Union County Water District
Qualified Infrastructure Improvement Plan
PSC Case #2023-00119

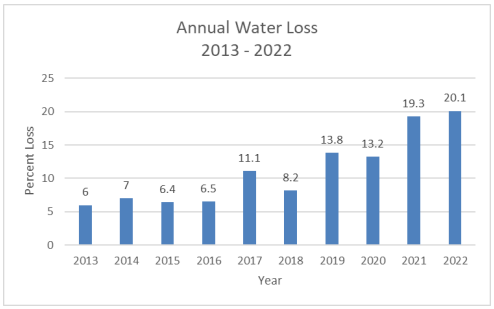
Purpose

On May 5, 2023, the Public Service Commission of Kentucky issued an Order in Case No. 2023-00119 directing Union County Water District ("UCWD") to prepare an infrastructure plan that included an unaccounted-for water (UFW) loss reduction plan. This document is submitted to respond to that directive.

Background

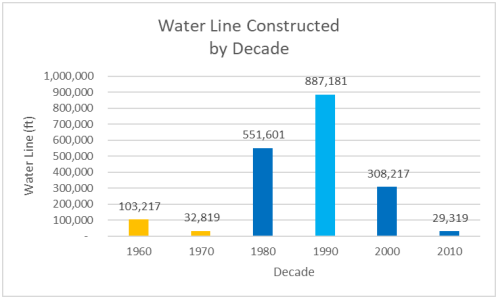
Union County Water District (UCWD)was created April 4, 1964, as a single county district. The Board of Commissioners of the water district consists of three members appointed by the County Judge/Executive and approved by the Union County Fiscal Court. The term of each commissioner is four (4) years. Its territory encompasses all of Union County, Kentucky, excluding the incorporated boundaries of the cities of Morganfield, Sturgis and Uniontown. As of March 13, 2023, it supplied water to 2,272 customers (2,178 residential customers, 61 commercial customers, 4 industrial customers and 27 other). UCWD purchases all their water from the City of Morganfield and presently supplies water to the City of Sturgis. The infrastructure required to provide water service includes 362 miles of water line, 10 storage tanks and 13 pump stations. A generalized infrastructure map for all of Union County is provided on page 2.

UCWD has maintained water loss below 15% for eight of the past ten years with 2021 and 2022 being the highest at 19.3% and 20.1%, respectively. District staff spends a considerable amount of time tracking leaks to minimize water loss and purchase water expense. Following the COVID restrictions/recommendations of 2020-2022 the utility staff rarely worked together as a crew to facilitate social distancing. This upset in the workflow allowed smaller leaks to go unchecked until they grew large enough to warrant a repair. This event in addition to the severe cold weather of winter 2021 & 2022 revealed that the district needs to complement its staff with technology that offers early detection of leakage, effective management of its assets and promotes the efficient use of time to conduct repairs.

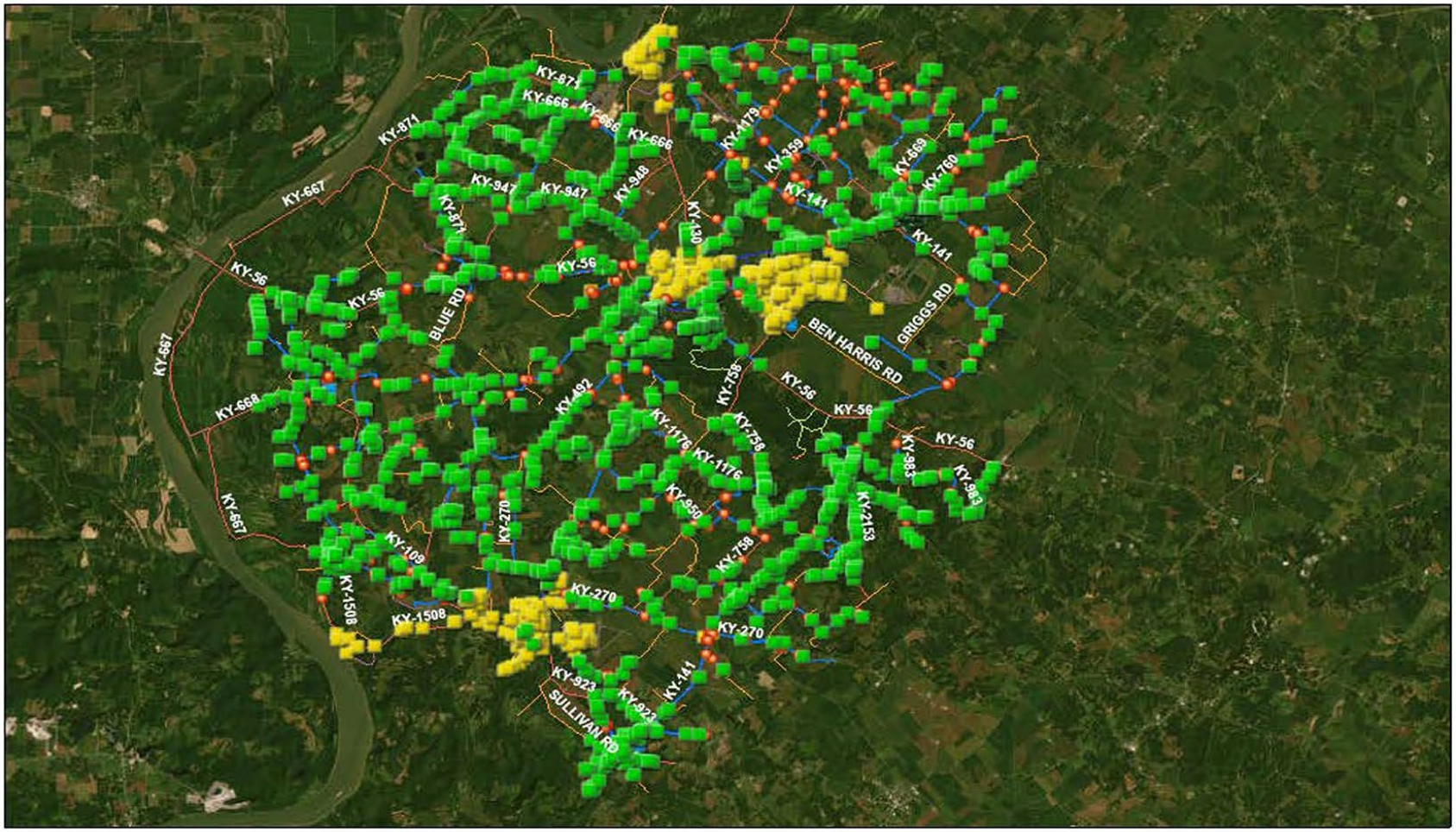


Water Infrastructure Inventory

Aging infrastructure is a significant source of water loss along with personnel and repair materials for the district. Specifically, the 1960's and 1970's asbestos-cement (AC) distribution lines (136,036 ft) that have exceeded their operational life. There are two project profiles (WX21225054 & WX21225055) that combined will replace 29,600 feet of the 136,036 feet of the AC pipe. The AC pipes within the Waverly 1 Zone and Daviess Tank Zone are under the additional stress of pump station operation. Some of the pump stations in these zones have contact starters that when energized, cause pressure spikes that continue to weaken the pipe with each pumping cycle. Repeated pressure spikes over time can weaken water mains and increase the frequency of leaks and breaks.



Union County Drinking Water Infrastructure



A listing of UCWDs primary capital assets is presented below. The inventory identifies their current condition and performance, the need or urgency to replace the asset, and the cost of replacement where indicated.

An asset's current condition is based upon the following scale that is accepted by state regulatory and funding agencies:

Rating Code	Condition Rating	Performance Rating	Priority Rating
0			Not a priority
1	New or Excellent - None or minor defects.	Exceeds/Meets all performance targets.	It would be nice to have.
2	Good - Defects that have not begun to deteriorate.	Minor performance deficiencies.	Improved system operations & maintenance (O&M) efficiency.
3	Fair - Moderate defects that will continue to deteriorate.	Considerable performance deficiencies.	Internal safety concern or public nuisance.
4	Poor - Severe defects that will collapse/break in near future.	Major performance deficiencies.	Potential public health, safety, or environmental concern.
5	Inoperable - Defects need immediate attention.	Fails to meet performance targets.	Existing threat to public health, safety, or environment.

Water Line Assets									
Size (inches)	Material	Decade Constructed	Length (feet)	Condition ID	Performnce ID	Priority ID	WRIS PNum	Cost	Comment
Assessment Area: 141 ZONE									
Up to 2	PVC	1980	37,521	3	2	1			
Up to 2	PVC	1990	46,003	2	2	0			
Up to 2	PVC	2000	12,206	1	1	0			
Up to 2	UNKNOWN	1980	28						
3	PVC	1990	2,588	2	2	0			
3	PVC	2000	5,513	1	1	0			
4	PVC	1980	26,522	3	2	1			
4	PVC	1990	72,393	2	2	0			
4	PVC	2000	30,782	1	1	0			
6	PVC	1980	1,781	3	2	1			
6	PVC	1990	7,718	2	2	0			
6	PVC	2000	8,659	1	1	0			
6	UNKNOWN	1980	101	3	2	1			
Assessment Area: DEKOVEN ZONE									
Up to 2	AC	1964	842	4	4	4	WX21225054	$ 63,150	Frequent breaks, pipe is exposed in spots and has insufficient valves. Partial funding secured.
Up to 2	PVC	1980	42,837	3	2	1			
Up to 2	PVC	2000	1,961	1	1	0			
4	AC	1964	6,260	4	4	4	WX21225054	$ 469,500	Frequent breaks, pipe is exposed in spots and has insufficient valves.
4	PVC	1980	646	3	2	1			
4	PVC	2000	7,132	1	1	0			
6	AC	1964	12,615	4	4	4	WX21225054	$ 946,125	Frequent breaks, pipe is exposed in spots and has insufficient valves.
6	AC	1964	10,689	4	4	4	WX21225054	$ 801,675	Frequent breaks, pipe is exposed in spots and has insufficient valves.
6	PVC	1980	8,634	3	2	1			

Water Line Assets									
Size (inches)	Material	Decade Constructed	Length (feet)	Condition ID	Performnce ID	Priority ID	WRIS PNum	Cost	Comment
Assessment Area: BLUEBERRY ZONE									
Up to 2	AC	1970	4,563	4	4	4		$ 342,225	
Up to 2	PE	1990	4,960	2	2	0			
Up to 2	PVC	1980	39,899	3	2	1			
Up to 2	PVC	1990	74,672	2	2	0			
Up to 2	PVC	2000	23,500	1	1	0			
Up to 2	PVC	2010	78	1	1	0			
3	PVC	1980	1,074	3	2	1			
3	PVC	1990	969	2	2	0			
3	PVC	2000	2,085	1	1	0			
4	AC	1970	17,629	4	4	4		$ 1,322,175	
4	PVC	1980	27,945	3	2	1			
4	PVC	1990	44,295	2	2	0			
4	PVC	2000	8,963	1	1	0			
6	AC	1970	8,944	4	4	4		$ 670,800	
6	AC	1970	511	4	4	4		$ 38,325	
6	PVC	1980	9,417	3	2	1			
6	PVC	1980	1,251	3	2	1			
6	PVC	1990	48,686	2	2	0			
6	PVC	2000	3,570	1	1	0			
6	PVC	2010	22	1	1	0			
8	PVC	1980	15,109	3	2	1			
8	PVC	2010	12,914	1	1	0			
10	PVC	1980	22	3	2	1			
10	PVC	2010	10,090	1	1	0			
Assessment Area: WAVERLY 1 ZONE									
Up to 2	PVC	1980	2,650	3	2	1			
Up to 2	PVC	1990	23,363	2	2	0			
Up to 2	PVC	2000	14,294	1	1	0			
3	PVC	1990	3,846	2	2	0			
4	AC	1964	19,693	4	4	4	WX21225055	$ 40,000	Replace approximately 1350 ft. of (4) inch AC line with (4) inch HDPE line along Yancy Greenwell Rd. Replace 5500 ft of (4) inch AC line with 1 inch HDPE to service one meter along Irvin Hancock Rd.
4	PVC	1980	7,699	3	2	1			
4	PVC	1990	114,164	2	2	0			
4	PVC	2000	45,288	1	1	0			
6	PVC	1990	43,524	2	2	0			
6	PVC	2000	38,886	1	1	0			
8	PVC	1990	12,553	2	2	0			
Assessment Area: WAVERLY 2 ZONE									
Up to 2	CAST IRON	1990	2,413	2	2	0			
Up to 2	PVC	1990	17,632	2	2	0			
3	PVC	1990	1,923	2	2	0			
4	CAST IRON	1990	20,583	2	2	0			
4	PVC	1990	43,836	2	2	0			
4	PVC	2000	7,145	1	1	0			
6	PVC	1990	7,704	2	2	0			
8	PVC	1990	10,434	2	2	0			

Water Line Assets									
Size (inches)	Material	Decade Constructed	Length (feet)	Condition ID	Performnce ID	Priority ID	WRIS PNum	Cost	Comment
Assessment Area: BUCKTRACK ZONE									
Up to 2	PVC	1990	34,779	2	2	0			
4	PVC	1990	132,997	2	2	0			
6	PVC	1980	2,888	3	2	1			
Assessment Area: DAVIESS TANK									
Up to 2	AC	1964	467	4	4	4		$ 35,025	
Up to 2	AC	1964	3	4	4	4		$ 225	
Up to 2	AC	2000	1,172	4	4	4		$ 87,900	
Up to 2	PVC	1980	85,740	3	2	1			
Up to 2	PVC	1990	25,863	2	2	0			
Up to 2	PVC	2000	20,461	1	1	0			
Up to 2	PVC	2010	2,117	1	1	0			
3	PVC	1980	25,337	3	2	1			
3	PVC	1990	5,947	2	2	0			
3	PVC	2000	3,133	1	1	0			
4	AC	1964	66	4	4	4		$ 4,950	
4	PVC	1980	141,603	3	2	1			
4	PVC	1990	51,182	2	2	0			
4	PVC	2000	32,881	1	1	0			
4	PVC	2010	2,786	1	1	0			
6	AC	1964	2,196	4	4	4		$ 164,700	
6	AC	1964	9,561	4	4	4		$ 717,075	
6	PVC	1980	71,553	3	2	1			
6	PVC	1990	25,729	2	2	0			
6	PVC	2000	3,394	1	1	0			
6	PVC	2010	4	1	1	0			
8	AC	1964	21,049	4	4	4		$ 1,578,675	
8	AC	1964	11,752	4	4	4		$ 881,400	
8	PVC	1980	1,344	3	2	1			
10	PVC	2000	33,708	1	1	0			
10	PVC	2010	1,308	1	1	0			
12	AC	1964	8,024	4	4	4		$ 601,800	
12	PVC	1990	6,425	2	2	0			
12	PVC	2000	4,656	1	1	0			

Water Tank Assets									
Asset Name	Capacity (gallons)	Date Constructed	Date Inspected	SCADA	Condition ID	Performance ID	Priority ID	WRIS PNum	Comment
Assessment Area: 141 ZONE									
HIGHWAY 141	100,000	12/30/1996	06/30/2003	Y	2	1	0		
Assessment Area: BLUEBERRY ZONE									
BLUEBERRY #2	500,000	09/01/2014	10/01/2015	Y	1	1	0		
BLUEBERRY HILL	300,000	12/30/1991	04/01/2013	N/A					Closed
SULLIVAN	161,000	12/30/1987	10/30/2012	N/A					Closed
Assessment Area: BUCKTRACK ZONE									
BUCK TRACK	60,000	12/30/1996	10/01/2012	Y	3	2	2		
Assessment Area: DAVIESS TANK									
DAVIESS	750,000	08/01/2000	09/01/2013	Y	2	1	0		
RALEIGH	80,600	12/30/1987	06/30/2012	N/A					Closed
Assessment Area: DEKOVEN ZONE									
DEKOVEN	100,000	12/30/1967	10/01/2013	N/A					Closed
Assessment Area: WAVERLY 1 ZONE									
WAVERLY 1	200,000	12/30/1993	06/30/2013	Y	2	2	0		
Assessment Area: WAVERLY 2 ZONE									
WAVERLY II	400,000	06/09/2009	06/09/2013	Y	2	1	0		

Pump Station Assets											
Asset Name	Capacity (gpm)	Hp	Pump Count	Motor Starter	SCADA	Condition ID	Performnce ID	Priority ID	WRIS PNum	Cost	Comment
Assessment Area: BLUEBERRY ZONE											
BETHEL CHURCH PUMP STATION	30	1	1	Booster	Y	2	1	0			
PRIDE PUMP STATION	250	7	2	VFD	Y	3	1	0			
Assessment Area: BUCKTRACK ZONE											
SPRING GROVE PUMP STATION	70	15	2	Contact	Y	2	1	2		$ 9,000	Motor starter upgrade
Assessment Area: DAVIESS TANK											
CITY PUMP STATION	720	75	2	VFD	Y	1	1	0			
GROVE CENTER PUMP STATION	70	15	2	Contact	N	3	1	2			Emergency use only
HWY 60 PUMP STATION	300	25	2	VFD	Y	1	1	0			
MCFALL PUMP STATION	30	1	1	Booster	N	2	1	0			
MINERVA LIMP PUMP STATION	90	5	1	Booster	N	2	1	0			
TERRY HILL PUMP STATION #1	60	5	1	Booster	Y	2	1	0			
TERRY HILL PUMP STATION 2	60	3	2	Booster	Y	2	1	0			
Assessment Area: DEKOVEN ZONE											
DEKOVAN PUMP STATION	30	1	1	Booster	N	3	1	0			
Assessment Area: WAVERLY 1 ZONE											
FLOURNOY PUMP STATION	350	20	2	Contact	Y	3	1	2		$ 9,000	Motor starter upgrade
WAVERLY PUMP STATION	500	30	2	Contact	Y	2	1	2		$ 9,000	Motor starter upgrade

The estimated $181,852 generated by the surcharge over 48 months is insufficient to replace the remaining AC pipe. The capital costs to replace the balance of the AC pipe after the proposed projects are completed is over $4,000,000.

Supervisory Control and Data Acquisition (SCADA) is another asset that is critical to water system operation and especially useful for leak detection. The UCWD storage tanks and pump stations are equipped with SCADA. The system only monitors/records tank level and pump station flow but lacks data analysis capability. Having the ability to analyze data gives the operator insight into system behavior, identify patterns, and implement proactive measures to prevent leaks and other issues.

Water Accountability Process

The goal of the water loss program is to reduce “unaccounted-for water” to below 15%. In doing so, real and apparent losses must be addressed. Real loss consists of physical water losses from leaks, line breaks, tank overflows, etc. that place a financial and operational burden on the utility. Apparent loss consists of unauthorized consumption, customer metering inaccuracies, and errors in the meter reading and billing processes. This can result in overtime and wasted hours testing for leaks that are not real.

Proper distribution management is the key to reducing water loss. The first step is to divide the system into distribution management areas (DMAs) which are manageable geographic regions within a pipe network where the flow of water can be controlled, measured, and analyzed separately. The main purposes of DMAs are to reduce water loss, improve water quality, and enhance overall network efficiency. Once the customer meters are validated within a DMA the demand factor will be assigned. The demand factor is a “theoretical” calculation of the expected flow in gallons per minute needed to satisfy customer demand. The objective is to obtain a baseline flow (gpm) within each zone to determine where real water loss occurs.

Once DMAs are created, an inventory and condition assessment of all infrastructure assets is conducted within the zone. Since UCWDs primary assets have been assessed the focus will be on secondary assets

such as valves, hydrants and meters. Each of these secondary features plays a role in controlling water flow, identifying water loss and locating the leak.

Valves:

1. Gate valves are used on water lines either in an open or closed position that controls the flow of water. Gate valves that do not close increases the search area for leak detection. Gate valves that do not seal when closed obscure or prevent the location of leaks.
2. Control valves are used to modulate flow and pressure. These valves range from simplistic check valves to complex multi-stage systems. In either case, when they fail or operate erratically, they tend to make it appear that a line is leaking. Tank control valves when failing can allow the tank to overflow.
3. Valves should be assessed on age, ease of movement, number of turns to close and sealing ability.
4. Control valves should be assessed on age, size, use (application), last service date and functionality.

Hydrants:

1. Hydrants are installed for two main purposes: water quality and fire protection. Hydrants are access points to the distribution system used to flush water from the pipe network to remove debris that accumulates over time and to stabilize disinfectant residuals. As access points, hydrants are used to test the hydraulic capabilities (flow and pressure) of the distribution system. Pressure monitoring can be used as an early warning system to detect water loss.
2. Hydrants that can supply adequate flow and pressure to sustain fire protection are a bonus to a rural community.
3. Hydrants should be assessed on age, barrel size, ease of opening, and weep hole drainage.

Meters:

1. Meters measure the volume of water. The two most important factors to meter accuracy is installation and whether it is the proper type and size for the application.
2. Master / zone meters are typically full pipe size that measure the flow and volume of water entering a distribution system or sub-system through a DMA. The volume of water passed through the zone meter over a period of time should closely total that of the customer meters in that area.
3. Customer meters within UCWD range from 5/8”x3/4” residential up to 6” industrial customers.
4. Meters should be assessed by installation date, size, use (application) and last test date.
5. Additional meter information that should be recorded during the assessment is the account number, meter serial number, brand and model. These data are critical to validating the meter to the customer information system.

Water District Improvements

- Distribution Management Areas: UCWD with assistance of Kentucky Rural Water Association (KRWA) staff has identified six DMAs to correspond with the active storage tanks. To create these hydraulically isolated areas, 20 non-functioning valves need to be replaced.

Action: Prioritize the DMAs and install the isolation valves and the zone meter. The zone meters should be full pipe size magnetic flow meters with cellular data so that flow can be transmitted to the operator throughout the day and trended over time.

- Data Management: UCWD has a skillfully created GIS base map. The point features (valves, meters, etc.) were located with high accuracy GPS however the condition assessments have not been completed. The water lines on the other hand have condition codes but the location of the lines are digitized relative to the valve locations.

  Action: UCWD will take advantage of the GIS based Asset Management (GIS-AM) program that is offered through the Division of Water's Small Disadvantaged Underserved Communities through a partnership with KRWA. With this GIS-AM program KRWA will convert the districts GIS data into a framework that promotes a sustainable system of data analytics to support operations, management and capital planning. The completed project will provide the district with an iPad to begin tracking system repairs and condition coding assets. This system should be integrated with high resolution GPS so that the operators can continue to improve the location of assets, especially the pipe network. The greatest impact the GIS-AM will have on water accountability is two-fold: 1) the meters can be validated monthly to the customer allowing the water usage within each DMA to be compared to the zone meter and 2) the demand factor calculation for each DMA is continuously refined.

- Infrastructure Improvements: Pump station motor control, SCADA and sub-zone metering points.

  Action: Upgrade the pump station motor controls to reduced voltage soft starters. They provide a gentle ramp up to full speed and are used to start and stop AC motors. Ramping up the initial voltage to the motor produces this gradual start/ stop that extends the life of the motor, reduces pressure spikes and decreases the stress on the pipe network. Professional installation will ensure that the soft start is properly sized and installed with surge protection.

  The SCADA system needs to be upgraded with data analysis capability to detect variations in flow rates, tank level, pressure, and other parameters. This early detection capability allows operators to identify leaks at their initial stages before they become major issues.

  Constructing sub-zone metering points within a DMA are useful for leak location and for data collection prior to placing a zone meter. These points are constructed meter boxes or small vaults that allow access to the water main to attach an ultrasonic flow meter. These meters are extremely responsive to changes in flow when conducting valve isolation to pinpoint water leaks.

- Leak Detection and Repair Equipment: The DMAs, zone metering and SCADA monitoring provide the operator with a birds-eye view of system performance and the ability to detect leakage within a specific area. Once the zone is identified for leakage the operator assembles a team to pinpoint the leak for repair.

  Action: Pinpointing a leak is aided by flow metering and acoustic listening devices. Leak repair is augmented by non-destructive excavation such as hydro-excavating. This reduces the damage to fragile infrastructure such as the AC pipelines and decreases the repair time since hydro-excavating is exempt from KY 811 notification. These units should be purchased with the optional integrated valve exercise machine. With this combination, the valve boxes can easily be cleaned and the valves properly exercised to remain functional.

Project Timeline

Short Term Goals (0-6 months) – 3% UAW reduction

1. Purchase leak detection equipment and with the assistance of Kentucky Rural Water, conduct a water audit and train district staff to utilize the leak detection tools.
2. Authorize KRWA to update the districts GIS data through the WIIN Grant Asset Management Program. UCWD will purchase a sub-foot grade GPS receiver and accessories to continue capturing assets.
3. Conduct an inspection of all meters and document the results with GIS.
4. Purchase and install VFDs for the Spring Grove, Flournoy and Waverly pump stations.

Medium Range Goals (0-18 months) – 3% UAW reduction

1. UCWD will prioritize the sequence for creating the first three DMAs and schedule the material purchase and installation of the valves and zone meters.
2. Continue with valve and hydrant condition assessments.
3. Implement SCADA upgrades to tanks and pump stations.

Long Range Goals (0-60 months) – 5% UAW reduction

1. Develop a capital asset plan for replacing the remaining AC pipe.
2. Schedule the material purchase and installation of the valves and zone meters for the last three DMAs.
3. Purchase towable hydro-excavator with integrated valve exerciser.

Project Cost

Estimated Project Cost		
Item	**Cost**	
Leak detection equipment	$	10,000.00
Sub-foot grade GPS / accessories	$	7,000.00
Pump Station soft starter and installation	$	27,000.00
SCADA upgrade	$	6,000.00
Mag-flow zone meters	$	25,000.00
Valves and installation	$	45,000.00
Towable Hydro-vac	$	65,000.00
Total	$	185,000.00