) pipe. The district does not know of any AC pipe, so this amount is included in the PVC totals for that size and decade installed.

CHAPTER 2, PAGE 2-6

A new table (**Table 2-3 Water Meter Testing Program – Short Term**) should be added to page 2-6 to 1. Short Term Goals (0-6 months). The district has established a program that will replace all meters installed in years 2006, 2007 and 2008. They will test 2048 meters, using the newly installed meter test bench, which were installed in years 2009, 2010 and 2011 in their system by the end of January 2022.

Table 2-3 Water Meter Testing Program – Short Term

Total Meters to be Tested	2049	
Meters Tested per Day	Number of Days	Total # of Meters per Week
32	4	128

Week Number	Month	Date	Goal	Actual	Goal Met
1	October	15	128		
2	October	22	128		
3	October	29	128		
4	November	5	128		
5	November	12	128		
6	November	19	128		
7	November	26	128		
8	December	3	128		
9	December	10	128		
10	December	17	128		
11	December	24	128		
12	December	31	128		
13	January	7	128		
14	January	14	128		
15	January	21	128		
16	January	28	128		
Total Meters Tested			**2048**		
Goal is to be Completed by the END of January 2022					
We are replacing meters installed in 2006, 2007, 2008					
We are replacing meters installed in 2009, 2010, 2011					

TABLE OF CONTENTS

Chapter 1 Executive Summary

The Morgan County Water District (MCWD) was created as a subset of County Government in 1989 and currently has close to 3000 customers. Unaccounted-for water (UAW) for the district has been reported at over 40%, which is financially devastating to a District that purchases all of the water that they sell to their customers

This report will discuss the UAW and the steps to lower this metric to a desired 15% or less.

First, MCWD is not alone in their challenge to reduce UAW. This is a nation-wide challenge as a result of aging infrastructure. A study by Professor Steven Folkman Ph.D., PE at Utah State University's Buried Structures Laboratory looks at water main breaks in the USA and Canada. He found that water main breaks were up 27% in the eight-year period from 2008 to 2016.

Second, due to the vastly changing topography of Morgan County, deep valleys and steep hillsides, a greater amount of water line pressure has to be carried through the valleys in order to be able to serve the customers located on the steep hillsides. This greater pressure exacerbates the UAW. This higher pressure causes greater shock waves as pumps cycle and when a leak occurs, discharges more water than if the pressure could be maintained at a lower level. MCWD has pressures in these valley areas approaching 200 psi. This is not an uncommon design for areas of great change in topography.

Third, each component of the District and distribution system were addressed to see their impact on the reduction of UAW. A three-prong plan was developed to cause the percentage of UAW to decrease

Finally, through the heightened attention and awareness of all MCWD employees and customers to UAW, the three-prong plan, the current Waterline Replacement Project – Phase 1 and the "Already Funded and In Design" Phase 2 Waterline Replacement Project, the District should be able to effectively lower the percentage of UAW to 15% or lower over the next 5 years.

The KY PSC through their ordered leak surcharge and the KY Rural Water Association through their leak detection assistance will aid in accomplishing this goal and their assistance is greatly appreciated.

Chapter 2 Introduction/Purpose

The Morgan County Water District (MCWD)(DOW Permit ID KY0660594) was created in 1989 and has grown steadily ever since (see notification of establishment of water district in Appendix A). See Figure 1 for location. They currently have 2800 residential, 122 commercial and 3 wholesale (emergency connections). They have the ability to sell wholesale water on an emergency basis, to the cities of Frenchburg, Campton/Wolf County and Paintsville through master meter connections.

MCWD purchases all the water they resell from two sources, i.e., Cave Run Water Association providing approx. 40% through one master meter and the City of West Liberty who provides the other 60% through 7 different master meter locations. Any purchased water that is not accounted for or sold creates a greater financial impact on their bottom line than if they had their own treatment plant and could produce water at a lower unit cost than purchasing it from another supplier/entity. Figure 2 presents a map of Morgan County with the existing district facilities shown. One can see the extent of their facilities and the vast coverage within Morgan County.

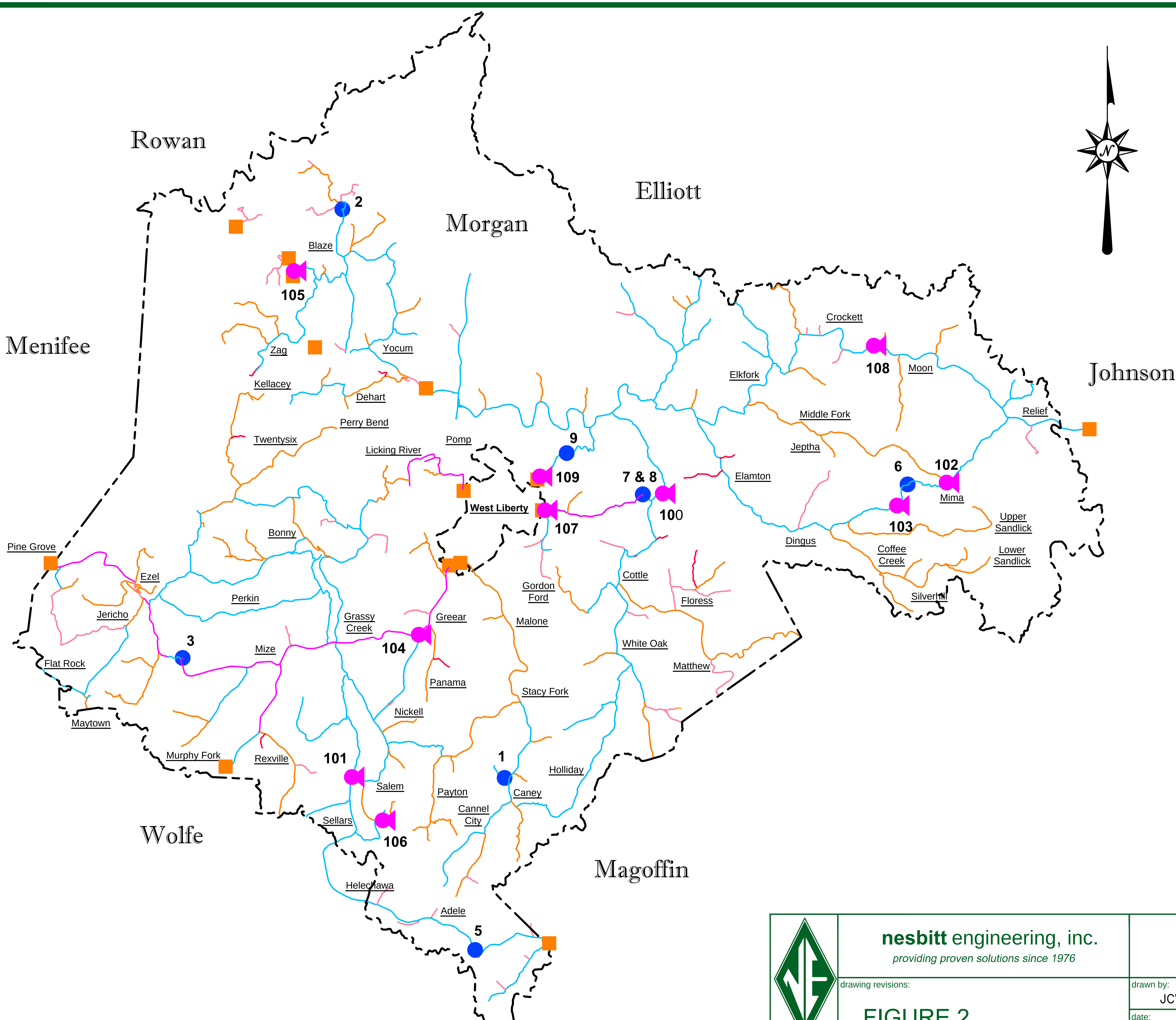
MCWD's distribution system has grown over the years as demand for potable water has increased. Extensions to serve addition customers were made based on what size pipe and materials were available in the district's pipe yard. Some of these projects were done by local backhoe operators, plumbers, and some by district personnel. There are some lines that were installed in the late decade of 1980's and are over 30 years old.

The Kentucky Infrastructure Authority (KIA) accumulates system inventory data submitted by the Area Development District and provided by the various entities. This data is available in the Water Resources Information System (WRIS) and is relied on for facility inventory data in this report. The existing facilities include approximately 356 miles of various size waterlines, 6 active pump stations and 7 water storage tanks with a total storage volume of 1,042,000 gallons.

Table 2-1 Water Lines by Decade Installed

Decade Constructed	Linear Feet of Pipe	% of Total Linear Feet
1980	591,854	31
1990	51,849	3
2000	1,183,102	63
2010	55,627	3
Totals	1,882,432	100


ROWAN
ELLIOTT
MENNIFEE
JOHNSON
West Liberty
WOLFE
MAGOFFIN
MORGAN COUNTY
OHIO
INDIANA
WEST VIRGINIA
ILLINOIS
MISSOURI
VIRGINIA
TENNESSEE
MAP OF KENTUCKY
nesbitt engineering, inc.
providing proven solutions since 1976
PROPOSED WATERLINE REPLACEMENT
EXISTING WATER DISTRIBUTION SYSTEM
PERRY COUNTY SANITATION DISTRICT #1
FIGURE 1
AREA MAP
drawn by: JCW
job no.: 1191.01
date: 5-16-2019
scale: NOT TO SCALE
LAST PLOTTED ON: 5/16/2019 BY: WHITE, JILL C. DRAWING FILE LOCATION: P:\MORGAN COUNTY WATER DISTRICT\1191-01 WATERLINE REPLACEMENT\-01 PRELIM\PER\STATE MAP.DWG



Morgan County Water District				
Number	Feature	Name	Capacity	Year Constructed
1	Tank	Hwy 191	175,000	1992
2	Tank	Ditney Ridge Hwy 1002	100,000	2004
3	Tank	Ezel Tank	150,000	1995
4	Tank	Hwy 172 (Abandoned)	110,000	1996
5	Tank	Hwy 134	100,000	2009
6	Tank	Smith Creek Tank	50,000	2007
7	Tank	Spaws Creek Tank #1	157,000	2002
8	Tank	Spaws Creek Tank #2	200,000	2014
9	Tank	Hwy 172 (Abandoned)		
100	Pump Station	Cow Branch (Abandoned)		
101	Pump Station	Hwy 205		
102	Pump Station	Hwy 437		
103	Pump Station	Hwy 437 (Abandoned)		
104	Pump Station	Hwy 460		
105	Pump Station	Hwy 519		
106	Pump Station	Perkins Cemetery		
107	Pump Station	Spaws Creek		
108	Pump Station	Split Wood (Abandoned)		
109	Pumap Station	Hwy 172 (Abandoned)		

EXISTING FINISH WATERLINES

8" 3"

6" 2" OR LESS

4"

EXISTING SYSTEM FEATURES

STORAGE TANK

BOOSTER PUMP

PURCHASE METER

WEST LIBERTY CORPORATE LIMITS

MORGAN COUNTY BOUNDARY

nesbitt engineering, inc.

providing proven solutions since 1976

drawing revisions:

FIGURE 2

EXISTING WATER DISTRIBUTION SYSTEM
MORGAN COUNTY WATER DISTRICT
MORGAN COUNTY, KENTUCKY

drawn by: JCW	job no.: 1191.01
date: 5–20–2019	scale: NOT TO SCALE

DRAWING FILE LOCATION: N:\MARKETING\GATEWAY ADD\MORGAN CO\MORGAN CO WATER DISTRICT\UTILITY MAPS\WATER DISTRIBUTION\WATER DISTRIBUTION 11X17.DWG

Table 2-2 Water Lines by Material Installed

Existing System Pipes (Sorted by Decade Installed)

Size (inches)	Material	Decade Installed*	Length (LF)	LF by Decade Installed	% of Total System
Up to 2	PVC	1980	9,195		
3	PVC	1980	30,706		
4	PVC	1980	130,129		
4	DUCTILE IRON	1980	41,087		
6	PVC	1980	259,278		
8	PVC	1980	111,251		
8	AC	1980	10,208		
Total per Decade Installed				381,506	20%
6	PVC	1990	2,715		
Up to 2	PVC	1990	2,387		
4	PVC	1990	1,795		
6	PVC	1990	44,952		
Total per Decade Installed				51,849	3%
Up to 2	PVC	2000	1,253		
3	PVC	2000	7,730		
3	PVC	2000	2,461		
4	PVC	2000	11,611		
6	PVC	2000	56,244		
3	PVC	2000	2,138		
4	PVC	2000	13,533		
6	PVC	2000	6,070		
Up to 2	PVC	2000	5,747		
3	PVC	2000	27,120		
4	PVC	2000	222,484		
6	PVC	2000	164,778		
Up to 2	PVC	2000	4,128		
3	PVC	2000	31,218		
4	PVC	2000	70,083		
6	PVC	2000	97,173		
3	PVC	2000	9,542		
Up to 2	PVC	2000	7,213		
3	PVC	2000	23,242		
4	PVC	2000	175,453		
6	PVC	2000	242,735		
8	PVC	2000	1,146		
Total per Decade Installed				1,183,102	63%

Up to 2	PVC	2010	511		
3	PVC	2010	35,830		
8	DUCTILE IRON	2010	5,694		
8	PVC	2010	10,393		
3	PVC	2010	3,199		
Total per Decade Installed				55627	3%
Total Linear Feet in Distribution System			1,882,432	1,882,432	100%
Total Miles in Distribution System			356.5		

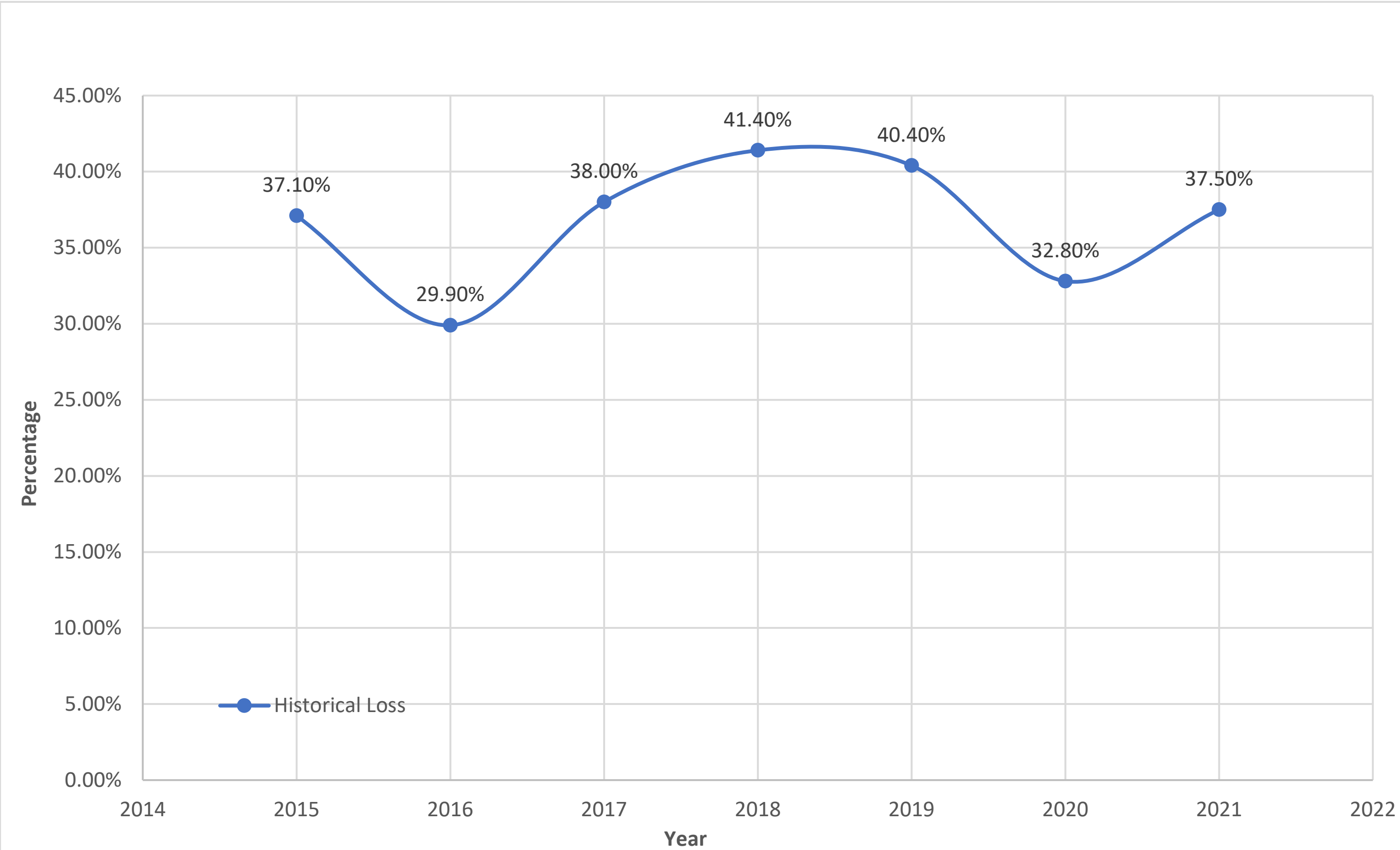
District began in 1989, so totals shown in 1970 in the WRIS Info. system is included in the 1980 totals.

The KY Public Service Commission (PSC), which monitors the district's operations and water customer rates had requested that the district reduce the reported Unaccounted - For Water (UAW). The PSC's recent Orders (2020 and 2021) address this need to reduce UAW and as an incentive, allows only the costs of a 15% lost water amount in determining the district's rates to their customers. These orders are included in the Appendix B. By only allowing a 15% UAW, this puts the onus on MCWD to reduce their lost water to this amount, or less, or continue to endure the unbillable water as a financial impact to their bottom line.

The goal of this report is to address and identify sources of lost (unbilled) water and reduce these losses to 15%, or less if possible. These losses can occur due to water, entering MCWD's system and then escaping without being metered or accounted for, by the staff of MCWD. Water used in the operation of the system, such as flushing or used for fighting fires must be estimated to assist in accounting for all water leaving the system without going through a meter. **Graph 2-1** shows the historical water loss percentage over time from 2015 to 2021.

The project approach to reducing the water loss for MCWD involves three distinct phases. They are broken down as follows:

Percentage of Lost Water
Morgan County Water District



1. Short Term Goals (0-6 months) - With the assistance of Kentucky Rural Water, an aggressive program to locate and fix leaks will be implemented. In addition, the procedures in filling out the water loss report for filing with the Kentucky Public Service Commission will be reviewed to ensure that the data reported is in alignment with the PSC guidelines. The results of the effort will give a consistent reporting number that can accurately track the results of the Program as it continues forward. The goals of this effort are a Reduction of lost water by 5% b. Reduction of purchased water of 5 %, leading to a savings of over $35,000 per year.

2. Medium Range Goals (0-18 months) - A Waterline Replacement project is currently in the construction phase (to be completed in November 2021) and was funded by Rural Development (RD)and Appalachian Regional Commission (ARC). The total funding for this project was $1.2M and the purpose of the project is to replace an old line which has experienced a large number of breaks in the past. The project profile is in the Kentucky Infrastructure Authority (KIA) Water Resources Information System (WRIS) system. After this current project is completed, a number of zones in the distribution system will be identified and distribution metering areas (DMA)will be established and provided with master meters which will be installed to assist is the location of leaks. The goals of the program are:

a. An understanding of which zones/sections of the distribution system are most in need of replacement.

b. Placement of system meters (DMA) would allow quicker identification of leaks, which should result in a lesser quantity of water leaking from the system.

c. Additional reduction of water loss of 5%.

d. Additional reduction of purchased water of 5 %, leading to a savings of over $35,000 per year.

3. Long Range Goals (0-60 months) - With the information that has been gathered in the Short Term and Medium range programs, additional capital improvement projects will be developed to aide in the lowering the percentage of UAW.

Chapter 3 Sources of Unaccounted-for Water

What are the sources of unaccounted-for water (UAW)? They are identified as 1.) physical sources of water escaping the system without being metered, after it enters MCWD's system thru a master meter, i.e., related to the district's distribution system and 2. Accounting sources related to quantifying the amount of water lost.

First, we will look at the physical ways that UAW can happen. We will track a drop of water that enters MCWD distribution system all the way to when it leaves the system. The ideal result would be that it leaves the system through a meter which accurately measures the water to a home or business.

We will identify each component of the distribution system and discuss the possible effect that that particular component could have on UAW. The major components in MCWD's water distribution system are;

- Master Meters (either Cave Run or West Liberty)
- Distribution Lines
- Pump Stations
- Tanks
- Fire Hydrants
- Automatic Flushing Devices
- Blow Offs
- Customer meters

MASTER METERS

MCWD has **1** master meter vault measuring the water entering their system from the west, Cave Run Water Assoc., along US 460 west of Ezel. The City of West Liberty has **7** master meter vault locations providing water to MCWD. These vaults are identified on the Figure 2 system map, in Table 3-1 and photos of each are included in this chapter.

There are two items that should be verified related to master meters. The accuracy of the meter is crucial and the fact that there is no possible way the water could enter the system through the meter and then go backwards thru the meter or a bypass line and be counted a second time. Meters larger than 2-inchs should be calibrated/certified at least once a year. There should also be a large meter for high flow and a smaller meter, which would provide more accuracy at low flow conditions. When these functions are combined in one meter it is called a combination meter. The amount of metered flow should be sent by radio signal to MCWD's Scada system in the district office. This Scada system should be set so that it would activate an alarm and autodial the staff, if the reading is not within a range of predetermined/preset limits.

The meter vault should contain a check valve, or one should be installed prior to the vault/bypass line. It should be confirmed that the meter will not allow the water to reverse thru it. This would only happen if the pressure on the supply side is less than the pressure on the discharge side of the meter. This would not be a normal occurrence but could happen if a pump station on the supply side were to start and pull the water away from the meter or a line break in the supply system could cause the pressure drop on the supply side. There is a 3-inch meter at Cave Run and six 3-inch and one 2-inch meters at the W. Liberty connections.

Table 3-1 Master Meter Information

Location	Latitude	Longitude	# of meters	Meter Size(s)	Manufacturer	Date Certified	Bypass (Y or N)	Bypass Size
US 460 Co. Line West of Ezel	37.900834	-83.48577	1	3	Sensus	2021	Y	2
Kristen Lane	38.034158	-83.389922	1	3	Sensus	2021	Y	2
Frank Blevins	38.019669	-83.366058	1	3	Sensus	2021	Y	2
Hickory Road	38.014206	-83.361943	1	3	Sensus	2021	Y	2
Lee's Lane	37.985057	-83.350728	1	2	Sensus	2021	Y	2
Hot Mix Road	37.965411	-83.29736	1	3	Sensus	2021	Y	2
Hwy 191	37.897079	-83.281201	1	3	Sensus	2021	Y	2
Spaws Creek	37.917039	-83.239962	1	3	Sensus	2021	Y	2


Kristen Lane Meter


Frank Bevins Meter


Hickory Road Meter


Lee's Lane Meter


Hot Mix Road Meter


KY 191 Meter


Spaws Creek Meter

A second concern is the meter manufacture's recommendation of the length of straight pipe before and after the meter. This provision would ensure that the flow through the meter is not turbulent. Both of these concerns (reverse flow and straight pipe requirements) will be verified with the manufacturer of the various master meters.

DISTRIBUTION LINES

Following the water thru the distribution system, it would flow from the master meter vaults either thru a pump station or thru the distribution system lines. We will address the Pump Station component in a latter section.

The district has approximately 357 miles of various diameters and materials of pipe per WRIS. Table 2-2 shows the decade in which the lines were installed. Some of the water lines have been in service for more than 30 years. Approx. 1/3 or their lines were installed prior to year 2000.

Table 2-2 indicates the percentage of lines by diameter. Almost ½ of their water lines are of a diameter of 4" and smaller. The pipe material used in their system in predominantly PVC with some minor amounts of Ductile Iron.

Due to the topography of Morgan County, deep valleys and steep hillsides, the distribution system was originally designed to carry very high pressure in the valleys in order to be able to reach those customers high on the hillsides. This high pressure is a definite factor in causing leaks in the system and then also in the quantity of water that escapes the system thru leakage as a result of any line breaks.

PUMP STATIONS

The district has 6 active pump stations (PS) boosting the water to the higher-pressure zones mentioned previously and into the system's water storage tanks. Table 3-3 lists the known information of each pump station. A photo of each PS is also presented. Engineered Fluid, Inc. was the manufacturer of most of these PS's. These PSs have been maintained very well as evidenced by the attached photos

Table 3-1 Pump Station Information

Name	Date Constructed	# of Pumps Mf/Type	Pump Capacity (GPM)	Pump Motor HP/RPM	Model #	Above Grnd (A) Under Grnd (U)	Pump Head (Ft)	Pumps to	Pumps Start/Stop Control
Pneumatic Perkins Cemetery Highway 844 Feeds 10-12	2002	2 Armstrong/Vert.	30	2/3600	VMS-3004	A	135	10-12 Homes	Bladder
Highway 519	2004	2 Aurora, Peerless/Cent.	100	5/1800	341	U	65	Ditney Ridge Tank & Zag	98/105
Highway 437 (New)	2007	2 Grundfos/Vert	96	7.5/3500	CRN15-4	A	195	Smith Creek Tank	76/87
Highway 205	2009	2 Goulds/ Vert.	100	5/1750	33SVDG04J6TC	A	135	134 Tank	71/78
Morris Cemetery Dog House	2009	1 Berkeley/Vert.	25	1.5/3500	BVM4-40	A	125	2 Homes	Bladder
Highway 460 E Spaws Creek	2014	2 Grundfos/Vert.	400	30/3500	CR90-2-1	A	190	Cow Branch Tanks #1 & #2	24'/30' transducer needs replaced
~~Perkins Cemetery~~		2							
~~Spaws Creek~~		2							

*Sorted by Date Installed – Oldest to Newest


KY 437 Pump Station


KY 205 Pump Station


Spaws Creek Pump Station

Information, flow, pump running and run time are all transmitted back to the District Office thru Scada. Here again limits can be established for normal operation and alarms/auto dialers could be programed to alert staff of operations outside these normal set points.

Pump operation is controlled by the pressure on the discharge side of the pump. As staff visits these sites to mow the grass or weed eat, they should be prompted to be alerted to look for any unusual pressure, flow or noise and to notice any water around the pump station that is not a result of surface drainage.

TANKS

Water should flow into the tanks either by the pressure on the supply side or from a pump station and there should be some means to stop the flow into the tank when full. This can be accomplished by either an attitude valve, pressure sensors/transmitters or floats. Altitude valves with pressure transmitters and pressure sensors in the tank valve vaults are the most prevalent today.

Pressure sensors have the added benefit of being able to transmit the levels of the water in the tank back to the office by Scada. If an altitude valve fails to shut off the flow of water into the tank, the tank could overflow and create UAW. Likewise, if the pressure sensors do not shut off the water flow into the tank and allows the tank to overflow, this creates a source of UAW. The Scada system at the office could also have set points established for normal operations and flags for levels outside of these norms. As staff visits these sites to mow the grass or weed eat, they should also be aware to notice any water around the tank that is not a result of surface drainage. They should look at the overflow ditch to see if there is any evidence of water overflowing the tanks.

The district has 6 standpipes and one elevated tank as shown in **Table 3-2** below. Photos of each tank are also presented. These tanks were physically inspected by divers in 2020. They are all equipped with Scada back to the district office and can be monitored there.

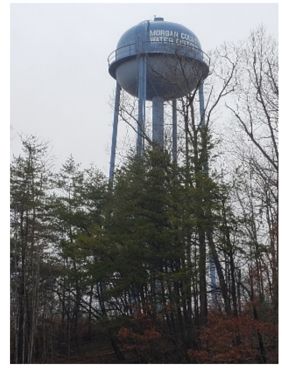
Table 3-2 Water Storage Tank Information

Tank Name	Date Constructed	Capacity (Gallons)	Type of Tank Const.	Dimensions	Ground Elevation	Overflow Elevation (Ft)	From Pump Station	Water Level Control (Telemetry or AV)
Highway 191	2/11/1992	175,000	Steel, glass lined	25.18'D x 46.76' H Standpipe	1,052	1232	Gravity from City	T
Ezel Tank	1/8/1995	150,000	Steel, glass lined	18' D x 84' H Standpipe	1,148	1232	Gravity from CRWC	T
Spaws Creek # 1	2/2/2002	157,000	Steel, glass lined	25'.18' D x 42.17' H Standpipe	1,224	1266	From KY 460 E PS	T
Highway 1002 Ditney Ridge	5/31/2004	100,000	Steel, glass lined	Elevated 80' 10"	1,182	1254	From KY 519 PS	T/AV
Smith Creek Tank	2/1/2007	50,000	Steel	10' D x 97.5' H Standpipe	1,252.5	1350	From KY 434 PS	T
Highway 134	10/1/2009	100,000	Steel, glass lined	14' D x 90' H Standpipe		1270	From KY 205 PS	T
Spaws Creek # 2	12/1/2014	200,000	Steel, glass lined	28' D x 42' H	1,223.5	1266	From US 460E PS	T

Ezel Tank

Spaws Creek

(2 Tanks)



Highway 1002 Ditney Ridge Tank

Highway 134 Tank

Caney Tank

Highway 437 Tank

CUSTOMER METERS

It's a known fact that small customer water meters tend to lose accuracy as they age. They slow down (read a lower quantity) after they have been in service for greater than 10 years. That is the reason the KY PSC requires customer meters to be changed out every ten years.

The district, under the current 2021 Waterline Replacement Project (to be completed in 2021), have purchased and installed a water meter test bench to accomplish certification of small customer meters. Also, as a part of the current construction project, there will be 331 new 5/8" x ¾"customer meters (approx. 12% of their total customer meters) furnished and installed in their system to replace some of the oldest meters. If there are contingency funds remaining these funds could also be used to replace even more meters. Future projects will also have replacement meters as a line item in their bid form.

SCADA

Supervisory control and data acquisition (SCADA) is provided to the District by MicroCom. A staff member can view all master meters, pump stations and tanks and get a visual representation of what is happening in the distribution system instantaneously. This system can also alert staff when preset parameters are not within the normal operating range. Data can be stored in the system to monitor water flowing into the system, into tanks or operation hours of pump stations. This system has recently been updated by MicroCom to ensure accurate data is transmitted to the office. This is a valuable aid in helping to lessen the amount of UAW. The staff are trained in how to get the most information from this system and what to do if an alarm is triggered.

STAFF/INSTITUTIONAL CONTROL

Below is a current listing of MCWD personnel, which handles the daily operations of the district.

Shannon Elam	General Manager
Chernell Holbrook	Office Manager
Andy Legg	Field Manager
Donna Bailey	Customer Service Rep
Ashlee Ferguson	Customer Service Rep
John Coffee	Field Tech
Tim Carver	Field Tech
Drayton Kenderick	Operator
Dean Kennard	Leak Detection Tech

These folks serve a board of five members which meet monthly to conduct district business. The general manager came on board in November 2019.The Leak Detection Tech was hired in June 2020 and his job responsibilities are stated in the job description, in Appendix C.

All of the staff of MCWD will have heightened awareness to be vigilant for any signs of UAW. Sometimes, merely the knowledge of what might indicate UAW, puts everyone, from office staff, field personnel, the manager, the chairman and even the Board, on alert to concentrate on reducing the amount of lost water.

A flyer could be inserted into customer water bills alerting them of signs of UAW and to watch for standing water, greener grass or weeds and flowing water, when it has not rained in a couple of days. If they notice a fire hydrant running or an automatic flushing device running for an extended period of time, they should be instructed to call and report the situation to the office.

DISTRICT EQUIPMENT

The district has the following equipment to aid in finding and repairing water leaks;

- 2017 Ford 150
- 2017 F-350
- 2018 F-250
- 2018 F-150
- 2020 Ford Escape
- Kubota Mini Excavator
- Trailer
- Pipe saw
- Leak Detection Equipment Listening Device

As a part of the current project under construction, the district will add Leak Detection Vaults to their distribution system along with additional Leak Detection monitors. These will expedite finding leaks or eliminating sections of their system if no leaking water is detected. By eliminating parts of their system that don't show any evidence of leakage, that should expedite them in finding and repairing leaks. Distribution meters will be installed on branch sections of the distribution system.

Another item that has been installed in the current construction project was the purchase and installation of a meter test bench to verify customer meter accuracy. This bench can test eight meters at a time. Hundreds of new radio-read meters were purchased as an item in the current project. The replacement of an old existing water line with a history of many repairs was the focus of the current project. Adding a pressure reducing vault on this replaced line will lower the pressure by 100 psi at the lowest end of the line and will lessen the pressure in approximately 4,000 feet of line. These are some of the things that MCWD is actively doing to lower the UAW.

EXISTING RETAIL AND WHOLESALE RATE STRUCTURES

PSC Order # 2021-146 listed the rates in an Appendix page 1 of 1, entered April 26, 2021. These rates were increased in PSC Order # 2020-386 in Appendix B, page 1 and 2 entered June 9, 2021. The Order with the oldest date (2020) was not entered until after the most recent (2021) dated Order had been entered.

Both Orders are included as Appendix A to this report.

Chapter 4 System Data

HISTORICAL UAW DATA – 2015 thru 2021

The Morgan County Water District (MCWD) has maintained records of all water purchased and all water sold. The difference in these two values, less district uses flushing, fighting fires and leak repair) is shown in the Table 4-1 below as the percentage of UAW. Backup information on a monthly basis is included in Appendix D. These percentages are plotted in a line graph and shown on Chart 4-1 below.

PROJECTED FUTURE UAW DATA

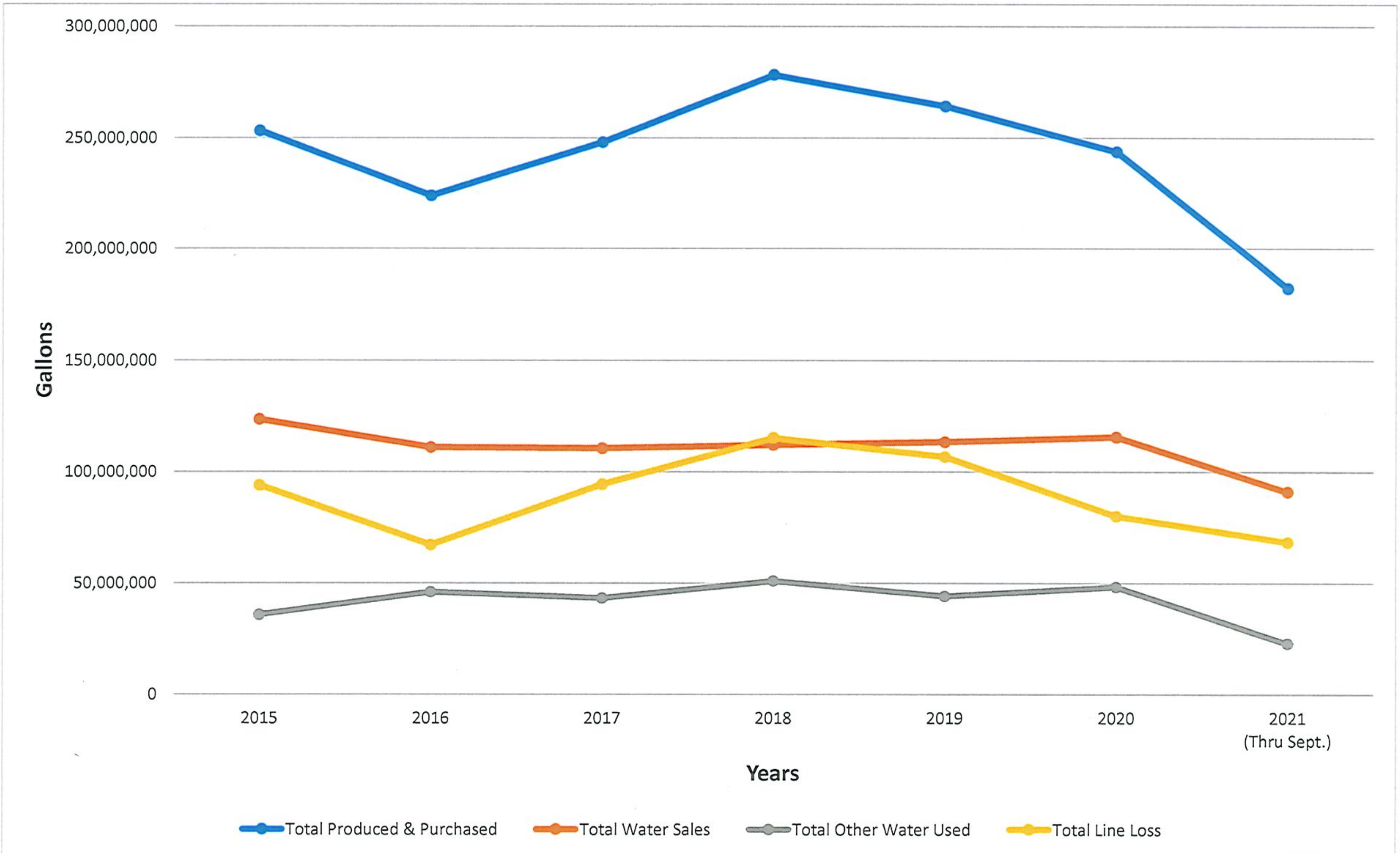
The historical percentage on Chart 4-1 were projected to determine amount of estimated UAW. The projection estimated a reduction of 6% in 2022, 5% in 2023, 5% in 2024, 4% in 2025 and 3% in 2026. As more leaks are eliminated, it becomes increasingly more difficult to lower the % of UAW. That is why a lesser reduction is estimated as awe look forward over a five-year period. The goal of 15% or less appears to be doable with the increased attention and diligence applied to the reduction of UAW.

Table 4-1
Morgan County Water District

Monthly Water Loss Report							
Water Utility:							
2015 - 2021	2015	2016	2017	2018	2019	2020	2021 (Thru Sept.)
Total Produced & Purchased	253,165,340	223,967,650	248,089,530	278,317,850	264,209,000	243,703,000	182,073,000
Total Water Sales	123,544,390	111,057,850	110,554,310	112,059,650	113,389,360	115,568,890	90,990,000
Total Other Water Used	35,720,299	45,889,733	43,167,392	50,977,821	44,046,992	48,216,933	22,858,000
Total Line Loss	93,900,651	67,029,067	94,370,828	115,280,379	106,772,648	79,917,177	68,225,000
Water Loss Percentage (unaccounted-for water)	37.09%	29.93%	38.04%	41.42%	40.41%	32.79%	37.47%

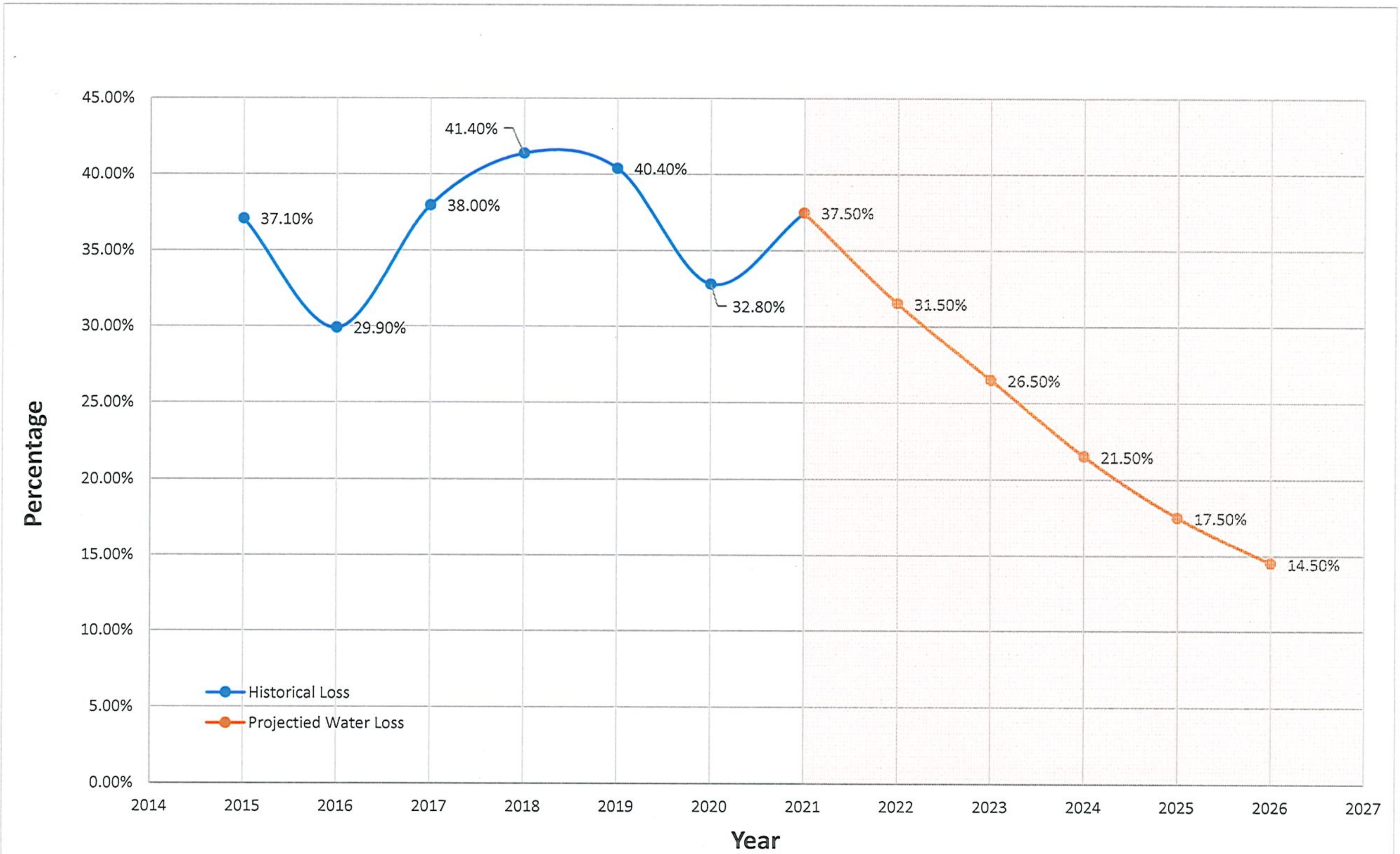
0.40263192

Annual Lost Water
Morgan County Water District



Annual Percentage of Lost Water
Morgan County Water District

(With Projections Through 2026)



Chapter 5 Water Loss Control Plan

The project approach to reducing the water loss for MCWD involves three distinct phases as presented earlier in this report. They are broken down as follows:

CORRECTIVE ACTION GOALS & PRIORITY

1. Short Term Goals (0-6 months) - With the assistance of Kentucky Rural Water, an aggressive program to locate and fix leaks will be implemented. In addition, the procedures in filling out the water loss report for filing with the Kentucky Public Service Commission will be reviewed to ensure that the data reported is in alignment with the PSC guidelines. The results of the effort will give a consistent reporting number that can accurately track the results of the Program as it continues forward. The goals of this effort are a Reduction of lost water by 5% b. Reduction of purchased water of 5 %, leading to a savings of over $35,000 per year.

2. Medium Range Goals (0-18 months) - A Waterline Replacement project is currently in the construction phase (to be completed in November 2021) and was funded by Rural Development (RD)and Appalachian Regional Commission (ARC). The total funding for this project was $1.2M and the purpose of the project is to replace an old line which has experienced a large number of breaks in the past. The project profile is in the Kentucky Infrastructure Authority (KIA) Water Resources Information System (WRIS) system. After this current project is completed, a number of zones in the distribution system will be identified and distribution metering areas (DMA)will be established and provided with master meters which will be installed to assist is the location of leaks. The goals of the program are:

a. An understanding of which zones/sections of the distribution system are most in need of replacement.

b. Placement of system meters (DMA) would allow quicker identification of leaks, which should result in a lesser quantity of water leaking from the system.

c. Additional reduction of water loss of 5%.

d. Additional reduction of purchased water of 5 %, leading to a savings of over $35,000 per year.

3. Long Range Goals (0-60 months) - With the information that has been gathered in the Short Term and Medium range programs, additional capital improvement Projects will be developed. These projects will be developed with reducing UAW in mind and project Profiles will be submitted to the State of Kentucky through the Gateway Area Development District to the KY Infrastructure Authority web portal.

PROJECTED FUTURE UAW DATA

A copy of two pages from this site shows projects already in the Funding Request approval cycle for MCWD. There are construction projects listed and as projects get constructed, other projects will be added to that list. The Phase 2 of the WLR Project is for amount of requested funds has already been approved by KIA. These pages along with some of the project profiles are included in Appendix D.

The district has a PP (WX 21175041) for Phase 2 of the Waterline Replacement Project in the system now which is fully funded. Design is underway for this project. This project has been approved by KIA, but not funded yet. It will replace a line that is over 30 years old (KY 191) and is suspected to have a lot of UAW either thru leaks or under registering of the customer water meters.

The district will replace more lines and meters as funds become available to reduce the UAW to less than 15%.

The challenges to this plan of action will be securing adequate funding to continue replacing lines/meters. Another challenge will be to maintain the attention and enthusiasm to track down and reduce the amount of UAW. A solution to this wanning attention to UAW could be the district set up the month of April each year as Reduction of UAW month. An educational effort for customers and staff could enhance the attention to this annually.

Chapter 6 Conclusion

MCWD has an UAW loss of greater than the KY PSC recommended 15%.They are not alone in Districts in Eastern KY which are challenged to get their UAW loss to be less than that percentage. They are actively working to reduce the UAW. The PSC has ordered them to collect a surcharge of $5.87/customer/month and place the funds collected into a special account which can only be used for lowing the percentage of loss water.

There is a professor at Utah State University who has published two studies related to water main breaks, causes and statistics, one in 2008 and one in 2016. The 2016 study, “Water Main Break Rates in the USA and Canada: A Comprehensive Study”, attached as Appendix F to this report. Professor Steven Folkman, Ph.D., PE, found that overall water main breaks have increased 27% in the six years since his first study in 2008. MCWD is not alone in their fight against UAW. One factor he found that contributed to these breaks was the age of the infrastructure in the systems he reviewed.

Water Districts located in areas of deep valleys and steep hillsides are generally designed, most economically, to carry higher than usual pressures in the valleys in order to be able to serve customers on the hillsides without having to install pumps and tanks to provide service to them. This higher pressure tends to cause more leaks and will discharge more water when a leak occurs than if a lower pressure could be provided in the valleys. Professor Folkman also stated the average supply pressure in systems he looked at was 69 psi and the average maximum was 119 psi. In MCWD, sometimes the pressure in the valleys approaches 200 psi. Maybe this is reason to open the discussion as to the validity of the PSC’s recommended amount of 15% UAW in great topography relief areas such as are found in Eastern KY.

MCWD hired a new General Manager in 2019 and a new Leak Detection Technician in 2020 so they were and are being proactive in lowering the amount of loss water. They have developed a Plan stated in Chapter 2 which address the short-, medium- and long-term objectives to lower loss water. They have a current construction project, Waterline Replacement Project – Phase 1, which will replace one of the oldest waterlines in their system, which has had numerous leaks in the past. Phase 2 is a $3M+ project which will replace even more old waterlines and meters. That project is funded by KY KIA and is in design currently. Construction on that phase should happen early next year. The district will continue submitting Project Profiles and replacing lines as they are able to, based on the funding being available.

The PSC mandated leak reduction surcharge will be spent effectively to aid in reducing loss water.

Yes, the UAW is greater than 15%, but the district is focused on addressing the UAW and working diligently to decrease the amount to less than 15% over a 5-year period. It didn’t occur overnight, and it won’t be corrected overnight.

Appendix A

MORGAN COUNTY WATER DISTRICT
450 Prestonsburg Street
West Liberty, Kentucky
41472
(606)-743-1204

James H. Finch, Chairman
Jack Cline, Secretary
Virgil Cole, Treasurer

Jerry Jackson, Superintendent

December 16, 1994

Ms. Janis C. Williams
County Court Clerk
Morgan County Office Building
P.O. Box 26
West Liberty, Kentucky 41472

In re: Compliance with KRS 65.005; Notification of Establishment of Water District

Ms. Williams:

Please be advised that the Morgan County Water District ("District") was established pursuant to Ordinance of the Fiscal Counrt of the County of Morgan, Kentucky passed and adopted on December 13, 1989 in accordance with the provisions Chapter 74 and Sections 65.810, 67.075 and 67.077 of the Kentucky Revised Statutes.

The principal office of the District is located at 450 Prestonsburg Street, West Liberty, Kentucky.

The governing body of the District is it's Board of Water Commissioners whose names and addresses are as follows:

James H. Finch, Chairman
HC68, Box 275
West Liberty, Kentucky 41472

Jack Cline, Secretary
White Oak, Kentucky 41474

Virgil Cole, Treasurer
P.O. Box 40
Ezel, Kentucky 41425

The District's existence and operations have been approved by Order of the Public Service Commission of Kentucky entered on January 24, 1994.

The service area of the District in which it is to provide water service is that portion of Morgan County, Kentucky not served by the City of West Liberty, Kentucky.

MORGAN COUNTY WATER DISTRICT

By\ James H Finch
James H. Finch, Chairman
Board of Water Commissioners

Appendix B

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC APPLICATION OF MORGAN COUNTY WATER DISTRICT FOR A RATE ADJUSTMENT PURSUANT TO 807 KAR 5:076	)))	CASE NO. 2020-00386

ORDER

On December 10, 2020, Morgan County Water District (Morgan District) filed an application with the Commission, pursuant to 807 KAR 5:076, requesting to adjust its rates for water service. The Commission had ordered Morgan District to file for an adjustment in rates pursuant to the November 22, 2019 Order in Case No. 2019-00041,[1] to which Morgan District was a party due to its sustained excessive water loss and related financial distress.[2]

In its application, Morgan District requested rates that would increase annual water sales revenues by $374,842, a 26.45 percent increase in two phases to pro forma present rate water sales revenues.[3]

To ensure the orderly review of the application, the Commission established a procedural schedule by Order dated January 11, 2021, which, among other things, required the Commission Staff (Staff) to file a report (Staff Report) containing its findings

---

[1] *See* Case No. 2019-00041, *Electronic Investigation into Excessive Water Loss by Kentucky's Jurisdictional Water Utilities* (Ky. PSC Nov. 22, 2019), Appendix L, *Confronting the Problems Plaguing Kentucky's Water Utilities: An Investigative Report by the Kentucky Public Service Commission November 2019.*

[2] *Id.*

[3] Application, Attachment 3.

regarding Morgan District's application. On March 10, 2021, an informal conference was held between Morgan District and Staff to discuss additional information that was required to complete the Staff Report and an amended procedural schedule that included additional discovery requests that was issued on March 23, 2021.

Pursuant to the amended procedural Order, on April 6, 2021, Staff issued a Staff Report summarizing its findings regarding Morgan District's requested rate adjustment. In the Staff Report, Staff found that Morgan District's adjusted test-year operations support revenues required from rates of $1,743,358 and that an annual revenue increase of $326,393, or 23.03 percent, over pro forma present rate revenues of $1,416,965, is necessary to generate the overall revenue requirement of $1,773,916.[4] In addition to the recommendations regarding the base rate revenue requirement and authorized rates, Staff further recommended a monthly surcharge to fund water loss reduction efforts of $5.87 per active meter be authorized by the Commission.[5]

On April 13, 2021, Morgan District filed, with the Commission, its comments on the Staff Report wherein it objected to the removal of certain labor expenses from nonrecurring charges, but did not contest the adjustment. Morgan District accepted the findings and recommendations presented in the Staff Report, but requested the inclusion of the debt service and coverage for the United States Department of Agriculture, Rural Development (RD) loan approved in Case No. 2021-00146[6] in the final calculation of the

[4] Staff Report at 3 and 19.

[5] *Id.* at 6.

[6] Case No. 2021-00146, *Electronic Application of Morgan County Water District for a Certificate of Public Convenience and Necessity to Construct a System Improvements Project and an Order Approving a Change in Rates and Authorizing the Issuance of Securities Pursuant to KRS 278.023* (Ky. PSC Apr. 26, 2021).

revenue requirement. With its comments, Morgan District did not request that a conference or hearing be held.[7]

The evidentiary hearing was held on April 21, 2021, and testimony was presented on behalf of Morgan District by consultants, Alan Vilines of Kentucky Rural Water Association (KRWA), and Paul Nesbitt of Nesbitt Engineering. Shannon Elam, general manager of Morgan District also testified at the hearing.[8] Mr. Elam reiterated Morgan District's acceptance of the findings and recommendations in the Staff Report[9] and Mr. Vilines explained the utility accepted the findings and recommendations in the Staff Report but noted its objection to including certain labor expenses in nonrecurring charges.[10]

WATER LOSS

Pursuant to 807 KAR 5:066, Section (6)3, water loss is limited to 15 percent for ratemaking purposes. As noted in the Staff Report, Morgan District's test-year water loss was 39.804 percent. Accordingly, Staff reduced test-year expenses by $199,863 to account for the 24.804 percent excess water loss.[11]

The Commission is placing greater emphasis on monitoring utilities that consistently exceed the 15 percent unaccounted-for water loss threshold. Morgan District was a party to Case No. 2019-00041 due to its sustained excessive water loss, and the

[7] Letter from Shannon Elam, Morgan District general manager (filed on Apr. 13, 2021).

[8] Hearing Video Transcript (HVT) of the Apr. 21, 2021 Hearing.

[9] *Id.* at 3:01:51–3:02:24.

[10] *Id.* at 40:42–43:18.

[11] Staff Report at 16–17.

Commission recognizes that Morgan District has filed the current case as a result of ordering paragraph 2 of Appendix G of the November 22, 2019 Order in that case.[12] While Morgan District did not specifically request a surcharge to fund water loss efforts in its application, the Commission finds that the recommendations made in the Staff Report are consistent with prior Commission action in cases involving water districts with excessive unaccounted-for water loss.[13] The Commission recognizes that the adjustments required to be made to comply with the 15 percent line-loss limitation in 807 KAR 5:066, Section 6(3), could severely restrict cash flow and county impair a water district's ability to make the necessary action to focus on its leak detection and repair. Using a surcharge to fund a water district's water loss reduction project allows the Commission to place strict controls governing the surcharge proceeds to ensure their effective use, public acceptance of the surcharge, and public confidence in the water district's use of those funds.[14]

The Commission recommended more frequent rate cases and pursuing qualified infrastructure improvement surcharges; the proceeds of which will be devoted exclusively to infrastructure improvement and replacement in its report entitled, "*Confronting the Problems Plaguing Kentucky's Water Utilities: An Investigative Report by the Kentucky*

---

[12] *See* Case No. 2019-00041, *Electronic Investigation into Excessive Water Loss by Kentucky's Jurisdictional Water Utilities* (Ky. PSC Nov. 22, 2019), Appendix G.

[13] *See* Case No. 96-126, *An Investigation into the Operations and Management of Mountain Water District* (Ky. PSC Aug. 11, 1997); Case No. 2011-00217, *Application of Cannonsburg Water District for (1) Approval of Emergency Rate Relief and (2) Approval of the Increase in Nonrecurring Charges* (Ky. PSC June 4, 2012); Case No. 2018-00017, *Electronic Application of Martin County Water District for an Alternative Rate Adjustment* (Ky. PSC Nov. 5, 2018); Case No. 2018-00429, *Application of Graves County Water District for an Alternative Rate Adjustment* (Ky. PSC Sept. 30, 2019); and Case No. 2019-000119, *Electronic Application of Estill County Water District No. 1 for a Surcharge to Finance Water Loss Control Efforts* (Ky. PSC Mar. 24, 2020).

[14] HVT of the Apr. 21, 2021 Hearing, 46:30, Alan Vilines stating he agrees with the Commission's policy to implement surcharges to fund water loss reduction and infrastructure improvement.

Public Service Commission November 2019," which was fully incorporated in the final Order in Case No. 2019-00041.[15]

The Commission finds that a monthly surcharge is a reasonable means for Morgan District to be afforded the opportunity to recover costs for its efforts to reduce water loss and Morgan District should be authorized to assess a monthly water loss reduction surcharge of $5.87 per active meter over 48 months from the date of entry of this Order. Morgan District should be restricted to expending any funds collected under the surcharge subject to the authorization by the Commission. Morgan District should file a qualified infrastructure improvement plan, including a comprehensive unaccounted-for water loss reduction plan that establishes priorities, a time schedule for eliminating each source of unaccounted-for water loss, and provide a detailed spending plan for the proceeds of the surcharge. To ensure that such a plan provides sufficient detail for the Commission to make a determination as to the reasonableness of the expenditures requested in the comprehensive unaccounted-for water loss reduction plan, the Commission further finds that Morgan District should be permitted to use surcharge proceeds to contract with and pay a certified engineer or consultant to draft the plan.

Morgan District was ordered specifically in the final Order in Case No. 2019-00041, to revise its leak adjustment policy to align the expenses of the utility with the amount charged to the ratepayer for a leak.[16] Morgan District submitted a revised version of its leak adjustment policy in its May 22, 2020 filing in response to the Commission's April 7,

---

[15] *See* Case No. 2019-00041, *Electronic Investigation into Excessive Water Loss by Kentucky's Jurisdictional Water Utilities* (Ky. PSC Nov. 22, 2019), Appendix L, *Confronting the Problems Plaguing Kentucky's Water Utilities: an Investigative Report by the Kentucky Public Service Commission November 2019* at 24–25.

[16] *Id.*, Appendix G.

2020 Order in Case No. 2019-00041.[17] At the hearing on April 21, 2021, Mr. Elam agreed to clarify the time period used to determine a customer's average usage in the revised leak adjustment policy and that the utility has already started keeping record of the expenses to the utility when installing a tap.[18] Morgan District was also ordered specifically to file an application for alternative rate adjustment, pursuant to 807 KAR 5:076, within six months.[19] Morgan District required a rate increase due in large part to its decision not to implement the full amount of the rate increase recommended by Staff in Case No. 2016-00068.[20] The final Order in Case No. 2019-00041 stated:

> Despite being increased in August 2017,[21] Morgan District's current rates fail to ensure sufficient revenue to pay operating expenses, adversely affecting Morgan District's financial condition. Morgan District should file an application for alternative rate adjustment, pursuant to 807 KAR 5:076, within six months of the date of entry of this Order.[22]

The Commission entered an Order on April 7, 2020, granting an extension until September 22, 2020, to the parties of Case No. 2019-00041 to comply with the November 22, 2019 Order, and requiring a progress report be filed by May 22, 2020.[23] Morgan

---

[17] *Id.*, Morgan County Water District's Response Report to PSC Order of April 7, 2020 (filed May 22, 2020).

[18] Elam, explaining the utility is recording any extra time spent installing a tap: HVT of the Apr. 21, 2021 Hearing, 2:28:14–2:30:09; explaining that the utility will make changes to clarify the leak adjustment policy: HVT of the Apr. 21, 2021 Hearing, 2:30:29–2:31:55 and 2:46:30–2:47:03.

[19] Case No. 2019-00041, Appendix G.

[20] *See* Case No. 2016-00068, *Application of Morgan County Water District for Rate Adjustment*, (Ky. PSC Aug.17, 2016).

[21] *Id.*

[22] *See* Case No. 2019-00041, *Electronic Investigation into Excessive Water Loss by Kentucky's Jurisdictional Water Utilities* (Ky. PSC Nov. 22, 2019), Appendix G.

[23] *See Id.*, Order (Ky. PSC Apr. 7. 2020).

District included a revision to its leak adjustment policy and attached new policies to its filing on May 22, 2020.[24] Morgan District filed a motion for an extension of time on September 18, 2020, in which it requested additional time to comply with the requirement to file an alternative rate adjustment from the November 22, 2019 Order.[25] The Commission denied Morgan County's motion, stating that Morgan District had ignored

> the clear directives of the November 22, 2019 Order and the attached investigative report at Appendix L, which describes at length the difference between a base rate increase and increasing rates as a part of obtaining a USDA/RD loan. Morgan District's financial predicament based upon its mistakes in failing to accept the rate recommendation of the Commission in Case No. 2016-0068, and failing to include depreciation as part of a prior USDA/RD loan is an example of the poor financial planning discussed in the report.[26]

Morgan District filed this case on December 10, 2020, to comply with the Commission's November 22, 2019 Order and October 13, 2020 Orders.[27] At the hearing in this matter, Mr. Elam and Mr. Nesbitt both acknowledged that Morgan District, as early as 2018, was aware that its rates were not sufficient to fund the utility's operations as and indicated that the utility understood the ramifications of not accepting the full amount of rates recommended by Staff in Case No. 2016-00068 during the July 2019 hearing in Case No. 2019-00041.[28] However Morgan District did not file this rate case until December 10, 2020. Despite the Commission naming Morgan District as a party to Case

---

[24] *Id.* Morgan County Water District's Response Report to PSC Order of April 7, 2020 (filed May 22, 2020).

[25] *Id.*, Morgan County Water District's Motion for Extension of Time (filed Sept. 18, 2020).

[26] *Id.*, Order (Ky. PSC Oct.13, 2020) at 2.

[27] *Id.*, final Order (Ky. PSC Nov.22, 2019).

[28] HVT of July 9, 2019 Hearing, 1:10:50–1:13:32; 2:09:25–2:11:40.

No. 2019-00041 due to its sustained excessive water loss, the utility acknowledging its financial deficits, the assistance of a professional consultant, and the Commission ordering the utility to file a rate case to address its lack of funds, the utility did not file a rate case for almost two years.

The Commission acknowledges the impact that COVID-19 has had on all utilities and that small utilities in distress are disproportionally disadvantaged in times of crisis. However, Morgan District's plans were to file a case pursuant to KRS 278.023 prior to the end of 2019. The final Order in Case No. 2019-00041 was entered on November 22, 2019, the contents of which, among other things, went into great detail differentiating alternative rate filings pursuant to 807 KAR 5:076 versus the filings under KRS 278.023 that included an adjustment of rates. Morgan District should implement written policies to prevent similar delays and misunderstandings in the future. The importance of a written policy is to outlast the inevitable turnover of utility boards and turnover at the Commission.[29] Accordingly, the Commission finds that Morgan District should create a written policy that addresses review of its rate sufficiency, the frequency of filing a base rate case, and implementing the full recommended rate increase.

Mr. Elam testified at the hearing in Case No. 2019-00041 about his awareness of the necessity of depreciation funds and the fact that in the past, the deprecation funds had been used for bond payments if the utility could not make the payment otherwise.[30] The report at Appendix L of the November 22, 2019 Order discussed the issues related

---

[29] HVT of the Apr. 21, 2021 Hearing, 2:07:50–2:09:57, discussion stating that a utility must take the full amount recommended by the Commission, however there is not an Order and policy may change with turnover. The direct way to address the policy changes will be at the utility level.

[30] Case No. 2019-00041, Transcript of the Testimony of PSC Hearing July 9, 2019, at 20–21.

to the fact that a base rate case is the only time that the Commission can review of a utility's depreciation schedule or depreciation policies.[31] Staff advised Morgan County about the damage to the financial health of the utility because of the lack of records to account for its assets. Staff contacted the utility and its consultants on multiple occasions to gather the missing records, only to discover that the records had not been properly kept. Mr. Vilines testified that the lack of funds is Morgan District's most significant current difficulty.[32] Mr. Vilines also noted the fact that Morgan District had poor bookkeeping and accounting records that caused its depreciation schedule to be lacking pertinent information. He also explained how the utility was financially burdened because it could not assign the proper deprecation lives to its assets and account for required maintenance and upgrades.[33] In addition to the need for a rate increase, Mr. Vilines agreed that a rate case could have addressed all three of the obstacles Morgan District identified in discovery responses in Case No. 2019-00041: a lack of funds, a lack of employees dedicated to leak detection, and a lack of leak detection equipment.[34]

Mr. Elam noted that his plans include making sure that utility creates policies to ensure a fully funded depreciation account.[35] It is understandable that when a utility is building itself up after a financial crisis, it has to address one task at a time. In this case, there has been action from the utility; however, the priority should have been to take

[31] Case No. 2019-00041, Appendix L.

[32] HVT of the Apr. 21, 2021 Hearing, 26:50–27:44.

[33] *Id.* at 26:05–27:44.

[34] *Id.* at 32:07–32:27

[35] *Id.* at 2:31:55–2:34:12.

action on the utility's most significant problems first. The November 22, 2019 Order prioritized two actions for Morgan District to undergo: a revised leak adjustment policy and to file an alternative rate adjustment, pursuant to 807 KAR 5:076.[36] Mr. Elam expressed his motivation for keeping the utility on track to regain a healthy financial viability, but acknowledged that he has no previous experience managing a water utility and is learning about the position of general manager.[37] The Commission finds that Morgan District should create a written policy to ensure that it has a depreciation fund and adequate depreciation schedule. The Commission also finds that Morgan District should maintain its records properly to make an informed determination of the reasonable lives of its assets.

Along with the other parties to the investigation in Case No. 2019-00041, it was recommended that Morgan District "begin installing zone meters to help identify problem areas,"[38] and to dedicate personnel to leak detection and water loss prevention.[39] It is encouraging that Mr. Elam is signed up to attend the management program offered by the KRWA in May 2021 and that he explained how the utility is utilizing the resources available through its Area Development office and organizations like KRWA. Mr. Elam sought additional guidance on best policies and practices. The Commission directs Mr. Elam to the resources recommended in the investigative report filed with the November

---

[36] Case No. 2019-00041, (Ky. PSC Nov. 22, 2019) Appendix G.

[37] HVT of Apr. 21, 2021 Hearing, 2:49:12.

[38] Case No. 2019-00041, *Electronic Investigation into Excessive Water Loss by Kentucky's Jurisdictional Water Utilities* (Ky. PSC Nov. 22, 2019) at 6.

[39] *Id.* at 7.

22, 2019 Order in Case No. 2019-00041, which directed utilities to "several user-friendly guides to which water systems can refer in addition to any in-person training received, including "The Water Board Bible: The handbook of modern water utility management" by Ellen G. Miller and Elmer Ronnebaum; "Getting Results From Your Experts: Engineers, Attorneys & More" by Ellen G. Miller and Elmer Ronnebaum; "Practical Personnel Management for Small Systems" by Ellen G. Miller; "Customers and You: Practical Communications for Small Systems" by Ellen G. Miller; and the "Financial Accounting Guide for Small Water"[40] The Commission also referenced best practices shared from Northern Kentucky Water District and Kentucky-American Water Company in that report.[41] These resources, along with Morgan District's commitment to providing training to its manager and employees, will help provide guidance on better internal controls, such as the board creating a written policy for the use of the utility's debit or credit card, including a limit and description of what should be purchased with the card.[42] Morgan District should also develop a contract for its pay roll services to ensure a duty of care, as well as set expectations with which to comply.[43]

Mr. Elam also explained that an employee was hired to be dedicated to leak detection based upon the recommendations from the Commission and that employee had

[40] Case No. 2019-00041, Appendix L, 9–11, footnotes 35–39.

[41] *Id.*

[42] HVT of the Apr. 21, 2021 Hearing, 2:35:37–2:38:20. Discussing the lack of a policy for using the debit card, and lack of a limit to purchases that can be made without prior approval. Also, that an employee of a local bank performs payroll duties for free because a county employee once held those duties and passed those down.

[43] *Id.* Discussing the practice of a county employee performing pay roll duties for free.

received training from KRWA.[44] Morgan District has not yet installed zone meters; however, Mr. Elam testified that he and Mr. Nesbitt had discussed the benefit of those in the future.[45] Additional recommendations from the November 22, 2019 Order to all parties included revising policies for record-keeping and funding regarding meter testing and replacement, evaluating the need for more frequent rate increases, and reevaluating the roles of boards and managers regarding water loss and leak detection.[46] Morgan District was ordered along with the other parties to Case No. 2019-00041 to improve its policies on water loss reduction and create better business practices to improve the financial health of the utility.[47] All of the parties to Case No. 2019-00041 were also ordered to follow the water loss calculation adopted by the Commission in Case No. 2018-00394.[48] Mr. Elam testified that the greatest gains made by Morgan District since the final Order in Case No. 2019-00041 were in revising its flushing schedule, focusing on asset management, developing an extensive GIS mapping system and hiring a dedicated employee for leak detection.[49]

Morgan District has acknowledged the mistakes it made in the past and has taken steps to correct those. Additionally, throughout the investigation in Case No. 2019-00041 and this case, the utility has taken guidance suggested by the Commission and its Staff

---

[44] HVT of the Apr. 21, 2021 Hearing, 2:41:42–2:42:19.

[45] *Id.* at 2:49:50–2:50:44.

[46] Case No. 2019-00041, *Electronic Investigation into Excessive Water Loss by Kentucky's Jurisdictional Water Utilities* (Ky. PSC Nov. 22, 2019) at 7.

[47] *Id.* at 9.

[48] *Id.*

[49] HVT of the Apr. 21, 2021 Hearing, 2:41:42–2:44:50.

to correct current practices and revise submissions to meet Commission standards. The responses submitted in both cases and the testimony given at the April 21, 2021 hearing show a commitment to improving the financial and operational health of the utility and putting policies in place to ensure its viability beyond the board or employees currently in place. The Commission acknowledges the progress made, yet there is much improvement to be made. The utility will continue to provide status reports and submit improvement plans in Case No. 2021-00206, as the Commission will monitor its water loss surcharge. Therefore, the Commission finds that Morgan District's response to the April 7, 2020 Order along with the additional materials submitted in this case are sufficient to comply with the requirements of the November 22, 2019 Order in Case No. 2019-00041.

BACKGROUND

Morgan District is a water district organized pursuant to KRS Chapter 74. It owns and operates a water distribution system through which it provides water service to approximately 2,835 customers in Morgan County, Kentucky.[50] Morgan District does not produce any of its own water; rather, it purchases its water from the city of West Liberty and the Cave Run Water Commission. Morgan District last adjusted its water service rates pursuant to the alternative rate filing adjustment procedure on August 17, 2016.[51]

TEST PERIOD

[50] *Annual Report of Morgan County Water District to the Public Service Commission for the Calendar Year Ended December 31, 2019* (*Annual Report*) at 12 and 49.

[51] Case No. 2016-00068, *Application of Morgan County Water District for Rate Adjustment* (Ky. PSC Aug. 17, 2016).

The calendar year ended December 31, 2019, was used as the test year to determine the reasonableness of Morgan District's existing and proposed water rates, as required by 807 KAR 5:076, Section 9.

SUMMARY OF REVENUE AND EXPENSES

The Staff Report summarizes Morgan District's pro forma income statement as follows:[52]

	2019 Annual Report	Pro Forma Adjustments	Staff Pro Forma Operations
Operating Revenues	$1,428,505	$ 19,252	$1,447,757
Operating Expenses	1,839,911	(353,085)	1,486,826
Net Operating Income	(411,406)	372,337	(39,069)
Interest Income	75		75
Nonutility Income	6,575	(6,575)	-
Income Available for Debt Service	$ (404,756)	$ 372,337	$ (38,994)

REVENUE REQUIREMENT ADJUSTMENTS

Reported Water Sales. In the Staff Report, Staff recommended the Commission increase water sales by $15,836 to match actual amounts billed to customers in 2019 supported by Morgan District's general ledger.[53] The Commission finds that this adjustment meets the ratemaking criteria of being known and measurable[54] and is reasonable and should be approved.

---

[52] *See* Appendix A to the Staff Report for a complete pro forma.

[53] Staff Report at 8, Adjustment A.

[54] Commission regulation 807 KAR 5:076, Section 9 sets the standard for the determination of the reasonableness of proposed rates and states, in pertinent part, that the test period shall be "adjusted for known and measurable changes."

Billing Analysis Adjustment. In the Staff Report, Staff recommended the Commission accept Morgan District's proposed adjustment to increase test-year revenues from water sales by $27,748 to reflect its current billing analysis filed with the application.[55] The Commission finds that this adjustment meets the ratemaking criteria of being known and measurable and is reasonable and should be approved.

Bulk Water Sales. In the Staff Report, Staff recommended the Commission reclassify $309 in bulk water sales into its own category of water sales to accurately reflect the amounts reported on the general ledger.[56] The Commission finds that the effect of this adjustment causes the pro forma to accurately reflect test year sales as reported on Morgan District's books, and should be approved.

Late Payment Penalties. In the Staff Report, Staff recommended the Commission increase Forfeited Discounts $26,326 that appeared on Morgan District's general ledger, but was not properly reported on Morgan District's annual report.[57] The Commission believes the evidence of record supports Staff's assertion that this amount was not properly included in Morgan District's annual report and finds that it should be included in pro forma operations.

Annual Report Inaccuracy. In the Staff Report, Staff proposed to adjust Miscellaneous Service revenues by $3,185 to reflect the test year balance of non-recurring charges recorded in general ledger account, 471 – Misc. Service Revenue.[58]

---

[55] Staff Report at 8, Adjustment B.

[56] *Id.*, Adjustment C.

[57] *Id.*, Adjustment D.

[58] *Id.* at 9, Adjustment E.

The Commission finds that this adjustment properly reflects the level of Miscellaneous Service Revenue experienced by Morgan District during the test period and should be accepted.

Nonrecurring Charges. In the Staff report, Staff recommended the Commission decrease Nonrecurring Charges by $19,694 to reflect recent Commission decisions regarding labor costs during normal business hours that were previously included in the calculation of a utility's nonrecurring charge.[59] The Commission finds that this adjustment accurately reflects recent Commission precedent on this issue and should be accepted.

Salaries and Wages. In the Staff Report, Staff recommended the Commission increase pro forma salaries and wages by $60,576 and additionally make a corresponding increase to pro forma taxes other than income by $4,683 to reflect the current staffing level at Morgan District which included an additional full time employee that worked minimal hours during the test year.[60] The Commission finds that the proposed adjustments meet the ratemaking criteria of being known and measurable and should be accepted.

Expenses Related to Installation of Taps. In the Staff Report, Staff recommended the Commission decrease and capitalize on its depreciation schedule test year expenses of $63,800 to reflect the District's current tap fee multiplied by the number of taps installed during the test period.[61] Staff further recommended the Commission require Morgan District to retain sufficient information in its utility records going forward to properly

[59] *Id* at 9–10, Adjustment F.

[60] *Id.* at 11, Adjustment G.

[61] *Id.* at 12–14, Adjustment H.

calculate the expenses directly related to the installation of its meter taps.[62] The Commission finds that in the absence of utility records to properly account for expenses related to the installation of meter taps, the alternative method proposed by Staff is a reasonable method to perform the reduction in test-year expenses to be capitalized on Morgan District's depreciation schedule. Further, the Commission finds that Staff's recommendation to require Morgan District in the future to keep a precise record of the expenses related to its meter taps is reasonable.

Retirement Expense. In the Staff Report, Staff recommended the Commission increase Employee Pensions and Benefits expense by $8,982 to reflect the pro forma adjustment to Salaries and Wages expense as discussed in adjustment (G) of the Staff Report.[63] The Commission finds, based on the evidence of record, the adjustment proposed by Staff accurately reflects the level of retirement expense that will increase as a result of the pro forma adjustment that the Commission has additionally found reasonable regarding salaries and wages and therefore should be accepted by the Commission.

Adjustment for GASB 68 and 75. In the Staff Report, Staff recommended the Commission reduce Employee Pensions and Benefits expense by $45,510 to reverse the effect of adjustments made by Morgan District's auditor to be in compliance with the requirements of GASB 68 and 75.[64] The Commission finds that it is proper to include

---

[62] *Id.*

[63] *Id.* at 14, Adjustment I.

[64] *Id.* at 15–16, Adjustment J.

actual test year contributions to the County Employees' Retirement System, and this adjustment should be accepted for ratemaking purposes.

Employee Benefits. In the Staff Report, Staff recommended the Commission accept Morgan District's proposed adjustment to reduce Employee Pensions and Benefits to net an increase to health insurance premiums subsequent to the test year and reduce premiums paid by Morgan District to bring its contributions in line with the Bureau of Labor Statistic's national average for single coverage based on recent Commission decisions on this issue.[65] The Commission finds that the adjustment proposed by Morgan District, and subsequently by Staff, meets the criteria formerly set by the Commission, is known and measurable, and should be accepted.

Excess Water Loss. In the Staff Report, Staff recommended the Commission accept Morgan District's proposed adjustment to reduce test year expenses for Purchased Power and Purchased Water expenses attributable to water loss pursuant to 807 KAR 5:066, Section 6(3).[66] The Commission finds the adjustment proposed by Morgan District and further recommended by Staff properly reflects the limitations imposed by the regulation and should be accepted.

Reclassification of Purchased Power Expense. In the Staff Report, Staff recommended the Commission accept Morgan District's proposed adjustment to reclassify $35,182 of purchased power expenses that were incorrectly classified as miscellaneous expenses in Morgan District's annual report.[67] The Commission finds that

[65] *Id.* at 16, Adjustment K.

[66] *Id.*, Adjustment L.

[67] *Id.* at 17, Adjustment M.

purchased power expenses should be reported by Morgan District in the correct category in order to properly perform the proposed reduction accepted by the Commission regarding its excessive water loss and the reclassification adjustment should be accepted.

Depreciation Expense. In the Staff Report, Staff recommended the Commission reduce depreciation expense by $116,847,[68] which was supported by the calculations outlined by Staff in Appendix A to the report.[69] In addition to the findings regarding the level of detail of Morgan District's depreciation schedule discussed earlier in this Order, the Commission finds, that in the absence of proper recordkeeping and documentation which has been represented by Morgan District in this proceeding through its application and multiple requests for information, the depreciation rates presented by Staff in Appendix A represent a reasonable alternative level of depreciation expense and should be accepted by the Commission. In addition to the findings above, which state that the Commission should require Morgan District to keep adequate records to properly classify its assets on its asset ledger, the Commission notes that in future proceedings, Morgan District should be prepared to classify its assets that properly utilize the 1979 report published by the National Association of Regulatory Utility Commissioners (NARUC) titled *Depreciation Practices for Small Water Utilities* (NARUC Study).

Nonutility Income. In the Staff Report, Staff recommended the Commission reduce Nonutility Income by $6,575 for funds received as part of an Abandoned Mine Lands

[68] *Id.* at 17–18, Adjustment N.

[69] *Id.*, Appendix A.

grant. The Commission finds that the funds received should not be classified as income to Morgan District and therefore should be included in the pro forma adjustments.

Debt Service Payments and Additional Working Capital. In the Staff Report, Staff recommended the Commission include in the calculation of Morgan District's Overall Revenue Requirement, $239,242 in principal and interest payments on Morgan District's current indebtedness, and $47,848 in corresponding additional working capital.[70] Subsequent to the issuance of Staff's Report, the Commission approved a Certificate of Convenience and Necessity (CPCN) and associated indebtedness to the United States Department of Agriculture Rural Development (RD) pursuant to KRS 278.023 in Case No. 2021-00146.[71] In Morgan District's comments to the Staff Report, it requested recovery of the debt service and corresponding coverage of the approved loan and included as an attachment, the debt service schedule on the RD loan.[72] The Commission finds that through its approval of the indebtedness to RD in that case, Morgan District should be permitted recovery of both the principal and interest payments and additional working capital as proposed by Morgan District in its comments and has included these amounts in the final calculation of the revenue requirement.

Based upon the Commission's findings and determinations herein, Morgan District requires an increase in revenues of $338,270, or 23.87 percent above pro forma present rate revenues, as shown below:

---

[70] *Id.* at 19–21.

[71] Case No. 2021-00146, *Electronic Application of Morgan County Water District for a Certificate of Public Convenience and Necessity to Construct a System Improvements Project and an Order Approving a Change in Rates and Authorizing the Issuance of Securities Pursuant to KRS 278.023* (Ky. PSC Apr. 26, 2021).

[72] Letter from Shannon Elam, Morgan District general manager (filed on Apr. 13, 2021).

Pro Forma Operating Expenses	$ 1,486,826
Plus: Average Annual Principal and Interest Payments	249,139
Additional Working Capital	49,828
Overall Revenue Requirement	1,785,793
Less: Other Operating Revenue	(30,483)
Interest Income	(75)
Revenue Required from Rates	$ 1,755,235
Less: Pro Forma Present Rate Service Revenues	(1,416,965)
Required Revenue Increase	$ 338,270
Percentage Increase	23.87%

RATE DESIGN

Morgan District proposed to increase all of its monthly retail water service rates evenly across the board by approximately 26.45 percent. Morgan District has proposed a phased-in approach to implementing the rate increase, whereby approximately half of the increase would be recovered during the first year and the remainder of the increase would be recovered after the first year. Mr. Vilines testified that he recommended a gradual or phased-in approach due to the large amount of the increase in rates needed by the utility.[73] As referenced previously, Morgan District required a such a large rate increase due in large part to its decision not to implement the full amount of the rate increase recommended in Case No. 2016-00068.[74] Morgan District has not completed a cost of service study (COSS) at this time as there has not been any material change in the water system to warrant a COSS. The Commission finds that the full amount of rate

[73] HVT of the Apr. 21, 2021 Hearing, 39:30–40:40.

[74] *See* Case No. 2016-00068, *Application of Morgan County Water District for Rate Adjustment*, (Ky. PSC Aug.17, 2016).

increase should be implemented because the full amount is required at this time by the utility to improve its financial state and fully fund depreciation.

The Commission finds that the allocation of a revenue increase evenly across the board to a utility's rate design is appropriate when there has been no evidence entered into the record demonstrating that this method is unreasonable an in the absence of a COSS. In the Staff Report, Staff followed the method proposed by Morgan District and allocated Staff's calculated revenue increase across the board to Morgan's monthly retail water service rates.

The rates set forth in Appendix A to this Order are based upon the revenue requirement the Commission has found to be fair, just and reasonable and will produce sufficient revenues from water sales to recover the $1,755,235 Revenue Required from Rates, an approximate 23.87 percent increase. Pursuant to the final Order in Case No. 2021-00146, Morgan District was authorized to increase its retail water service rates by the rates calculated by RD in its application.[75] The revenue requirement percentage calculated in this Order is based on base rate revenues provided in the billing analysis in Morgan District's application and does not reflect the revised rates approved in Case No. 2021-00146. Therefore, the approved rates as shown in Appendix B will reflect an increase to a typical residential customer's monthly water bill from $38.83 to $43.15, an

---

[75] Case No. 2021-00146, *Electronic Application of Morgan County Water District for a Certificate of Public Convenience and Necessity to Construct a System Improvements Project and an Order Approving a Change in Rates and Authorizing the Issuance of Securities Pursuant to KRS 278.023* (Ky. PSC Apr. 26, 2021) at 6, ordering paragraph 14.

increase of $4.32, or approximately 11.13 percent over the rates approved in Case No. 2021-00146.[76]

SUMMARY

After consideration of the evidence of record and being otherwise sufficiently advised, the Commission finds that:

1. The findings contained in the Staff Report are supported by the evidence of record and are reasonable.

2. Morgan District should maintain its records following the date of this Order that are sufficient to determine the actual costs incurred to install its meter taps.

3. Morgan District should develop a written policy to address internal controls for use of its debit and credit card, contract for payroll duties, and use of the full recommended rate amount in future base rate cases with the Commission.

4. The Commission has historically used a DSC method to calculate the revenue requirement for water districts or associations with outstanding long-term debt. Application of the Commission's DSC method to Morgan District's pro forma operations results in an Overall Revenue Requirement of $1,785,793. A revenue increase of $1,755,235 from water service rates is necessary to generate the overall revenue requirement.

5. The water service rates proposed by Morgan District should be denied.

---

[76] Current average bill calculated by using the rates approved in Case No. 2021-00146 *Electronic Application of Morgan County Water District for a Certificate of Public Convenience and Necessity to Construct a System Improvements Project and an Order Approving a Change in Rates and Authorizing the Issuance of Securities Pursuant to KRS 278.023* (Ky. PSC Apr. 26, 2021). The typical residential customer uses approximately 3,000 gallons per month.

6. The water service rates set forth in Appendix B to this Order are fair, just and reasonable and should be approved.

7. Morgan District should be authorized to assess a monthly surcharge of $5.87 per meter for 48 months to fund its water loss control efforts, subject to the conditions set forth in finding paragraph 7.

8. The Commission should open a separate case to monitor the surcharge proceeds collection and expenses, with the following conditions:

a. Within 120 days of the date of this Order, Morgan District should file with the Commission a qualified infrastructure improvement plan, including a comprehensive unaccounted-for water loss reduction plan that establishes priorities and a time schedule for eliminating each source of unaccounted-for water loss and provides a detailed spending plan for the proceeds of a surcharge.

b. Morgan District should deposit surcharge collections in a separate interest-bearing account.

c. Morgan District should file monthly activity reports with the Commission that include a statement of monthly surcharge billings and collections; a monthly surcharge bank statement; a list of each payment from the account, its payee, and a description of the purpose; and invoices supporting each payment.

d. Morgan District should file monthly water loss reports with the Commission.

e. Surcharge proceeds should not be used to reimburse Morgan District for unaccounted-for water loss reduction expenses incurred prior to the date of this Order.

f. Morgan District's surcharge and water loss detection and repair program is subject to annual Commission reviews that will examine the progress of the water loss detection and repair program and expenditures made with surcharge proceeds and consider adjustments to the program and the surcharge amount.

g. Morgan District's failure to comply with any conditions attached to its assessment of the surcharge will result in termination of the surcharge and the refund of collected surcharge proceeds disbursed on expenses or projects outside the scope of expenses and projects approved by the Commission.

9. Morgan District should use the midpoint of the depreciable lives of the NARUC ranges, as proposed in the application and agreed upon by Staff, to depreciate water plant assets for accounting purposes in all future reporting periods. No adjustment to accumulated depreciation, or retained earnings should be made to account for this change in the accounting estimate.

10. Morgan District should begin maintaining its records sufficient to properly determine the proper assignment of the depreciable lives utilizing the ranges included in the NARUC Study on a going forward basis.

IT IS THEREFORE ORDERED that:

1. The findings contained in the Staff Report are adopted and incorporated by reference into this Order as if fully set out herein.

2. The water service rates proposed by Morgan District are denied.

3. The rates set forth in Appendix B to this Order are approved for services rendered by Morgan District on and after the date of this Order.

4. Within 20 days of the date of entry of this Order, Morgan District shall file with this Commission, using the Commission's electronic Tariff Filing System, new tariff sheets setting forth the rates and charges approved herein and their effective date, and stating that the rates and charges were authorized by this Order.

5. Morgan District shall maintain its records following the date of this Order that are sufficient to determine the actual costs incurred to install its meter taps.

6. Morgan District shall develop a written policy to address internal controls for use of its debit and credit card, contract for payroll duties, and use of the full recommended rate amount in future base rate cases with the Commission.

7. Morgan District shall use the midpoint of the depreciable lives of the NARUC ranges, as proposed in the application and agreed upon by Staff, to depreciate water plant assets for accounting purposes in all future reporting periods. No adjustment to accumulated depreciation, or retained earnings should be made to account for this change in the accounting estimate.

8. Morgan District shall begin maintaining its records sufficient to properly determine the proper assignment of the depreciable lives utilizing the ranges included in the NARUC Study on a going forward basis.

9. The Commission shall open a separate proceeding, Case No. 2021-00206,[77] to monitor the surcharge proceeds collection and expenses, subject to the following conditions:

---

[77] Case No. 2021-00206, *Electronic Morgan County Water District's Unaccounted-For Water Loss Reduction Plan, Surcharge and Monitoring* (Ky. PSC June 9, 2021).

a. Within 120 days of the date of this Order, Morgan District shall file with the Commission a qualified infrastructure improvement plan, including a comprehensive unaccounted-for water loss reduction plan that establishes priorities and a time schedule for eliminating each source of unaccounted-for water loss and provides a detailed spending plan for the proceeds of a surcharge.

b. Morgan District shall be permitted to use surcharge proceeds to contract with and pay a certified engineer or consultant to draft the plan.

c. Morgan District shall deposit surcharge collections in a separate interest-bearing account.

d. On the 15th day of each month for 48 months from the date of this Order or until all surcharge proceeds are expended, Morgan District shall file with the Commission a monthly activity report that includes a statement of monthly surcharge billings and collections; a monthly surcharge bank statement; a list of each payment from the account, its payee, and a description of the purpose; and invoices supporting each payment.

e. On the 15th day of each month for 48 months from the date of this Order or until all surcharge proceeds are expended, Morgan District shall file a monthly water loss report with the Commission.[78]

f. Morgan District shall not use any surcharge proceeds for reimbursement of unaccounted-for water loss reduction expenses without prior Commission authorization.

---

[78] The report format is found at https://psc.ky.gov/Home/UtilForms under "Water Use & Loss Calculations (Excel format)."

g. Morgan District shall consider all surcharge collections as contributions and shall account for them in the manner that the Uniform System of Accounts for Class A and B Water Districts and Associations prescribes.

h. Morgan District shall debit monthly billings for the surcharge to customers' accounts receivable and credit the contribution account.

i. When Morgan District collects the surcharge from the customers, it shall debit special funds and credit the customer account.

j. One year after the date of entry of this Order and annually thereafter, Morgan District shall file in Case No. 2021-00206 a schedule of the estimated and actual progress of the water loss detection and repair program, and estimated and actual expenditures made with surcharge proceeds, for the purpose of evaluating whether adjustments to the program or to the surcharge amount are required.

k. Morgan District's failure to comply with the conditions set forth in ordering paragraph 7 shall result in termination of the surcharge and the refund of collected surcharge proceeds disbursed on expenses or projects outside the scope of expenses and projects approved by the Commission.

10. Morgan District has complied with the November 22, 2019 Order in Case No. 2019-00041[79] and should be dismissed as a party to that case.

11. A copy of this Order shall be filed in Case No. 2019-00041.[80]

12. This case is closed and removed from the Commission's docket.

---

[79] *See* Case No. 2019-00041, *Electronic Investigation into Excessive Water Loss by Kentucky's Jurisdictional Water Utilities* (Ky. PSC Nov. 22, 2019).

[80] *Id.*

By the Commission

ENTERED

JUN 09 2021

rcs

KENTUCKY PUBLIC SERVICE COMMISSION

ATTEST:

Linda C. Bridwell

Executive Director

APPENDIX A

APPENDIX TO AN ORDER OF THE KENTUCKY PUBLIC SERVICE COMMISSION IN CASE NO. 2020-00386 DATED JUN 09 2021

	Test Year	Adjustment	(Ref.)	Pro Forma
Operating Revenues				
Retail Sales of Water	$ 1,407,839	$ 15,836	(A)	
		(6,710)	(B)	$ 1,416,965
Bulk Sales of Water	-	309	(C)	309
Other Water Revenues				
Forfeited Discounts	-	26,326	(D)	26,326
Miscellaneous Service Revenues	20,666	3,185	(E)	
		(19,694)	(F)	4,157
Total Operating Revenues	1,428,505	19,252		1,447,757
Operating Expenses				
Operation and Maintenance Expenses				
Salaries and Wages - Employees	189,310	60,576	(G)	
		(31,900)	(H)	217,986
Employee Pensions and Benefits	148,997	8,982	(I)	
		(45,510)	(J)	
		(1,306)	(K)	111,163
Purchased Water	770,593	(191,137)	(L)	579,456
Purchased Power for Pumping	-	35,182	(M)	
		(8,726)	(L)	26,456
Chemicals				-
Materials and Supplies	85,232	(31,900)	(H)	53,332
Contractual Services	32,431			32,431
Transportation Expense	16,600			16,600
Insurance	17,516			17,516
Advertising	1,286			1,286
Miscellaneous Expense	55,091	(35,182)	(M)	19,909
Total Operation and Maintenance Expenses	1,317,056	(240,921)		1,076,135
Taxes Other Than Income	14,433	4,683	(G)	19,116
Depreciation	508,422	(116,847)	(N)	391,575
Total Operating Expenses	1,839,911	(353,085)		1,486,826
Net Operating Income	(411,406)	372,337		(39,069)
Interest Income	75			75
Nonutility Income	6,575	(6,575)	(O)	-
Income Available to Service Debt	$ (404,756)	$ 365,762		$ (38,994)

APPENDIX B

APPENDIX TO AN ORDER OF THE KENTUCKY PUBLIC SERVICE COMMISSION IN CASE NO. 2020-00386 DATED JUN 09 2021

The following rates and charges are prescribed for the customers in the area served by Morgan County Water District. All other rates and charges not specifically mentioned herein shall remain the same as those in effect under the authority of the Commission prior to the effective date of this Order.

Monthly Water Rates

5/8- x 3/4-Inch Meter

First	2,000	gallons	$ 31.49 Minimum bill
Next	3,000	gallons	0.01166 per gallon
Next	5,000	gallons	0.01080 per gallon
Next	5,000	gallons	0.00995 per gallon
All Over	15,000	gallons	0.00909 per gallon

1-Inch Meter

First	5,000	gallons	$ 66.62 Minimum bill
Next	5,000	gallons	0.01080 per gallon
Next	5,000	gallons	0.00995 per gallon
All Over	15,000	gallons	0.00909 per gallon

2-Inch Meter

First	15,000	gallons	$ 168.93 Minimum bill
All Over	15,000	gallons	0.00909 per gallon

6-Inch Meter

First	100,000	gallons	$943.03 Minimum bill
All Over	100,000	gallons	0.00909 per gallon

Wholesale Water Rate $0.00528 per gallon

Water Loss Surcharge $5.87 per meter per month

Nonrecurring Charges

Meter Test Request	$35.40
Service Call/Investigation	$17.40
Returned Payment Fee	$ 2.00
Reconnection Fee	$17.40

*Alan Vilines
Kentucky Rural Water Association
Post Office Box 1424
1151 Old Porter Pike
Bowling Green, KENTUCKY 42102-1424

*Shannon Elam
General Manager
Morgan County Water District
1009 Hwy 172
West Liberty, KY 41472

*Morgan County Water District
1009 Hwy 172
West Liberty, KY 41472

COMMONWEALTH OF KENTUCKY

BEFORE THE PUBLIC SERVICE COMMISSION

In the Matter of:

ELECTRONIC APPLICATION OF MORGAN COUNTY WATER DISTRICT FOR A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY TO CONSTRUCT A SYSTEM IMPROVEMENTS PROJECT AND AN ORDER APPROVING A CHANGE IN RATES AND AUTHORIZING THE ISSUANCE OF SECURITIES PURSUANT TO KRS 278.023	)	CASE NO. 2021-00146

ORDER

On March 31, 2021, Morgan County Water District (Morgan District) filed an application, pursuant to KRS 278.023, requesting a Certificate of Public Convenience and Necessity (CPCN) to construct a water system improvements project, approval of the proposed plan of financing the project, and approval of the proposed rates in its application.[1] No party has sought intervention in this matter.

Morgan District, a water district organized under KRS Chapter 74, provides retail water service to approximately 2,835 water customers[2] in Morgan County, Kentucky.[3] The Commission's Division of Inspections last inspected Morgan District on September 25, 2019. Commission Staff noted four deficiencies in a letter that it furnished to Morgan District on October 14, 2019. Morgan District responded to the deficiencies by

---

[1] Application at 4.

[2] *Annual Report of Morgan County Water District for the Year Ended December 31, 2019* at 49.

[3] *Id.* at 12.

letter dated October 29, 2019, wherein Morgan District stated that in addition to adopting a safety manual, it had begun the process of documenting its inspection of valves, meters, and meter settings, it had also been approved for a loan with the United Stated Department of Agriculture Rural Development (USDA/RD) to replace approximately 265 meters, purchase leak detection equipment, replace aging water lines, and zone its systems.

In the present case, Morgan District has submitted its application pursuant to KRS 278.023. The Commission is required, pursuant to KRS 278.023, to accept agreements between water utilities and USDA/RD regarding construction projects and to issue the necessary orders to implement the terms of such agreements no later than 30 days after filing the application with the Commission. KRS 278.023 does not grant the Commission any discretionary authority to modify or reject any portion of the agreement between the USDA/RD and Morgan District or to defer the issuance of all necessary orders to implement the terms of that agreement. It further denies the Commission any authority to reject an application when the evidence of record indicates that a water utility's proposed construction will result in the wasteful duplication of facilities, result in an excessive investment, or its proposed rates are unfair, unjust or unreasonable. The Commission, therefore, is not able to review this application using the same standards that are used for applications that are not filed pursuant to KRS 278.023. The Commission notes that Morgan District is currently undergoing an investigation of the reasonableness of its current rates in Morgan District's application for Alternative Rate Filing pursuant to 807 KAR 5:076 in Case No. 2020-00386. As a result of the timing of the filing of the rate case pursuant to Commission Order,[4] and the filing of the pending case, the result was that the Commission Staff Report (Staff Report) did not include the additional debt service, nor depreciation expense on the project proposed in this case. This issue was noted in Morgan District's comments to the Staff Report, which included as an attachment the debt service schedule on the proposed debt in this proceeding.[5] The Commission finds that it should address the issue of any additional debt service that should be included in the final calculation of rates in Case No. 2020-00386.

The proposed project consists of the purchase and installation of approximately 12,700 linear feet of six-inch PVC waterline and 1,300 linear feet of two-inch PVC waterline designed to replace existing waterline located along Old Highway 172 and along Walter Litteral Road in Morgan District's service territory.[6] Additionally, Morgan District intends to install four flushing hydrants to be used for the maintenance of the new waterline, and the replacement of 59 water meters and service lines that connect to the mains being replaced in this project.[7] Morgan District states that it will acquire leak detection equipment, purchase flow metering equipment, purchase a water meter test bench, and install leak detection vaults throughout the system to locate leaks.[8] Finally,

[4] Case No. 2019-00041, *Investigation into Excessive Water Loss by Kentucky's Jurisdictional Water Utilities* (Ky. PSC Oct. 13, 2020) at 5.

[5] Case No. 2020-00386, *Electronic Application of Morgan County Water District for a Rate Adjustment Pursuant to 807 KAR 5:076* (filed on Apr. 13, 2021), Response to Staff Report.

[6] Application, Exhibit A, Project Description.

[7] *Id.*

[8] *Id.*

Morgan District plans to rehabilitate the chlorine room of the KY 437 pump station near Mima.[9]

The total estimated cost of the proposed project, including but not limited to development, legal expenses, engineering, construction, and contingencies, is approximately $1,200,000.[10] Morgan District proposes to finance the $1,200,000 cost of the project through the issuance of $315,000 of Waterworks Revenue Bonds, a USDA/RD grant of $85,000, and an Appalachian Regional Commission (ARC) grant of $800,000.[11] Morgan District has a commitment from USDA/RD to purchase the $315,000 in bonds maturing over 40 years, at an interest rate not to exceed 1.125 percent per annum.[12]

The proposed rates contained in the application are the minimum rates and charges required under the agreement with USDA/RD.[13] Morgan District's proposed rates meet the total revenue requirements recommended in the summary addendum to its application.[14] The monthly bill of an average residential water customer who uses 3,272 gallons will increase from $41.17 to $45.89, an increase of $4.72 or approximately 11.46 percent.[15]

---

[9] *Id.*

[10] Application, Exhibit B, RD Letter of Conditions and Forms RD 1940-1, March 29, 2021 letter at 2.

[11] Application at 1–2, paragraph 5.

[12] *Id.*

[13] Application, Exhibit B, RD Letter of Conditions and Forms RD 1940-1 at 12.

[14] *See* Summary Addendum filed separately with application entitled "Summary_Addendum_3-36-31.pdf" at 32 and Excel spreadsheet filed separately with application entitled "MCWD_Billing_Analysis_Prop_Rates_-_2019_cust_5_rate_blls_2-11-2021.xlsx."

[15] Application, Exhibit E at 2.

IT IS THEREFORE ORDERED that:

1. Morgan District is granted a CPCN for the proposed project as submitted.

2. Morgan District's proposed plan of financing is approved.

3. Morgan District is authorized to issue $315,000 of its Waterworks Revenue Bonds in the amount of $315,000 maturing over 40 years at an interest rate not to exceed 1.125 percent per annum.

4. The proceeds from the issuance of the Water System Revenue Bonds shall be used only for the purposes specified in Morgan District's application.

5. Morgan District is authorized to obtain a grant in the amount of $85,000 from USDA/RD.

6. Morgan District is authorized to obtain a grant from ARC in the amount of $800,000.

7. Morgan District shall obtain approval from the Commission prior to performing any additional construction not expressly authorized by this Order.

8. Morgan District shall file with the Commission documentation of the total costs of this project, including the cost of construction and all other capitalized costs (e.g., engineering, legal, and administrative), within 60 days of the date that construction is substantially completed. Construction costs shall be classified into appropriate plant accounts in accordance with the Uniform System of Accounts for water utilities prescribed by the Commission.

9. Morgan District shall file a copy of the "as-built" drawings and a certified statement from the engineer that the construction has been satisfactorily completed in

accordance with the contract plans and specifications within 60 days of substantial completion of the construction certified herein.

10. Morgan District shall require the construction to be inspected under the general supervision of a professional engineer with a Kentucky registration in civil or mechanical engineering to ensure that the construction work is done in accordance with the contract drawings and specifications and in conformance with the best practices of the construction trades involved in the project.

11. Morgan District shall notify the Commission in writing one week prior to the actual start of construction and at the 50 percent completion point.

12. Any documents filed in the future pursuant to ordering paragraphs 8, 9, and 11 of this Order shall reference this case number and shall be retained in the post-case correspondence file.

13. The Executive Director is delegated authority to grant reasonable extensions of time for filing of any documents required by this Order upon Morgan District's showing of good cause for such extension.

14. The rates set forth in the Appendix to this Order are approved for service that Morgan District renders on and after the date of this Order.

15. Within 20 days of the date of this Order, Morgan District shall file revised tariff sheets with the Commission, using the Commission's electronic Tariff Filing System, containing the rates set forth in the Appendix to this Order.

16. This case is closed and removed from the Commission's docket.

Nothing contained herein shall be deemed a warranty of the Commonwealth of Kentucky, or any agency thereof, of the financing, herein approved.

By the Commission

ENTERED

APR 26 2021 bsb

KENTUCKY PUBLIC SERVICE COMMISSION

ATTEST:

Linda C. Bridwell

Executive Director

APPENDIX

APPENDIX TO AN ORDER OF THE KENTUCKY PUBLIC SERVICE COMMISSION IN CASE NO. 2021-00146 DATED APR 26 2021

The following rates and charges are prescribed for the customers in the area served by Morgan County Water District. All other rates and charges not specifically mentioned herein shall remain the same as those in effect under authority of the Commission prior to the effective date of this Order.

Monthly Water Rates

5/8- x 3/4-Inch Meter

First	2,000	Gallons	$28.34 Minimum bill
Next	3,000	Gallons	0.01049 Per Gallon
Next	5,000	Gallons	0.00972 Per Gallon
Next	5,000	Gallons	0.00895 Per Gallon
Over	15,000	Gallons	0.00818 Per Gallon

1-Inch Meter

First	5,000	Gallons	$59.97 Minimum bill
Next	5,000	Gallons	0.00972 Per Gallon
Next	5,000	Gallons	0.00895 Per Gallon
Over	15,000	Gallons	0.00818 Per Gallon

2-Inch Meter

First	15,000	Gallons	$152.06 Minimum bill
Over	15,000	Gallons	0.00818 Per Gallon

6-Inch Meter

First	100,000	Gallons	$848.86 Minimum bill
Over	100,000	Gallons	0.00818 Per Gallon

Wholesale Rates * Connection for Emergency Use Only

City of Campton	0.00475 Per Gallon
City of Frenchburg	0.00475 Per Gallon

*Shannon Elam
General Manager
Morgan County Water District
1009 Hwy 172
West Liberty, KY 41472

*Morgan County Water District
1009 Hwy 172
West Liberty, KY 41472

*Ora C Main, PE, MBA
Project Manager
Nesbitt Engineering, Inc.
227 North Upper Street
Lexington, KENTUCKY 40507-1016

*Honorable W. Randall Jones
Attorney at Law
Rubin & Hays
Kentucky Home Trust Building
450 South Third Street
Louisville, KENTUCKY 40202

Appendix C

MCWD

Morgan County Water District

JOB DESCRIPTION

Job Title:	**Field Service Leak Detection Specialist**
Department:	Field
Reports To:	Field Manager

Job Summary:
Work tasks involve, but are not limited to OPERATE VARIOUS TYPES OF ELECTRONIC EQUIPMENT USED TO DETECT AND RECORDLEAK SOUNDS RELATED TO WATER LOSS FROM THE WATER DISTRIBUTION SYSTEM.SUBMIT DATA COLLECTED TO LEAK DETECTION COORDINATOR FOR ANALYSIS AND APPROPRIATE ACTION.

Job Responsibilities:
1. OPERATE EQUIPMENT INCLUDING LOGGERS, SCANNERS, CORRELATORS AND OTHER DEVICES TO LISTEN TO AND INTERPRET QUALITY AND TYPE OF SOUNDS TO DETECT LEAKS IN THE WATER AUTHORITY'S WATER DISTRIBUTION SYSTEM.
2. DOWNLOAD DATA FROM MONITORING EQUIPMENT AND ENTER DATA GATHERED INTO DATABASE TO FACILITATE ANALYSIS OF WATER LOSSES BY LEAK DETECTION COORDINATOR.
3. PERFORM SEQUENTIAL ACTIONS TO LOCATE LEAKS BY APPLYING KNOWLEDGE OF LEAK DETECTION PRACTICES AND READING AND INTERRUPTING WATER DISTRIBUTION MAPS AND DRAWINGS.
4. UTILIZE HAND AND CONSTRUCTION TOOLS TO EXPOSE MAINS, VALVES AND SERVICE STOP BOXES.
5. SET UP BARRICADES OR OTHER TRAFFIC DEVICES IN THE FIELD TO ENSURE SAFETY IN THE WORKING ENVIRONMENT.
6. COLLECT GLOBAL POSITION SYSTEM (GPS) DATA REGARDING LOCATION OF FIRE HYDRANTS, VALVES AND METERS.
7. LOG ACTIVITIES AND PREPARE REPORTS AS DIRECTED.

Physical Requirements:
This position involves work requiring the employee to exert in excess of 100 pounds of force occasionally and less force frequently to move objects. Physical activity related to this position may include climbing, stooping, kneeling, crouching, reaching, standing, walking, grasping, feeling, talking, hearing and repetitive motion. Employee will be exposed to indoor and outdoor environmental conditions including extreme heat and cold; subject to noise, fumes, odors, gases, poor ventilation, oil and grease.

Job Requirements:
HIGH SCHOOL DIPLOMA OR GED PLUS ONE (1) YEAR WATER UTILITY OPERATIONS, ENVIRONMENTAL INSPECTION AND/OR COMPLIANCE EXPERIENCE. LEAK DETECTION EXPERIENCE AND ASSOCIATE'S DEGREE OR TECHNICAL TRAINING IN ENVIRONMENTAL SCIENCE OR RELATED FIELD PREFERRED. Must have a valid KY driver's license. Full time position and must be willing to work on an "on call" basis for emergency situations, and be willing to work on weekends and holidays, if required.

Appendix D

Morgan County Water District

Monthly Water Report

	January	February	March	April	May	June	July	August	September	October	November	December	Total Annual, Water Loss %	
Total Producted & Purchased	22,348,090	23,793,900	22,818,610	21,642,940	20,883,760	21,979,040	21,018,240	20,125,520	19,610,200	18,779,690	21,809,070	18,356,280	253,165,340	2015
Total Water Sales	9,401,220	10,408,320	11,529,280	10,702,210	11,623,770	10,685,940	12,925,130	9,394,030	10,978,800	9,889,010	8,148,170	7,858,510	123,544,390	
Total Other Water Used	2,540,321	2,175,106	1,750,885	1,954,444	1,738,601	1,669,807	3,619,589	3,089,190	3,925,776	4,080,551	4,293,674	4,882,355	35,720,299	
Total Line Loss	10,406,549	11,210,474	9,538,445	8,986,286	7,521,389	9,623,293	4,473,521	7,642,300	4,705,624	4,810,129	9,367,226	5,615,415	93,900,651	
Water Loss Percentage (unaccounted-for water)	46.57%	47.11%	41.80%	41.52%	36.02%	43.78%	21.28%	37.97%	24.00%	25.61%	42.95%	30.59%	37.09%	
Total Producted & Purchased	18,955,840	20,981,020	17,200,600	18,528,600	17,533,910	20,092,660	17,700,100	17,970,150	18,841,420	17,282,000	18,286,480	20,594,870	223,967,650	2016
Total Water Sales	9,751,570	9,411,400	7,846,380	9,096,790	9,234,600	10,948,390	9,697,230	8,765,790	10,869,240	8,240,810	8,447,390	8,748,260	111,057,850	
Total Other Water Used	4,140,292	4,098,465	3,200,701	1,825,727	2,182,549	4,220,288	4,100,812	5,014,386	4,450,073	4,079,009	4,471,043	4,106,388	45,889,733	
Total Line Loss	5,063,978	7,471,155	6,153,519	7,606,083	6,116,761	4,923,982	3,902,058	4,189,974	3,522,107	4,962,181	5,368,047	7,740,222	67,020,067	
Water Loss Percentage (unaccounted-for water)	26.71%	35.61%	35.78%	41.05%	34.89%	24.51%	22.05%	23.32%	18.69%	28.71%	29.36%	37.58%	29.92%	
Total Producted & Purchased	22,073,420	21,433,020	19,484,720	21,706,130	21,495,600	22,709,150	20,263,460	19,336,370	19,060,680	19,100,610	19,634,990	21,791,380	248,089,530	2017
Total Water Sales	10,123,250	8,276,250	8,346,630	9,074,780	8,834,590	10,810,030	9,948,440	9,398,940	10,047,260	8,176,080	9,020,850	8,497,210	110,554,310	
Total Other Water Used	3,125,350	3,808,678	3,080,453	2,761,181	3,196,032	3,671,455	3,821,797	3,979,496	4,493,767	3,934,439	3,788,409	3,506,335	43,167,392	
Total Line Loss	8,824,820	9,348,092	8,057,637	9,870,169	9,464,978	8,227,665	6,493,223	5,957,934	4,519,653	6,990,091	6,825,731	9,787,835	94,367,828	
Water Loss Percentage (unaccounted-for water)	39.98%	43.62%	41.35%	45.47%	44.03%	36.23%	32.04%	30.81%	23.71%	36.60%	34.76%	44.92%	38.04%	
Total Producted & Purchased	29,271,160	28,443,440	21,668,570	24,481,020	22,234,580	21,457,760	20,158,960	19,930,330	23,672,720	21,024,210	23,149,910	22,825,190	278,317,850	2018
Total Water Sales	11,810,040	8,679,040	7,736,900	8,514,240	9,630,700	10,651,510	9,070,430	9,763,950	9,030,040	9,739,670	9,657,920	7,775,210	112,059,650	
Total Other Water Used	3,893,591	3,940,188	3,741,206	3,793,210	3,650,215	3,913,019	4,017,656	4,984,284	4,810,655	4,725,328	4,830,598	4,677,871	50,977,821	
Total Line Loss	13,567,529	15,824,212	10,190,464	12,173,570	8,953,665	6,893,231	7,070,874	5,182,096	9,832,025	6,559,212	8,661,392	10,372,109	115,280,379	
Water Loss Percentage (unaccounted-for water)	46.40%	55.60%	47.00%	49.70%	40.30%	32.10%	35.10%	26.00%	41.50%	31.20%	37.40%	45.40%	41.42%	
Total Producted & Purchased	25,077,000	28,588,000	24,566,000	21,898,000	19,976,000	22,185,000	20,960,000	20,298,000	19,803,000	19,499,000	20,972,000	20,387,000	264,209,000	2019
Total Water Sales	9,505,070	9,799,760	8,703,180	8,282,720	9,682,380	11,470,780	8,861,520	11,071,420	9,315,780	8,638,350	10,013,560	8,044,840	113,389,360	
Total Other Water Used	1,887,392	1,775,663	1,761,765	1,912,356	4,763,409	4,771,072	4,342,765	4,591,031	4,551,431	4,533,741	4,600,783	4,555,584	44,046,992	
Total Line Loss	13,684,538	17,012,577	14,101,055	11,702,924	5,530,211	5,943,148	7,755,715	4,635,549	5,935,789	6,326,909	6,357,657	7,786,576	106,772,648	
Water Loss Percentage (unaccounted-for water)	54.57%	59.51%	57.40%	53.44%	27.68%	26.79%	37.00%	22.84%	29.97%	32.45%	30.31%	38.19%	40.41%	

Morgan County Water District

Monthly Water Report

	January	February	March	April	May	June	July	August	September	October	November	December	Total Annual, Water Loss %	
Total Producted & Purchased	19,734,000	21,178,000	19,286,000	20,423,000	21,122,000	23,063,000	19,428,000	20,856,000	20,256,000	19,000,000	19,592,000	19,765,000	243,703,000	2020
Total Water Sales	9,481,280	9,139,420	7,415,860	9,220,620	9,235,010	11,880,540	10,569,540	10,726,450	9,894,410	9,144,280	9,072,500	9,788,980	115,568,890	
Total Other Water Used	6,422,265	5,606,933	4,578,881	4,858,555	5,424,646	5,779,309	4,184,300	4,575,930	1,831,415	1,374,406	1,597,835	1,982,458	48,216,933	
Total Line Loss	3,830,455	6,431,647	7,291,259	6,343,825	6,462,344	5,403,151	4,674,160	5,553,620	8,530,175	8,481,314	8,921,665	7,993,562	79,917,177	
Water Loss Percentage (unaccounted-for water)	19.41%	30.37%	37.81%	31.06%	30.60%	23.43%	24.06%	26.63%	42.11%	44.64%	45.54%	40.44%	32.79%	
Total Producted & Purchased	22,060,000	24,638,000	19,143,000	19,414,000	18,246,000	20,805,000	18,795,000	20,637,000	18,335,000				182,073,000	2021
Total Water Sales	8,922,000	8,386,000	9,586,000	9,219,000	9,340,000	11,619,000	10,843,000	11,619,000	11,456,000				90,990,000	
Total Other Water Used	3,664,000	6,758,000	2,401,000	1,373,000	1,342,000	1,579,000	1,664,000	2,450,000	1,627,000				22,858,000	
Total Line Loss	9,474,000	9,494,000	7,156,000	8,822,000	7,564,000	7,607,000	6,288,000	6,568,000	5,252,000				68,225,000	
Water Loss Percentage (unaccounted-for water)	42.95%	38.53%	37.38%	45.44%	41.46%	36.56%	33.46%	31.83%	28.64%				37.47%	

Appendix E

Kentucky Infrastructure Authority
Office of the Governor

WRIS Contact
Don Schierer
502-892-3486
E-mail

Water Resource Information System

TEAM KENTUCKY

Reload << Click here to reload the last saved version of this page.

Login: Login

WRIS Project Profile

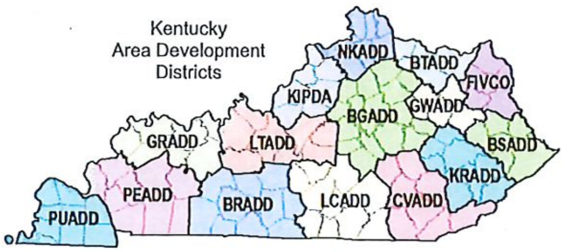
Search the WRIS for drinking water or waste water projects by entering any combination of the following fields:

Regulatory Framework: Safe Drinking Water Act (Water)
Area Dev. Dist. (ADD):
Legislative District:
Planning Unit:
Primary County: Morgan
Project Status:
Funding Status:
Project Applicant:
Project Beneficiary:
KIA Loan Number:
Project Administrator.:
Project Engineer:
Project Number*:
Project Title*:

☐ Include constructed projects in this search.

Clear Query Submit Query

.* Indicates a fuzzy search will be performed on these fields.



Legislative District Options	
District Type	Sort Option
◉ Kentucky House	◉ By District Number
○ Kentucky Senate	○ By Legislator
○ Congressional	

Document Downloads
Download CWSRF Guidance Document
Download DWSRF Guidance Document
Download Clean Water Pre-Application Form
Download Drinking Water Pre-Application Form

22 records found. Click here to view results.

22 records found. Download PDF Download Excel

WX21175023	Morgan	Liberty	Johnson Hill Storage Tank Rehabilitation	Approved	Funded	3-5 Years	$170,600	08-13-2018	2020
WX21175030	Morgan	City of West Liberty	City of West Liberty Broadway and Main Street Line Replacement Project	Withdrawn	Not Funded	3-5 Years	$250,000	11-20-2018	11-14-2016
WX21175036	Morgan	City of West Liberty	Glenn Avenue Waterline Replacement	Withdrawn	Not Funded	3-5 Years	$180,000	10-02-2018	
WX21175037	Morgan	Morgan County Water District	Countywide Waterline Extensions	Withdrawn	Not Funded	6-10 Years	$1,239,355	05-11-2021	12-02-2016
WX21175040 (CURRENT)	Morgan	Morgan County Water District	Scattered Waterline Replacement and Pump Station Rehab	Approved	Fully Funded	0-2 Years	$2,400,000	06-02-2021	09-24-2019
WX21175041	Morgan	Morgan County Water District	KY Hwy 191 Waterline Replacement Project Phase 2	Approved	Fully Funded	0-2 Years	$3,262,000	04-20-2021	04-23-2021
WX21175042	Morgan	Morgan County Water District	MCWD New Woodsbend Water Storage Tank	Approved	Not Funded	0-2 Years	$500,000	03-18-2021	12-18-2020
WX21175043	Morgan	Morgan County Water District	MCWD Pump Station Relocation Project and Tank Replacement	Approved	Not Funded	3-5 Years	$250,000	05-11-2021	12-18-2020
			City of West Liberty						

Back to top

Reload << Click here to reload the last saved version of this page.

WRIS Contact
Don Schierer
502-892-3486
E-mail

Water Resource Information System

TEAM KENTUCKY

Reload << Click here to reload the last saved version of this page.

Login: Login

WRIS Project Profile

Search the WRIS for drinking water or waste water projects by entering any combination of the following fields:

Regulatory Framework: Safe Drinking Water Act (Water)
Area Dev. Dist. (ADD):
Legislative District:
Planning Unit:
Primary County: Morgan
Project Status:
Funding Status:
Project Applicant:
Project Beneficiary:
KIA Loan Number:
Project Administrator.:
Project Engineer:
Project Number*:
Project Title*:

☐ Include constructed projects in this search.

Clear Query | Submit Query

* Indicates a fuzzy search will be performed on these fields.

Legislative District Options

District Type	Sort Option
◉ Kentucky House	◉ By District Number
○ Kentucky Senate	○ By Legislator
○ Congressional	

Document Downloads

- Download CWSRF Guidance Document
- Download DWSRF Guidance Document
- Download Clean Water Pre-Application Form
- Download Drinking Water Pre-Application Form

22 records found. Click here to view results.

22 records found. Download PDF | Download Excel

WX21175044	Morgan	City of West Liberty	Glenn Avenue Broadway, Pointner, Hutchinson	Approved	Not Funded	3-5 Years	$500,000	03-18-2021	09-21-2021
WX21175045	Morgan	Morgan County Water District	Morgan County Water District Replacement/Bore of Exposed Water L	Approved	Unknown	3-5 Years	$0	05-11-2021	05-21-2021
WX21175046	Morgan	Morgan County Water District	New Construction Or Acquisition of New Office Space and Shop for	Approved	Unknown	3-5 Years	$0	03-26-2021	02-05-2021
WX21175047	Morgan	Morgan County Water District	Ditney Ridge Pump Station Remodel	Approved	Unknown	3-5 Years	$0	03-26-2021	02-09-2021
WX21175048	Morgan	Morgan County Water District	Replacement of Bore Machine	Approved	Unknown	3-5 Years	$0	03-26-2021	02-05-2021
WX21175049	Morgan	Morgan County Water District	Purchase of A Generator On Trailer	Approved	Unknown	3-5 Years	$0	03-26-2021	02-05-2021
WX21175050	Morgan	Morgan County Water District	Purchase of A New Gate Valve Cleaner and Valve Turner	Approved	Unknown	3-5 Years	$0	03-26-2021	02-05-2021
WX21175051	Morgan	Morgan County Water District	The Purchase 200 Flush Hydrant Locks	Approved	Unknown	3-5 Years	$0	03-26-2021	02-05-2021

Back to top

Reload << Click here to reload the last saved version of this page.

Drinking Water Project Profile

Legal Applicant: **Morgan County Water District**
Project Title: **Countywide Waterline Extensions**
Project Number: **WX21175037** View Map
Funding Status: **Not Funded**
Project Status: **Approved**
Project Schedule: **6-10 Years**
E-Clearinghouse SAI:
Applicant Entity Type: **Water District (KRS 74)**
Date Approved (AWMPC): **12-08-2016**

Submitted By: **GWADD**
Primary County: **Morgan**
Planning Unit: **Morgan**
Multi-County: **No**
ECH Status:
ADD WMC Contact: **Benjamin Hamm**

Project Description:

This project proposes to extend waterlines to serve residents that currently do not have access to public water service. The following extensions are outlined below.

Dedman Road - pump station to serve existing waterline and potential customers at the top of the hill that currently would not have sufficient water pressure.
Day Branch - approximately 3,400 LF of 3" PVC waterline.
Griffy Branch - approximately 7,395 LF of 4" PVC waterline (tie in two dead end waterlines).
Haney Branch - approximately 5,950 LF of 3" PVC waterline.
Henry Ross Road - approximately 1,000 LF of 3" PVC waterline.
Hog Branch - approximately 2,000 LF of 3" PVC waterline.
KY 772 - approximately 3,495 LF of 4" PVC waterline (tie in two dead end waterlines).
KY 844 - approximately 5,575 LF of 4" PVC waterline (tie in two dead end waterlines).
Oney Road - approximately 3,700 LF of 3" PVC waterline.
Rube Woods - approximately 18,700 LF of 4" PVC waterline.
Splitwood Branch - approximately 4,600 LF of 2" PVC waterline.
US 460 East - approximately 9,250 LF of 6" PVC waterline (tie in two dead end waterlines).
Sam Litteral Road - approximately 1,000 LF of 2" PVC waterline.
Poor Boys Road - approximately 1,250 LF of 2" PVC waterline.

This project will serve approximately 93 unserved households and six (6) underserved households.

Need for Project:
Briefly describe how this project promotes public health or achieves and/or maintains compliance with the Clean Water Act or Safe Drinking Water Act:
The completion of the waterline extension will provide potable water to currently un-served households.

Project Alternatives:

Alternate A:

Complete project in phases.

Alternate B:

Legal Applicant:

Entity Type: **Water District (KRS 74)** PSC Group ID: **25603**
Entity Name: **Morgan County Water District**
Web URL:
Office EMail: **morganwater@gmail.com**
Office Phone: **606-743-1204** Toll Free: Fax: **606-743-9585**

Mail Address Line 1: **1009 Hwy 172** Phys Address Line 1: **1009 Hwy 172**
Mail Address Line 2: Phys Address Line 2:
Mail City, State Zip: **West Liberty, KY 41472** Phys City, State Zip: **West Liberty, KY 41472**

Contact:	**Shannon Elam**	Financial Contact:		Auth Official:	**Linda Bradley**
Contact Title:	**Chairman of The Board**	Financial Contact Title:		Auth Official Title:	**Chairman of The Board**
Contact EMail:	**mcwdshannon@gmail.com**	Financial Contact EMail:		Auth Official EMail:	**shelam89@yahoo.com**
Contact Phone:	**606-743-1204**	Financial Contact Phone:		Auth Official Phone:	**606-743-1204**

Data Source: **Kentucky Infrastructure Authority** Date Last Modified: **07.01.2020**

Drinking Water Project Profile

WX21175037 - Morgan County Water District
Countywide Waterline Extensions

Project Administrator (PA) Information

Name: **Jocelyn R Gross**
Title: **Project Administrator**
Organization: **Gateway Area Development District**
Address Line 1: **110 Lake Park Dr**
Address Line 2:
City: **Morehead** State: **KY** Zip: **40351**
Phone: **606-780-0090** Fax: **606-780-0111**

Applicant Contact (AC) Information

Name: **Kyle Risner**
Title: **General Manager**
Organization: **Morgan County Water District**
Address Line 1: **1009 Hwy 172**
Address Line 2:
City: **West Liberty** State: **KY** Zip: **41472**
Phone: **606-743-1204** Fax: **606-743-9585**

Estimated Budget

Project Cost Categories:

Cost Category	Cost
Administrative Expenses:	$ 25,000
Legal Expenses:	$ 5,000
Land, Appraisals, Easements:	
Relocation Expenses & Repayments:	
Planning:	
Engineering Fees - Design:	$ 86,320
Engineering Fees - Construction:	
Engineering Fees - Inspection:	$ 54,957
Engineering Fees - Other:	
Construction:	$ 970,980
Equipment:	
Miscellaneous:	
Contingencies:	$ 97,098
Total Project Cost:	**$ 1,239,355**

Construction Cost Categories:

Cost Category	Cost
Treatment:	
Transmission & Distribution:	$ 970,980
Source:	
Storage:	
Purchase of Systems:	
Restructuring:	
Land Acquisition:	
Non-Categorized:	
Total ConstructionCost:	**$ 970,980**

Total Sustainable Infrastructure Costs:	

Note: Total Sustainability Infrastructure Costs are included within construction and other costs reported in this section. This breakout is provided for SRF review purposes.

Project Funding Sources:

Total Project Cost: **$1,239,355**
Total Committed Funding: **$0**
Funding Gap: **$1,239,355 (Not Funded)**

☐ This project will be requesting SRF funding for fiscal year 2022.

Funding Source	Loan or Grant ID	Fiscal Year	Amount	Status	Applicable Date

Funding Source Notes:

Estimated Project Schedule:

Est. Environmental Review Submittal Date:
Estimated Bid Date:
Estimated Construction Start Date:
Estimated Construction Completeion Date:

The following systems are beneficiaries of this project:

✓ **KY0880594 Morgan County Water District**

Note: Check mark indicates primary system for this project.

Project Ranking by AWMPC:
Regional Ranking(s):
Planning Unit Ranking:

○ Plans and specs have been sent to DOW.
○ Plans and specs have been reviewed by DOW.
○ Plans and specs have been sent to PSC.

Drinking Water Project Profile

WX21175037 - Morgan County Water District
Countywide Waterline Extensions

Total Points:

◯ Plans and specs have been reviewed by PSC.

Economic, Demographic and Geographic Impacts

Economic Impacts	
Jobs Created:	
Jobs Retained:	

*Demographic Impacts (GIS Census Overlay)			
Servceable Demographic	Project Area	Included Systems	Included Utilities
Population:	111	8,852	8,851
Households:	56	4,103	4,103
MHI:	$29,617	$33,900	*$33,900
MHI MOE	$9,870	$5,854	*$5,854
MOE as Pct:	33%	17.0%	17.0%
**NSRL:		2	2

Population and household counts are based on 2010 census block values from the SF1 (100%) dataset.

MHI Source is from the American Community Survey 2014-2018 5Yr Estimates (Table B19013) *(for the primary system operated by the above listed beneficiary utilities).

MHI MOE = Med HH Income Margin of Error.

** NSRL (Non-Standard Rate Levels):
0 = Income above Kentucky MHI (KMHI).
1 = Income between 80% KMHI and KMHI.
2 = Income less than or equal to 80% KMHI.
- KMHI = $48,392
- 80% KHMI = $38,714

New Customers	
New Residential Customers:	
New Commercial Customers:	
New Institutional Customers:	
New Industrial Customers:	

New or Improved Service		
Service Demographic	Survey Based	Census Overlay*
To Unserved Households:	93	56
To Underserved Households:	6	
To Total Households:	99	56
** Cost Per Household:	$12,519	

* GIS Census block overlay figures are estimates of population and households potentially served by systems and projects based on a proximity analysis of relevant service lines to census block boundaries.

** Cost per household is based on surveyed household counts, not GIS overlay values.

Geographic Impacts For Project Area

Counties
Morgan

Legislative Districts	
District Name	Legislator
House 097	Bobby McCool
Senate 31	Phillip Wheeler
Congressional 5	Hal Rogers

Groundwater Sensitivity Zones

HUC 10 Watersheds	
HUC Code	Watershed Name
0507020304	Paint Creek
0510010102	Elk Fork
0510010105	Blackwater Creek-Licking River

Geographic Impacts For Included System(s)

Counties
Johnson
Magoffin
Menifee
Morgan
Wolfe

Legislative Districts	
District Name	Legislator
House 074	David Hale
House 092	John Blanton
House 097	Bobby McCool
Senate 21	Albert Robinson
Senate 25	Robert Stivers II
Senate 30	Brandon Smith
Senate 31	Phillip Wheeler
Congressional 5	Hal Rogers
Congressional 6	Andy Barr

DW Specific Impacts:

- ☐ This project relates to a public health emergency.
- ☐ This project will assist a non-compliant system to achieve compliance.
- ☐ This project will assist a compliant system to meet future requirements
- ☐ This project will provide assistance not compliance related.
- ☐ This project is necessary to achieve full or partial compliance with a court order, agreed order, or a judicial or administrative consent decree.
- ☐ Primary system has not received any SDWA Notices of Violation within the previous state fiscal year-July through June, i.e. July 2014 – June 2015).

Project Inventory (Mapped Features):

Mapped Point Features

DOW Permit ID	Count	FeatureType	Purpose	Status	Existing Capacity	Proposed Capacity	Units
KY0880594	1	PUMP STATION	PUMP - BOOST PRESSURE	NEW		25.00	GPM
KY0880594	1	INTERCONNECT METER	METER - EMERGENCY ONLY INTERCONNECT	NEW			EA

Mapped Line Features

DOW Permit ID	Line Type	Purpose	Activity	Size (in.)	Material	Length (LF)
KY0880594	WATER LINE: FINISHED	DISTRIBUTION	EXTENSION	2.00	PVC	6,850
KY0880594	WATER LINE: FINISHED	DISTRIBUTION	EXTENSION	3.00	PVC	16,050
KY0880594	WATER LINE: FINISHED	DISTRIBUTION	EXTENSION	4.00	PVC	35,165
KY0880594	WATER LINE: FINISHED	DISTRIBUTION	EXTENSION	6.00	PVC	9,250
					Total Length	67,315

Administrative Components:

☑ Planning ☐ Design ☑ Construction ☑ Management

Regionalization Components:

Public Water Systems Eliminated:

☐ this project includes the elimination of public water system(s) through merger or acquisition.

Water Treatment Plants Eliminated:

☐ This project includes the elimination of water treatment plant(s) through interconnect(s).

Supplementation of Raw Water Supply:

☐ This project includes supplementing the existing raw water supply.

Supplementation of Potable Water Supply:

☐ This project includes supplementing the existing potable water supply.

Emergency Only Water Supply:

☐ This project provides emergency only water supply.

Water Source Protection:

☐ This project includes land acquisition for water source protection.

Water Treatment Components:

☐ This project includes water treatment components

Treatment Activities:

☐ This project includes a new water treatment plant.

☐ This project includes an expansion of an existing water treatment plant.

☐ This project includes rehabilitation of an existing water treatment plant.

☐ This project includes upgrades to an existing water treatment plant.

☐ This project includes emergency power generators for treatment activities.

☐ This project includes redundant treatment processes.

☐ This project includes replacement of raw water lines.

Treatment - Upgrades/Modifications:

☐ This project includes infrastructure options to meet Cryptosporidium removal/inactivation requirements.

☐ This project includes infrastructure options to meet CT inactivation requirements.

☐ This project includes treatment modifications to meet the Disinfectants/Disinfection Byproducts Rule at the water treatment plant.

☐ This project will provide treatment modifications for VOCs, IOCs, SOC, or Radionuclides.

☐ This project includes treatment modifications to address Secondary Contaminants.

Security:

☐ This project includes security components for water treatment facilities.

Water Distribution and Storage:

☑ This project includes water distribution and/or storage components.

Water Line Extensions:

☑ This project includes water line extension(s).

Length of extensions: **67,315 LF**

Number of new connections:

Redundancy Components:

☐ This project includes emergency power generators for distribution and/or storage activities.

Number of units provided: **0**

☐ This project includes redundant distribution and/or storage processes.

Finished Water Quality:

☐ This project includes infrastructure to address inadequate water turnover and disinfection byproducts (DBPs).

☐ This project includes infrastructure to address inability to maintain disinfection residual.

Water Line Replacement:

☐ This project replaces problem water lines (breaks, leaks, or restrictive flows due to age, water lines consisting of lead and/or asbestos-cement (AC), and/or inadequately sized water lines.

☐ This project replaces lead service lines.

Water Loss in the Last 12 Months:

Water Loss Volume (MG)	111.215
Water Loss Percent (%)	42 %

Water Storage and Pressure Components:

☐ This project includes the construction of new water tank(s).

☐ This project includes the replacement of existing water tank(s).

☐ This project includes the rehabilitation of existing water tank(s).

☑ This project includes the construction of new pump station(s).

☐ This project includes the rehabilitation of existing pump station(s).

Security:

☐ This project includes security components for water distribution infrastructure.

Sustainable Infrastructure - Green Infrastructure:

Green stormwater infrastructure includes a wide array of practices at multiple scales that manage wet weather and that maintains and restores natural hydrology by infiltrating, evapotranspiring and harvesting and using stormwater. On a regional scale, green infrastructure is the preservation and restoration of natural landscape features, such as forests, floodplains, and wetlands, coupled with policies such as infill and redevelopment that reduce overall imperviousness in a watershed. On the local scale, green infrastructure consists of site and neighborhood-specific practices, such as:

Component	Cost
☐ Bioretention	$0
☐ Trees	$0
☐ Green Roofs	$0
☐ Permeable Pavement	$0
☐ Cisterns	$0
Total Green Infrastructure Cost:	**$0**

There are no Green Infrastructure components specified for this project.

Sustainable Infrastructure - Water Efficiency:

The use of improved technologies and practices to deliver equal or better services with less water. Water efficiency encompasses conservation and reuse efforts, as well as water loss reduction and prevention, to protect water resources for the future. Examples include:

	Component	Cost
☐	Installing or retrofitting water efficient devices such as plumbing fixtures and appliances (toilets, showerheads, urinals).	$0
☐	Installing any type of water meter in previously unmetered areas (can include backflow prevention if in conjunction with meter replacement).	$0
☐	Replacing existing broken/malfunctioning water meters with AMR or smart meters, meters with leak detection, backflow prevention.	$0
☐	Retrofitting/adding AMR capabilities or leak equipment to existing meters.	$0
☐	Conducting water utility audits, leak detection studies, and water use efficiency baseline studies, which are reasonably expected to result in a capital project or in a reduction in demand to alleviate the need for additional capital investment.	$0
☐	Developing conservation plans/programs reasonable expected to result in a water conserving capital project or in a reduction in demand to alleviate the need for capital investment.	$0
☐	Recycling and water reuse projects that replace potable sources with non-potable sources (Gray water, condensate, and wastewater effluent reuse systems, extra treatment or distribution costs associated with water reuse).	$0
☐	Retrofit or replacement of existing landscape irrigation systems to more efficient landscape irrigation systems.	$0
☐	Water meter replacement with traditional water meters.*	$0
☐	Distribution pipe replacement or rehabilitation to reduce water loss and prevent water main breaks.*	$0
☐	Storage tank replacement/rehabilitation to reduce water loss.*	$0
☐	New water efficient landscape irrigation system, where there currently is not one.*	$0
	Total Water Efficiency Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Water Efficiency components specified for this project.

Sustainable Infrastructure - Energy Efficiency:

Energy efficiency is the use of improved technologies and practices to reduce the energy consumption of water projects, use energy in a more efficient way, and/or produce/utilize renewable energy. Examples include:

	Component	Cost
☐	Renewable energy projects, which are part of a public health project, such as wind, solar, geothermal, and micro-hydroelectric that provides power to a utility.	$0
☐	Utility-owned or publicly-owned renewable energy projects.	$0
☐	Utility energy management planning, including energy assessments, energy audits, optimization studies, and sub-metering of individual processes to determine high energy use areas.	$0
☐	Energy efficient retrofits, upgrades, or new pumping systems and treatment processes (including variable frequency drives (VFDs).*	$0
☐	Pump refurbishment to optimize pump efficiency.*	$0
☐	Projects that result from an energy efficient related assessment.*	$0
☐	Projects that cost effectively eliminate pumps or pumping stations.*	$0
☐	Projects that achieve the remaining increments of energy efficiency in a system that is already very efficient.*	$0
☐	Upgrade of lighting to energy efficient sources.*	$0
☐	Automated and remote control systems (SCADA) that achieve substantial energy savings.*	$0
	Total Energy Efficiency Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Energy Efficiency components specified for this project.

Sustainable Infrastructure - Environmentally Innovative:

Environmentally innovative projects include those that demonstrate new and/or innovative approaches to delivering services or managing water resources in a more sustainable way. Examples include:

	Component	Cost
☐	Total integrated water resources management planning, or other planning framework where project life cycle costs are minimized, which enables communities to adopt more efficient and cost-effective infrastructure solutions.	$0
☐	Plans to improve water quantity and quality associated with water system technical, financial, and managerial capacity.	$0
☐	Source water protection planning (delineation, monitoring, modeling).	$0
☐	Planning activities to prepare for adaptation to the long-term effects of climate change and/or extreme weather.	$0
☐	Utility sustainability plan consistent with EPA's sustainability policy.	$0
☐	Greenhouse gas inventory or mitigation plan and submission of a GHG inventory to a registry as long as it is being done for an SRF eligible facility.	$0
☐	Construction of US Building Council LEED certified buildings, or renovation of an existing building.	$0
☐	Projects that significantly reduce or eliminate the use of chemicals in water treatment.*	$0
☐	Treatment technologies or approaches that significantly reduce the volume of residuals, minimize the generation of residuals, or lower the amount of chemicals in the residuals.*	$0
☐	Trenchless or low impact construction technology.*	$0
☐	Using recycled materials or re-using materials on-site.*	$0
☐	Educational activities and demonstration projects for water or energy efficiency (such as rain gardens).*	$0
☐	Projects that achieve the goals/objectives of utility asset management plans.*	$0
	Total Environmentally Innovative Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Environmentally Innovative components specified for this project.

Sustainable Infrastructure - Asset Management:

If a category is selected, the applicant must provide proof to substantiate claims. The documents must be submitted to Anshu Singh (Anshu.Singh@ky.gov) for CW projects

Component

Last Rate Adjustment Date: **10-13-2019** **Download Fee Schedule**

Rate Adjustment Age: **15 months**

System's monthly water bill, based on 4,000 gallons, as a percentage of MHI: **1.57%**

☐ The system(s) has an Asset Management Plan (AMP).

☐ The system(s) involved in this project have specifically allocated funds for the rehabilitation and replacement of aging and deteriorating infrastructure.

Project Notes:

Date	Notes
11/21/2016	Dedman Road - pump station to serve existing waterline and potential customers at the top of the hill, $135,000 Day Branch - approximately 3,400 LF of 3" PVC waterline, $27,200 Griffy Branch - approximately 7,395 LF of 4" PVC waterline (tie-in two dead end waterlines), $59,160 Haney Branch - approximately 5,950 LF of 3" PVC waterline, $47,600 Henry Ross Road - approximately 1,000 LF of 3" PVC waterline, $6,000 Hog Branch - approximately 2,000 LF of 3" PVC waterline, $16,000 KY 772 - approximately 3,495 LF of 4" PVC waterline (tie-in two dead end waterlines), $27,960 KY 844 - approximately 5,575 LF of 4" PVC waterline (tie-in two dead end waterlines), $44,600 Liberty Road - approximately 14,910 LF of 8" PVC waterline, $238,560 & $25,000 (meter pit) Golf Course Road - approximately 2,000 LF of 3" PVC waterline, $12,000 Lowe Hollow - approximately 1,000 LF 2" PVC waterline, $8,000 Oney Road - approximately 3,700 LF of 3" PVC waterline, $22,200 Rube Woods - approximately 18,700 LF of 4" PVC waterline, $149,600 Splitwood Branch - approximately 4,600 LF of 2" PVC waterline, $27,600 US 460 East - approximately 9,250 LF of 6" PVC waterline (tie-in two dead end waterlines), $111,000 Sam Litteral Road - approximately 1,000 LF of 2" PVC waterline, $6,000 Poor Boys Road - approximately 1,250 LF of 2" PVC waterline, $7,500

Project Status: Approved   Date Approved: 12-08-2016   Date Revised:

Drinking Water Project Profile

Legal Applicant:	**Morgan County Water District**		
Project Title:	**MCWD New Water Storage Tank Project**		
Project Number:	**WX21175042** View Map	Submitted By:	**GWADD**
Funding Status:	**Unknown**	Primary County:	**Morgan**
Project Status:	**Pending**	Planning Unit:	**Morgan**
Project Schedule:	**3-5 Years**	Multi-County:	**No**
E-Clearinghouse SAI:		ECH Status:	
Applicant Entity Type:	**Water District (KRS 74)**	ADD WMC Contact:	**Benjamin Hamm**
Date Approved (AWMPC):			

Project Description:

The proposed project will construct a new water storage tank for Morgan County Water District.

1) What is the tank capacity? Ex. 100,000 Gallon
2) What type of tank? Elevated Storage, Stand Pipe Tank, Ground Storage Tank, Glass Lined Tank
3) Where is the tank going to be located?
4) Who is the tank going to serve/what area will the tank serve?
5) How many customers will be served?
6) What other infrastructure is needed? Ex. waterline, pump station, etc.

Need for Project
1) Why is the tank needed? What is the purpose?

Additional clarification:
1) How will this project impact Disinfection By-Products (DBPs)?
2) How will this tank fit in the existing system? EX. will it feed other tanks, will other tanks feed this tank, etc.

Need for Project:
Briefly describe how this project promotes public health or achieves and/or maintains compliance with the Clean Water Act or Safe Drinking Water Act:

Project Alternatives:

Alternate A:

Alternate B:

Legal Applicant:

Entity Type:	**Water District (KRS 74)**	PSC Group ID:	**25603**
Entity Name:	**Morgan County Water District**		
Web URL:			
Office EMail:	**morganwater@gmail.com**		
Office Phone:	**606-743-1204**	Toll Free:	Fax: **606-743-9585**
Mail Address Line 1:	**1009 Hwy 172**	Phys Address Line 1:	**1009 Hwy 172**
Mail Address Line 2:		Phys Address Line 2:	
Mail City, State Zip:	**West Liberty, KY 41472**	Phys City, State Zip:	**West Liberty, KY 41472**

Contact:	**Shannon Elam**	Financial Contact:		Auth Official:	**Linda Bradley**
Contact Title:	**Chairman of The Board**	Financial Contact Title:		Auth Official Title:	**Chairman of The Board**
Contact EMail:	**mcwdshannon@gmail.com**	Financial Contact EMail:		Auth Official EMail:	**shelam89@yahoo.com**
Contact Phone:	**606-743-1204**	Financial Contact Phone:		Auth Official Phone:	**606-743-1204**

Data Source: **Kentucky Infrastructure Authority** Date Last Modified: **07.01.2020**

Project Administrator (PA) Information

Name: **Ben Hamm**
Title: **Community Development Coordinator**
Organization: **Gateway Area Development District**
Address Line 1: **110 Lake Park Dr**
Address Line 2:
City: **Morehead** State: **KY** Zip: **40351**
Phone: **606-780-0090** Fax:

Drinking Water Project Profile

WX21175042 - Morgan County Water District
MCWD New Water Storage Tank Project

Estimated Budget

Project Cost Categories:

Cost Category	Cost
Administrative Expenses:	
Legal Expenses:	
Land, Appraisals, Easements:	
Relocation Expenses & Repayments:	
Planning:	
Engineering Fees - Design:	
Engineering Fees - Construction:	
Engineering Fees - Inspection:	
Engineering Fees - Other:	
Construction:	
Equipment:	
Miscellaneous:	
Contingencies:	
Total Project Cost:	$ 0

Construction Cost Categories:

Cost Category	Cost
Treatment:	
Transmission & Distribution:	
Source:	
Storage:	
Purchase of Systems:	
Restructuring:	
Land Acquisition:	
Non-Categorized:	
Total ConstructionCost:	$ 0

Total Sustainable Infrastructure Costs:	

Note: Total Sustainability Infrastructure Costs are included within construction and other costs reported in this section. This breakout is provided for SRF review purposes.

Project Funding Sources:

Total Project Cost: **$0**
Total Committed Funding: **$0**
Funding Gap: **$0 (Unknown)**

☐ This project will be requesting SRF funding for fiscal year 2022.

Estimated Project Schedule:

Est. Environmental Review Submittal Date:
Estimated Bid Date:
Estimated Construction Start Date:
Estimated Construction Completeion Date:

Funding Source	Loan or Grant ID	Fiscal Year	Amount	Status	Applicable Date

Funding Source Notes:

The following systems are beneficiaries of this project:

✓ **KY0880594 Morgan County Water District**

Note: Check mark indicates primary system for this project.

Project Ranking by AWMPC:

Regional Ranking(s): **GWADD 32**
Planning Unit Ranking: **5**
Total Points: **25**

- Plans and specs have been sent to DOW.
- Plans and specs have been reviewed by DOW.
- Plans and specs have been sent to PSC.
- Plans and specs have been reviewed by PSC.

Economic, Demographic and Geographic Impacts

Economic Impacts	
Jobs Created:	
Jobs Retained:	

***Demographic Impacts (GIS Census Overlay)**

Servceable Demographic	Project Area	Included Systems	Included Utilities
Population:		8,852	8,851
Households:		4,103	4,103
MHI:		$33,900	*$33,900
MHI MOE		$5,854	*$5,854
MOE as Pct:		17.0%	17.0%
**NSRL:		2	2

Drinking Water Project Profile

WX21175042 - Morgan County Water District
MCWD New Water Storage Tank Project

Population and household counts are based on 2010 census block values from the SF1 (100%) dataset.

MHI Source is from the American Community Survey 2014-2018 5Yr Estimates (Table B19013) *(for the primary system operated by the above listed beneficiary utilities).

MHI MOE = Med HH Income Margin of Error.

** NSRL (Non-Standard Rate Levels):
0 = Income above Kentucky MHI (KMHI).
1 = Income between 80% KMHI and KMHI.
2 = Income less than or equal to 80% KMHI.
- KMHI = $48,392
- 80% KHMI = $38,714

New Customers	
New Residential Customers:	
New Commercial Customers:	
New Institutional Customers:	
New Industrial Customers:	

New or Improved Service		
Service Demographic	Survey Based	Census Overlay*
To Unserved Households:		
To Underserved Households:		
To Total Households:		
** Cost Per Household:		

* GIS Census block overlay figures are estimates of population and households potentially served by systems and projects based on a proximity analysis of relevant service lines to census block boundaries.

** Cost per household is based on surveyed household counts, not GIS overlay values.

Geographic Impacts For Project Area

Counties

Legislative Districts	
District Name	Legislator

Groundwater Sensitivity Zones

HUC 10 Watersheds	
HUC Code	Watershed Name

Geographic Impacts For Included System(s)

Counties
Johnson
Magoffin
Menifee
Morgan
Wolfe

Legislative Districts	
District Name	Legislator
House 074	David Hale
House 092	John Blanton
House 097	Bobby McCool
Senate 21	Albert Robinson
Senate 25	Robert Stivers II
Senate 30	Brandon Smith
Senate 31	Phillip Wheeler
Congressional 5	Hal Rogers
Congressional 6	Andy Barr

DW Specific Impacts:

- ☐ This project relates to a public health emergency.
- ☐ This project will assist a non-compliant system to achieve compliance.
- ☐ This project will assist a compliant system to meet future requirements
- ☐ This project will provide assistance not compliance related.
- ☐ This project is necessary to achieve full or partial compliance with a court order, agreed order, or a judicial or administrative consent decree.
- ☐ Primary system has not received any SDWA Notices of Violation within the previous state fiscal year-July through June, i.e. July 2014 – June 2015).

Project Inventory (Mapped Features):

Administrative Components:

☑ Planning ☑ Design ☑ Construction ☐ Management

Regionalization Components:

Public Water Systems Eliminated:

☐ this project includes the elimination of public water system(s) through merger or acquisition.

Water Treatment Plants Eliminated:

☐ This project includes the elimination of water treatment plant(s) through interconnect(s).

Supplementation of Raw Water Supply:

☐ This project includes supplementing the existing raw water supply.

Supplementation of Potable Water Supply:

☐ This project includes supplementing the existing potable water supply.

Emergency Only Water Supply:

☐ This project provides emergency only water supply.

Water Source Protection:

☐ This project includes land acquisition for water source protection.

Water Treatment Components:

☐ This project includes water treatment components

Treatment Activities:

☐ This project includes a new water treatment plant.

☐ This project includes an expansion of an existing water treatment plant.

☐ This project includes rehabilitation of an existing water treatment plant.

☐ This project includes upgrades to an existing water treatment plant.

☐ This project includes emergency power generators for treatment activities.

☐ This project includes redundant treatment processes.

☐ This project includes replacement of raw water lines.

Treatment - Upgrades/Modifications:

☐ This project includes infrastructure options to meet Cryptosporidium removal/inactivation requirements.

☐ This project includes infrastructure options to meet CT inactivation requirements.

☐ This project includes treatment modifications to meet the Disinfectants/Disinfection Byproducts Rule at the water treatment plant.

☐ This project will provide treatment modifications for VOCs, IOCs, SOC, or Radionuclides.

☐ This project includes treatment modifications to address Secondary Contaminants.

Security:

☐ This project includes security components for water treatment facilities.

Water Distribution and Storage:

☐ This project includes water distribution and/or storage components.

Water Line Extensions:

☐ This project includes water line extension(s).

Redundancy Components:

☐ This project includes emergency power generators for distribution and/or storage activities.

☐ This project includes redundant distribution and/or storage processes.

Finished Water Quality:

☐ This project includes infrastructure to address inadequate water turnover and disinfection byproducts (DBPs).

☐ This project includes infrastructure to address inability to maintain disinfection residual.

Water Line Replacement:

- ☐ This project replaces problem water lines (breaks, leaks, or restrictive flows due to age, water lines consisting of lead and/or asbestos-cement (AC), and/or inadequately sized water lines.
- ☐ This project replaces lead service lines.

Water Loss in the Last 12 Months:

Water Loss Volume (MG)	111.215
Water Loss Percent (%)	42 %

Water Storage and Pressure Components:

- ☐ This project includes the construction of new water tank(s).
- ☐ This project includes the replacement of existing water tank(s).
- ☐ This project includes the rehabilitation of existing water tank(s).
- ☐ This project includes the construction of new pump station(s).
- ☐ This project includes the rehabilitation of existing pump station(s).

Security:

- ☐ This project includes security components for water distribution infrastructure.

Sustainable Infrastructure - Green Infrastructure:

Green stormwater infrastructure includes a wide array of practices at multiple scales that manage wet weather and that maintains and restores natural hydrology by infiltrating, evapotranspiring and harvesting and using stormwater. On a regional scale, green infrastructure is the preservation and restoration of natural landscape features, such as forests, floodplains, and wetlands, coupled with policies such as infill and redevelopment that reduce overall imperviousness in a watershed. On the local scale, green infrastructure consists of site and neighborhood-specific practices, such as:

Component	Cost
☐ Bioretention	$0
☐ Trees	$0
☐ Green Roofs	$0
☐ Permeable Pavement	$0
☐ Cisterns	$0
Total Green Infrastructure Cost:	**$0**

There are no Green Infrastructure components specified for this project.

Sustainable Infrastructure - Water Efficiency:

The use of improved technologies and practices to deliver equal or better services with less water. Water efficiency encompasses conservation and reuse efforts, as well as water loss reduction and prevention, to protect water resources for the future. Examples include:

	Component	Cost
☐	Installing or retrofitting water efficient devices such as plumbing fixtures and appliances (toilets, showerheads, urinals).	$0
☐	Installing any type of water meter in previously unmetered areas (can include backflow prevention if in conjunction with meter replacement).	$0
☐	Replacing existing broken/malfunctioning water meters with AMR or smart meters, meters with leak detection, backflow prevention.	$0
☐	Retrofitting/adding AMR capabilities or leak equipment to existing meters.	$0
☐	Conducting water utility audits, leak detection studies, and water use efficiency baseline studies, which are reasonably expected to result in a capital project or in a reduction in demand to alleviate the need for additional capital investment.	$0
☐	Developing conservation plans/programs reasonable expected to result in a water conserving capital project or in a reduction in demand to alleviate the need for capital investment.	$0
☐	Recycling and water reuse projects that replace potable sources with non-potable sources (Gray water, condensate, and wastewater effluent reuse systems, extra treatment or distribution costs associated with water reuse).	$0
☐	Retrofit or replacement of existing landscape irrigation systems to more efficient landscape irrigation systems.	$0
☐	Water meter replacement with traditional water meters.*	$0
☐	Distribution pipe replacement or rehabilitation to reduce water loss and prevent water main breaks.*	$0
☐	Storage tank replacement/rehabilitation to reduce water loss.*	$0
☐	New water efficient landscape irrigation system, where there currently is not one.*	$0
	Total Water Efficiency Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Water Efficiency components specified for this project.

Sustainable Infrastructure - Energy Efficiency:

Energy efficiency is the use of improved technologies and practices to reduce the energy consumption of water projects, use energy in a more efficient way, and/or produce/utilize renewable energy. Examples include:

	Component	Cost
☐	Renewable energy projects, which are part of a public health project, such as wind, solar, geothermal, and micro-hydroelectric that provides power to a utility.	$0
☐	Utility-owned or publicly-owned renewable energy projects.	$0
☐	Utility energy management planning, including energy assessments, energy audits, optimization studies, and sub-metering of individual processes to determine high energy use areas.	$0
☐	Energy efficient retrofits, upgrades, or new pumping systems and treatment processes (including variable frequency drives (VFDs).*	$0
☐	Pump refurbishment to optimize pump efficiency.*	$0
☐	Projects that result from an energy efficient related assessment.*	$0
☐	Projects that cost effectively eliminate pumps or pumping stations.*	$0
☐	Projects that achieve the remaining increments of energy efficiency in a system that is already very efficient.*	$0
☐	Upgrade of lighting to energy efficient sources.*	$0
☐	Automated and remote control systems (SCADA) that achieve substantial energy savings.*	$0
	Total Energy Efficiency Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Energy Efficiency components specified for this project.

Sustainable Infrastructure - Environmentally Innovative:

Environmentally innovative projects include those that demonstrate new and/or innovative approaches to delivering services or managing water resources in a more sustainable way. Examples include:

Component	Cost
☐ Total integrated water resources management planning, or other planning framework where project life cycle costs are minimized, which enables communities to adopt more efficient and cost-effective infrastructure solutions.	$0
☐ Plans to improve water quantity and quality associated with water system technical, financial, and managerial capacity.	$0
☐ Source water protection planning (delineation, monitoring, modeling).	$0
☐ Planning activities to prepare for adaptation to the long-term effects of climate change and/or extreme weather.	$0
☐ Utility sustainability plan consistent with EPA's sustainability policy.	$0
☐ Greenhouse gas inventory or mitigation plan and submission of a GHG inventory to a registry as long as it is being done for an SRF eligible facility.	$0
☐ Construction of US Building Council LEED certified buildings, or renovation of an existing building.	$0
☐ Projects that significantly reduce or eliminate the use of chemicals in water treatment.*	$0
☐ Treatment technologies or approaches that significantly reduce the volume of residuals, minimize the generation of residuals, or lower the amount of chemicals in the residuals.*	$0
☐ Trenchless or low impact construction technology.*	$0
☐ Using recycled materials or re-using materials on-site.*	$0
☐ Educational activities and demonstration projects for water or energy efficiency (such as rain gardens).*	$0
☐ Projects that achieve the goals/objectives of utility asset management plans.*	$0
Total Environmentally Innovative Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Environmentally Innovative components specified for this project.

Sustainable Infrastructure - Asset Management:

If a category is selected, the applicant must provide proof to substantiate claims. The documents must be submitted to Anshu Singh (Anshu.Singh@ky.gov) for CW projects

Component

Last Rate Adjustment Date: **10-13-2019** **Download Fee Schedule**

Rate Adjustment Age: **15 months**

System's monthly water bill, based on 4,000 gallons, as a percentage of MHI: **1.57%**

☐ The system(s) has an Asset Management Plan (AMP).

☐ The system(s) involved in this project have specifically allocated funds for the rehabilitation and replacement of aging and deteriorating infrastructure.

Project Status: Pending | Date Approved: | Date Revised:

Drinking Water Project Profile

Legal Applicant:	**Morgan County Water District**		
Project Title:	**MCWD Pump Station Relocation Project**		
Project Number:	**WX21175043** View Map	Submitted By:	**GWADD**
Funding Status:	**Unknown**	Primary County:	**Morgan**
Project Status:	**Pending**	Planning Unit:	**Morgan**
Project Schedule:	**3-5 Years**	Multi-County:	**No**
E-Clearinghouse SAI:		ECH Status:	
Applicant Entity Type:	**Water District (KRS 74)**	ADD WMC Contact:	**Benjamin Hamm**
Date Approved (AWMPC):			

Project Description:

The propose project will relocation the existing "name of pump station" to the Adele Hill area.
What is the existing pump station name?
What is the capacity of the existing pump station?
What is the capacity of the proposed pump station?
What is the service area of the proposed pump station?
What other infrastructure is needed?
What other systems will the proposed pump station effect?
Why is the relocation needed?
How will this improve service?

Need for Project:
Briefly describe how this project promotes public health or achieves and/or maintains compliance with the Clean Water Act or Safe Drinking Water Act:

Project Alternatives:

Alternate A:

Alternate B:

Legal Applicant:

Entity Type:	**Water District (KRS 74)**	PSC Group ID:	**25603**
Entity Name:	**Morgan County Water District**		
Web URL:			
Office EMail:	**morganwater@gmail.com**		
Office Phone:	**606-743-1204**	Toll Free:	Fax: **606-743-9585**

Mail Address Line 1:	**1009 Hwy 172**	Phys Address Line 1:	**1009 Hwy 172**
Mail Address Line 2:		Phys Address Line 2:	
Mail City, State Zip:	**West Liberty, KY 41472**	Phys City, State Zip:	**West Liberty, KY 41472**

Contact:	**Shannon Elam**	Financial Contact:		Auth Official:	**Linda Bradley**
Contact Title:	**Chairman of The Board**	Financial Contact Title:		Auth Official Title:	**Chairman of The Board**
Contact EMail:	**mcwdshannon@gmail.com**	Financial Contact EMail:		Auth Official EMail:	**shelam89@yahoo.com**
Contact Phone:	**606-743-1204**	Financial Contact Phone:		Auth Official Phone:	**606-743-1204**

Data Source: **Kentucky Infrastructure Authority** Date Last Modified: **07.01.2020**

Project Administrator (PA) Information

Name:	**Ben Hamm**
Title:	**Community Development Coordinator**
Organization:	**Gateway Area Development District**
Address Line 1:	**110 Lake Park Dr**
Address Line 2:	
City:	**Morehead** State: **KY** Zip: **40351**
Phone:	**606-780-0090** Fax:

Drinking Water Project Profile

WX21175043 - Morgan County Water District
MCWD Pump Station Relocation Project

Estimated Budget

Project Cost Categories:

Cost Category	Cost
Administrative Expenses:	
Legal Expenses:	
Land, Appraisals, Easements:	
Relocation Expenses & Repayments:	
Planning:	
Engineering Fees - Design:	
Engineering Fees - Construction:	
Engineering Fees - Inspection:	
Engineering Fees - Other:	
Construction:	
Equipment:	
Miscellaneous:	
Contingencies:	
Total Project Cost:	**$ 0**

Construction Cost Categories:

Cost Category	Cost
Treatment:	
Transmission & Distribution:	
Source:	
Storage:	
Purchase of Systems:	
Restructuring:	
Land Acquisition:	
Non-Categorized:	
Total ConstructionCost:	**$ 0**

Total Sustainable Infrastructure Costs:	

Note: Total Sustainability Infrastructure Costs are included within construction and other costs reported in this section. This breakout is provided for SRF review purposes.

Project Funding Sources:

Total Project Cost: **$0**
Total Committed Funding: **$0**
Funding Gap: **$0 (Unknown)**

☐ This project will be requesting SRF funding for fiscal year 2022.

Estimated Project Schedule:

Est. Environmental Review Submittal Date:
Estimated Bid Date:
Estimated Construction Start Date:
Estimated Construction Completeion Date:

Funding Source	Loan or Grant ID	Fiscal Year	Amount	Status	Applicable Date

Funding Source Notes:

The following systems are beneficiaries of this project:

✓ **KY0880594 Morgan County Water District**

Note: Check mark indicates primary system for this project.

Project Ranking by AWMPC:

Regional Ranking(s): **GWADD 20**
Planning Unit Ranking: **4**
Total Points: **70**

- Plans and specs have been sent to DOW.
- Plans and specs have been reviewed by DOW.
- Plans and specs have been sent to PSC.
- Plans and specs have been reviewed by PSC.

Economic, Demographic and Geographic Impacts

Economic Impacts	
Jobs Created:	
Jobs Retained:	

***Demographic Impacts (GIS Census Overlay)**

Serviceable Demographic	Project Area	Included Systems	Included Utilities
Population:		8,852	8,851
Households:		4,103	4,103
MHI:		$33,900	*$33,900
MHI MOE		$5,854	*$5,854
MOE as Pct:		17.0%	17.0%
**NSRL:		2	2

Drinking Water Project Profile

WX21175043 - Morgan County Water District
MCWD Pump Station Relocation Project

Population and household counts are based on 2010 census block values from the SF1 (100%) dataset.

MHI Source is from the American Community Survey 2014-2018 5Yr Estimates (Table B19013) *(for the primary system operated by the above listed beneficiary utilities).

MHI MOE = Med HH Income Margin of Error.

** NSRL (Non-Standard Rate Levels):
0 = Income above Kentucky MHI (KMHI).
1 = Income between 80% KMHI and KMHI.
2 = Income less than or equal to 80% KMHI.
- KMHI = $48,392
- 80% KHMI = $38,714

New Customers	
New Residential Customers:	
New Commercial Customers:	
New Institutional Customers:	
New Industrial Customers:	

New or Improved Service		
Service Demographic	Survey Based	Census Overlay*
To Unserved Households:		
To Underserved Households:		
To Total Households:		
** Cost Per Household:		

* GIS Census block overlay figures are estimates of population and households potentially served by systems and projects based on a proximity analysis of relevant service lines to census block boundaries.

** Cost per household is based on surveyed household counts, not GIS overlay values.

Geographic Impacts For Project Area

Counties

Legislative Districts	
District Name	Legislator

Groundwater Sensitivity Zones

HUC 10 Watersheds	
HUC Code	Watershed Name

Geographic Impacts For Included System(s)

Counties
Johnson
Magoffin
Menifee
Morgan
Wolfe

Legislative Districts	
District Name	Legislator
House 074	David Hale
House 092	John Blanton
House 097	Bobby McCool
Senate 21	Albert Robinson
Senate 25	Robert Stivers II
Senate 30	Brandon Smith
Senate 31	Phillip Wheeler
Congressional 5	Hal Rogers
Congressional 6	Andy Barr

DW Specific Impacts:

- ☐ This project relates to a public health emergency.
- ☐ This project will assist a non-compliant system to achieve compliance.
- ☐ This project will assist a compliant system to meet future requirements
- ☐ This project will provide assistance not compliance related.
- ☐ This project is necessary to achieve full or partial compliance with a court order, agreed order, or a judicial or administrative consent decree.
- ☐ Primary system has not received any SDWA Notices of Violation within the previous state fiscal year-July through June, i.e. July 2014 – June 2015).

Project Inventory (Mapped Features):

Administrative Components:

☐ Planning ☐ Design ☐ Construction ☐ Management

Regionalization Components:

Public Water Systems Eliminated:

☐ this project includes the elimination of public water system(s) through merger or acquisition.

Water Treatment Plants Eliminated:

☐ This project includes the elimination of water treatment plant(s) through interconnect(s).

Supplementation of Raw Water Supply:

☐ This project includes supplementing the existing raw water supply.

Supplementation of Potable Water Supply:

☐ This project includes supplementing the existing potable water supply.

Emergency Only Water Supply:

☐ This project provides emergency only water supply.

Water Source Protection:

☐ This project includes land acquisition for water source protection.

Water Treatment Components:

- ☐ This project includes water treatment components

Treatment Activities:

- ☐ This project includes a new water treatment plant.
- ☐ This project includes an expansion of an existing water treatment plant.
- ☐ This project includes rehabilitation of an existing water treatment plant.
- ☐ This project includes upgrades to an existing water treatment plant.
- ☐ This project includes emergency power generators for treatment activities.
- ☐ This project includes redundant treatment processes.
- ☐ This project includes replacement of raw water lines.

Treatment - Upgrades/Modifications:

- ☐ This project includes infrastructure options to meet Cryptosporidium removal/inactivation requirements.
- ☐ This project includes infrastructure options to meet CT inactivation requirements.
- ☐ This project includes treatment modifications to meet the Disinfectants/Disinfection Byproducts Rule at the water treatment plant.
- ☐ This project will provide treatment modifications for VOCs, IOCs, SOC, or Radionuclides.
- ☐ This project includes treatment modifications to address Secondary Contaminants.

Security:

- ☐ This project includes security components for water treatment facilities.

Water Distribution and Storage:

- ☐ This project includes water distribution and/or storage components.

Water Line Extensions:

- ☐ This project includes water line extension(s).

Redundancy Components:

- ☐ This project includes emergency power generators for distribution and/or storage activities.
- ☐ This project includes redundant distribution and/or storage processes.

Finished Water Quality:

- ☐ This project includes infrastructure to address inadequate water turnover and disinfection byproducts (DBPs).
- ☐ This project includes infrastructure to address inability to maintain disinfection residual.

Water Line Replacement:

- ☐ This project replaces problem water lines (breaks, leaks, or restrictive flows due to age, water lines consisting of lead and/or asbestos-cement (AC), and/or inadequately sized water lines.
- ☐ This project replaces lead service lines.

Water Loss in the Last 12 Months:

Water Loss Volume (MG)	111.215
Water Loss Percent (%)	42 %

Water Storage and Pressure Components:

- ☐ This project includes the construction of new water tank(s).
- ☐ This project includes the replacement of existing water tank(s).
- ☐ This project includes the rehabilitation of existing water tank(s).
- ☐ This project includes the construction of new pump station(s).
- ☐ This project includes the rehabilitation of existing pump station(s).

Security:

- ☐ This project includes security components for water distribution infrastructure.

Sustainable Infrastructure - Green Infrastructure:

Green stormwater infrastructure includes a wide array of practices at multiple scales that manage wet weather and that maintains and restores natural hydrology by infiltrating, evapotranspiring and harvesting and using stormwater. On a regional scale, green infrastructure is the preservation and restoration of natural landscape features, such as forests, floodplains, and wetlands, coupled with policies such as infill and redevelopment that reduce overall imperviousness in a watershed. On the local scale, green infrastructure consists of site and neighborhood-specific practices, such as:

Component	Cost
☐ Bioretention	$0
☐ Trees	$0
☐ Green Roofs	$0
☐ Permeable Pavement	$0
☐ Cisterns	$0
Total Green Infrastructure Cost:	**$0**

There are no Green Infrastructure components specified for this project.

Sustainable Infrastructure - Water Efficiency:

The use of improved technologies and practices to deliver equal or better services with less water. Water efficiency encompasses conservation and reuse efforts, as well as water loss reduction and prevention, to protect water resources for the future. Examples include:

	Component	Cost
☐	Installing or retrofitting water efficient devices such as plumbing fixtures and appliances (toilets, showerheads, urinals).	$0
☐	Installing any type of water meter in previously unmetered areas (can include backflow prevention if in conjunction with meter replacement).	$0
☐	Replacing existing broken/malfunctioning water meters with AMR or smart meters, meters with leak detection, backflow prevention.	$0
☐	Retrofitting/adding AMR capabilities or leak equipment to existing meters.	$0
☐	Conducting water utility audits, leak detection studies, and water use efficiency baseline studies, which are reasonably expected to result in a capital project or in a reduction in demand to alleviate the need for additional capital investment.	$0
☐	Developing conservation plans/programs reasonable expected to result in a water conserving capital project or in a reduction in demand to alleviate the need for capital investment.	$0
☐	Recycling and water reuse projects that replace potable sources with non-potable sources (Gray water, condensate, and wastewater effluent reuse systems, extra treatment or distribution costs associated with water reuse).	$0
☐	Retrofit or replacement of existing landscape irrigation systems to more efficient landscape irrigation systems.	$0
☐	Water meter replacement with traditional water meters.*	$0
☐	Distribution pipe replacement or rehabilitation to reduce water loss and prevent water main breaks.*	$0
☐	Storage tank replacement/rehabilitation to reduce water loss.*	$0
☐	New water efficient landscape irrigation system, where there currently is not one.*	$0
	Total Water Efficiency Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Water Efficiency components specified for this project.

Sustainable Infrastructure - Energy Efficiency:

Energy efficiency is the use of improved technologies and practices to reduce the energy consumption of water projects, use energy in a more efficient way, and/or produce/utilize renewable energy. Examples include:

	Component	Cost
☐	Renewable energy projects, which are part of a public health project, such as wind, solar, geothermal, and micro-hydroelectric that provides power to a utility.	$0
☐	Utility-owned or publicly-owned renewable energy projects.	$0
☐	Utility energy management planning, including energy assessments, energy audits, optimization studies, and sub-metering of individual processes to determine high energy use areas.	$0
☐	Energy efficient retrofits, upgrades, or new pumping systems and treatment processes (including variable frequency drives (VFDs).*	$0
☐	Pump refurbishment to optimize pump efficiency.*	$0
☐	Projects that result from an energy efficient related assessment.*	$0
☐	Projects that cost effectively eliminate pumps or pumping stations.*	$0
☐	Projects that achieve the remaining increments of energy efficiency in a system that is already very efficient.*	$0
☐	Upgrade of lighting to energy efficient sources.*	$0
☐	Automated and remote control systems (SCADA) that achieve substantial energy savings.*	$0
	Total Energy Efficiency Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Energy Efficiency components specified for this project.

Sustainable Infrastructure - Environmentally Innovative:

Environmentally innovative projects include those that demonstrate new and/or innovative approaches to delivering services or managing water resources in a more sustainable way. Examples include:

	Component	Cost
☐	Total integrated water resources management planning, or other planning framework where project life cycle costs are minimized, which enables communities to adopt more efficient and cost-effective infrastructure solutions.	$0
☐	Plans to improve water quantity and quality associated with water system technical, financial, and managerial capacity.	$0
☐	Source water protection planning (delineation, monitoring, modeling).	$0
☐	Planning activities to prepare for adaptation to the long-term effects of climate change and/or extreme weather.	$0
☐	Utility sustainability plan consistent with EPA's sustainability policy.	$0
☐	Greenhouse gas inventory or mitigation plan and submission of a GHG inventory to a registry as long as it is being done for an SRF eligible facility.	$0
☐	Construction of US Building Council LEED certified buildings, or renovation of an existing building.	$0
☐	Projects that significantly reduce or eliminate the use of chemicals in water treatment.*	$0
☐	Treatment technologies or approaches that significantly reduce the volume of residuals, minimize the generation of residuals, or lower the amount of chemicals in the residuals.*	$0
☐	Trenchless or low impact construction technology.*	$0
☐	Using recycled materials or re-using materials on-site.*	$0
☐	Educational activities and demonstration projects for water or energy efficiency (such as rain gardens).*	$0
☐	Projects that achieve the goals/objectives of utility asset management plans.*	$0
	Total Environmentally Innovative Cost:	**$0**

** Indicates a business case may be required for this item.*

There are no Environmentally Innovative components specified for this project.

Sustainable Infrastructure - Asset Management:

If a category is selected, the applicant must provide proof to substantiate claims. The documents must be submitted to Anshu Singh (Anshu.Singh@ky.gov) for CW projects

Component

Last Rate Adjustment Date: **10-13-2019** **Download Fee Schedule**

Rate Adjustment Age: **15 months**

System's monthly water bill, based on 4,000 gallons, as a percentage of MHI: **1.57%**

☐ The system(s) has an Asset Management Plan (AMP).

☐ The system(s) involved in this project have specifically allocated funds for the rehabilitation and replacement of aging and deteriorating infrastructure.

Project Status: Pending Date Approved: Date Revised:

Appendix F

3-1-2018

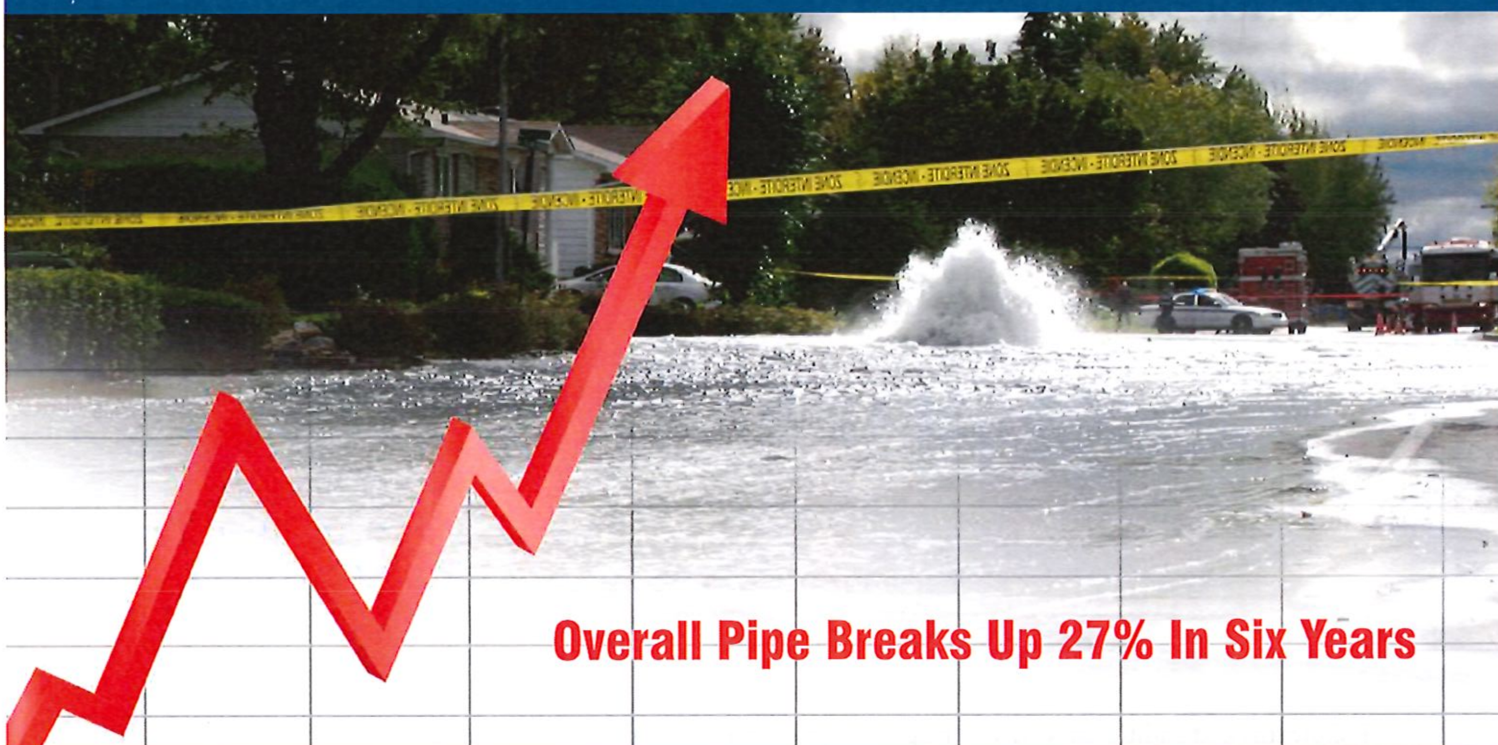
Water Main Break Rates In the USA and Canada: A Comprehensive Study

Steven Folkman
Utah State University

Water Main Break Rates In the USA and Canada: A Comprehensive Study

March 2018

An Asset Management Planning Tool for Water Utilities



Utah State University
Buried Structures Laboratory
Steven Folkman, Ph.D., P.E.

UtahStateUniversity

Executive Summary

The economic prosperity of modern cities is based on a complex infrastructure network located both above and below ground. A critical component to public health and economic well-being is our drinking water which is brought to the tap through an elaborate network of underground pipe distribution systems. Since most of this infrastructure is underground, it is out of sight and often neglected. Empirical data on water main breaks helps utilities in their repair and replacement decision making processes in order to deliver clean drinking water to their customers at an affordable price. This report documents the survey results of water main breaks and operating characteristics at utilities located in the US and Canada. A similar survey was conducted by Utah State University approximately six years ago and published in 2012 (Folkman, 2012). This 2018 report references this previous study to compare and examine changes over time and discuss the importance of water main break data in the context of water asset management planning.

Evidence of Decline

North America's water infrastructure is in decline. The signs of distress surface daily as water mains break creating floods and service disruptions. The loss of service is more than an inconvenience, causing significant social and economic disruptions. Economic impacts include loss of treated water, increased maintenance budgets, overtime hours for service personnel, traffic and business disruptions, and damage to private property. "Aging and deteriorated water mains are threats to the physical integrity of distribution systems, causing adverse effects on flow capacity, pressure, and water quality in drinking water services" (Grigg, et al., 2017). Disruptions due to water main failures are now a common occurrence. The overall assessment of our infrastructure is not good. In 2009, the American Society of Civil Engineers issued a USA Infrastructure Report Card and gave a D- to drinking water and wastewater infrastructure (ASCE, 2009). In a small sign of improvement, the 2017 ASCE Infrastructure Report Card (ASCE, 2017) grade was raised to a D. In the 1990s, a comprehensive American Water Works Association (AWWA) study also indicated that water main replacement was inadequate (Kirmeyer et al., 1994). The AWWA has formally tracked issues and trends in the US. The top concern in the AWWA surveys for both 2016 and 2017 is "renewal and replacement (R&R) of aging water and wastewater infrastructure" (AWWA, 2017).

The Measurement

The most important and critical factor used to quantify the condition and occurrences of failing underground pipe networks is **water main break rates**. Water main break rates are calculated for all pipe materials used in the transport of water to create a measurement to judge pipe performance and durability. Water main break rates for each utility can vary year to year and even seasonally. However, in aggregate, break rates produce a compelling story which can aid in asset management decision making as it relates to defining pipe criticality and costs of repairing and replacing our underground water pipes.

Purpose and Highlights

This comprehensive water main break rate study for the USA and Canada compiles the collective experience of 308 utilities which should be used for making future pipe replacement decisions. It is the desire of the researchers and participants to offer data and analysis that utility managers, engineers and elected officials can apply to the circumstances of their own operations to facilitate water infrastructure asset management planning and pipe replacement decision making. The objective is to reduce operating costs, service level impacts and health risks to their customers. Highlights of the water main break study include aggregate data on pipe material break rates, the analysis of age and corrosion in failure modes, related observations on pressure, delivery demands, effects of soil corrosivity, and new national metrics for pipe replacement rates and population served per mile of pipe.

The Primary Researcher

Dr. Steven Folkman is a registered Professional Engineer, a member of AWWA and a member of the Transportation Research Board Committee on Culverts and Hydraulic Structures, and has oversight of Utah State University's (USU) Buried Structures Laboratory. The Buried Structures Laboratory at USU has been involved in analysis and testing of all kinds of pipe and associated structures for over 50 years. Previous directors include Dr. Reynold Watkins and Dr. Al Moser who are internationally recognized experts. Dr. Moser and Dr. Folkman are coauthors of the widely used text, *Buried Pipe Design* (McGraw Hill, 3rd Edition). Dr. Folkman's expertise includes structural dynamics, linear and nonlinear finite element analysis utilizing soil/structure interaction, and testing. The USU Buried Structures Laboratory is recognized as one of two laboratories in the United States for performing large scale tests on buried pipes. It is from this expertise and background that the surveys of water main breaks were developed and analyzed to complete this comprehensive study.

Major Findings

The comprehensive nature of this study has provided a national water infrastructure condition assessment and review comparing pipe material performance. Additionally, several national-level metrics which utilities can use for asset management benchmarking purposes are included.

1. Nearly 200,000 Miles of Pipe Condition and Operation Surveyed

A total of 197,866 miles of pipe were reported by the 308 basic survey participants. Of those, 281 participants were able to provide water main break data covering 170,569 miles of pipe. This represents 12.9% of the total length of water mains in the USA and Canada. Equally significant, the utilities providing break data serve a total population of 52,477,346 people. This represents 14.5% of the total population of the US and Canada. The survey recorded 23,803 failures that needed repairs which is a significant basis for break data. It is one of the largest surveys conducted on water main failures and the results give an accurate representation of water main performance and operating conditions in North America. This report can be used to update "average estimated service life" assumptions for pipe materials when considering asset management pipe renewal and replacement decision-making.

2. Break Rates Have Increased 27% in the Past Six Years

Between 2012 and this 2018 report, overall water main break rates increased by 27% from 11.0 to 14.0 breaks/(100 miles)/year. Even more concerning is that break rates of cast iron and asbestos cement pipe, which make up 41% of the installed water mains in the US and Canada, have increased by more than 40% over a 6-year period.

3. 82% of Cast Iron Pipes are Over 50 Years Old and Experiencing a 46% Increase in Break Rates

Cast iron (CI) pipes represent the largest pipe material inventory in North America. 82% of all CI pipe is over 50 years old and their break rates have increased significantly by 46% since 2012 and are expected to continue to increase. 27% of asbestos cement (AC) pipe is also over 50 years in age and AC pipe breaks have increased by 43% in that same 6-year period. CI and AC pipe together are mostly responsible for the spike in overall break rates since 2012. Utilities with large amounts of cast iron and/or asbestos cement pipes may need to accelerate their replacement rates. CI and AC pipes are no longer manufactured and many are reaching the end of their expected lives.

4. Nationwide One Mile of Installed Water Main Serves 308 People

While the industry has assumed 325 people are served for 1 mile of distribution system pipe in urban areas, this survey finds a new national metric of 308 people served per mile of pipe regardless of utility size (or 191 people/km). The data indicates that an average utility has 607 miles of pipe and serves a population of 186,752 people.

5. 85% of Water Main Inventory is Less Than 12" in Diameter

67% of all water mains are 8" (200 mm) or less in diameter and the range of 10" to 12" (250 to 300 mm) sizes make up another 18% of all installed water mains.

6. Smaller Utilities Have Two Times More Main Breaks Than Large Utilities

The survey results show that smaller utilities can have break rates more than twice as high as larger ones. This may be attributable to the fact that larger utilities are better funded which results in improved data, engineering design, installation procedures, and asset management practices. A small or rural utility would typically have more pipe miles per customer. This can result in greater financial burdens in maintaining their water systems compared to larger or urban utilities.

7. Pipe Material Use Differs by Region

Water main pipe material usage varies significantly over geographic regions (see Figure 11). This suggests that the selection and use of pipe materials are based on historical preference versus comparative cost analysis or environmental conditions. The upper northwest and eastern half of the USA (Regions 1, 4, 6, 7, and 8 as illustrated in Figure 1) have either cast iron or ductile iron pipe for much of the installed pipe length. Regions 3, 5, and 9 have more PVC pipe than any other material. The most common pipe material in Region 2 is asbestos cement and it is unique in that respect.

8. A Large Data Set Provides Increased Accuracy

The water main break experiences of one utility may not represent another. Factors such as climate, pipe material, installation practices, and soil corrosivity can greatly affect failure rates. Design and installation practices are very important. Every utility should properly design and install pipe - regardless of material. Many previous studies have been based on a small subset of large utilities. This study provides an increase in accuracy due to the extensive participation of utilities.

9. Four Types of Pipe Materials Make Up 91% of Water Mains

91% of the installed water mains utilize a combination of cast iron (CI) at 28%, ductile iron (DI) at 28%, polyvinyl chloride (PVC) pipe at 22%, and asbestos cement (AC) at 13%. The remaining 9% of pipes used are represented by polyethylene (HDPE), steel, molecularly oriented PVC (PVCO), concrete steel cylinder (CSC), and other materials.

10. PVC Pipe Has the Lowest Overall Failure Rate

When failure rates of cast iron, ductile iron, PVC, concrete, steel, and asbestos cement pipes were compared, PVC had the lowest overall failure rate. This was also the case in the 2012 survey and is confirmed by other industry sources. A lower failure rate contributes to a lower total cost of ownership and helps confirm the performance and longevity of PVC pipes. PVC is not subject to corrosion, unlike ferrous and concrete steel cylinder pipes.

11. Corrosion is a Major Cause of Water Main Breaks

75% of all utilities surveyed reported one or more areas with corrosive soil conditions. Utilities with a higher percentage of iron pipe may experience a higher percentage of corrosion related breaks. This would especially apply to pipe installed without an increased investment in condition assessment, pipe monitoring and corrosion control measures. Corrosive soils and other environmental risks drive up the total cost of ownership. The most common failure mode reported in the detailed survey is a circumferential crack which is the most common failure mode of cast iron (CI) and asbestos cement (AC) pipes. Corrosion issues can be a contributor to many failure modes.

12. Cast Iron Pipe Has 20 Times More Breaks in Highly Corrosive Soils Than in Low Corrosive Soils

Analyses of soil corrosivity completed in this study shows that a cast iron (CI) pipe in highly corrosive soil is expected to have over 20 times the break rate of a CI pipe in low corrosive soil. Traditionally, the thickness of the iron pipe wall provided the additional corrosion protection. CI pipes manufactured after World War II have significantly higher failure rates due to thinner walls. The resulting higher main breaks with iron pipes due to corrosive soils is consistent with other research and studies.

13. Newer and Thinner-Wall Ductile Iron Pipe Has 10 Times More Breaks in Highly Corrosive Soils Than in Low Corrosive Soils

Ductile iron (DI) pipe in highly corrosive soil has over 10 times the break rate than a DI pipe in low corrosive soil. Cast iron (CI) and DI pipe corrode at about the same rate. Corrosion is an important failure mode for CI pipe and is the predominant failure mode for DI pipe. The many types of corrosion can also be combined with other environmental and operating conditions, all contributing to water main failures. Because the wall thickness of DI pipe has decreased over time, internal and external corrosion are a bigger concern for this pipe product.

14. 80% of Utilities Use Some Form of Corrosion Protection for Ductile Iron Pipe

80% of respondents to the detailed survey indicated they utilized some form of corrosion protection for ductile iron pipe with polywrap being the predominate method.

15. The Average Age of Failing Water Mains is Approximately 50 Years Old

When asked for the typical age of a failing water main, the detailed survey participants reported an average value of 50 years. 43% of water mains are between 20 and 50 years old and 28% of all mains are over 50 years old. In 2012 the average age of failing water mains was reported as 47 years. Based on the detailed survey, the average expected life of installed pipe today is 84 years, up from 79 years in the 2012 study. Given the qualitative nature of these questions, the typical age of a failing water main and expected pipe life have not changed significantly over the past 6 years. While pipe life can be estimated at over 100 years, actual life is affected by soil corrosivity, installation practices, and other factors.

16. 45% of Utilities Conduct Condition Assessment of Water Mains

45% of utilities use some form of regular condition assessment of their water mains. Condition assessment is considered a basic part or early step in the development of an asset management program.

17. Over 16% of Installed Water Mains are Beyond Their Useful Life

A total of 16% of installed water mains are beyond their useful lives (up from 8% reported in the 2012 study) and utilities do not have the funds to replace them. For utilities to survive this trend, and considering 28% of all mains are over 50 years old, improved asset management will be essential. These figures correspond well with an EPA study (EPA, 2002) that shows the amount of pipe needing immediate replacement is growing rapidly.

18. The National Rate of Pipe Replacement is 125 Years

According to the survey, an average of 0.8% of installed pipe is replaced each year. This equates to a 125-year replacement schedule. Pipe replacement rates should be between 1% and 1.6%, equivalent to 100-year and 60-year depreciation and/or replacement schedules, respectively. In general, pipe replacement rates need to increase. Asset management and life cycle costing practices can help a utility optimize its pipe renewal and replacement activities. The report finds that on average, utilities have a 125-year replacement rate on water main pipes as the new national average.

19. Construction Related Failures are the Same for Both Ductile Iron and PVC Pipes

The detailed survey asked utilities to report the number of failures related to construction activities and identify the pipe material that failed. The vast majority of construction related failures involved either ductile iron (DI) or PVC pipe and the number of failures for each material was essentially identical. Therefore, DI and PVC pipe have an equivalent rate of construction related failures. This points to the need to improve construction practices for underground infrastructure regarding installation, location services and inspection.

20. Acceptance of PVC Pipe for Use in Water Systems Has Increased by 23% Since 2012

PVC pipe approval has increased from 60% of water utilities allowing its use in 2012 to 74% of utilities allowing its use in 2018. The number of utilities approving of ductile iron, concrete steel cylinder, and steel pipes for use in water systems remains essentially the same.

21. Open Cut Remains the Primary Pipe Installation Method

Open cut pipe installation/replacement remains the primary method used. Where open cut is difficult, other installation methods are used. 62% of utilities have used directional drilling and it is highly recommended in locations where open cut replacement is difficult.

22. The Average Supply Pressure is 69 psi With the Average Maximum at 119 psi

Pressure is an important component in pipe design and material selection. A well-controlled system operated below design limits will lead to extended pipe life. The basic survey provided an average operating pressure of water mains as 69 psi, which is well below the pressure rating of most water mains. The reported maximum operating pressure in the basic survey had an average value of 119 psi.

23. The Average Daily Gallons Per Day Per Person is 137 With a Peak Demand Factor of 1.8

The average daily water demand for utilities which participated in the detailed survey was 137 gallons per day per person with a peak demand of 251 gallons per day per person. This suggests successful water conservation efforts and "value of water" campaigns nation-wide.

24. Estimated Average Water Loss to Leakage is 10%

A total of 200 utilities provided an estimate of their water loss due to leakage and the average reported value was 10%. This statistically significant number suggests that pressure reduction, leak detection and pipe replacement has contributed to the overall reduction of water loss in water distribution systems.

25. Most Utilities Have a Moderate to High Soil Corrosion Risk

Using soil analysis data, corrosion index values were computed for 281 of the cities that participated in the survey. The study found a direct correlation between soil corrosiveness and break rates of metallic pipes. A typical city has a corrosion risk rating somewhere between moderate and high, demonstrating the importance of corrosion mitigation for water systems.

1.0 Introduction

In the United States and Canada, population growth during three main time periods – 1800s, 1900–1945, and post 1945 – led to the installation of underground water infrastructure. Pipes constructed in each of these three eras could all start to fail at nearly the same time over the next couple of decades for a number of reasons ranging from age and corrosion to inadequate design and poor installation. Additionally, the life span of the materials used has become shorter with each new investment cycle (WIN, 2002).

There are approximately 155,693 public water systems in the United States with 52,110 community water systems providing year-round water services for residents. Over 286 million Americans get their tap water from a community water system (CDC, 2017). These community water systems across the US face the inevitable cost of pipe repair and replacement while dealing with decreasing water quality and increasing water loss. It is believed that at many utilities, pipe replacement levels are inadequate to keep up with the rate of deterioration. Maintaining an obsolete system can cause severe financial hardship for cities as well as increase public health risks. Infrastructure asset management is an approach which can help utilities bring together the concepts, tools, and techniques to manage assets at an acceptable service level at the lowest life-cycle cost. Life-cycle costing and assessment analysis can help utility management select pipe materials with a long-expected life that also contributes to a low cost over the expected life of the pipe, while also considering environmental impacts and risks (see Sustainable Solutions, 2017 or Khurana, 2017).

This study provides key inputs to water asset management's life-cycle cost analysis through a comparison of break-rates of commonly used pipe materials. Also, utility operating characteristics given in this report can provide the pipeline designers and system operators with reference values to plan for system replacement and expansion.

1.1. Aging Water Infrastructure

In 2007, the Conference of Mayors conducted a survey of over 300 cities representing over 55 million citizens and over 186,149 miles of water distribution mains (US Conference of Mayors, 2007). A high majority (86.2%) of cities use the number of water main breaks per unit length to evaluate drinking water pipe performance. The survey results concluded that water main breaks continue to be a major concern with 45% of cities experiencing more than 50 breaks annually. Cities also stated that repair and replacement cycles require a long-term view: 43% of city drinking water pipe system repair and replacement cycles extend beyond 50 years; and, 65% of city sewer pipe system repair and replacement cycles extend beyond 200 years. Water operation and maintenance managers recognize that older pipe systems may be constructed with multiple materials such as concrete, cast iron, wood, and some of these pipes may be over 125 years old. Asset inventory, condition assessment and asset management planning practices provide valuable information to enable utilities to more efficiently replace older pipes constructed with underperforming materials.

The EPA's Aging Water Infrastructure research program (EPA, 2010) is working toward the goal of making our nation's water infrastructure sustainable by supporting research and by promoting strategic asset management. The current efforts of the American Society of Civil Engineers Grand Challenge (ASCE, 2017) also helps engineers focus on improving the nation's infrastructure report card grade. ASCE's Grand Challenge aims to enhance the performance and value of water infrastructure by 2025 with a focus on innovation, life cycle costing and transformational change from design to delivery.

The water industry has seen many types of academic surveys and studies on water main replacement programs and the benefits of asset management, condition assessment and prioritization. However, many utilities have not historically tracked all of the elements of water main break data. Over the past 20 years, most utilities have come to realize the importance of tracking all aspects of their infrastructure in a GIS-centric platform and have collected records on the types, sizes, and repair histories of their pipes. As this trend continues, more data and analysis will be available to the industry to improve water distribution system repair and replacement decision making. This comprehensive report based on statistically significant experiences from 308 utilities also draws from other relevant studies to be the most complete and authoritative study on water main break data based on pipe material. Many water utilities consider pipe breaks to be a crucial factor when deciding which pipes to replace. According to a Water Research Foundation (WaterRF) study, 75% of water utilities cited pipe breaks as a key criterion in pipe replacement decisions. Other common factors noted were pipe age (45%), low flows (40%), condition or material type (30%), and need for pipe size changes (30%). In addition, pipe breaks in a water distribution system are one of three critical metrics that can be used to measure the degree of optimization in the system. The other two metrics are chlorine residual (measuring water quality integrity) and pressure management (measuring hydraulic integrity). Breaks reflect the physical condition of a distribution system (WaterRF, Asset Management, 2017).

According to another WaterRF publication, the average pipe break rate (regardless of cause) for water utilities is between 21 to 27 breaks per 100 miles of pipeline per year. An additional WaterRF study cited an average of 25 breaks per 100 miles per year. Although water utilities typically take action to manage and reduce pipe breaks through monitoring, preventing all pipe failures is impossible (WaterRF, Knowledge Portals, 2017).

2.0 The Survey

2.1. Methodology

During 2017, Utah State University conducted a survey of utilities across the USA and Canada to obtain data on water main failures of water supply systems. The study was comprised of two parts: a basic survey and a detailed survey. The focus of the basic survey was to examine the number of failures utilities were experiencing and how those failures related to the pipe materials used and the age of the failing pipes. This effort focused on water supply mains (sewer and force main pipes were excluded) and excluded pipes with diameters under 3 inches. A variety of pipe materials are used in water supply systems and over the past 100 years the materials have evolved with different manufacturing technologies. As a result, pipe performance has changed. A goal of both the basic and detailed surveys was to look at which materials were performing best at a snapshot in time and to track how pipe age affects failure rates. The focus of the detailed survey was to obtain additional utility operational characteristics, pipe age and size, multi-year failure data, and applications of trenchless technologies.

The primary method used to distribute the surveys was email. A subcontractor experienced at mass emailing was utilized along with multiple email lists. Initial emails were sent to personnel at water utilities during April through June of 2017. This report will refer to the survey results herein as the 2018 study to correspond with its date of publication. Participants were given links to both the basic and detailed surveys and requested to complete both, or at a minimum, complete the basic survey. Follow up phone calls were also used to encourage participation. The basic survey participants were asked for data from a previous 12-month time period and thus the results represent a time period that mostly coincides with the year 2016. A total of 308 utilities responded to the basic survey. Of those, 281 utilities were able to provide water main break data in the basic survey and 98 responded to the detailed survey. This comprehensive study covers 170,569 miles of pipe with water main break data. An additional 27 utilities responded with partial data but are not included in the 170,569 mile total to simplify this report. The USA and Canada were divided into nine regions and the 281 basic survey respondents were categorized according to the region and the size of the utility based on amount of pipe. This comprehensive study documents the results from both the basic and detailed surveys and draws from other relevant industry sources.

2.2. Objectives and Goals of the Study

There were many objectives of the surveys. These objectives include:

- Understanding the age and size distribution of pipe in water utilities
- Providing utilities with data they can use such as typical and maximum water pressure in water mains, average and maximum daily demands of water, and leakage rates
- Itemizing pipe failures over a time period with the data broken down by material type and age
- Identifying the most common pipe failure modes and materials as identified by the utility
- Determining whether corrosive soils are present, analyzing the influence of corrosive soils on break rates, and identifying corrosion prevention methods being used
- Highlighting pipe replacement plans, expected pipe life of new pipe and condition assessment methods
- Determining which pipe materials are allowed

FIGURE 1: REGIONS USED TO REPORT SURVEY RESULTS

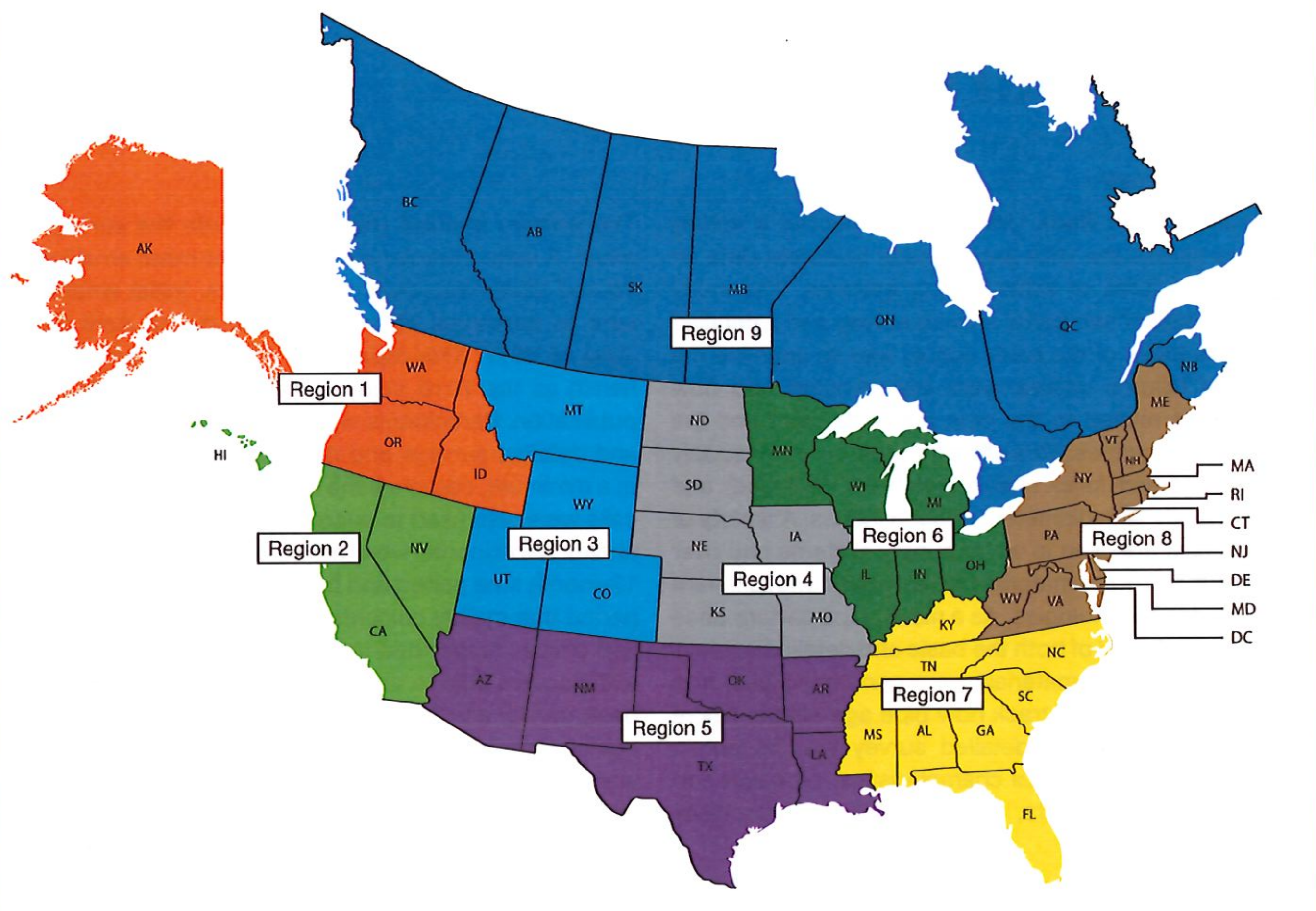


TABLE 1: NUMBER OF SURVEY RESPONDENTS WITH WATER MAIN BREAK DATA BY REGION

	Basic Survey			Detailed Survey		
Region	Number of Respondents	Miles of Pipe	Population Served	Number of Respondents	Miles of Pipe	Population Served
1	18	10,395	3,790,992	9	5,361	2,142,784
2	33	28,096	13,047,139	10	14,781	7,768,396
3	14	9,676	2,611,838	6	7,237	1,729,838
4	24	11,039	1,965,740	7	5,041	960,148
5	44	28,649	5,779,390	18	23,080	3,522,330
6	64	24,220	6,922,536	21	13,312	3,896,092
7	28	20,291	5,508,899	8	8,632	1,020,243
8	35	21,064	5,584,389	9	9,345	1,996,568
9	21	17,138	7,266,423	10	11,307	4,112,900
Total	281	170,569	52,477,346	98	98,097	27,149,299

FIGURE 2: LENGTH OF PIPE FROM EACH REGION THAT RESPONDED TO THE BASIC AND DETAILED SURVEYS

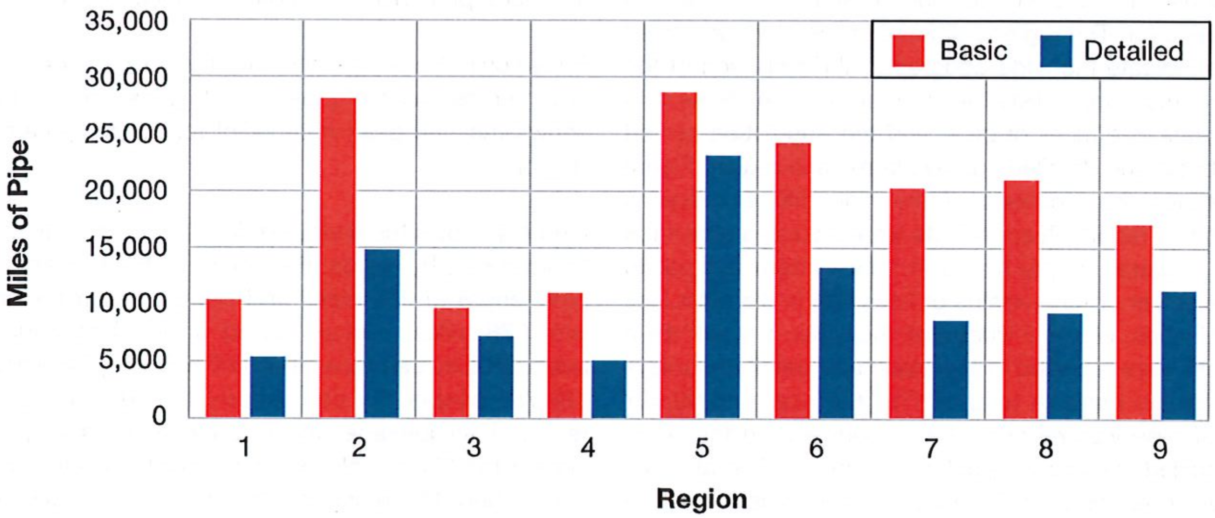
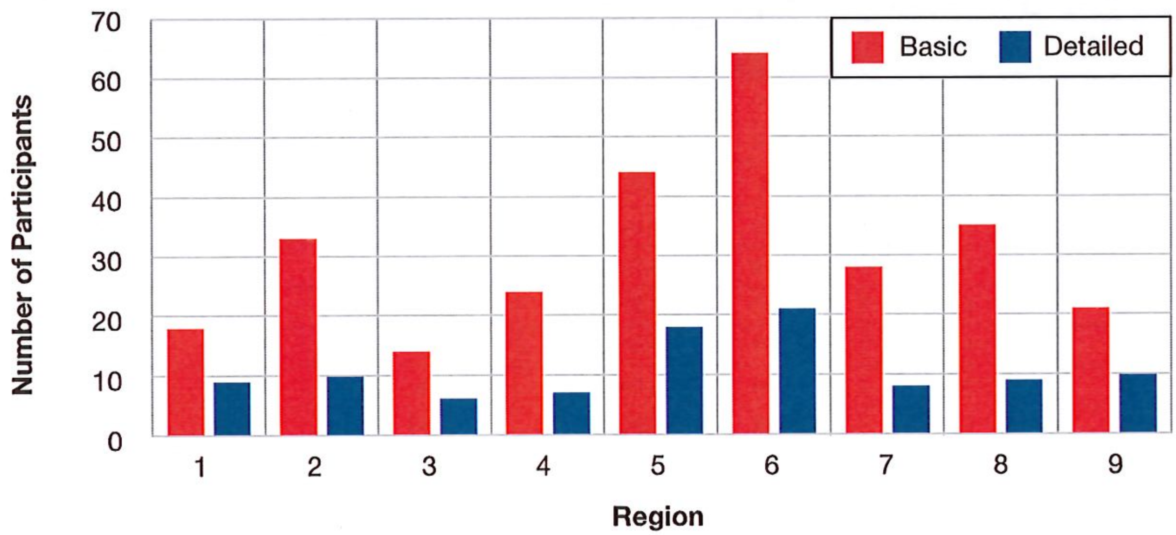


FIGURE 3: NUMBER OF RESPONDENTS FROM EACH REGION THAT RESPONDED TO THE BASIC AND DETAILED SURVEYS



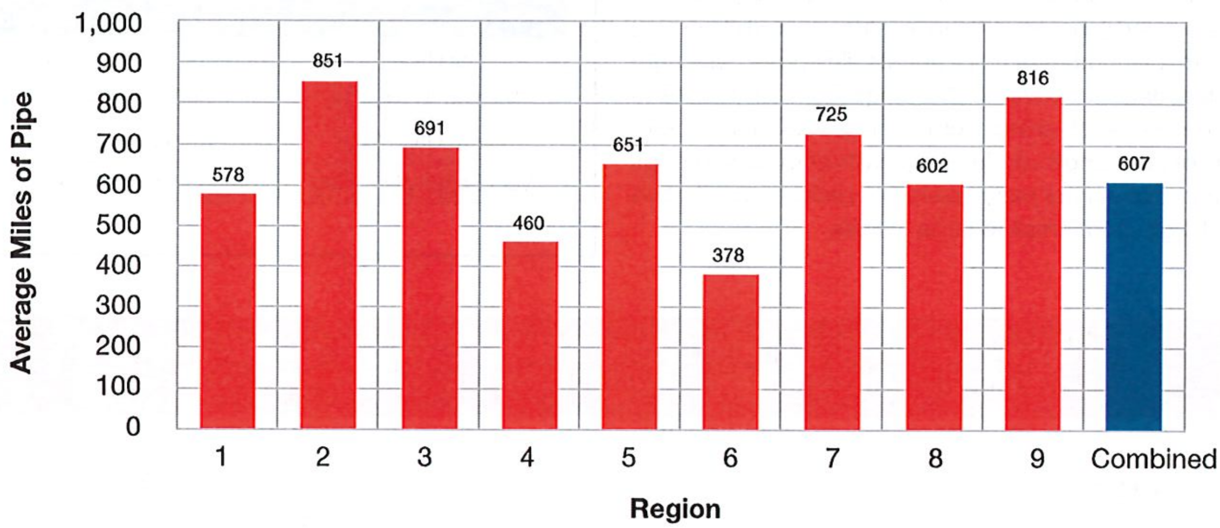
2.3. Survey Regions

In total, 281 utilities participated in the surveys and provided failure data. To examine regional variations, nine survey regions in the United States and Canada were selected. The regions defined in the study are used here to indicate the wide geographical distribution of the respondents. Table 1 lists the number of respondents with failure data, the miles of pipe, and the population served in the basic and detailed surveys from each region. Figure 1 illustrates the locations of the nine different regions used in this report. Respondents were asked to report the length of water supply mains in their system but not to include sewer or force mains or lines with a diameter less than 3 inches. Figure 2 illustrates the miles of water main pipe that were reported in the basic and detailed surveys on a regional basis. A total of 170,569 miles and 98,097 miles of pipe was reported by respondents in the basic and detailed surveys, respectively. Figure 3 illustrates the number of respondents from each region. There were 26 additional respondents to the basic survey that could not provide failure data and these are not included in the miles of pipe or populations served in Table 1. The respondents are distributed across a large survey area. The basic survey was able to get respondents from 48 of the 50 states in the US and 7 out of 10 provinces in Canada. This study is more comprehensive than other studies to date.

Based on miles of pipe shown in Figure 2, the basic survey got the most miles of pipe from Regions 2 and 5. Figure 3 shows that the peak number of respondents came from Region 6.

Figure 4 shows the average miles of pipe per utility for the basic survey by region. Region 2 had the highest average pipe length of 851 miles and Region 6 had the smallest with 378 miles. Overall, based on the basic survey, an average utility participant had 607 miles of pipe and served 186,752 people. For comparison, the 2012 survey results reported an average utility had 626 miles of pipe and served 164,325 people, which are similar results. The 2012 survey had 188 respondents covering 117,603 miles of pipe with failure data and thus the 2018 basic survey had a 49% increase in respondents and 45% more miles of pipe. This increase in survey coverage increases the statistical validity of this study.

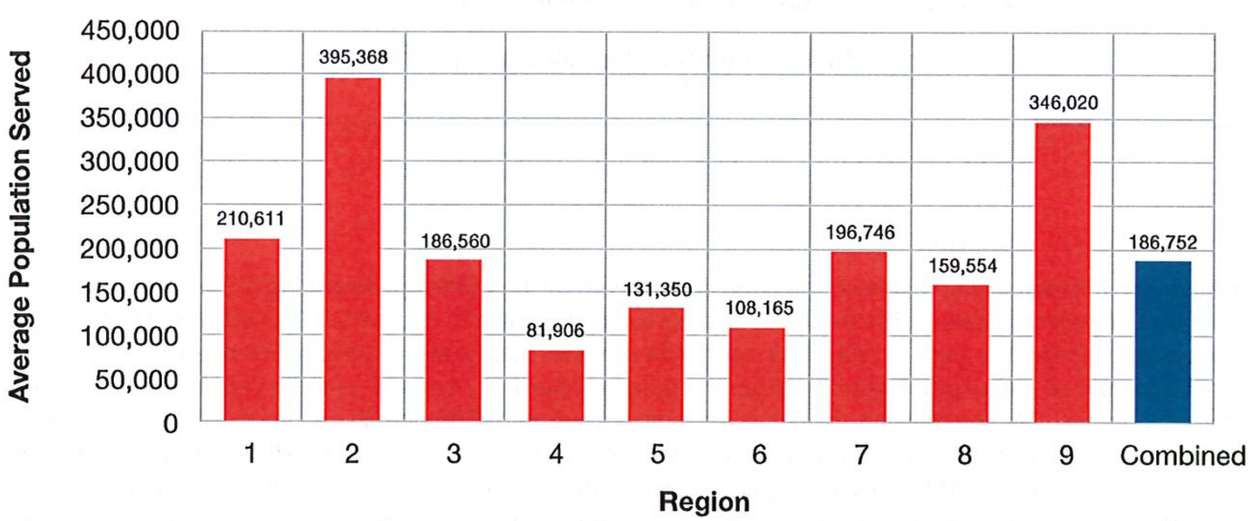
FIGURE 4: AVERAGE MILES OF PIPE FROM EACH REGION RESPONDING TO THE BASIC SURVEY



2.4. Size of Survey Participants

Figure 5 shows the average population served per utility for each region in Figure 1. The average population served per utility for the entire basic survey was 186,752.

FIGURE 5: AVERAGE POPULATION SERVED FROM EACH REGION RESPONDING TO THE BASIC SURVEY

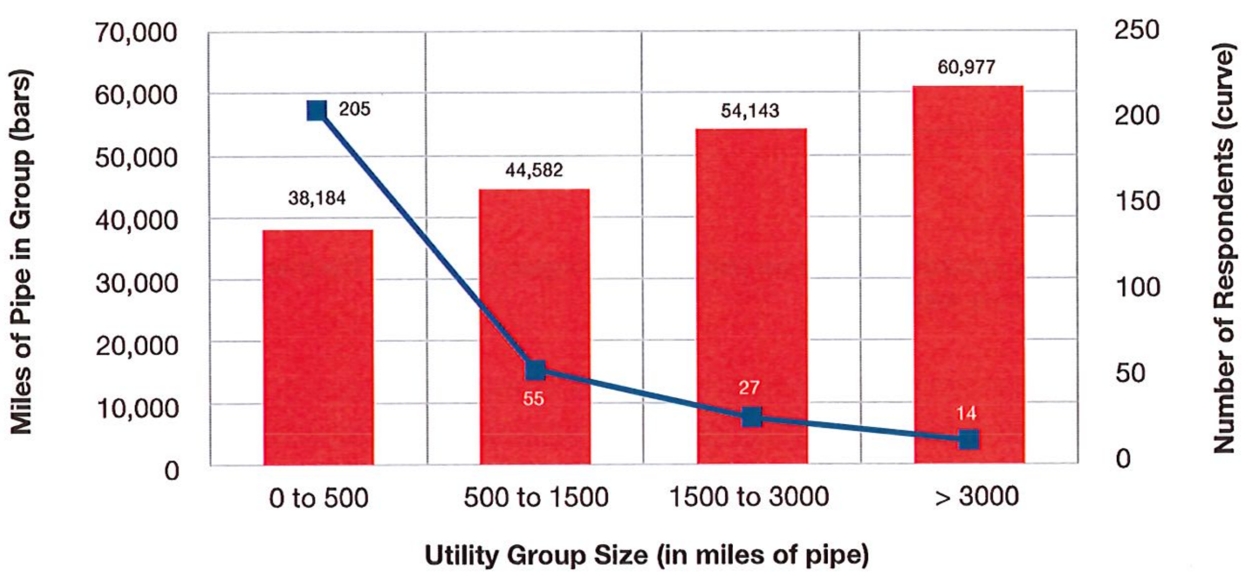


Four categories of utility size were used as shown in Table 2 and each survey participant was allocated to one of the categories based on the miles of installed water mains. Figure 6 shows the distribution of total miles of pipe from the basic survey based on these categories (bar graph) along with the number of respondents (line graph with right axis). Respondents covered the range from very small to very large with each group from Table 2 well represented. In terms of total length of pipe from each of the size groups in Table 2, this survey has reasonable uniform distribution of pipe length from small to large utilities.

TABLE 2: GROUPING OF UTILITY SIZE

Description	Miles of Pipe Installed
Small Utility/City	0 to 500 miles
Medium Utility/City	500 to 1500 miles
Large Utility/City	1500 to 3000 miles
Very Large Utility/City	Over 3000 miles

FIGURE 6: TOTAL MILES OF PIPE IN THE BASIC SURVEY IN EACH SIZE GROUP DEFINED IN TABLE 2 AND THE NUMBER OF RESPONDENTS (CURVE AND RIGHT AXIS)



2.5. Miles of Pipe vs. Population

Figure 7 illustrates the relationship between the population served by the utilities participating in the basic survey and the number of miles of water main pipe. The trend line and equation are a best fit to the data. The slope of this line indicates that there are on average 322 people served for each mile of water main installed. Figure 7 tends to be biased by the points most distant from the origin. Figure 8 utilizes the data in Table 1 to compute average population served per mile of pipe for each region. We see that this produces an overall average of 308 people served per mile. More rural areas such as Regions 3, 4, and 5 have lower population to miles of pipe ratios as expected. Utilities that were exclusively transmission systems were excluded. This compares with a commonly used estimate of 325 people per mile (Eidinger, 2001). The 2012 survey reported this value as 264 people served per mile. Pipe breaks in utilities with a higher count of people per mile would have a greater impact on the community.

FIGURE 7: POPULATION SERVED RELATIVE TO TOTAL MILES OF PIPE FROM THE BASIC SURVEY

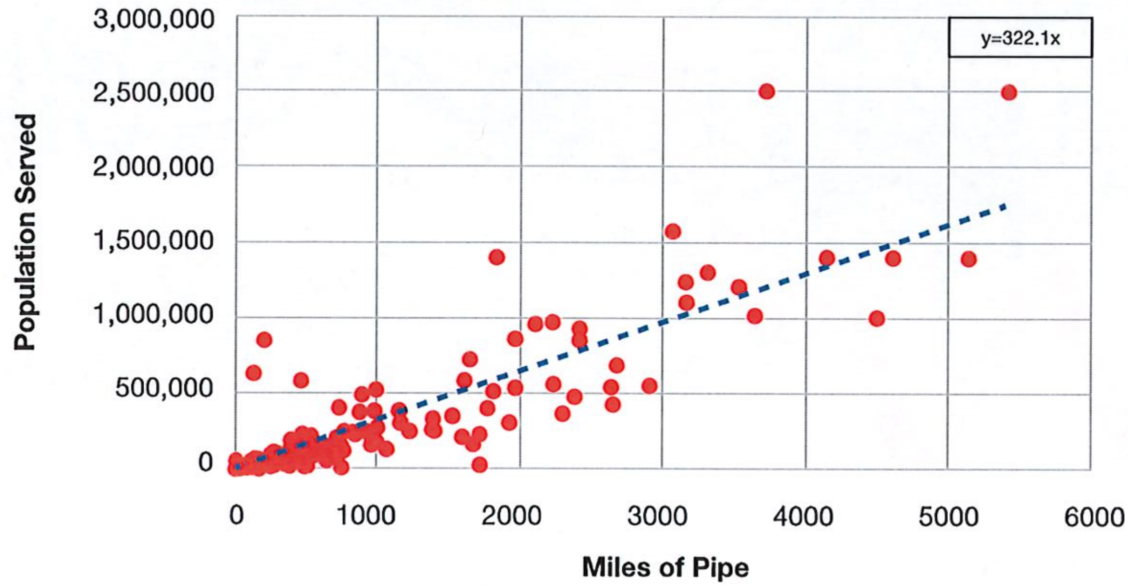
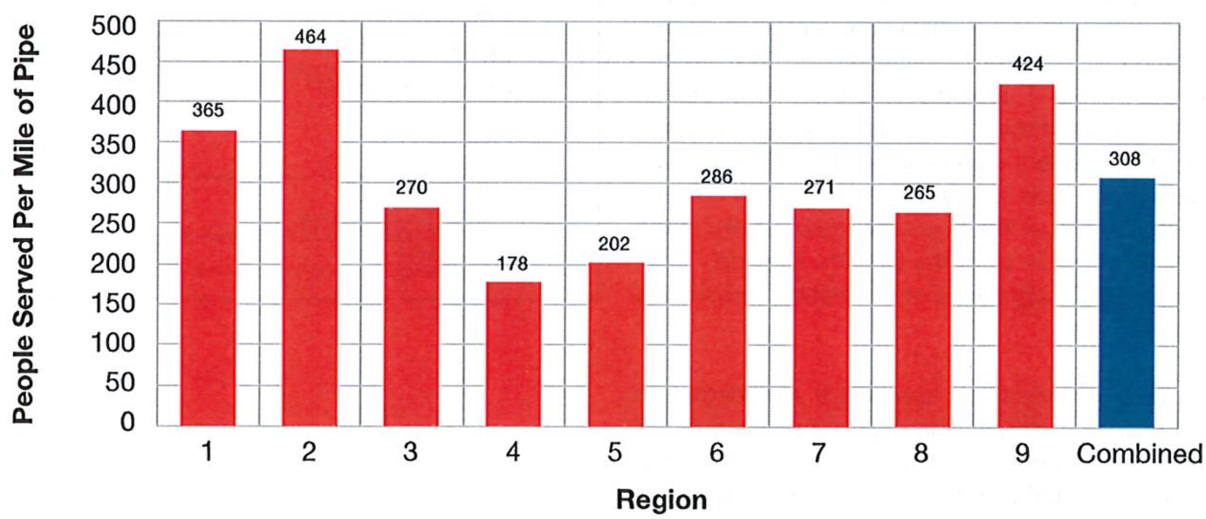


FIGURE 8: POPULATION SERVED PER MILE BY REGION



2.6. Survey Sample Size

The total length of water main pipe reported by the 281 basic survey participants with break data was 170,569 miles (the survey did not include sewer or force mains). Based on an EPA report, there are approximately 880,000 miles of distribution pipe in the USA (EPA, 2007). Other EPA reports (EPA, 2002 and EPA, 2013) estimate the amount of installed water main pipe in the USA at over 1 million miles and 1.5 million miles. Using the above result of 308 people/mile of water main and the current US population of 326.0 million, this produces an estimate of 1.06 million miles of pipe. Currently, a commonly cited value for the length of water mains in the US is 1.2 million miles (Walton, 2016). The population of Canada is estimated at 36.7 million. Assuming there are 308 people served per mile of pipe in Canada, then an estimate of the miles of pipe in Canada is 119,156 miles. Table 3 summarizes this data along with survey results from Table 1 to show that this survey covered approximately 14.5% of the population and 12.9% of the miles of water mains in both the US and Canada. Thus, survey sample size is significant and therefore can provide reliable results.

Small and rural communities may find it challenging to renew their water infrastructure in the coming years. Small utilities have fewer people, and those people are often more spread out, requiring more pipe "miles per customer" than urban systems (AWWA, 2012). This has the effect of increasing the financial burden of maintaining these systems.

TABLE 3: SUMMARY CALCULATIONS OF THE COVERAGE OF THE BASIC SURVEY

	Population	Miles of Pipe
US	326,000,000[1]	1,200,000[3]
Canada	36,700,000[2]	119,156[4]
Total	362,700,000	1,319,156
Survey Response (with break data)	52,477,346	170,569
Survey Coverage (%)	14.5%	12.9%

1- Source: https://www.census.gov/popclock/
2- Source: http://www.worldometers.info/world-population/canada-population/
3- Source: (Walton, 2016)
4- From: the population of Canada 36,700,000 and there are 308 people/mile of pipe.

3.0 Pipe Materials

Table 4 lists the pipe materials and their abbreviation used in this report. Many pipe products have evolved over the years of use, and most pipe products could be broken down into subcategories based on pipe manufacturing and surface treatments. These changes along with new installation techniques should affect life expectancy of the pipe. Both the basic and detailed surveys were intended to be relatively simple to complete and, thus, encourage wide scale participation of the water utilities. Most utilities have limited records as to which specific pipe materials were installed decades ago and what corrosion protection measures were used. Therefore, tracking subcategories of material types was not part of this study.

TABLE 4: MATERIAL TYPES AND THEIR ABBREVIATIONS

Abbreviation	Description
AC	Asbestos Cement
CI	Cast Iron
CSC	Concrete Steel Cylinder
DI	Ductile Iron
HDPE	High Density Polyethylene
PVC	Polyvinyl Chloride
PVCO	Molecularly Oriented PVC
Steel	Steel

Figure 9 illustrates the length of pipe reported in the basic survey broken down by pipe material. The "Other" category in Figure 9 includes materials such as copper, fiberglass (FRP), and some galvanized steel. It is noted that galvanized steel was reported in both the steel and other categories by participants, which was unfortunate. Figure 10 illustrates the percentage of total length of water mains separated by pipe material. There is so little HDPE pipe (859 miles) and PVCO pipe (83 miles) in this survey, that these two pipe materials will be added to the of the "Other" category in the remainder of this report. If there are only small amounts of a pipe material utilized, break rates can be highly inaccurate because of large scatter in the data. It is significant to consider that over 91% of the water mains are made from asbestos cement, cast iron, ductile iron, and PVC materials. This is consistent with earlier studies (Stone et al., 2002).

FIGURE 9: LENGTH OF PIPE SEPARATED BY MATERIAL TYPE FROM THE BASIC SURVEY

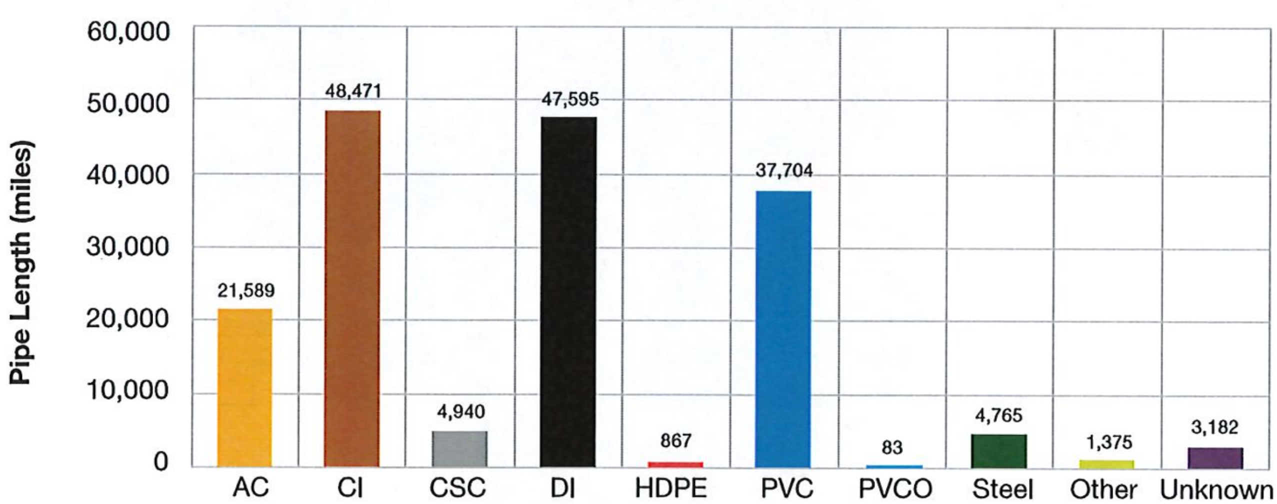


FIGURE 10: PERCENT OF TOTAL LENGTH OF PIPE SEPARATED BY MATERIAL TYPE

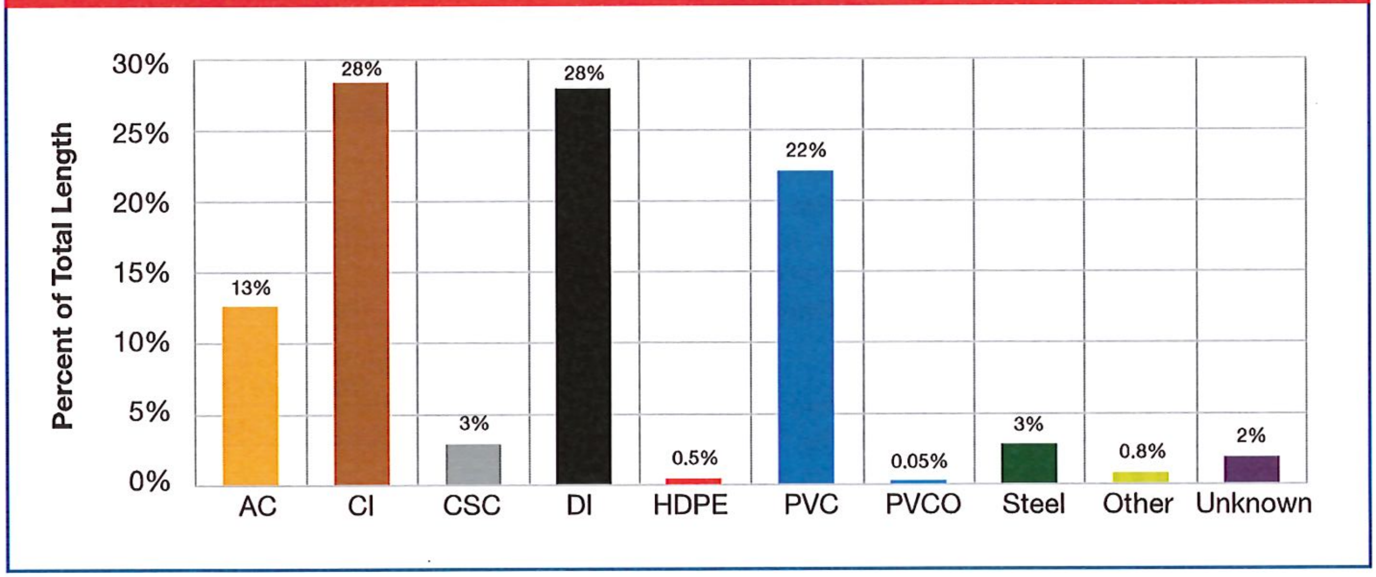


Figure 11 illustrates the regional distribution of pipe material usage as a percentage of the total length in that region. It is interesting to note the significant differences in regional pipe material utilization. Cast iron (CI) and ductile iron (DI) pipe represent approximately 86% of the water mains in Region 6 and over 75% in Regions 4, 7, and 8. PVC has a leading role in Regions 3, 5 and 9 and is slightly behind asbestos cement (AC) pipe in Region 2. AC pipe has a significant presence in Regions 2 and 5. Region 2 is unique in that it is the only region where AC pipe is the most common material. This suggests that the selection and use of pipe materials are based on historical preference versus comparative cost analysis or environmental conditions. Since CI and AC pipes are no longer manufactured in the US and Canada, the use of these materials in water systems should be decreasing with time as they are replaced. By applying asset management best practices, life cycle cost analysis should be used to do a comparative total cost of ownership evaluation of what pipe material should replace the CI and AC pipes.

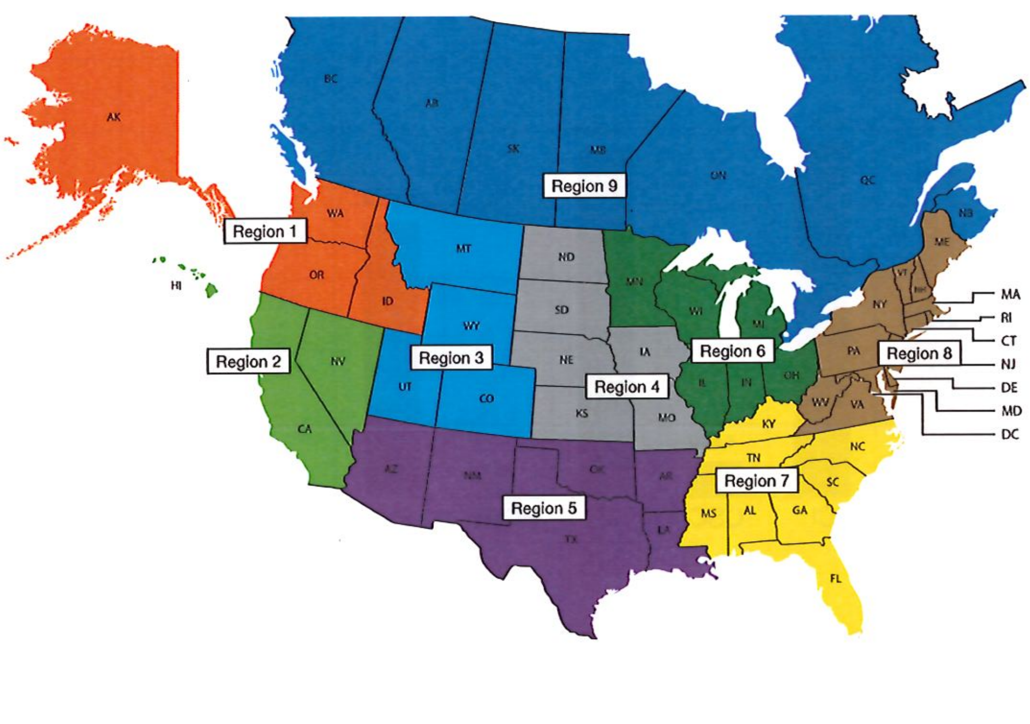
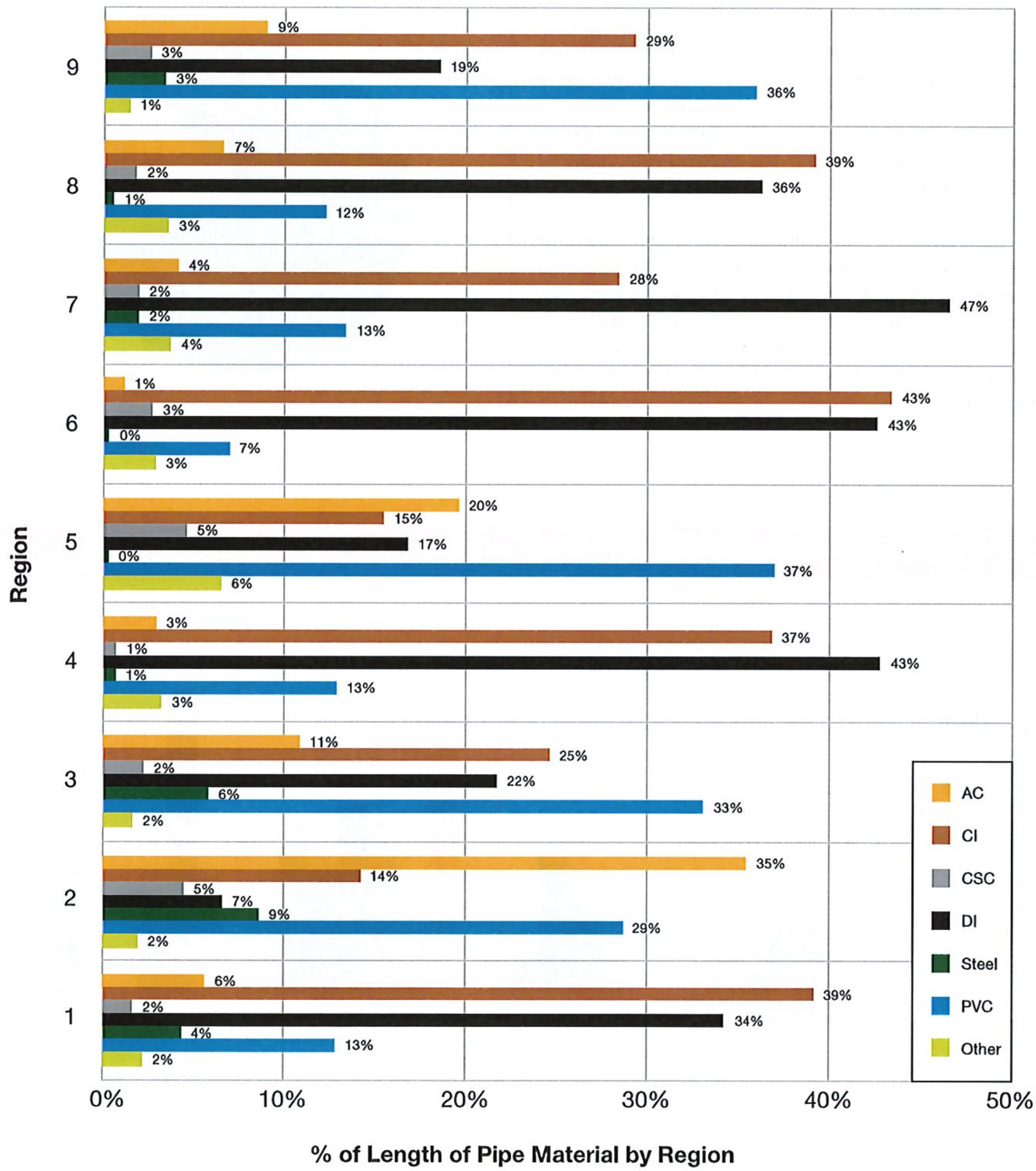


FIGURE 11: REGIONAL PERCENTAGE OF LENGTH OF PIPE BY MATERIAL TYPE (BASIC SURVEY)



3.1. Pipe Age and Diameter

The detailed survey asked respondents to provide the distribution of installed pipe by age and by material type. Four age groups were provided; 0 to 10 years, 10 to 20 years, 20 to 50 years, and over 50 years. Figure 12 shows the age distribution for all pipe materials combined and shows 28% of installed pipes are over 50 years old. Figure 13 illustrates the age distribution for each material type by length. For example, essentially all cast iron pipe is over 20 years old and 18% of it is in the 20 to 50 year category while 82% is over 50 years of age.

Figure 14 shows the age distribution as a percentage of total length of all pipe materials. For example, cast iron pipe older than 50 years is 20% of all installed pipe. For ages between 0 to 10 years, ductile iron (DI) and PVC both have about 5% of the total installed length. The most common pipe materials installed during the last 10 years are DI and PVC.

FIGURE 12: PIPE AGE DISTRIBUTION FOR ALL MATERIAL TYPES FROM THE DETAILED SURVEY

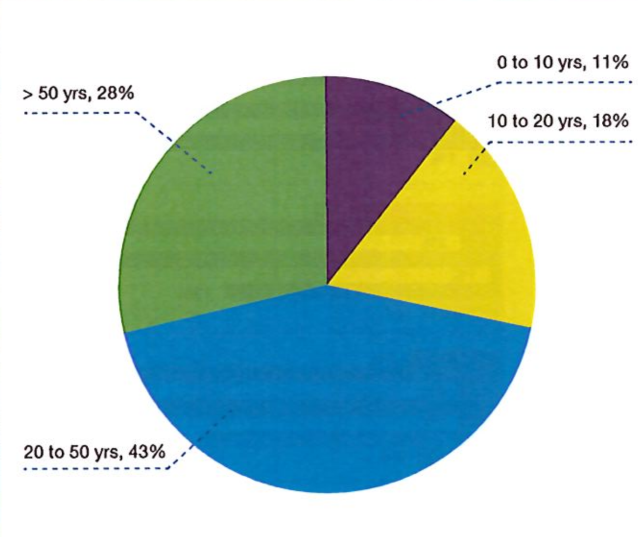


FIGURE 13: PIPE AGE DISTRIBUTION FOR EACH MATERIAL TYPE FROM THE DETAILED SURVEY

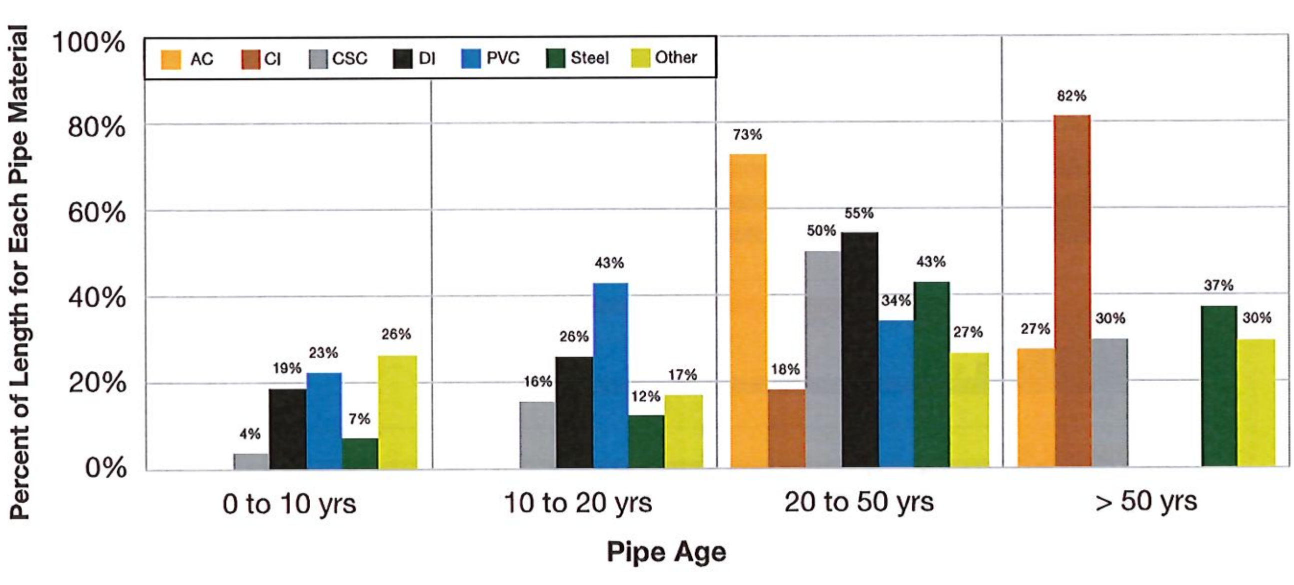
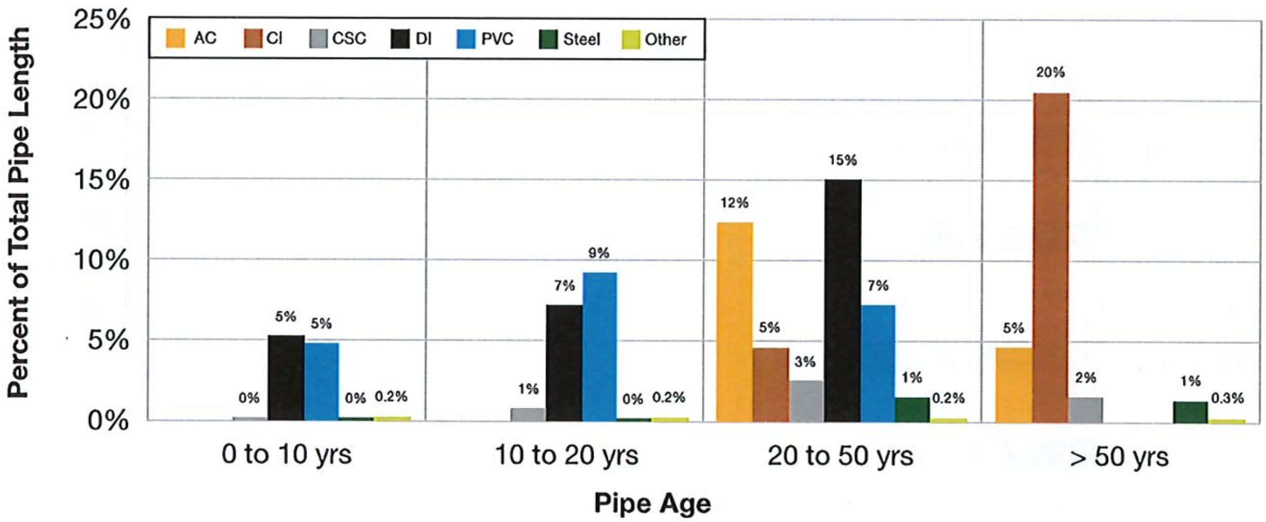


FIGURE 14: PERCENT OF TOTAL LENGTH OF PIPE BY AGE FROM THE DETAILED SURVEY



20 The detailed survey respondents were also asked to break down the fraction of total installed pipe length by six pipe diameter categories. Figure 15 illustrates the percentage of water main that fit into each size range. Figure 15 indicates that approximately 67% of the installed pipe is 8 inches or less in diameter. The 2012 survey found that 66% of the pipe was 8 inches or less in diameter showing good agreement. Earlier studies assumed 73% of water pipes were 10 inches or less in diameter (Stone et al., 2002). Figure 16 illustrates the diameter distribution for each material type. Figure 16 shows that large diameter transmission pipes are dominated by steel and concrete pipe materials with 18% of all concrete pipe and 14% of all steel pipe having a diameter greater than 48-inches. Figure 17 illustrates the percent of total length of all pipe materials broken down by material type and diameter. Figure 17 illustrates that cast iron pipe from 3 to 8 inches in diameter represents over 19% of the installed pipe.

FIGURE 15: PERCENT OF TOTAL LENGTH OF PIPE BY AGE FROM THE DETAILED SURVEY

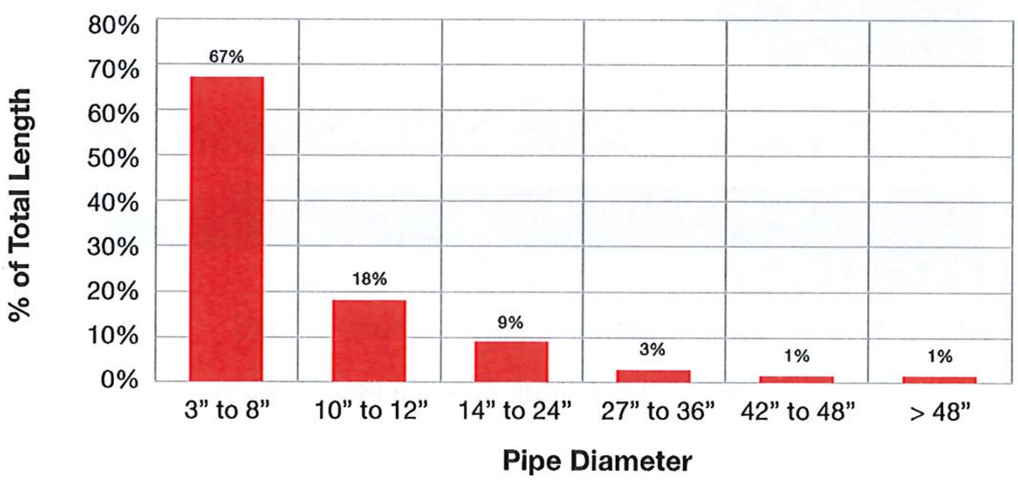


FIGURE 16: PIPE DIAMETER DISTRIBUTION BY MATERIAL TYPE FROM THE DETAILED SURVEY

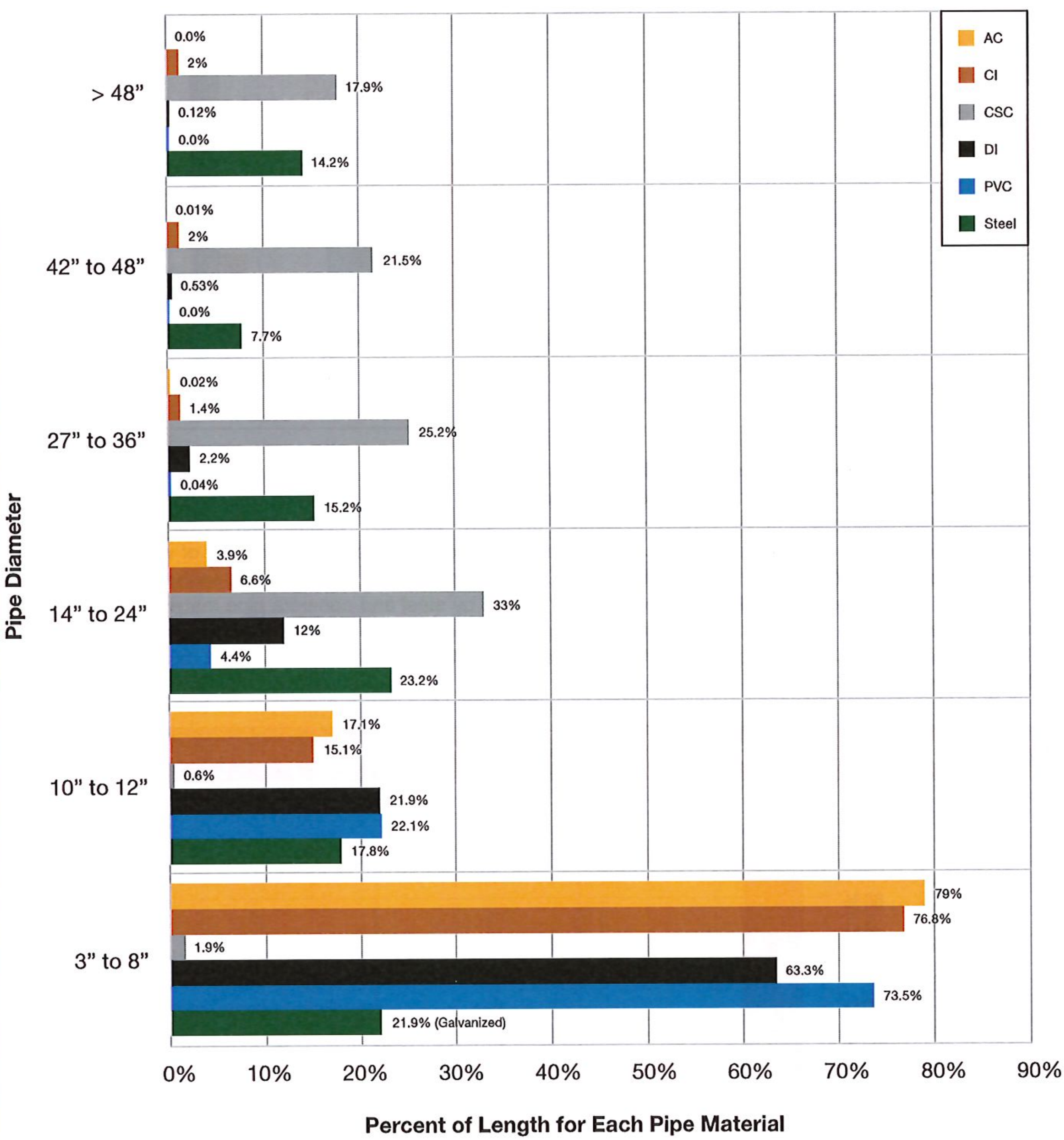
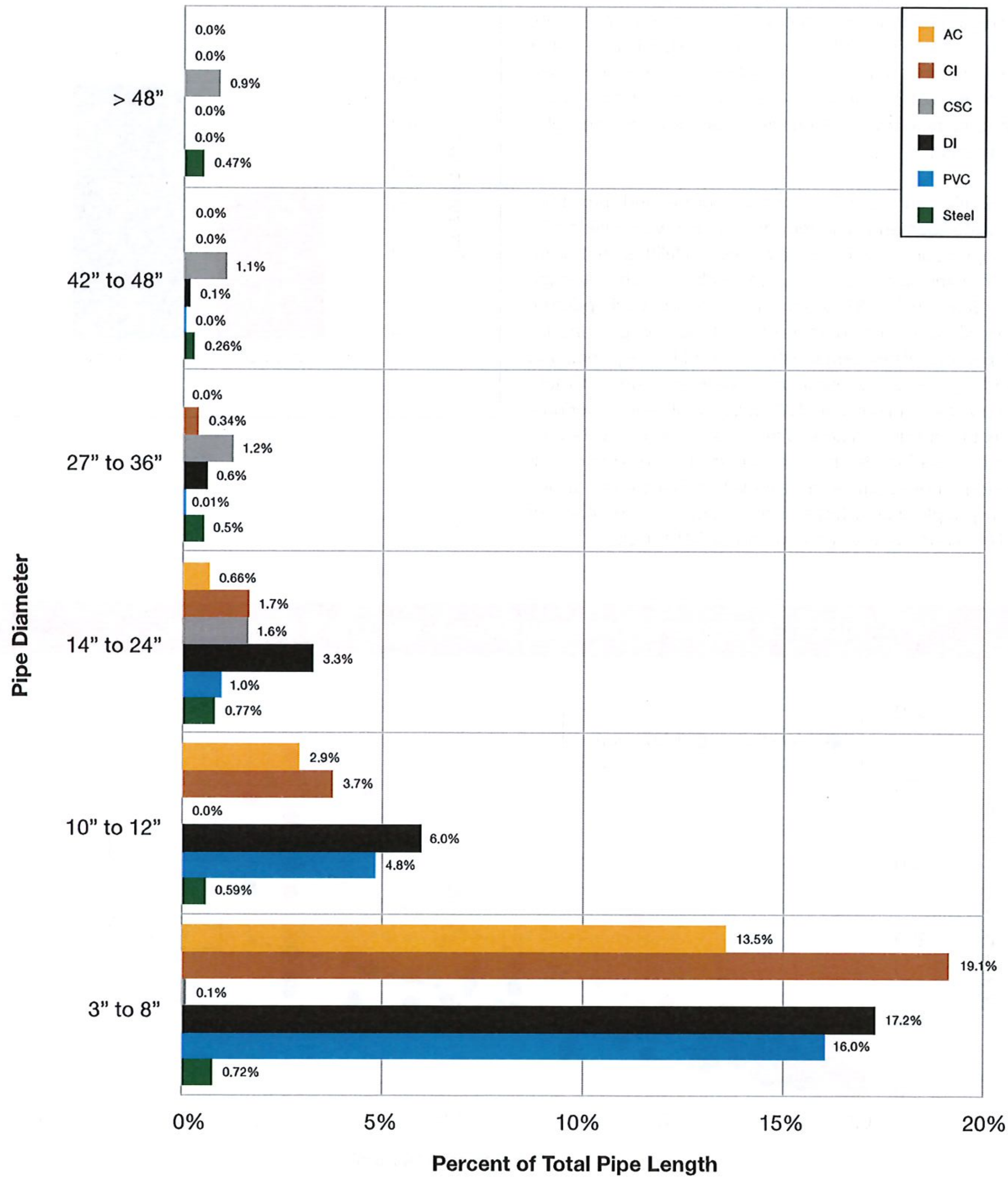


FIGURE 17: PERCENT OF TOTAL PIPE LENGTH BROKEN DOWN BY PIPE DIAMETER AND MATERIAL TYPE FROM THE DETAILED SURVEY



4.0 Delivery Pressure and Volume

The basic survey asked for the average and maximum water supply pressures. The mean values are 69 and 119 psi. The average of the reported values is illustrated in Figure 18. In the 2012 survey, the average pressure was 77 psi which has good agreement with this survey result but also indicates a possible downward trend. It is noted that some utilities have reduced operating pressures to reduce leakage rates. Pressure control and reduction is a common methodology to both reduce water leaks and reduce water main breaks.

The detailed survey asked for the average and maximum daily water demand. The reported values were divided by the population served and averaged. Utilities that were only transmission systems were excluded. The average water demand is 137 gallons per day for each person. The maximum water demand is 251 gallons per day for each person. Water demands are related to the population served. Figure 19 plots each utility's average and maximum demand values in units of MGD (millions of gallons per day) versus the population served in millions. Also provided are linear fit equations to the data (the dotted lines) and their equations. For example, a utility with a population of one million people would have a maximum water demand of 215 MGD and an average demand of 131 MGD.

FIGURE 18: AVERAGE AND MAXIMUM WATER SUPPLY PRESSURES

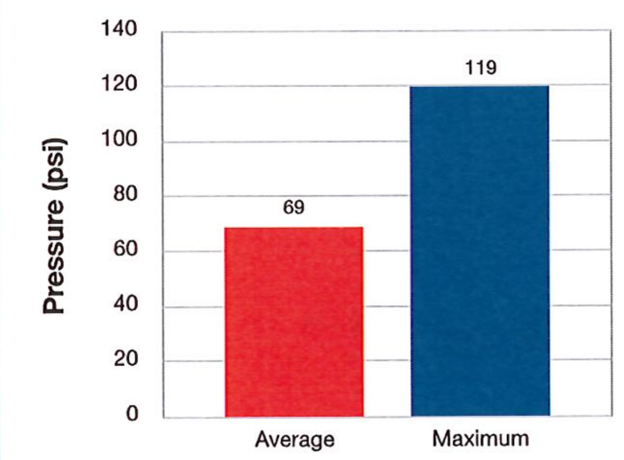
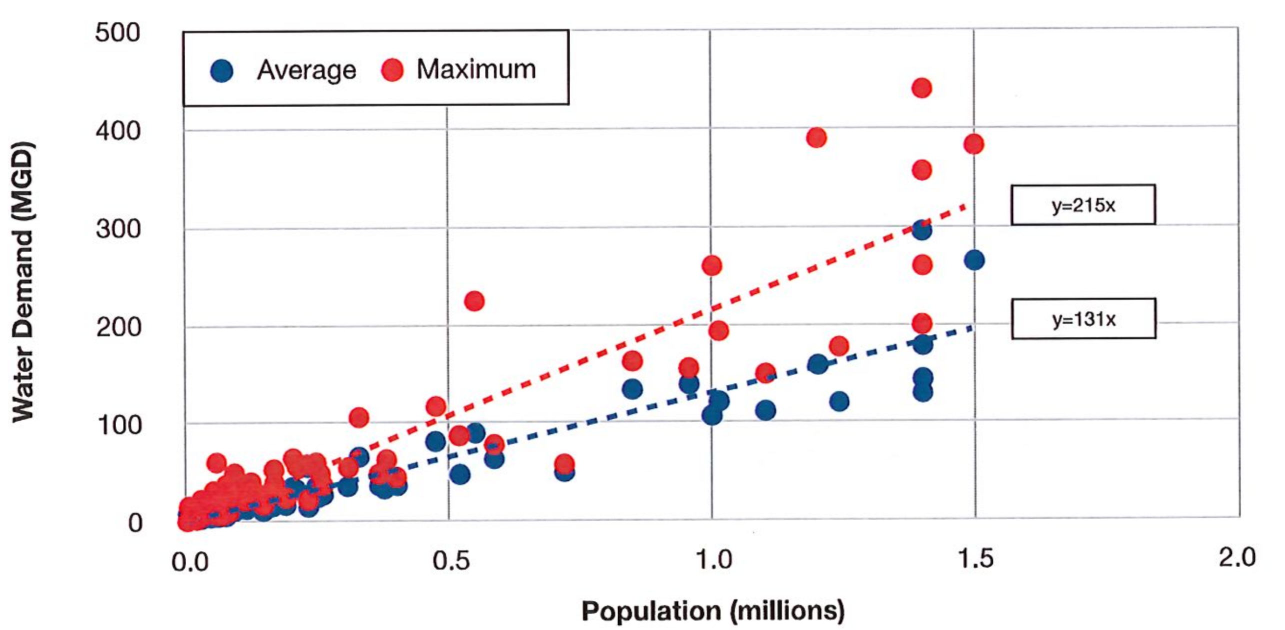


FIGURE 19: AVERAGE AND MAXIMUM WATER DEMAND VERSUS POPULATION



5.0 Computing Water Main Failure Rates

Both the basic and detailed surveys asked respondents to consider a water main failure as one where leakage was detected, and repairs were made. However, they were requested to not report failures due to joint leakage, construction damage, or tapping of service lines because these failures are not indicative of pipe degradation and are often identified early in the first year of operation. The goal was to examine pipe longevity.

Utilities reported the number of failures over a recent 12-month period for each pipe material and the installed length of each pipe material. The failure rate was computed by dividing the total number of failures from all utilities for a particular pipe material by the total length of that pipe material.

For example, the survey reported a total of 23,803 failures of water mains during a recent 12-month period for all pipe materials. The total installed water main length from the survey was 170,569 miles (or 1705.69 hundreds of miles). Thus, the overall failure rate is 23,803/1705.69 = 14.0 failures/(100 miles)/year. This represents a 27% increase from the 2012 survey which had a rate of 11 failures/(100 miles)/year.

This simple method for computing failure rates was used because it discourages biases toward large or small utilities. It is noted that utilities experience widely different failure rates for the same pipe material. Indeed, this should not be surprising. Several significant variables affect the results including pipe age, soil types (corrosive or noncorrosive), different corrosion prevention techniques, different installation practices, and climate such as extreme cold and drought events.

Literature reviews indicate that between 250,000 and 300,000 breaks occur every year in the U.S., which corresponds to a rate of 25 to 30 breaks/(100 miles)/year (Grigg, 2007; Deb et al., 2002). The AWWA Partnership for Safe Water Distribution System Optimization Program goal for a fully-optimized distribution system is 15 breaks per 100 miles of pipe annually (AWWA Partnership for Safe Water, 2011). Pipe material performance and selection is an important component of optimizing distribution systems.

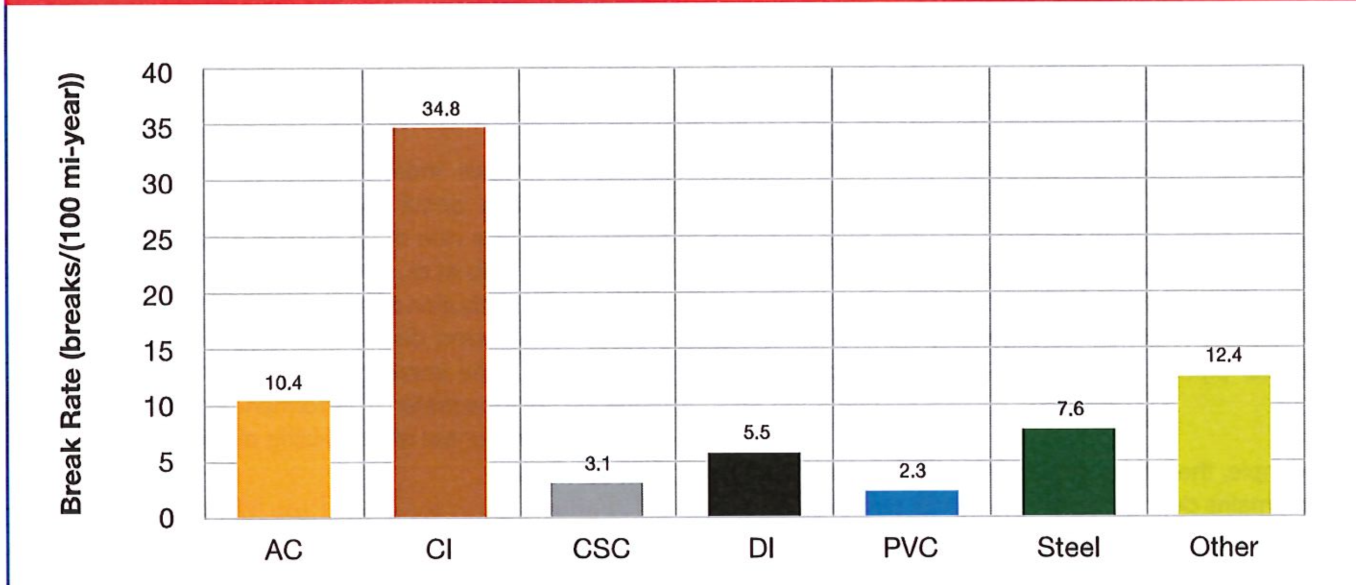
5.1. Failure Rates for Each Pipe Material

The survey measured pipe failures over a recent 12-month period and was broken down by material type. Table 5 lists the total length of pipe by material type, the number of failures (breaks) over a recent 12-month period, the break rate for each pipe material, the 2012 survey break rates, and the percent change in break rates. Figure 20 illustrates the failure rates as a function of material type. In both the 2012 and 2018 surveys, PVC was the pipe material with the lowest break rate.

TABLE 5: SUMMARY OF FAILURE DATA FROM THE BASIC SURVEY OVER A 12-MONTH PERIOD

	Length	Failures	2018 Break Rate	2012 Break Rate	% Change
AC	21,589	2,240	10.4	7.1	46%
CI	48,471	16,864	34.8	24.4	43%
CSC	4,940	152	3.1	5.4	-43%
DI	47,595	2,627	5.5	4.9	13%
PVC	37,704	878	2.3	2.6	-10%
Steel	4,765	362	7.6	13.5	-44%
Other	5,506	680	12.4	21	-41%
Total	170,569	23,803	14.0	11	27%

FIGURE 20: BREAK RATES OF EACH PIPE MATERIAL FROM THE BASIC SURVEY



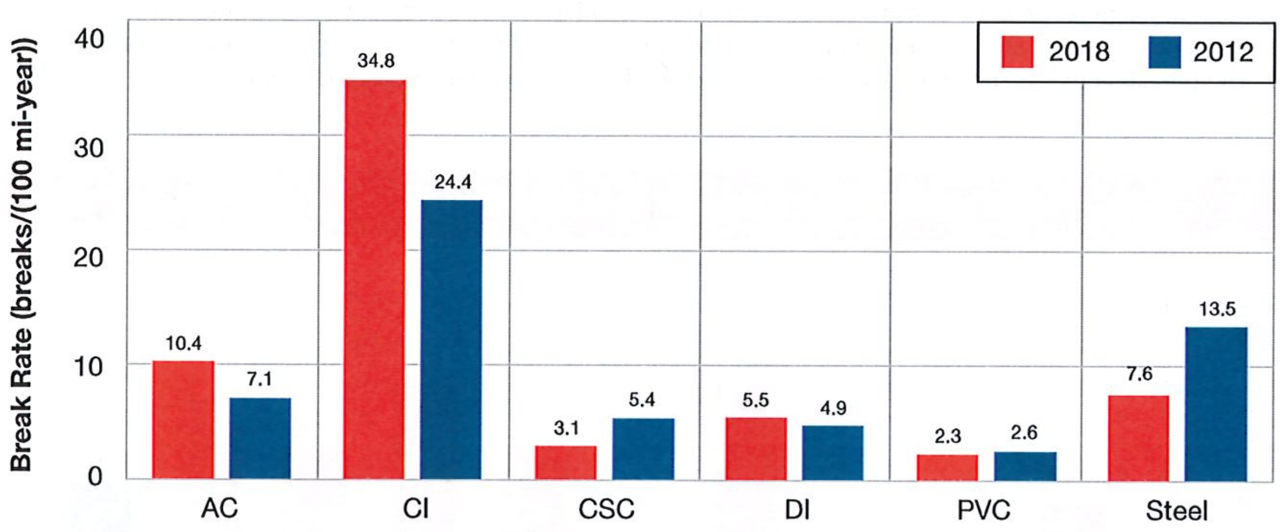
Comparing this 2018 survey with the 2012 survey in Table 5 shows that overall, break rates increased by 27%. The change is primarily due to failures in asbestos cement (AC) and cast iron (CI) pipes with increases of break rates by over 40%. As Figure 14 shows, AC and CI pipe represent the largest percentage of oldest pipe currently installed and thus are nearing the end of their useful lives. Many studies show that water-main failure rates generally increase exponentially over time (Kleiner, 2002). One could envision a rapid increase in break rates in the future as illustrated in Figure 21. Certain utilities could experience the need to rapidly accelerate the rate at which they are replacing CI and AC water mains. If a break rate doubles, the economic impact is significant; one would need to double the number personnel repairing the breaks along with supplies while loss of treated water increases, and societal impacts could be devastating.

Figure 22 compares the break rates of the 2012 and 2018 surveys. Since over 90% of installed pipe consists of AC, CI, DI, and PVC, the break rates for those material types will be most accurate. From 2012 to 2018, Figure 22 shows a small decrease in break rates for PVC and a small increase for DI pipe. The overall consistency of those values demonstrates they are accurate. Again, the increase in break rates for AC and CI pipes is a very significant observation.

The amount of concrete and steel pipe in this survey is less than 6% of the total installed pipe length. When only a small amount of pipe break data is available, the accuracy of the break rates from survey data will be decreased. The 42% decrease in break rate for concrete pipe was likely due to the fact that over twice as much concrete pipe is in this 2018 survey and should be more accurate. Steel pipe also saw a large decrease in break rates. The break rate for steel pipes are largely attributed to smaller diameter galvanized steel pipes that are rapidly being replaced. Large diameter steel pipes used in transmission lines have a very low break rate.

FIGURE 21: EXPONENTIAL CHANGE IN BREAK RATES

FIGURE 22: COMPARISON OF BREAK RATES OF THE 2018 AND 2012 SURVEYS



The size of a utility can affect break rates. Three sizes of utilities are considered here based on the length of pipe; small with less than 200 miles, intermediate with 200 to 1000 miles, and large with over 1000 miles. Figure 23 illustrates the overall break rate (for all pipe materials) and then separated by the four most common pipe materials in these three utility sizes. The large utilities consistently had lower break rates than intermediate and smaller utilities. This is likely due to better funding and larger staffs for engineering design, monitoring and information gathering, installation oversight, and repair of water mains. It is very significant that small utilities consistently have break rates at least double that of a large utility.

FIGURE 23: BREAK RATES BY UTILITY SIZE FROM THE BASIC SURVEY

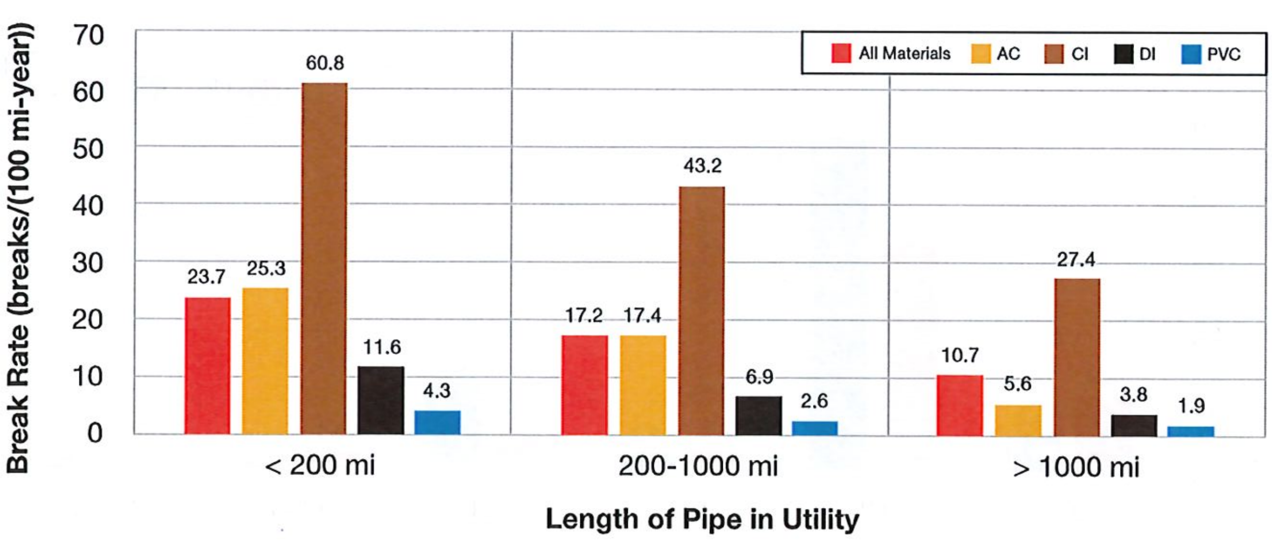


Figure 24 illustrates the overall break rate broken down by region. Clearly not all regions are experiencing the same failure rate. In Table 1, the number of respondents for each region is reported. It was desired to separate US and Canadian break rate data. This is illustrated in Figure 25. Canada can have very corrosive soils (Seargeant, 2013) and this is reflected in the high break rates of cast and ductile iron pipes in Figure 25. Seargeant reported that the highly corrosive soil in Edmonton necessitated a transition from cast iron to asbestos cement pipes in 1966 and then to PVC starting in 1977. The transition to PVC has produced a dramatic reduction in water main break rates for the city.

FIGURE 24: OVERALL BREAK RATES BY REGION FROM THE BASIC SURVEY

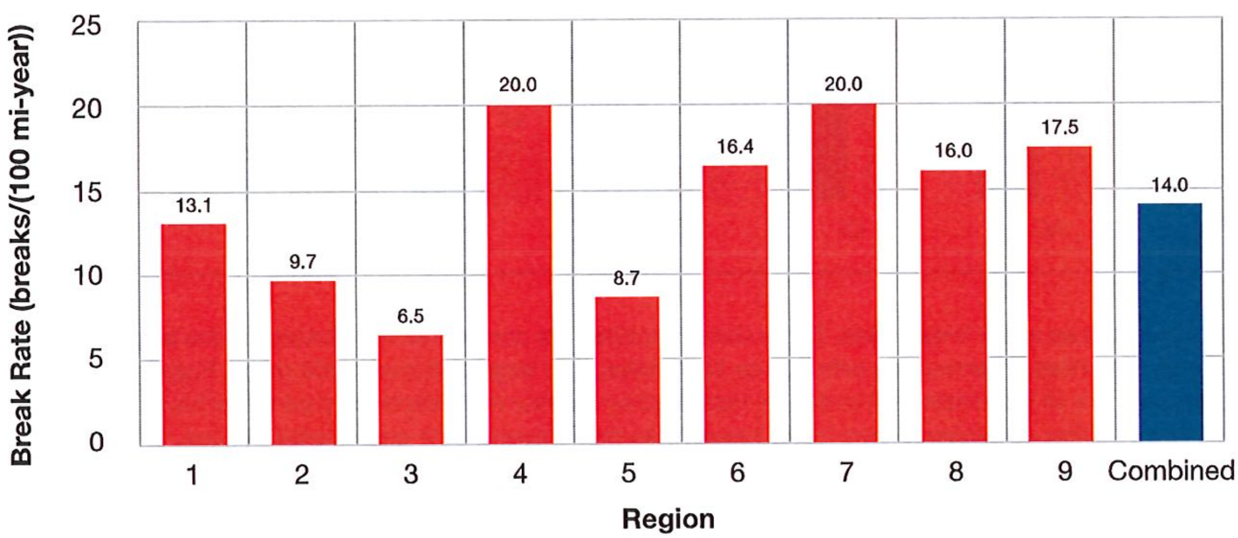
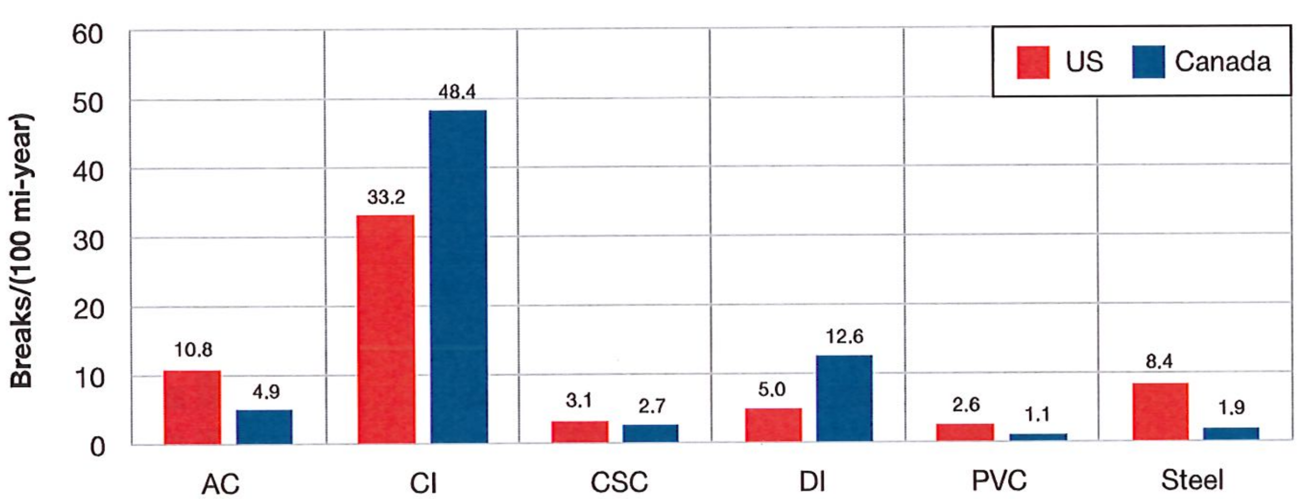


FIGURE 25: BREAK RATES FROM THE US AND CANADA FOR SELECTED MATERIAL TYPES



5.2. Effects of Age

The basic survey asked respondents to break down the failures into the decade when they were installed. Some of the respondents did not know the age of the failed pipes and they were not included in the results. Figure 26 illustrates the percentage of failures of each pipe material based on the decade of installation. For example, asbestos cement (AC) pipe had 60% of the breaks from pipe installed in the 1960's, 28% in the 1970's, and 12% of the breaks in pipes installed in the 1980's. Note that the largest percentage of failures is usually not in the oldest pipes (AC being an exception), which has several possible causes. One important cause is the amount of pipe present in a given age range. As the older pipe is replaced there is less available to fail. Also, cast iron and ductile pipe wall thickness has decreased over the years which can affect time to failure. The results in Figure 26 are also related to when a pipe material was introduced or removed from the market. AC pipe has not been installed in the USA and Canada in the past 25 years, and thus, all AC pipe failures date from the 1980's and earlier. Little cast iron pipe has been installed since the 1980's and that is reflected in Figure 26. Widespread ductile iron and PVC pipe production in the USA did not start until about 1970, so we should expect to see a small failure percentage for both DI and PVC installed in the 1960's and none in the 1950's and earlier.

Most of the failure versus age distributions in Figure 26 seem to be quasi bell-shaped (again, asbestos cement pipe failures are an exception). It would appear the AC pipe installed in the 1960's may be near its end of life and utilities may want to consider planning for rapid replacement of that pipe. Cast iron pipe shows the most uniform failure distribution and does not give much guidance on which pipe age needs replacement first.

5.3. Target Replacement Break Rate

The detailed survey asked participants if they utilized a target break rate at which pipe replacement was implemented. Only 28% of the respondents said that they had a specific value. The average response was a target rate of 11 breaks/(100 miles)/year. Most respondents commented that they do not have a specific target break rate. However, break rates are a very important factor when locations for critical services are considered and when roads are being reconstructed. Although Figure 26 provides some insight to when pipe needs to be replaced, the most appropriate metric to making this decision should come from looking at break rates at sections of pipe with a similar age and material.

5.4. Most Common Failure Age and Mode

The detailed survey asked the participants the typical pipe age of most water main failures. The average response was 50 years with a range from 10 to 100 years. In 2012 the average age of failing water mains was reported as 47 years. Given the qualitative nature of this question, the typical age of a failing water main has not changed significantly over the past six years.

The detailed survey requested participants to select the most common failure mode from the following: corrosion, bell split, circumferential crack, longitudinal crack, leakage at joints, fatigue, or other. Figure 27 illustrates that 56% of the respondents identified a circumferential crack as the most common followed by corrosion at 28%. These are the typical failure modes of CI and AC pipe.

An alternate approach to examine the failure modes is by using those reported in the basic survey. Participants were asked to provide a cause of failure from the following list; circumferential crack, longitudinal crack, corrosion (internal or external), bell splitting, rock impingement, other, or unknown. Where multiple failures occurred, multiple causes were given, and each was given equal weight. Figure 28 illustrates the percentage of each failure mode with unknown responses ignored. Again, the top two failure modes are circumferential cracks followed by corrosion.

FIGURE 26: PERCENT OF FAILURES PER DECADE OF INSTALLED PIPE MATERIAL

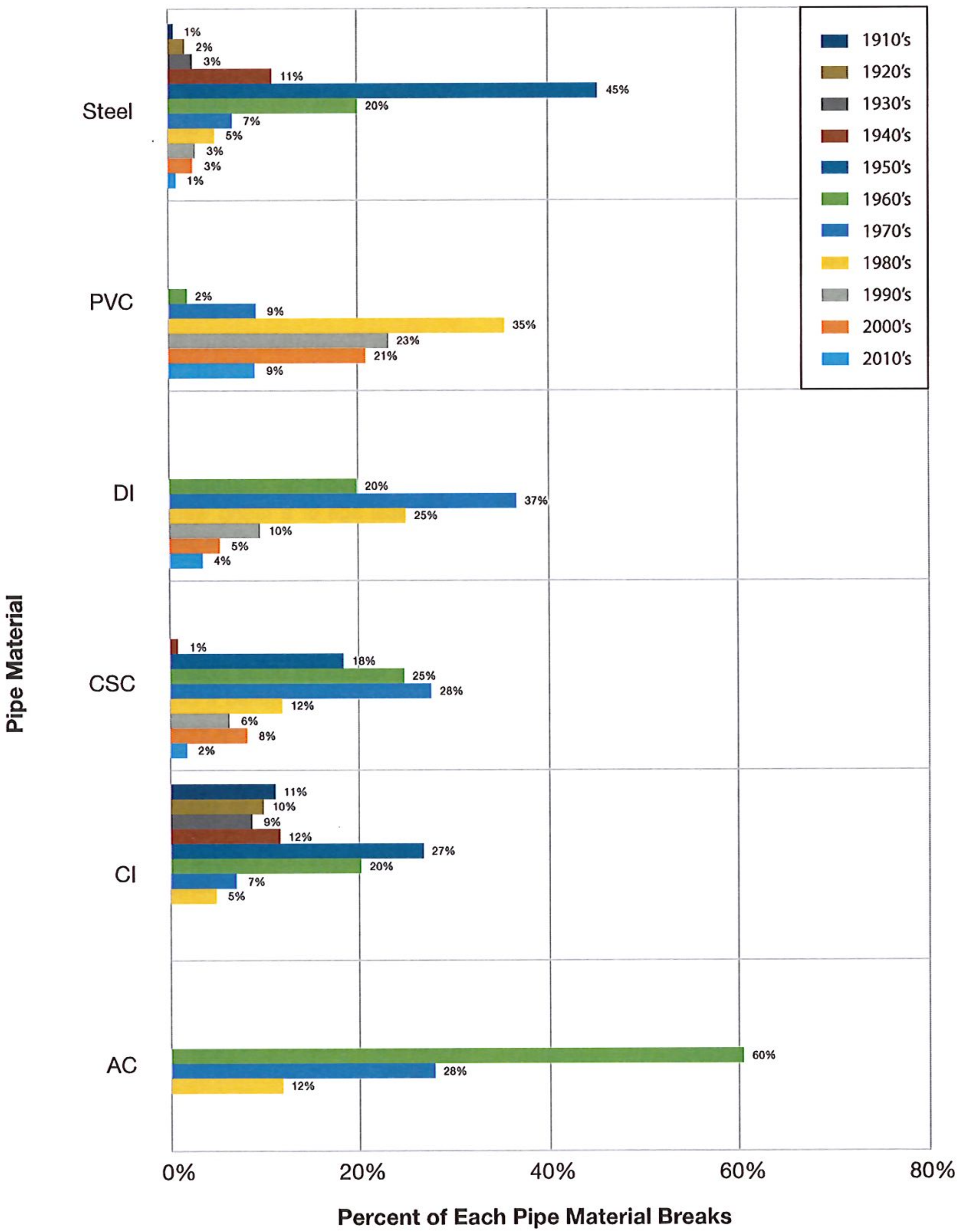


FIGURE 27: PERCENT OF RESPONDENTS SELECTING A MOST COMMON FAILURE

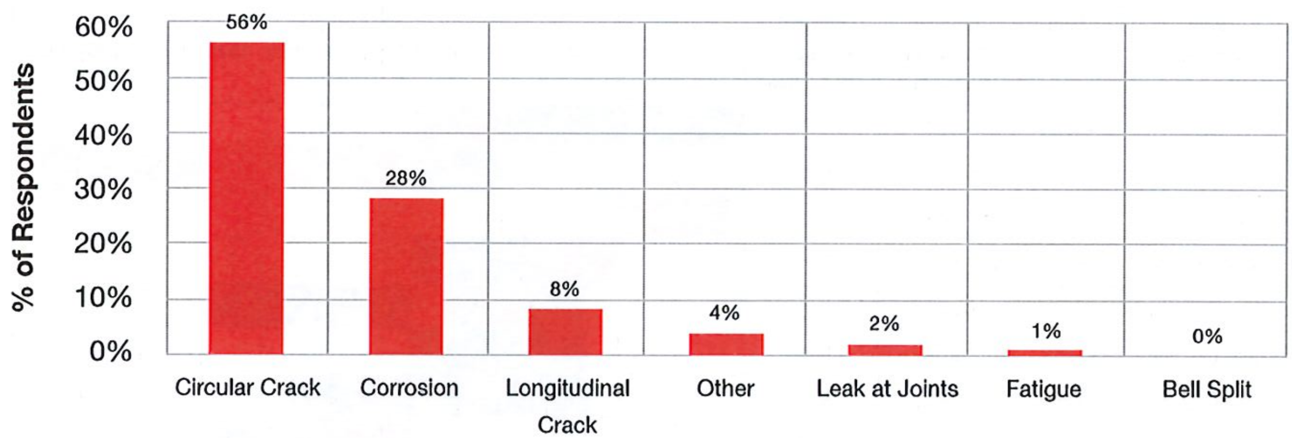
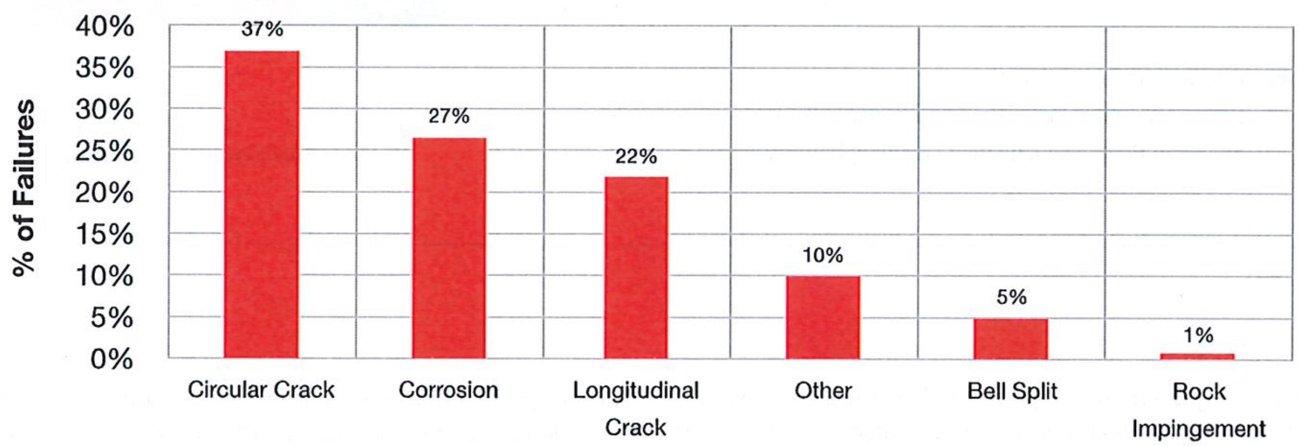


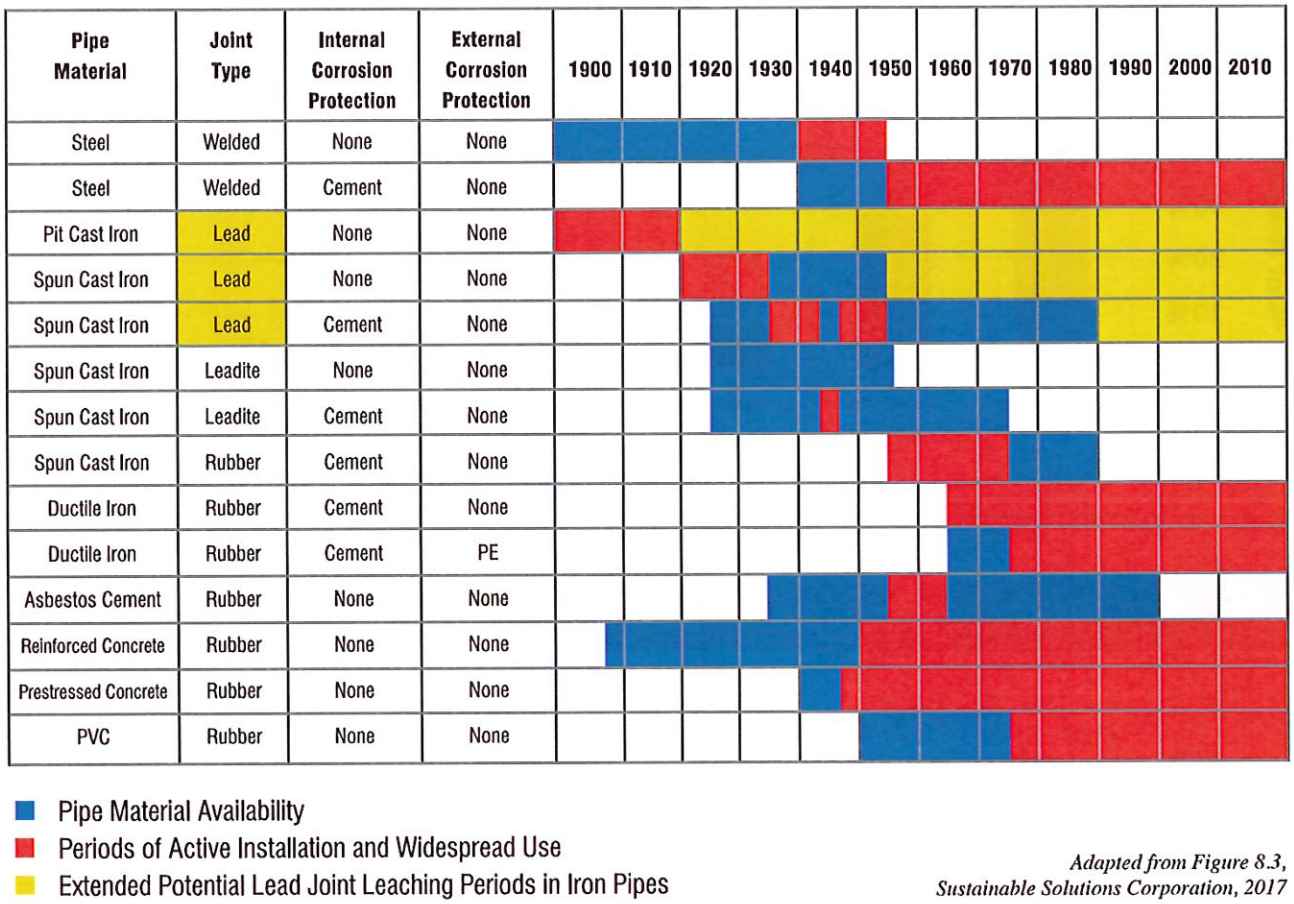
FIGURE 28: DISTRIBUTION OF FAILURE MODES FROM THE BASIC SURVEY



5.5. Pipe Cohorts and Vintage

As mentioned in section 3.0, the survey did not track the many subclasses of pipe that have been installed because many utilities do not have that information. Individual utilities should try to add to their database as much as they can about what is referred to as a pipe cohort and other details about their installation. Copeland, et al. (2015) provides a good example of data to record. A pipe cohort is a group of pipes with similar characteristics. This concept is useful in pipe management because defining different pipe cohorts can be helpful in identifying pipes that have different risk characteristics (see Figure 29).

FIGURE 29: TIMELINE OF PIPE TECHNOLOGY IN THE US IN THE 20TH CENTURY



Adapted from Figure 8.3, Sustainable Solutions Corporation, 2017

Changes in pipe manufacturing, such as the introduction of new pipe-making technologies, are a major criterion when identifying pipe cohort concerns (e.g., longevity of a pipe and risk of breakage). For instance, pit cast gray iron pipe and centrifugally cast gray iron pipe of the same diameter should likely be considered in different pipe cohorts, because the significant differences in manufacturing cause the pipes to behave differently. Other factors that can affect pipe longevity and breakage include transportation and installation methods (WaterRF, 2013).

Another pipe cohort is cast iron with leadite joints. There are at least two reasons for high failure rates associated with leadite joints: "First, leadite has a different coefficient of thermal expansion than cast iron and results in additional internal stresses that can ultimately lead to longitudinal splits in the pipe bell. Secondly, the sulfur in the leadite can facilitate pitting corrosion resulting in circumferential breaks on the spigot end of the pipe near the leadite joint. The failure rate in the industry for leadite joint pipe is significantly higher than for lead joint pipe even though the pipe may not be as old." (EPA, 2002, p3)

6.0 Corrosive Soils and Corrosion Prevention Methods

The detailed survey asked respondents if they have one or more regions in their service area with soils that tend to be corrosive. A total of 75% of the respondents reported that they do have at least one area with corrosive soils. This corresponds to the results found in the 2012 survey. The survey also asked if they utilized any kind of corrosion protection methods. A total of 80% of the respondents reported that they do utilize some kind of corrosion protection. The respondents were also asked to describe the method(s) they used. The most common answer was polywrap installation. Table 6 lists most of the methods mentioned ordered from most common (rank 1) to least common (rank 5).

TABLE 6: TYPICAL CORROSION PREVENTION METHODS

Rank	Corrosion Prevention Methods
1	Polywrap
2	Anodes or cathodic protection
3	V-bio polywrap
4	Impressed current
5	Dielectric coatings

Water utilities often do not know the specific cause of external corrosion observed on their water mains, and consequently, the chosen preventative measure may not work effectively. Historically, these choices are based on data from other industries (e.g., gas and oil) and may not be suitable for the water industry. Corrosion of metallic pipes can be caused by a variety of mechanisms, each of which requires a different solution. Determining which corrosion mechanism is at work is not a simple matter, because the resulting pipe damage looks similar for all of them. The failure to properly identify corrosion sources may produce prevention systems that are ineffective or do not last. For example, it is not effective to install an anode on a main that has a bacteriological corrosion problem. Similarly, an anode bag installed to reduce corrosion caused by a stray impressed current would be quickly used up and would provide only short-term protection. Also, polywrap does not protect a pipe from all corrosion types and may get damaged during the installation (Romer, 2005).

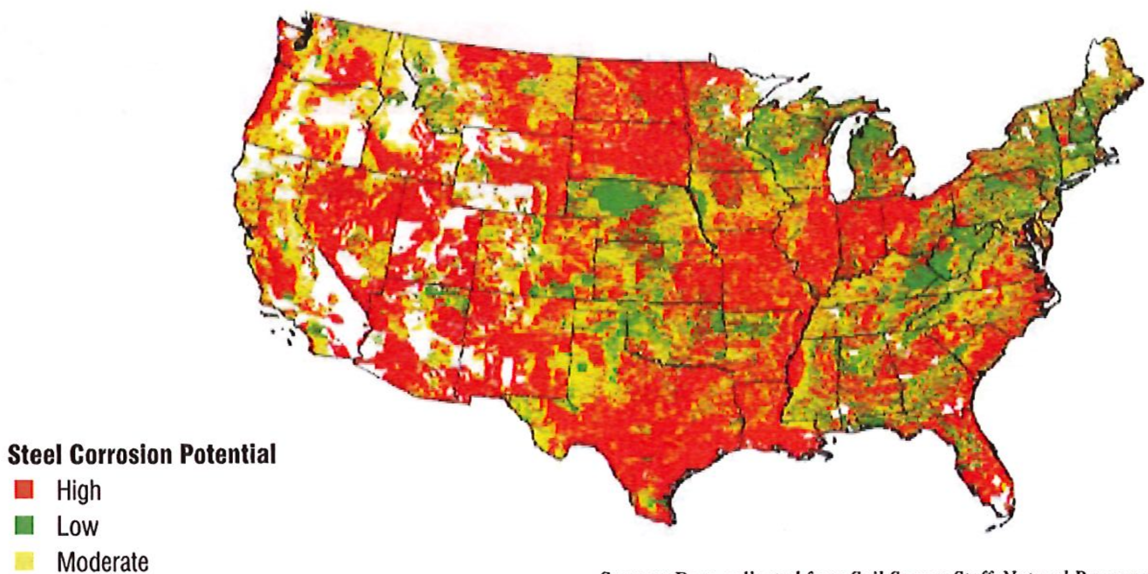
6.1. Effect of Corrosive Soils on Break Rate

The USDA Natural Resources Conservation Service provides results of soil surveys across the US. One of the aspects of the soil surveys is a "risk of corrosion" analysis that pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The soil is rated as either "low," "moderate," or "high" based on measurements of moisture, particle size, acidity, and electrical conductivity. This is not a precise analysis and additional factors may be neglected. Nevertheless, it is a reasonable estimate of soil corrosiveness in lieu of better data. The USDA soil survey website (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx) allows the user to select an area of interest (AOI) and then produces a plot coloring low risk areas in green, moderate risk areas in yellow, and high risk areas in red. An overview of soil across the US is given in Figure 30.

Soil risk can change over a distance of a few blocks. This is illustrated in Figure 31 which shows a screen capture of soil risk colors inside the boundaries of a town in California. This town has all three regions present; low (green), moderate (yellow), and high (red). Soil analysis data is not available in regions with a light gray color.

It was desired to relate water main break rates to soil corrosivity. Since most cities have a combination of low, moderate, and high regions, a numerical ranking was developed that provided an overall level of soil corrosiveness. To do that, pictures of each area served by the utilities in the basic survey were created. Next a program was developed that counted the number of reddish, greenish, and yellowish pixels in each photo. To provide a numerical ranking, pixels that were low risk were given a value of 1, moderate pixels were given the value 2, and high risk pixels were given the value 3. The pixel values were summed and then divided by the total number of red, yellow, and green pixels. The computed value is called a corrosion index. Cities with a corrosion index near 1 have low corrosion risk while those close to 3 have high corrosion risk. For the area in Figure 31, the computed corrosion risk was 2.1 or slightly above a moderate level.

FIGURE 30: US CORROSIVE SOILS MAP (CONUS POTENTIAL FOR STEEL CORROSION)



Source: *Data collected from Soil Survey Staff, Natural Resources Conservation Service, U.S. Department of Agriculture Soil Survey Geographic Database.*

Corrosion index values were computed for 281 cities in the US. Some US cities had little or no data for the soil inside their boundaries preventing computation of a corrosion index. For analysis, the corrosion index values were broken down into seven ranges and the number of utilities in each range is plotted in Figure 32. The average corrosion index for all the US utilities in the basic survey was 2.4 or close to midway between moderate and high corrosion risk. That is, most utilities in the US have a moderate to high soil corrosion risk which is consistent with the detailed survey report that showed 75% of utilities have one or more areas with corrosive soils.

FIGURE 31: CORROSIVE SOIL RISK PLOT

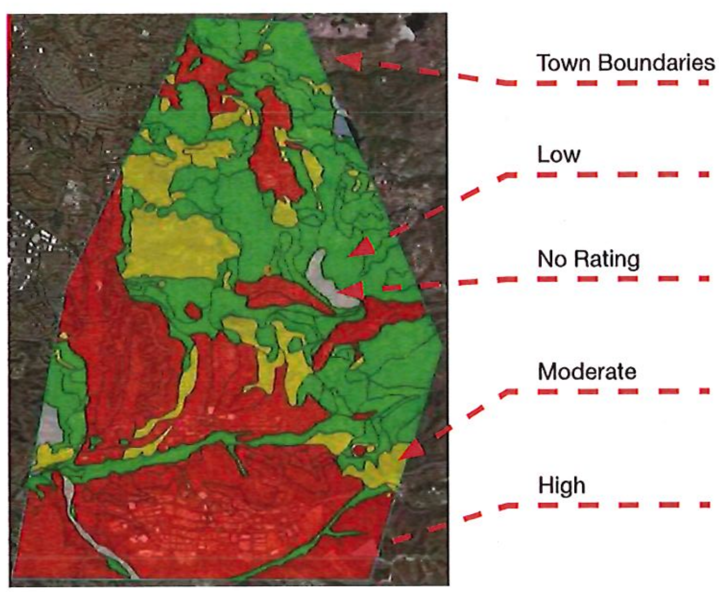
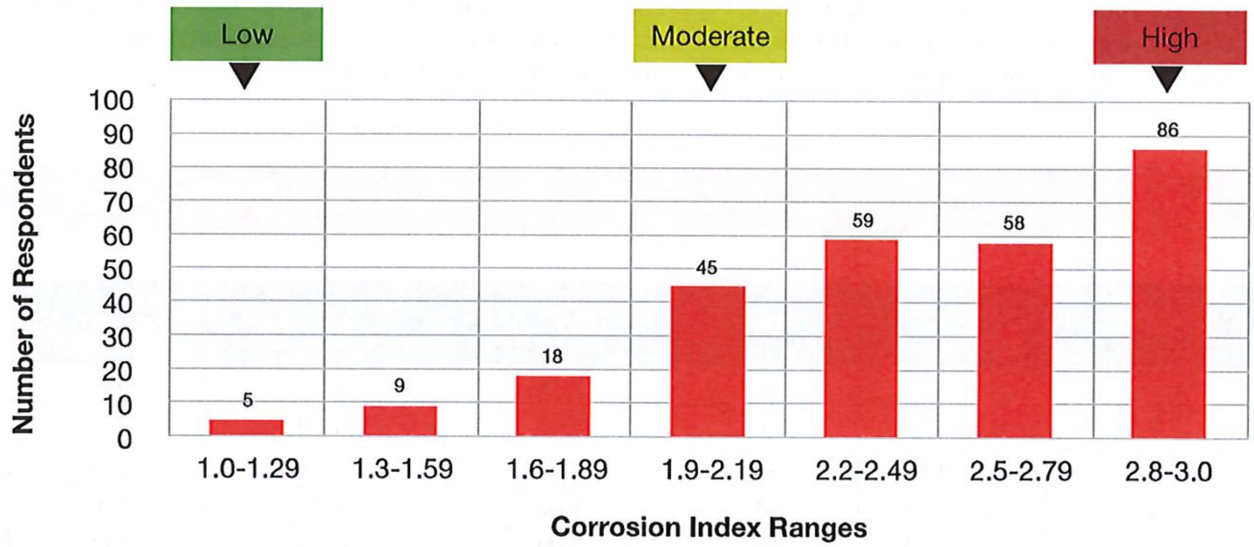
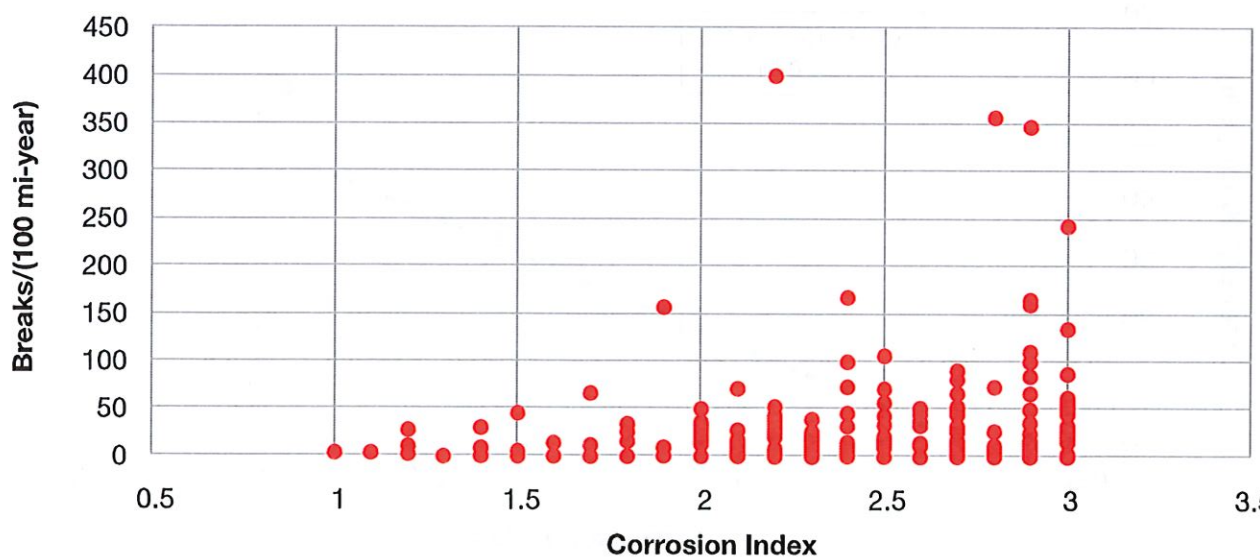


FIGURE 32: NUMBER OF UTILITIES VERSUS THEIR CORROSION INDEX



It is reasonable to expect break rates would increase when pipe is installed in corrosive soils. To examine this, plots were made of a utility's corrosion index versus break rate. Figure 33 illustrates this for cast iron pipe. There is a trend of higher break rates with increasing corrosion index, but the wide scatter in the data makes analysis difficult. The high break rates in Figure 33 are associated with small utilities that have a small amount of pipe. Consider a utility with 1 mile of cast iron pipe with 2 breaks during the past year. That would translate to a break rate of 200 breaks/(100 miles)/year. If that utility had no breaks the following year, the break rates drop to zero.

FIGURE 33: INDIVIDUAL UTILITY BREAK RATES FOR CAST IRON PIPE VERSUS THEIR CORROSION INDEX

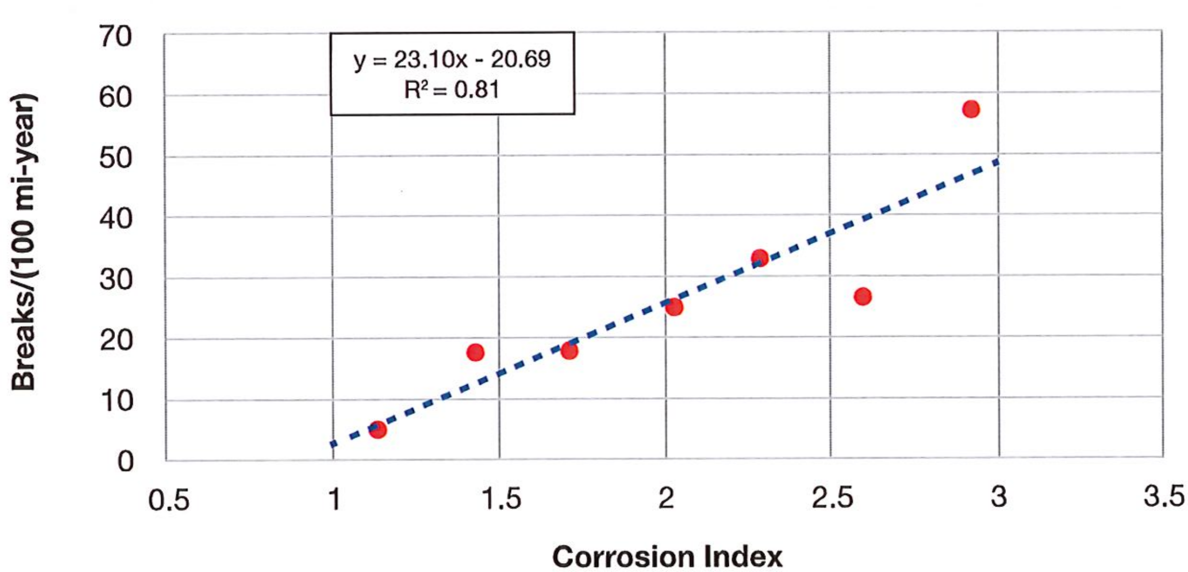


To get a realistic estimate of break rates, we need to add the number of breaks of a pipe type from several utilities and divide by the sum of the length of that pipe type to compute break rates. The corrosion index data was broken down into the same seven categories used in Figure 32. The results are listed in Table 7. The break rates versus corrosion index data are plotted in Figure 34 for cast iron pipe and Figure 35 for ductile iron pipe. The figures also contain a regression equation fit and a correlation coefficient. Correlation coefficients close to 1.0 indicates an excellent correlation and zero indicate no correlation. Both cast and ductile iron results in reasonably good fits to the data.

TABLE 7: BREAKDOWN OF CORROSION INDEX VALUES INTO SEVEN CATEGORIES

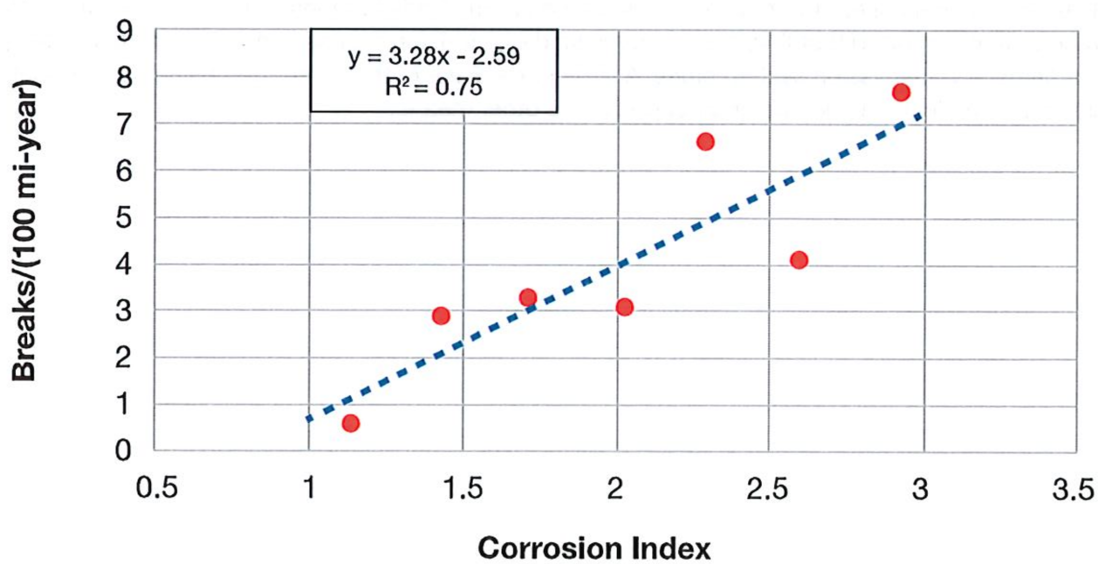
Category	Corrosion Index Range	# of Utilities	Average Corrosion Index	Break Rates (breaks/(100 mi-year))	
				Cast Iron	Ductile Iron
1	1.0 - 1.29	5	1.14	4.93	0.57
2	1.3 - 1.59	9	1.43	17.59	2.89
3	1.6 - 1.89	18	1.72	17.76	3.27
4	1.9 - 2.19	45	2.03	24.96	3.09
5	2.2 - 2.49	59	2.29	32.79	6.63
6	2.5 - 2.79	58	2.60	26.39	4.09
7	2.8 - 3.0	86	2.93	57.20	7.69

FIGURE 34: CAST IRON PIPE BREAK RATE VERSUS CORROSION INDEX



Using the equations in Figure 34 with x=1 for a low corrosion risk and x=3 for a high corrosion risk, one can show that a cast iron pipe in a high corrosion soil is expected to have over 20 times the break rate of one in a low corrosion soil. Similarly, ductile iron pipe in a high corrosion soil has over 10 times the break rate than one in a low corrosion soil. Very poor correlations were found for the other material types in this survey.

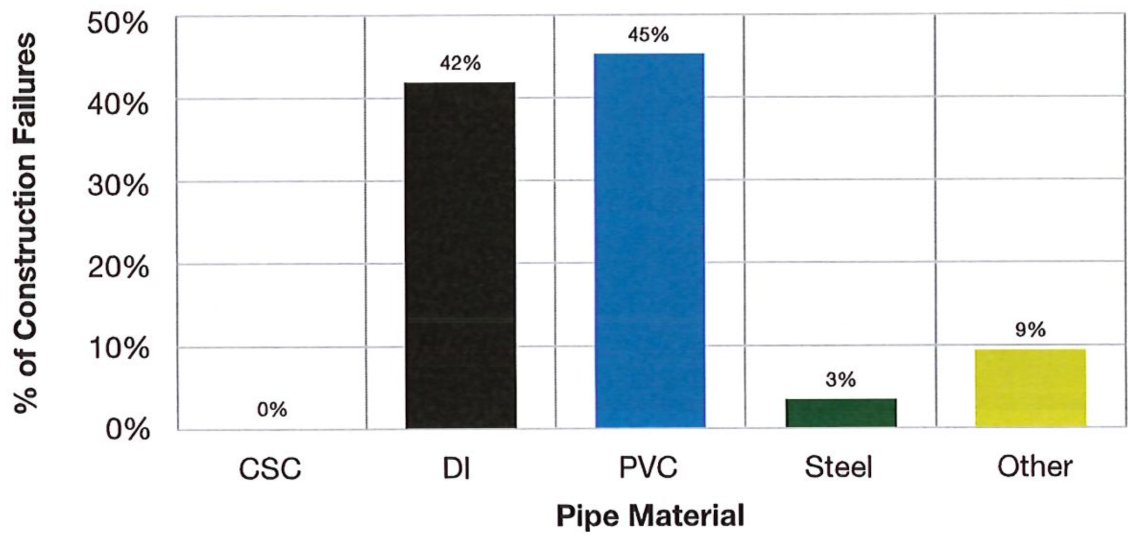
FIGURE 35: DUCTILE IRON PIPE BREAK RATE VERSUS CORROSION INDEX



7.0 Construction Related Failures

The detailed survey asked respondents to report failures related to construction activities. Figure 36 illustrates the percentage of total construction failure related to a particular pipe material. Ductile iron and PVC pipes have the majority of construction related failures at a nearly equal frequency. Figure 14 shows that DI and PVC are the two pipe materials that are also most commonly being installed today. This points to the need to improve construction practices for underground infrastructure regarding installation, location services and inspection.

FIGURE 36: PERCENT OF TOTAL REPORTED CONSTRUCTION RELATED FAILURES FROM THE DETAILED SURVEY



8.0 Condition Assessment Methods

The detailed survey asked if utilities utilize condition assessment methods to monitor the condition of their water mains. 45% of the respondents reported that they do use some kind of condition assessment process but normally limited this effort to larger diameter transmission system pipes. A large percentage of those reported using some visual assessment along with electromagnetic, acoustic, tapping coupons, and other means.

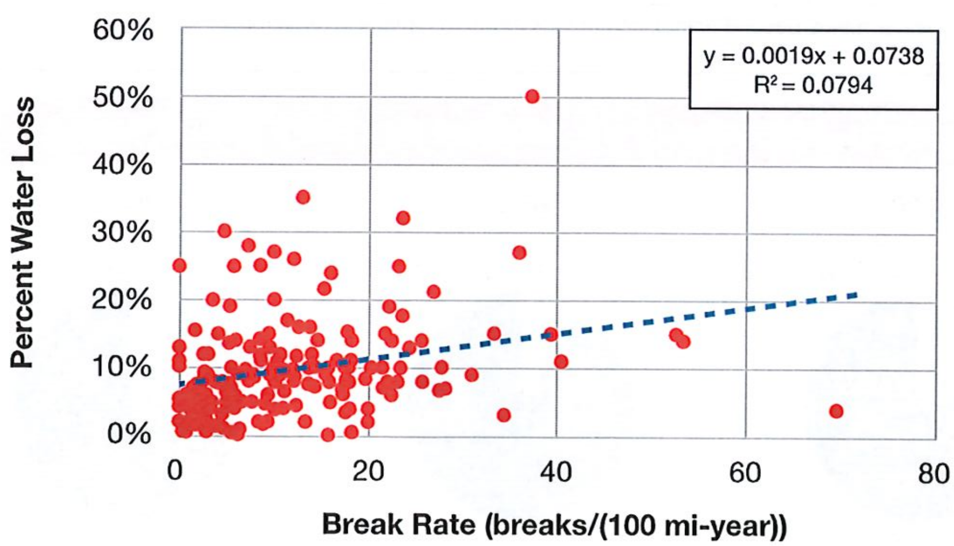
9.0 Water Loss Due to Leakage

Water loss due to leakage is reaching critical levels where in some cases 20% to 30% of water is leaking from water mains (New Jersey 101.5, 2017). The basic survey asked what percentage of water volume input to the system is water loss (due to leakage). A total of 201 utilities were able to provide a water loss value. The reported average leakage from the basic survey was 10% with a standard deviation of 7.7%. It is recognized that there are multiple ways to express and account for water loss (see Taylor, 2008). Water loss can be due to unbilled authorized consumption such as flushing water mains and fire-fighting, unauthorized consumption, and real losses due to leakage. The term non-revenue water comprises all of those losses. It was not anticipated that most of our respondents would have a recent detailed water audit that would provide just the water leakage amount. Thus, the 10% value may include authorized losses. For example, a recent analysis of utilities in Indiana which had a 100% participation rate showed that non-revenue water averaged 19% to 24% of the potable water supplied. The study also noted that a significant number of the state's water pipes are reaching the end of their useful lives (Indiana Finance Authority, 2017). More accurate audits of water utilization would be beneficial to understanding water losses and their cause.

It was postulated that there may be a correlation between water main break rates and water losses. Figure 37 plots individual overall break rates (breaks/(100 miles)/year) versus the reported utility loss rate. A linear regression to the data yields the equation in the figure which is illustrated in the dotted line in Figure 37. This plot omits a few small utilities with failure rates greater than 100 that skew the equation fit considerably. There is considerable scatter in the data and the correlation coefficient is very small indicating essentially no correlation. However, the trend of high leakage values with increasing break rates might be inferred. Perhaps if more accurate leakage values were used, a better correlation might be obtained.

Leaks can occur from pipe damage caused by third parties or corrosion in the pipes, as well as from joints in the distribution system. There are two ways in which water utilities can assess leakage. One way is through conducting a system-wide water audit, which estimates water consumption and water loss. The process enables water utilities to develop performance indicators to assess water loss, benchmark themselves with other water utilities, and set performance metrics. Another way in which water utilities can assess leakage is through conducting leakage investigations on all or part of the water system, using technologies to find the leaks. Many of these technologies can track the sound of a leak, allowing the utility to identify the exact point of the leakage and make needed repairs. There is also increasing use of various "smart technologies," typically tied to newer "smart meters," that can also aid in leak identification" (WaterRF, 2013).

FIGURE 37: PERCENT WATER LOSS VERSUS UTILITY BREAK RATES



10.0 Plans for Replacing Water Mains

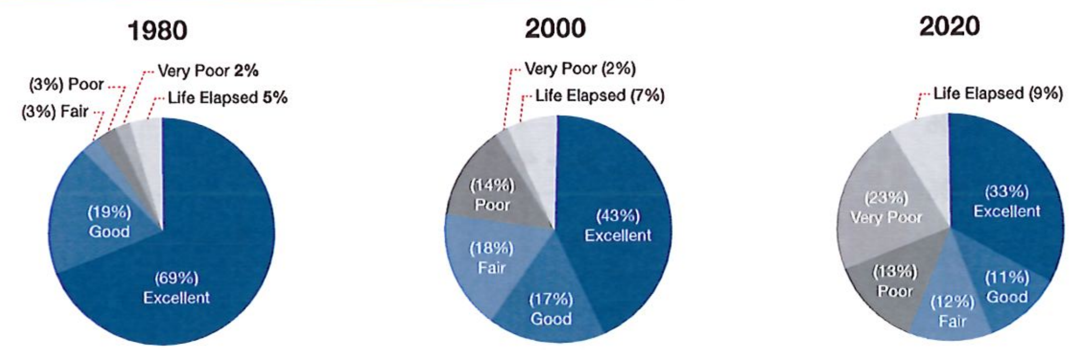
The detailed survey respondents were asked questions about expected pipe life and pipe replacement and the answers are summarized in Table 8. The typical age of failing water mains had an average response of 50 years (up from 47 years in 2012) which is well below what most manufacturers say should be expected. The average expected life of a newly installed pipe is 84 years (up from 79 years in 2012). Given the quantitative nature of these questions, the typical age of failing water mains and expected pipe life have not changed significantly over the last six years. The basic survey asked if utilities have a pipe replacement program and 77% said they did. However, the detailed survey asked utilities if they had a regular pipe replacement program and only 58% of the respondents stated they did and of those that did, the average amount replaced each year was 0.8% of their total installed length. Respondents were asked for the percentage of their water mains that are beyond their useful life but lacked funds to replace them. The average response was 16% of water mains are beyond their useful life. In the 2012 survey the same question was asked and the response was 8.4%. This would indicate that the backlog of needed pipe replacement is growing.

It is of interest to compare these results with a study done by the EPA (EPA, 2002). The report classified water main pipe condition into six categories: "Excellent," "Good," "Fair," "Poor," "Very Poor," and "Life Elapsed." The study examined data for the years 1980 and 2000 and provided forecasted data for 2020. Figure 38 below is reproduced from the EPA report and estimates that the condition of 9% of pipes will be categorized as "Life Elapsed" and 23% as "Very Poor" by the year 2020. Of note is the projected growth in the "Very Poor" category during this period as shown in Figure 38. This is consistent with the results of this survey. The rapid rate of growth of pipes in the "Very Poor" category will make it very difficult for utilities to keep pace and replace them before they reach end of life or their "Life Elapsed" condition. An AWWA study (AWWA, 2012) echoes this trend as illustrated in Table 9. Table 9 shows aggregate costs to cover both replacement and growth in water mains in the USA.

TABLE 8: QUESTIONS ABOUT REPLACEMENT OF FAILING WATER MAINS

Questions	Average or Response
Typical age of failing water main	50 years
Expected life of new water mains	84 years
Percentage with plan to replacing water mains	77%
Percentage regularly replacing water mains	58%
Percentage of total water main length replaced annually	0.8%
Percentage of water mains beyond useful life but lack funds to replace (overall response)	16%

FIGURE 38: ASSESSMENT OF PIPE CONDITION WITH TIME (FROM EPA, 2002)



Percentage of Pipe by Classification

TABLE 9: AGGREGATE NEEDS FOR INVESTMENT IN WATER MAINS THROUGH 2035 AND 2050 BY REGION OF THE UNITED STATES (AWWA, 2012)*

	2011 - 2035 Totals			2011 - 2050 Totals		
Region	Replacement	Growth	Total	Replacement	Growth	Total
Northeast	$92,218	$16,525	$108,744	$155,101	$23,200	$178,301
Midwest	$146,997	$25,222	$172,219	$242,487	$36,755	$279,242
South	$204,357	$302,782	$507,139	$394,219	$492,493	$886,712
West	$82,866	$153,756	$236,622	$159,476	$249,794	$409,270
Total	$526,438	$498,285	$1,024,724	$951,283	$802,242	$1,753,525

** (2010 $M)*

Table 9 represents an estimate of pipe material investment (in millions of dollars) which is needed in each region based on an AWWA report (AWWA 2012). Investment is needed in two areas - replacement (where existing users pay for the pipe at the end of its useful life) and growth (where system expansion needs to occur due to population growth). These two drivers impact each region differently. Over the coming 40-year period, through 2050, these needs exceed $1.7 trillion. Replacement needs account for about 54% of the national total, with about 46% attributable to population growth and migration over that period.

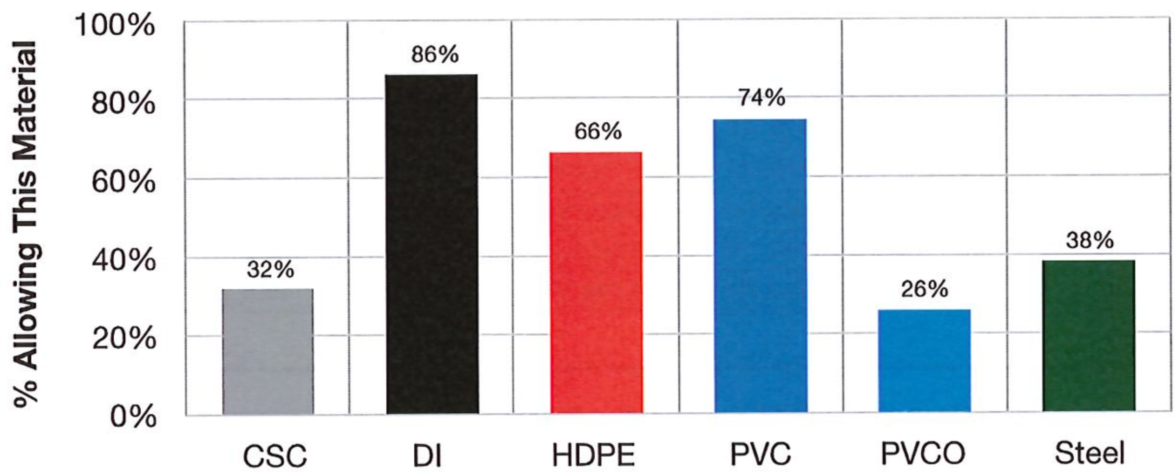
America's water main investment needs impact the nation's regions in different ways. The South and West will face the steepest investment challenges but this will be paid for through growth, unlike the Northeast and other parts of the country facing population decline or only modest growth, which means it will be difficult for them to pay for the needed upgrades (AWWA, 2012).

The US Conference of Mayors 2013 report, "Municipal Procurement: Procurement Process Improvements Yield Cost-Effective Public Benefits," provides expert advice on developing a business case for pipe material selection when evaluating pipe replacement strategies. It reads:

> "The conventional approach to water pipe replacement decision making has been to merely replace the pipe with roughly the same product regardless of price, and based on manufacturer's recommendations. In fact, this replacement ideology and tradition is still heavily imprinted upon the thinking of even modern engineers. Communities in the United States, a century ago, used thick cast iron pipes that are now failing. The majority of these pipes are failing for one basic reason – corrosion. Failure to recognize this systemic performance problem in metallic pipes has allowed traditional procurement practice to make suboptimal materials procurement decisions..."
>
> "An important step in effectively managing assets is to create an open procurement and selection process which allows for all appropriate materials to be considered and accurately and fairly compared. Any improvement in this area can represent a huge cost savings for rate payers considering the perpetual high cost of underground infrastructure replacement. Procurement habituation in pipe material consideration combined with a failure to take advantage of the open bidding process impedes competitive cost savings. Closed procurement processes lead to unnecessary costs, and may diminish public confidence in a local government's ability to provide cost effective services."
>
> *Source: US Conference of Mayors, 2013*

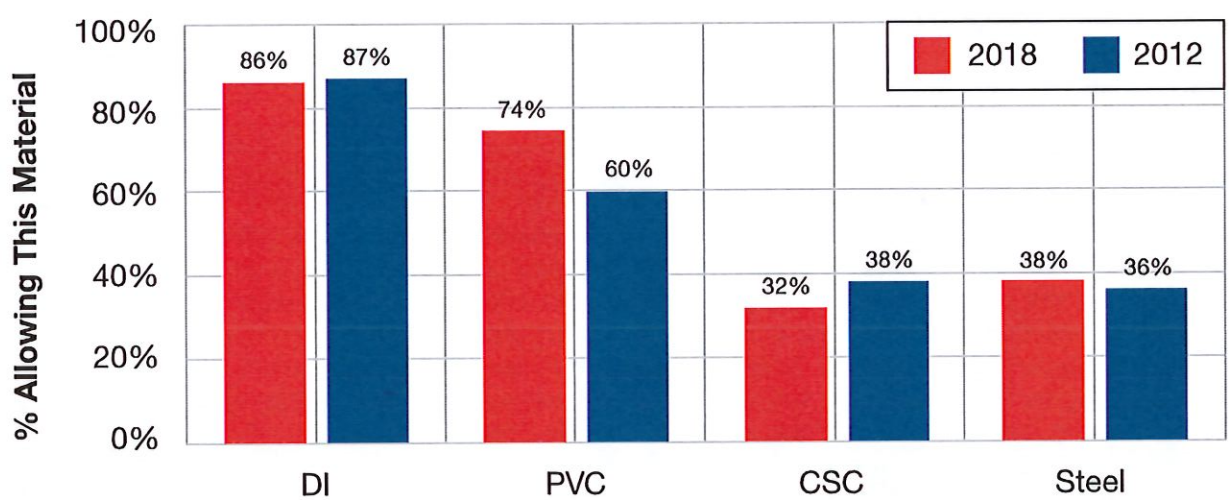
11.0 Approved Pipe Materials

FIGURE 39: RESPONDENTS ALLOWING INSTALLATION OF THESE WATER MAIN MATERIALS



The detailed survey also asked respondents what water main pipe materials are currently approved for use at their utility. Figure 39 illustrates the percentage of respondents that allow a particular pipe material to be installed. HDPE pipe at 66% allowance for use in water systems represents a high degree of acceptance for trenchless applications such as pipe bursting and directional drilling, whereas for open cut installations PVC and ductile iron pipe are the predominantly accepted materials (see Table 10). Figure 40 compares the pipe materials approved for use by utilities in the 2018 survey with the data obtained in the 2012 survey. Figure 40 shows a 23% increase in the acceptance of PVC water pipe by North American utilities since 2012. Specifically, PVC pipe approval among survey respondents increased from 60% of water utilities allowing its use in 2012 to 74% of utilities allowing its use in 2018. The number of utilities approving of ductile iron, concrete steel cylinder, and steel pipes for use in water systems remains essentially the same.

FIGURE 40: COMPARISON WITH 2012 SURVEY FOR ALLOWED MATERIALS



12.0 Preferences for Pipe Installation

The detailed survey asked respondents about experiences with three techniques of repairing, replacing, and installing water main pipes. They were relining deteriorated pipes, replacing pipes with a pipe bursting technique, and installation of new pipes using directional drilling. Table 10 summarizes their responses. The rating scale in Table 10 is from 1 to 5 with 1 being "Not Satisfied" to 5 being "Very Satisfied." Not many respondents have utilized pipe bursting, but an increasing number are looking at using both pipe relining and pipe bursting techniques. A majority of respondents have utilized directional drilling and are very happy with the results, but it is usually only used where open cut replacement is problematic. Open cut replacement remains the most commonly used method of pipe replacement.

TABLE 10: QUESTIONS ABOUT REPLACEMENT OF FAILING WATER MAINS

	Pipe Relining	Pipe Bursting	Directional Drilling	Open Cut
% of respondents that have used this technique	35%	10%	62%	100%
Most common materials installed	HDPE, CIPP, cement lining, epoxy	PVC, HDPE, DI	HDPE, PVC, DI	PVC, DI, CSC, Steel
Average Rating 1 to 5	3.8	3.8	4.4	4.7
% of respondents that will use this technique in the future	58%	44%	93%	100%
Comments	High cost, used when open cut not feasible, only for large diameter pipe, many not happy with it	High cost, useful in some situations, need to excavate for service lines	Worked well particularly for river and street crossings, more expensive	Standard installation method

13.0 Infrastructure Asset Management

Infrastructure asset management is an approach which can help utilities bring together the concepts, tools, and techniques to manage assets at an acceptable service level at the lowest life-cycle cost. Asset management practices applied to underground infrastructure help utilities understand the timing and costs associated with replacement activities. The knowledge gained from these efforts also helps in the development of effective pipe material selection through comparative financial analysis called "life cycle costing" as part of replacement strategies and funding plans. Understanding the longevity of a pipe improves the ability for management to make better infrastructure investment decisions with improved affordability results for customers.

Traditionally, there has been a lack of analysis which would combine both underground pipe performance and affordability. Existing practices tended to ignore the effect of environmental conditions on different pipe materials. Yet, every engineer understands how the complexity of underground infrastructure has increased along with the array of choices. The ability to change old habits and consider new materials requires additional analysis, and improved design and installation practices. This enhanced analysis of pipe design, selection and installation sets forth the longevity and life-cycle costs critically influencing water service affordability and sustainability for the next 100-200 years.

There have been many studies on water main failure rates in the US, Canada, Australia, and Europe over the last three decades. These studies mainly compared the number of pipe breaks by general pipe type and by length. While these studies have been very helpful to the water industry, the new driver has been the need to take into consideration the reduction of repair and replacement costs and improvement of water service affordability in underground pipe decisions. This new level of fiscal accountability and demand for transparent utility management back to their owners and stakeholders has increased the need for additional evidence to demonstrate the improved decision-making. Dig-up reports and pipe performance and longevity studies form the next body of evidence needed to corroborate water main break surveys and studies. The simple formula in a life cycle cost framework is essentially that "a pipe which has a long life at a low cost is the most affordable." Engineers are to make available every alternative that can answer the simple question of longevity and cost at each relevant point within the underground network providing service. A key issue in the life cycle cost framework is the expected life of a pipe.

Accurate pipe service and performance life estimates are critical to the effective management of underground infrastructure. This study provides accurate break data which can be used to improve life cycle costing analysis of water pipelines. Pipe break rate data is fact-based quantitative information which can help to precisely assess the durability, performance and longevity of pipe networks. Water main break rates are a critical decision making metric used in infrastructure asset management repair and replacement planning. Some of the data provided in this study, however, such as the average age of failing water mains and average expected pipe life, is qualitative in nature, i.e., subjective since it is based on perception rather than on quantitative data like break rates. While this can be helpful to utility officials, it lacks needed precision. A similar problem exists with the AWWA 2012 *Buried No Longer* report, which provides estimated service lives of different pipe materials based on a mixture of data which includes perceptions of service life versus quantitative data; and therefore is only of limited value for use in pipe material comparisons, asset management replacement planning, life cycle cost projections, and pipe service life estimates.

There is a large body of information on the importance of asset management and particularly as it relates to water systems. The reader is encouraged to refer to the following excellent documents that are available:

- *Asset Management for Water and Wastewater Utilities* https://www.epa.gov/sustainable-water-infrastructure/asset-management-water-and-wastewater-utilities
- *What is Asset Management?* https://www.michigan.gov/documents/deq/deq-ess-mfs-formsguidance-DWassetmngmntguide_426744_7.pdf
- *Life Cycle Assessment of PVC Water and Sewer Pipe and Comparative Sustainability Analysis of Pipe Materials* http://www.sustainablesolutionscorporation.com/paper-unibell.html

13.1. Life Cycle Cost Analysis and Life Cycle Assessment

According to Dr. Sunil Sinha, Professor of Civil and Environmental Engineering and Director of the Sustainable Water Infrastructure Management (SWIM) Center at Virginia Tech, "In order to meet the important challenges of the 21st century, a new paradigm for the planning, design, construction, and management of water pipeline infrastructure is required, one that addresses the conflicting goals of diverse economic, environmental, and societal interests." (Sinha, 2018) The new paradigm must include life cycle costs analysis (LCCA). LCCA helps in justifying the selection process of a particular system, product or activity based on the total life cycle cost rather than the initial design and installation cost. It enables a transparent selection process. Life cycle cost analysis helps in the identification of high cost areas during the life cycle of the asset and helps in minimizing the costs. Attributing costs to each phase in an asset's life cycle and understanding the full cost to deliver services is important for determining costs for various service levels, maintenance and renewal decision making and rate setting. For example, in a model utilizing utility cost data, PVC was found to have an overall lower total cost of ownership because each cost element (initial pipe cost, installation cost, condition assessment cost, pipe repair cost, rehabilitation cost, replacement cost, indirect and recurring costs and disposal costs) for PVC pipe was lower than ductile iron pipe (Khurana, 2017).

Life cycle assessment (LCA) is a tool used to measure the environmental impacts of different products or systems during their life cycle. By measuring the environmental impacts throughout the life cycle, life cycle assessment provides a complete picture related to sustainability and helps in providing true environmental tradeoffs in the product selection. For example, in a 2017 study following an ISO framework, PVC was found to have a lower carbon footprint than ductile iron pipe (Sustainable Solutions, 2017).

Life cycle cost analysis provides justification from the economic point of view to make better investment decisions, whereas life cycle assessment provides justification related to sustainability issues. It is important to integrate both life cycle cost analysis and life cycle assessment to provide a holistic picture to the decision maker.

14.0 Conclusion

This comprehensive water main break report for 2018 surveyed a statistically significant number of utilities that have collected data on underground infrastructure. The study was focused on material usage in water mains across the USA and Canada and was successful in getting 281 participants to respond to a basic survey and 98 utilities to respond to a detailed survey. The central focus was to obtain average values for water main break rates across North America. These results were presented in Figure 20, but are repeated in Figure 41. PVC has the lowest break rate of all the pipe materials considered. Lower break rates mean lower costs and improved longevity. Compared with the 2012 survey results, break rates for asbestos cement and cast iron pipes have increased significantly and should therefore be cause for concern for policy makers and utility officials alike.

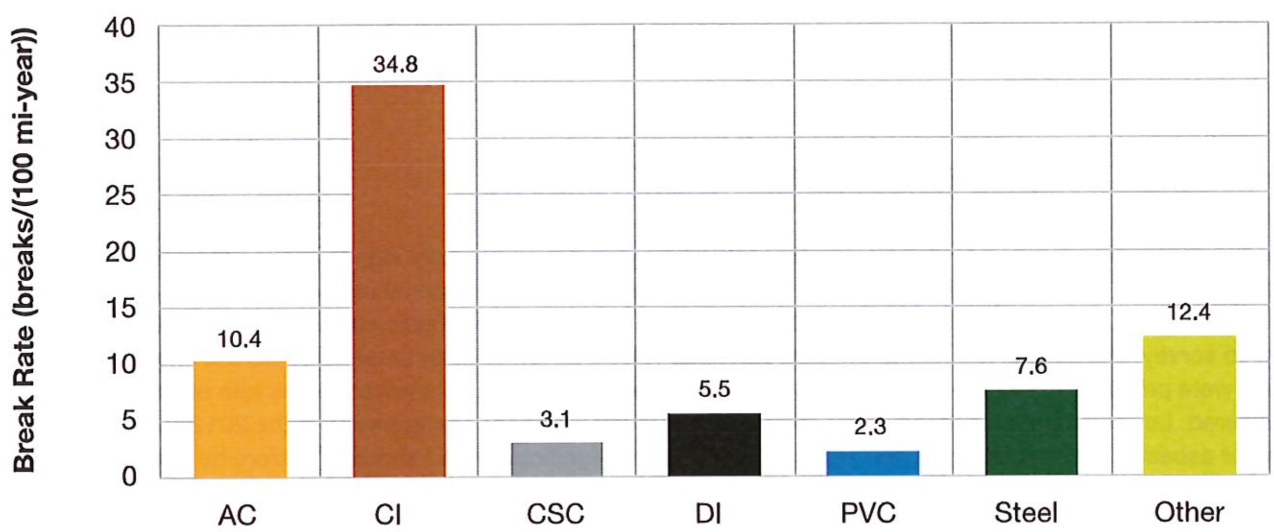
It is hoped that this study will be helpful to utility managers in comparing their experiences with the survey results and thereby make better decisions regarding possible changes in their asset management and procurement practices. Through greater understanding of the risks and issues surrounding the performance of our underground water infrastructure, utilities will be better able to manage our pipe networks and ensure their cost-effectiveness and sustainability.

14.1. Significant Results From This Study

Highlights of the water main break report also include:

- Pipe failure rate data for seven commonly used pipe materials
- Pipe break rates as a function of utility size
- Data on the distribution of pipe failures with pipe age for each material
- Data on the distribution of pipe failure modes for each material
- Analysis of the impact of soil corrosiveness on break rates
- The computation of a national corrosion index value for utilities
- A revised correlation of people served per mile of installed water main
- Average and maximum daily water demand correlations
- Current pipe material usage with a regional breakdown
- Pipe age and size distribution
- Average and maximum operation pressure data
- Most common pipe failure age and modes
- Percentage of utilities that allow installation of certain pipe materials
- Data on water main replacement rates and condition assessment
- Average water loss rate and correlation with break rates
- Preferences about pipe replacement methods

FIGURE 41: BREAK RATES OF EACH PIPE MATERIAL FROM THE BASIC SURVEY



14.2. Acknowledgements

This work was completed with support from Uni-Bell PVC Pipe Association and the Water Finance Research Foundation. Utah State University would like to thank the more than 300 water utilities that participated in this survey.

15.0 References

ASCE, "2009 Infrastructure Report Card," available from: https://www.infrastructurereportcard.org/2009/sites/default/files/RC2009_drinkwater.pdf, last accessed 2/28/2018.

ASCE, "2017 Infrastructure Report Card," available from: http://www.asce.org/reportcard/, last accessed 2/28/2018.

ASCE, "Grand Challenge," available from: http://www.asce.org/grand-challenge/, last accessed 2/28/2018.

AWWA Partnership for Safe Water, "Distribution System Optimization Program (Overview)," AWWA, 2011.

AWWA, "2017 State of the Water Industry Report," AWWA, 2017, available from: https://www.awwa.org/publications/opflow/abstract/articleid/65762696.aspx, last accessed 2/28/2018.

AWWA, "Buried No Longer: Confronting America's Water Infrastructure Challenge," Denver, CO, 2012.

AWWA, "Dawn of the Replacement Era: Reinvesting in Drinking Water Infrastructure," AWWA, Denver, CO, 2001.

Burn, S. et. al., "Long-Term Performance Prediction for PVC Pipes," AWWARF Report 91092F, May 2006.

CDC, "Drinking Water," https://www.cdc.gov/healthywater/drinking/public/index.html, last accessed 2/28/2018.

Copeland, B., Weinle, J., and Calder, B., "Evaluation of Water Main Replacement Program Helps Greater Cincinnati Water Works Achieve Asset Management Goals," 2015, available from: https://c.ymcdn.com/sites/oawwa.org/resource/collection/C5F0B813-925C-4E91-865A-D564B5814256/2015%20Spring%20Newsletter.pdf, last accessed 2/28/2018.

Deb, A. K., Grablutz, F. M., Hasit, Y. J., Snyder, J. K., Loganathan, G. V., and Agbenowsi, N., "Prioritizing Water Main Replacement and Rehabilitation," AWWA Research Foundation, Denver, CO, 2002.

Eidinger, J., "Replacing Seismically-Weak and Aging Water Pipes," Proceeding of The 2nd Japan and US Workshop on Seismic Measures for Water Supply, 2001.

EPA, "The Clean Water and Drinking Water Infrastructure Gap Analysis," EPA-816-R-02-020, 2002.

EPA, "Deteriorating Buried Infrastructure Management Challenges and Strategies," prepared by: American Water Works Service Co., Inc., 2002.

EPA, "Distribution System Inventory, Integrity and Water Quality," January 2007, available from: https://pdfs.semanticscholar.org/637e/02c28f3ee45b3c1f138fcbcec97e3bb3e008.pdf, last accessed 2/28/2018.

EPA, "Condition Assessment of Ferrous Water Transmission and Distribution Systems," EPA/600/R-09/05, June 2009.

EPA, "Science Matters: Aging Water Infrastructure," April 2010, available from: https://www.epa.gov/sciencematters/epa-science-matters-newsletter-volume-1-number-1, last accessed 2/28/2018.

EPA, "Primer on Condition Curves for Water Mains," EPA/600/R-13/080, 2013.

Folkman, S., "Water Main Break Rates In the USA and Canada: A Comprehensive Study April 2012," available from: http://digitalcommons.usu.edu/mae_facpub/171/, last accessed 2/28/2018.

Folkman, S., "Validation of the Long Life of PVC Pipes," Proceedings of the 17th Plastic Pipes Conference PPXVII, Chicago, IL, Sep. 22, 2014.

Grigg, N. S., "Main Break Prediction, Prevention and Control," AWWA Research Foundation, Denver, CO, 2007.

Grigg, N. S., and Hess, J., "Collecting Failure Data to Improve Asset Management," Advances in Water Research, July-September 2017.

Indiana Finance Authority, "Evaluation of Indiana's Water Utilities: An analysis of the state's aging infrastructure," Nov. 2016, available from: http://www.in.gov/ifa/files/IFA-Evaluation%20of%20Indiana%27s%20Water%20Utilities%20Report-11-18-2016.pdf, last accessed 2/28/2018.

Khurana, K., "A Framework for Holistic Life Cycle Cost Analysis for Drinking Water Pipelines," Master of Science Thesis, Civil Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA, 2017.

Kirmeyer, G. J., Richards, W., and Smith, C. D., "An Assessment of Water Distribution Systems and Associated Research Needs," AWWA Research Foundation, Denver, 1994.

Kleiner, Y., and Rajani, B., "Forecasting Variations and Trends in Water-Main Breaks," Journal of Infrastructure Systems, ASCE, 8(4):122-131, 2002.

New Jersey 101.5, "Why NJ Utilities Lose 130 Million Gallons of Drinking Water a Day," available from: http://nj1015.com/why-nj-utilities-lose-130-million-gallons-of-drinking-water-a-day/, last accessed 2/28/2018.

Romer, A. E., Bell G. E. C., Duranceau, S. J., and Foreman, S., "External Corrosion and Corrosion Control of Buried Water Mains," American Water Works Association, Jan. 5, 2005.

Sinha, S., "Virginia Tech leads efforts to develop national water pipeline database," available from: https://vtnews.vt.edu/articles/2018/02/eng-pipedwaterinfrastructuredatabase.html#.WpVTVk2fNO0.email, last accessed 2/28/2018.

Seargeant, D., "PVC Water Distribution Pipe; EPCOR's Continuing Success," Uni-Bell Annual Meeting, Newport Beach, CA, April 2013.

Stone, S. J., Dzuray, E., Meisegeier, D., Dahlborg, A., and Erickson, M., "Decision-Support Tools for Predicting the Performance of Water Distribution and Wastewater Collection Systems," prepared for U.S. EPA National Risk Management Research Laboratory, EPA/600/R-02/029, Edison, NJ, 2002.

Sustainable Solutions Corporation, "Life Cycle Assessment of PVC Water and Sewer Pipe and Comparative Sustainability Analysis of Pipe Materials," 2017, available from: http://www.sustainablesolutionscorporation.com/paper-unibell.html, last accessed 2/28/2018.

Taylor, R., "What is the Infrastructure Leakage Index (ILI) and How Did Waitakere City Council Manage to Achieve and ILI of 1.0?" 3rd International Conference on Sustainability Engineering and Science, 2008, New Zealand, available from: http://www.thesustainabilitysociety.org.nz/conference/2008/papers/Taylor.R.pdf, last accessed 2/28/2018.

US Conference of Mayors, "National City Water Survey 2007," US Mayors Water Council, Washington, DC, 2007.

US Conference of Mayors, "Municipal Procurement: Process Improvements Yield Cost-Effective Public Benefits," US Mayors Water Council, Washington, DC, 2013.

Walton, B., "Infographic: The Age of U.S. Drinking Water Pipes – From Civil War Era to Today," Circle of Blue, 2016, available from: http://www.circleofblue.org/2016/world/infographic-the-age-of-u-s-drinking-water-pipes-from-civil-war-era-to-today/, last accessed 2/28/2018.

Water Infrastructure Network (WIN), 2002, "Water Infrastructure Now: Recommendations for Clean and Safe Water in the 21st Century," available from: https://www.iatp.org/sites/default/files/Water_Infrastructure_NOW_Recommendations_for_C.htm, last accessed 2/28/2018.

Water Research Foundation (WaterRF), "Asset Management: Breaks & Leaks," 2017, available from: http://www.waterrf.org/knowledge/asset-management/breaks-leaks/Pages/faqs.aspx, last accessed 2/28/2018.

Water Research Foundation (WaterRF), "Knowledge Portals: Asset Management: Breaks and Leaks: FAQ's," 2017, available from: http://www.waterrf.org/knowledge/asset-management/FactSheets/AssetMgt-BreaksLeaks-FactSheet.pdf, last accessed 2/28/2018.

UtahStateUniversity

4130 Old Main Hill
Logan, UT 84322 4130

nesbitt engineering, inc.

Vision to Ribbon Cutting