ALLEN COUNTY WATER DISTRICT
QUALIFIED INFRASTRUCTURE IMPROVEMENT PLAN

PURPOSE

On February 3, 2021, the Public Service Commission of Kentucky ("Commission") issued an Order in Case No. 2020-00296 directing Allen County Water District ("ACWD") to prepare an infrastructure plan that included an unaccounted-for water loss reduction plan. This document is submitted to response to that directive.

BACKGROUND

ACWD was established under KRS Chapter 74, providing retail service to approximately 5,809 customers and one wholesale customer in Allen County, Kentucky. ACWD was formed in 1974 as a result of the merger of North Allen Water District and South Allen Water District (Order of Allen County Fiscal Court, September 1974). ACWD is the one of two water systems in Allen County, with the City of Scottsville being the other. ACWD purchases all of their water from Glasgow Water Company ("GWC") and the City of Scottsville.

ACWD has experienced a higher than desired water loss in the last decade. As shown in Attachment 1 to this report, its annual water loss for the period from 2012 to 2021, ranged from 12 percent to 31 percent of total water produced. In 2019, ACWD assigned a group of employees to the Water Loss Team, with the responsibility of implementing water loss controls that were established with the Water Loss Control Program.

WATER INFRASTRUCTURE INVENTORY

A discussion of ACWD's asset inventory is set forth below. The inventory identifies all existing assets, their current condition and performance, the need or urgency to replace the asset, and the cost of replacement.

An asset's current condition is based upon the following scale:

1. New or Excellent – No or minor defects
2. Good – Defects are present but have not begun to deteriorate
3. Fair – Moderate defects that will continue to deteriorate
4. Poor – Severe defects that will have catastrophic failure in the near future
5. Inoperable – Asset is not operational

An asset's evaluated current performance is based on the following scale:

1. Exceeds and/or meets all existing and future performance targets
2. Meets all existing performance targets with only minor deficiencies
3. Considerable performance deficiencies
4. Significant performance targets
5. Does not meet performance targets

The priority that ACWD has assigned to an asset's replacement is:

0. Not a priority to replace
1. Needed but not required at this time
2. Replacement will improve operations and maintenance
3. Operational concern and/or public nuisance
4. Potential public health or safety concern
5. Existing threat to public health or safety

Booster Pump Stations – ACWD's water distribution system currently has four (4) booster pump stations. Each station is equipped with two pumps and three of the stations have permanent on-site emergency generator with the exception being Red Hill BPS. Two of the booster pump stations are graded as being in poor operational condition. The Red Hill BPS and the Maysville Road BPS are below grade stations and have significant safety concerns with confined space entry as well as potential for electrical injuries. Currently, Red Hill BPS is only used in specific conditions that require additional flows to fill the Walker's Chapel Tank. ACWD is currently having various improvements made to Halfway BPS that will eliminate the need to continue the operation of the Red Hill BPS once those improvements are completed. As shown in Table 1, booster pump stations highlighted in yellow are either in poor condition, a potential public health or safety threat, or have internal safety concerns.

All of the booster pump stations lack variable frequency drive ("VFD") systems with the exception of the 31-E BPS. As a result, during start-up and shutdown sudden pressure spikes may occur causing adversely affect water mains. Repeated pressure spikes over time can weaken water mains and increase the frequency of leaks and breaks. ACWD plans to add VFD systems to all existing booster stations to eliminate the repeated pressure spikes while also improving operations, maintenance and reducing electrical consumption.

Table 1 – Booster Pump Stations

Asset Name	Pump Count	Condition Code	Performance Code	Priority Code	Replacement Cost
31-E BPS	2	2	2	3	$ 900,000.00
Halfway BPS	2	2	1	0	$ 800,000.00
Red Hill BPS	2	2	2	5	$ 300,000.00
Maysville Rd BPS	2	3	3	5	$ 400,000.00

Distribution System – ACWD currently utilizes six (6) pressure zones ranging in hydraulic grade lines from 930 MSL to 1070 MSL. ACWD currently has 2,553,207 linear feet of water mains within their service area. These water mains were initially installed at the creation of the ACWD in the 1970s and as the distribution system expanded over time from the district's inception. Future expansion will be due to infill within the boundaries of ACWD's service area due to development of land. Currently, ACWD is seeing approximately 100-200 new meters set each year.

ACWD's distribution system is relatively new (less than 40 years) but has several areas that are undersized for the current and future demands due to changes in land use within the service area.

These land uses will require ACWD to install larger water mains to improve service (volume and pressure). The older areas of the distribution system are generally located in the northern and northwest portions of the distribution systems. The ages of water mains are based upon record drawings and/or Kentucky Infrastructure Authority WRIS portal. As shown in Table 2, approximately 97 percent of its mains have been in service for 20 years or longer.

Table 2 – Distribution System Pipe Age

Decade	Mains (Linear Feet)	Percentage of Pipe
1970	1,323,515	52%
1980	518,761	20%
1990	226,008	9%
2000	416,289	16%
2010	68,632	3%

The majority of ACWD's water mains are 6-inch and less in diameter. In time, the district has seen growth that has led to changes in usage and land use of several areas within their distribution system. ACWD has seen that several of the pressure zones are predominately composed of water mains with diameters 4-inch or less, which greatly limits the ability to meet future demands. Table 3 displays the lengths of water mains within ACWD's distribution system. Approximately 89% of ACWD's water mains are 6-inch or less.

Table 3 – Distribution Main Size

Diameter	Mains (Linear Feet)	Percentage of Pipe Diameter
2-inch or less	33,749	1.3%
3-inch	239,783	9.5%
4-inch	1,473,814	58.1%
6-inch	514,047	20.3%
8-inch	94,047	3.7%
10-inch	17,831	0.7%
12-inch	161,675	6.4%

ACWD has begun to monitor work orders related to leaks on main lines throughout the system. Once a particular water main has repeated repairs (three times in a six-month time frame) then the line is marked for replacement. Since this system has been adopted, ACWD has replaced three

creek crossings that were problematic and the source of previous water loss due to their failures.

With the continued growth of the ACWD customer base, it is becoming paramount for smaller diameter mains be replaced to allow for the level of service to be maintained or in certain situations be improved.

The HWY 98 PZ and Glasgow PZ are two areas that have shown the greatest growth area in the recent years. These two pressure zones are located around the Barren River Lake where residential growth has been extremely strong in the last decade and is expected to continue for the foreseeable future. This area also has an extensive amount of 4-inch or less water mains. With future growth, the 4-inch or less water mains will not be able to deliver the necessary water and pressure as required.

The US 231 PZ is also expected to have significant growth but this PZ has already had many upgrades to handle the newly constructed industrial parks, residential subdivisions and altered operations of the distribution system.

Storage Tanks – ACWD's distribution system has five (5) storage tanks with a total storage capacity of 2.3 million gallons. The largest of these tanks is the US 231 Elevated Tank, which was constructed in 2020 and has a storage capacity of 500,000 gallons. Table 5 shows the complete assessment of ACWD's storage tanks. It identifies the Walker's Chapel and KY 1421 tanks as having moderate defects and considerable performance deficiencies, that should be scheduled for rehabilitation or replacement. ACWD has already submitted a project profile for the replacement of Walker's Chapel (WX21003029).

Table 4 – Water Storage Facilities

Storage Tank Name	Capacity (gallons)	Date Constructed	Condition Code	Performance Code	Priority Code	Replacement Cost
HWY 98	300,000	1995	1	3	0	$ 850,000
US 231	500,000	2020	1	1	0	$ 1,250,000
Walker's Chapel	170,000	1989	3	4	2	$ 750,000
KY 1421	230,000	2001	2	4	2	$ 800,000
Amos	165,000	1985	1	2	0	$ 750,000

WATER LOSS CONTROL PROGRAM

ACWD in 2019 determined that it was necessary to formally establish standard operating procedures (SOP) to help identify, locate and repair sources of water loss. ACWD commissioned Bluegrass Engineering, PLLC with developing a Water Loss Control Program (WLCP) to set forth the SOPs to reduce water loss, see Attachment 2. The report was never "officially" adopted by the board but it was implemented through the actions of ACWD. All of the short-term recommendations contained within th WLCP have been implemented by ACWD and ACWD staff are currently following the long-term recommendations to identify, locate and repair sources of water loss.

Since the draft report was provided to the board for discussions, several expenses have been

attributed to ACWD's pursuit of reducing water loss. ACWD has conducted the following programs to reduce water loss that were expenditures outside of their normal operating budget: installation of pressure zone meters, daily processes to document flows for establishing metrics to determine location of leaks, replacement of known water mains with leaks and switched meter manufacturer to increase low flow readings and higher overall recording accuracy. All of these program costs were covered by ACWD general funds and have resulted to lower water loss, see Attachment 3.

ACWD installed three zone meters in May of 2019 for a total cost of $38,500 ($23,500, installation and $15,000 material costs). ACWD utilized existing zone meters with the newly constructed zone meters to collect data to establish normal usage metrics from daily readings. ACWD also designated each account based upon the pressure zone being served. With the zone meter readings and having all accounts sortable based upon pressure zone, usage within a pressure zone could be calculated and monitored to help detect a possible source of water loss.

Once the zone meters were set in place and fully operational, staff recognized that a large leak was occurring and needed to be discovered. Staff began step down valving of the Glasgow Pressure Zone and discovered that the 12-inch transmission main between the Glasgow Purchase Points and the 31-E booster station was the source of the leak. Staff began walking the lines and discovered a large leak that was discharging at a creek bank and never "daylighting". In June of 2021, ACWD authorized the replacement of the 12-inch water main. During construction activities, two additional leaks were discovered upstream of the original leak. All of the sources of water loss were repaired and immediately water purchased decreased by nearly 1.00 MG per month beginning in August of 2021. Total project cost of the replacement was $133,863.

During the process of designating each account based upon location within the pressure zones, it was discovered that the staff were having an unusual amount of "no read" meters. These "no read" meters are a source of apparent water loss, not actual water loss. The district was delivering water to the point of sale but it was not being registered as being sold, increasing the water loss percentage. The ACWD Board and Water Loss Team recommended to implement the random testing of meters to determine the accuracy of meters that have not yet reached the replacement age of ten years of service. The random testing of residential meters determined the long-term viability of their existing meters as outlined in the WLCP. This program randomly pulled a total of sixty-nine residential meters of varying ages to be tested for accuracy pursuant PSC regulations. The tests yielded results that showed the current meters are a source of water loss for under registering water use.

Table 5 – Residential Water Meter

Meter Age	# of Meters Tested	Low Flow (1/4 gpm) Slow/Accurate/Fast	Intermediate Flow (2 gpm) Slow/Accurate/Fast	Maximum Flow (15 gpm) Slow/Accurate/Fast
1-Year	20	50%/50%/0%	30%/70%/0%	0%/70%/30%
4-Year	24	79%/21%/0%	25%/71%/4%	4%/79%/17%
6-Year	26	39%/61%/0%	4%/88%/8%	4%/77%/19%

After the reliability testing was completed, the board and staff determined that it was a necessity for the district to move to a more reliable manufacturer of retail meters. The staff reviewed various different meter manufacturers to find a balance of cost versus accuracy, low flow capability and options. ACWD is currently replacing all of their existing meters in an accelerated time frame (less

than the PSC regulated 10-year cycle) to help remove failing meters and apparent water loss. Any meter that is a “no read” meter is immediately switched out.

ACWD has also began to look at water loss percentage on a running 12-month average instead of a month-to-month basis due to the difference in when meters are read. Currently, GWC reads the master meters at the end of the month, the City of Scottsville reads their master meter on the first of the month and ACWD reads their master meters and retail meters beginning on the 18th of each month. These differences in dates of meter reads leads to a misrepresentation of the percentage of water loss. The fluctuations in water loss percentages month to month are unavoidable unless the date of all meters is conducted on the same day. A running 12 months average indicates a reduction in water loss has been achieved by the ACWD since implementing the measures set for in the WLCP, see Attachment 3.

To date ACWD has expended a total of $187,963.00 in measures to remove water loss, see Table 6. The results of these efforts can be demonstrated since August 2021 water loss calculations.

Table 6 – Qualified Infrastructure Previous Expenditures

Project	Project Description	Project Cost
31-E Emergency Repairs	Replaced approximately 1,500 LF of 12-inch water main that had significant water leaks.	$ 133,863.00
Pressure Zone Meters	Installation of pressure zone meters to help locate potential sources of leaks.	$ 38,500.00
Water Meter Replacement	Replacement of failed customer water meters.	$ 15,600.00
Total – Qualified Infrastructure Expenditures		$ 187,963.00

ACWD also has several branch lines off of the HWY 101 water main (HWY 98 PZ) that have pressures that reach over 200 psi as the roads descend toward the lake, creeks and/or hollows. Pursuant to AWWA, pressure reduction is a reliable source of water loss reduction. These five (5) branch lines pressures should be reduced to reduce existing water loss and potential water loss in these areas. It is estimated that each pressure reducing station would cost approximately $25,000 for a total of $125,000.00.

Another potential source of water loss is the 1970s era water transmission main that delivers water from the purchase point at the Barren River State Park. This line has already been a source of water loss based upon the emergency repair made along 31-E in 2021. There is approximately 10,000 LF of this line currently in service. The project cost to replace this line is $1,250,000.00. This could be handled in smaller projects as funds allow or public funding could be sought.

Future water loss projects are estimated at $1,375,000.00 for additional funding sources.

Table 7 – Qualified Infrastructure Future Expenditures

Project	Project Description	Project Cost
Meter replacement (on going)	Installation of new radio read ultrasonic meters.	$ 1,575,000
Pressure Reducing Station	Installation of pressure reducing stations on five branch lines.	$ 250,000
Replacement of 1970's water transmission main	Installing a new transmission main from the existing State Park Master Meter.	$ 2,900,000
Total – Qualified Infrastructure Future Expenditures		$ 4,750,000

CAPITAL IMPROVEMENTS – WATER LOSS

ACWD has two 12-inch transmission mains that are feed off of GWC purchase points in the northeastern portion of the distribution system. One of these mains was installed in the 1970s and has recently had a section of it replaced due to pipe leaks. This transmission main is laid at the bottom of the Barren River Lake and has previously been repaired. This portion of the system should be slated for replacement due to recent failures and the critical nature of the main. This project would run a new transmission main across the lake via directional drill methods or by sinking a new main to the bottom of the lake.

The district is also considering installing retail meters with the capability for Radio Read functionality to reduce manhours associated with meter reading. Currently, the district staff are reading meters for five days with four staff members for a total of 20 workdays each month. If this project is implemented it would allow for more time spent monitoring the water loss, fixing leaks and potentially installing additional water main extensions. The new metering system also has added value features of leak detection, data logging and communication capabilities depending upon which system was selected to be implemented. This would help assist the district in reducing water loss and increasing overall revenues in the future.

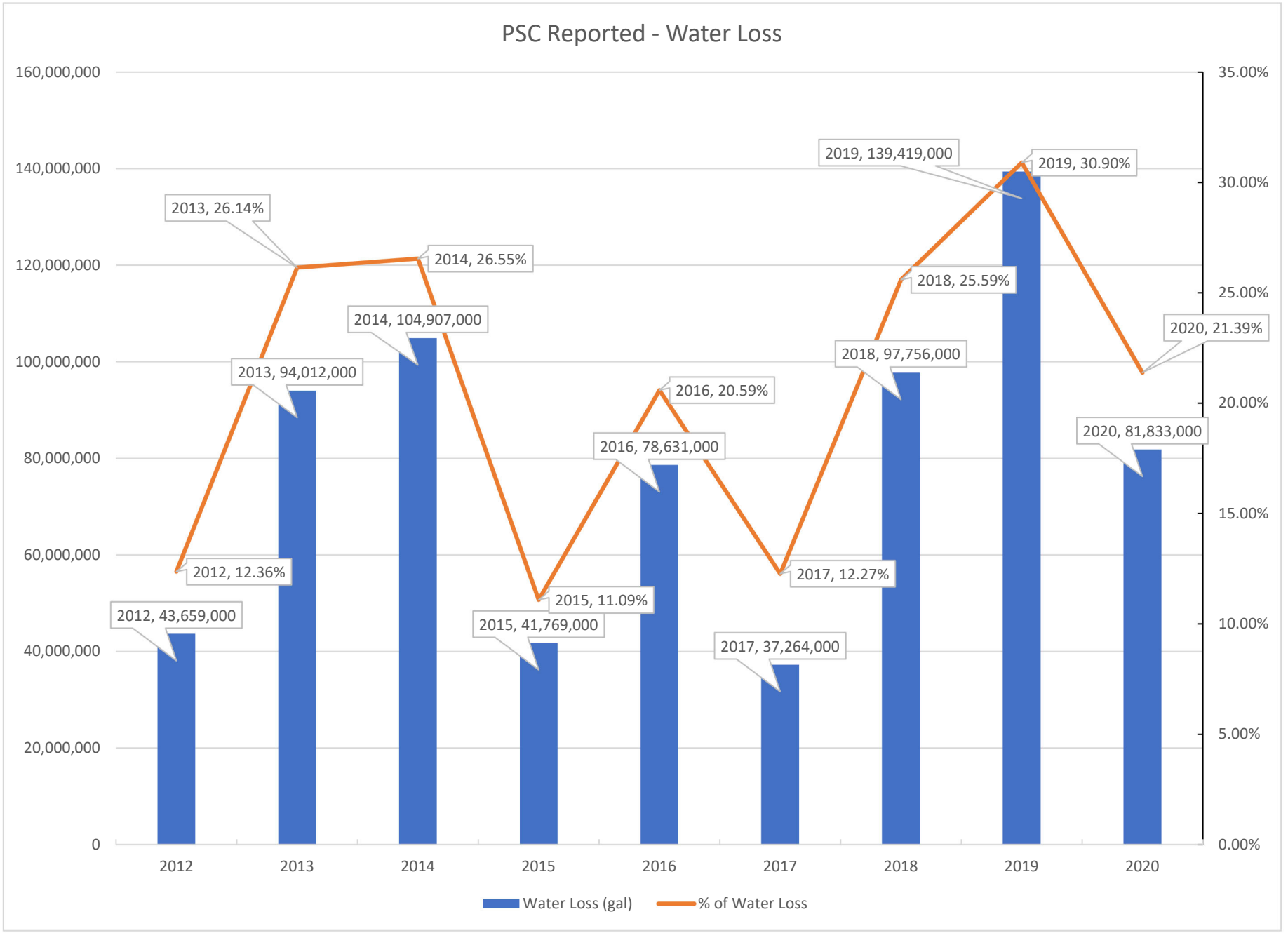
CONCLUSION

ACWD has been proactive in their pursuit to reduce water loss prior to the PSC Case No. 2020-00296 in establishing a water loss team, a Water Loss Control Program and implementing changes as necessary to reduce water loss. ACWD will continue to face challenges regarding water loss as their system ages. ACWD wishes to utilize the Water Loss Surcharge to reimburse themselves for expenses already incurred as outlined in Table 6 and any remaining funds be used to expediate the replacement of retail meters (see Table 7).

The remaining projects that are deemed water loss capital projects are significantly more expense than the money that will be collected for the water loss surcharge and will require funding from KIA, USDA Rural Development or other source. The remaining projects will become necessary in time as water loss increases outside a tolerable margin.

ATTACHMENT 1
HISTORICAL WATER LOSS

Attachment 1



ATTACHMENT 2
WATER LOSS CONTROL PROGRAM

Attachment 2

ALLEN COUNTY WATER DISTRICT

WATER LOSS CONTROL PROGRAM

MARCH 2019

Updated April 2022

Prepared By:

BLUEGRASS ENGINEERING PLLC
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APPENDICES

SECTION 1: EXECUTIVE SUMMARY

I. Purpose

The Water Loss Control Program (WLCP) was commissioned by the Allen County Water District (ACWD) board to reduce the water loss and proactively address pending orders from the Public Service Commission (PSC). The ACWD has determined it to be in their best interest to be proactive and establish set protocols to help determine steps to improve operations by reducing water loss.

The purpose and scope of the Water Loss Control Program includes the following:

- Examine the existing distribution system facilities and make recommendations for determining how to identify water losses with current operations.
- Make recommendations for improvement in operations that will reduce water loss and provide data for examination by staff on a regular basis to control water loss.
- Establish protocols for monitoring water loss within each pressure zone and the entirety of the distribution system.

II. Existing Conditions

ACWD's distribution system is operated and maintained in a good condition. Booster stations run time(s), tank levels and master meter(s) are tracked on a daily basis and recorded by field personnel. This data is collected but it is not monitored for long term trends and possible indicators of stresses upon the distribution system. As far as monitoring water loss, the ability to monitor the distribution system is minimal. The operators of the system have few "tools" to indicate the sources of water loss. The distribution system is operated with telemetry controlling the booster station operations but to our knowledge it is used as a snapshot in time and not an indicator of water loss. The two known "system" master meters are not accurate based upon comparison to tank fill times and the Glasgow Water Company (GWC) master meters.

III. Recommended Actions

This report examined the existing condition of the distribution system in regards to water loss. The WLCP examined billing data between 2016-2018 looking for patterns of usage and areas in which water loss can be reduced. The following recommendations to improve water loss are based upon examining MORs, SCADA Data, review of procedures of operation and utilizing AWWA M36 – Water Audits & Loss Control Programs.

Recommended actions have been broken down to short-term and long-term recommendations, due to the degree of time required to implement, whether Division of Water/Public Service Commission review would be required and cost associated with the recommendation(s).

Short-Term Recommendations

1. Read the GWC and City of Scottsville master meters daily.

2. ACWD should determine the discrepancy between the master meter at the 31-E booster station and the purchase point with GWC.

3. All master meters, booster station run times and tank levels should be read and recorded daily.

4. Customer accounts need to have a code added to the account to designate the pressure zone where water service is provided from. This will allow for reports from the existing billing software to pull specific usage within the pressure zone for comparison of the master meters.

5. ACWD staff should keep all water (purchased/sold) usage records in a spreadsheet for comparison to previous data.

6. ACWD could monitor and track tank and booster station operating metrics (tank levels, time to drain the tank, pump run time and flowrates, etc.) to determine if a portion of the system is requiring additional volume of water than normal.

7. ACWD should pull residential meters, randomly to determine the water loss occurring due to the age of the meters and total flow having passed through the meters. This will help determine the age in which the existing meters should be replaced due under recorded flows.

8. Install master meters with telemetry capabilities at the entrance and exits of all pressure zones. All master meters shall be read and recorded daily the flow rates for comparison to previous usage.

Long-Term Recommendations

1. If a pressure zone has a repeated history of water loss, ACWD staff or third-party contractor should conduct a step-down valve isolation during night time to locate the source of water loss.

2. ACWD could hire a third party to begin a leak detection program for areas where a leak is known to exist but can not be located via other means and methods.

3. ACWD should consider install flow sensing pressure reducing valves to lower pressures during low flow time periods. Lower pressure during low flow times have shown a reduction in water loss.

4. ACWD needs to determine if there are sections of the distribution system that has a high repair history. If there are sections of the distribution system that are the source of repeat repairs, it might warrant further examination for replacement of the entire section due to the repeated repair work.

IV. Estimated Cost

Costs of the associated recommendations are extremely dependent upon the specifics of the task/project. The costs associated below are estimates in the scope of this report and further consideration must be made in the future to establish construction and project budgets.

These costs can be offset by the potential savings from reducing water loss to acceptable levels. The average water purchased for the 2017-2018 years was 364 MG from GWC and City of Scottsville. The average water loss was 24% over the previous two years. Table 1.1 summarizes the amount of water recaptured and money saved by reducing water loss.

Table 1.1
Cost of Water Loss

Water Purchased (MG)	Percent of Water Loss	Water Loss (MG)	Target Percent of Water Loss	Water Loss (MG)	Money Saved[1] ($ 1,000s)
364	22%	80	15%	55	$ 47
365	26%	95	15%	55	$ 76
366	30%	110	15%	55	$ 105

Note:
[1] Money saved is calculated based upon difference between water loss (actual water loss %) minus water loss (target water loss %) divided by 1,000 multiplied by $1.95/1,000 gallons.

Short-Term Recommendations

The majority of short-term recommended actions are modifications to existing protocols currently in place and would incur minimal costs. These recommendations that have minimal costs include #1-5.

Short-term recommendation #7 would require the purchase of new residential meters to replace the existing meters. The anticipated costs for #7 meter validation of accuracy would include the cost of a new meter, installation of meter and testing of the pulled meter, as required by PSC and has an estimated cost of $10,000. Depending upon the margin of error the board is willing to determine is acceptable will greatly affect the cost of this recommendation. See Table 1.2 for a summary of the required number of meters to be pulled at each meter age.

Table 1.2
Meters to be Tested

Meter Year	Total Number of Meters	Margin of Error (%)		
		10 +/-	15 +/-	20 +/-
2022	537	82	40	23
2025	617	83	40	23
2028	709	85	40	23
Totals	1,863	250	120	69

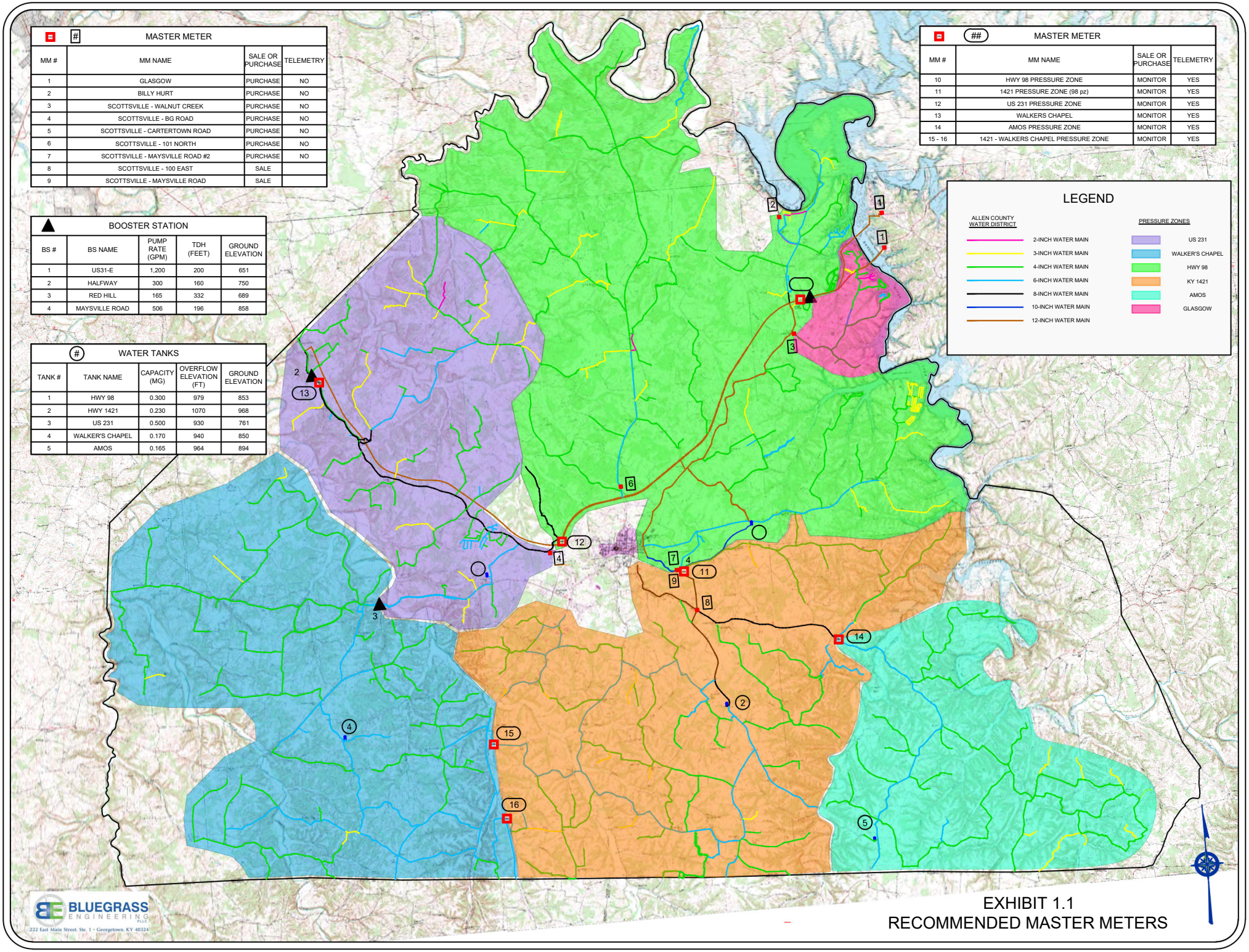
We feel that although a margin of error of 20 +/- is high it is cost effective to test these first and then expand the pulling of meter until the we have confidence in the results.

Short-term recommendation #8 would have construction costs associated to install new master meter vault and telemetry RTU. This recommendation would allow for a better understanding of where water is entering a pressure zone in comparison to water that is being sold within the pressure zone and if water is being transported to the next pressure zone. In our opinion this is critical to allow ACWD staff to pin point the area in which water loss is occurring. Based upon the review of the system mapping with staff we anticipate needing four (4) master meter sites while utilizing some existing master meters. The associated cost of this project is estimated to be $30,000 per new master meter site and $15,000 per existing site to add telemetry.

Long-Term Recommendations

The majority of long-term recommendations are open ended projects that until the specific project scope (time frame, project area, etc.) is determined then a cost cannot be assigned for each of the recommendations.

Kentucky Rural Water Association provides a service for searching for water loss for a fee. There are other entities that provide a similar service as KRWA and have a proven track record at identifying leaks for repair.



MASTER METER			
MM #	MM NAME	SALE OR PURCHASE	TELEMETRY
1	GLASGOW	PURCHASE	NO
2	BILLY HURT	PURCHASE	NO
3	SCOTTSVILLE - WALNUT CREEK	PURCHASE	NO
4	SCOTTSVILLE - BG ROAD	PURCHASE	NO
5	SCOTTSVILLE - CARTERTOWN ROAD	PURCHASE	NO
6	SCOTTSVILLE - 101 NORTH	PURCHASE	NO
7	SCOTTSVILLE - MAYSVILLE ROAD #2	PURCHASE	NO
8	SCOTTSVILLE - 100 EAST	SALE	
9	SCOTTSVILLE - MAYSVILLE ROAD	SALE	

BOOSTER STATION				
BS #	BS NAME	PUMP RATE (GPM)	TDH (FEET)	GROUND ELEVATION
1	US31-E	1,200	200	651
2	HALFWAY	300	160	750
3	RED HILL	165	332	689
4	MAYSVILLE ROAD	506	196	858

WATER TANKS				
TANK #	TANK NAME	CAPACITY (MG)	OVERFLOW ELEVATION (FT)	GROUND ELEVATION
1	HWY 98	0.300	979	853
2	HWY 1421	0.230	1070	968
3	US 231	0.500	930	761
4	WALKER'S CHAPEL	0.170	940	850
5	AMOS	0.165	964	894

MASTER METER			
MM #	MM NAME	SALE OR PURCHASE	TELEMETRY
10	HWY 98 PRESSURE ZONE	MONITOR	YES
11	1421 PRESSURE ZONE (98 pz)	MONITOR	YES
12	US 231 PRESSURE ZONE	MONITOR	YES
13	WALKERS CHAPEL	MONITOR	YES
14	AMOS PRESSURE ZONE	MONITOR	YES
15 - 16	1421 - WALKERS CHAPEL PRESSURE ZONE	MONITOR	YES

LEGEND

ALLEN COUNTY WATER DISTRICT

- 2-INCH WATER MAIN
- 3-INCH WATER MAIN
- 4-INCH WATER MAIN
- 6-INCH WATER MAIN
- 8-INCH WATER MAIN
- 10-INCH WATER MAIN
- 12-INCH WATER MAIN

PRESSURE ZONES

- US 231
- WALKER'S CHAPEL
- HWY 98
- KY 1421
- AMOS
- GLASGOW

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EXHIBIT 1.1
RECOMMENDED MASTER METERS

SECTION 2: PURPOSE & OBJECTIVES OF WLCP

I. History

Allen County Water District was established in 1974 by the Judge Executive of Allen County under KRS 74:010 to merge the two existing water districts in Allen County; North Allen Water District and South Allen Water District to provide potable water service to citizens of Allen County. ACWD is controlled by five commissioner who are appointed by the Allen County Judge Executive. The board meets regularly on the first Tuesday of each month at the offices located on New Gallatin Road.

II. Purpose & Objectives

The Water Loss Control Program (WLCP) was commissioned by the Allen County Water District (ACWD) board to identify and reduce the water loss and proactively address pending orders from the Public Service Commission (PSC). The ACWD has determined it to be in their best interest to be proactive and establish set protocols to help determine steps to improve operations by reducing water loss.

The purpose and objectives of the WLCP includes the following:

- Examine the existing distribution system in regards to water loss.
- Determine the impact of water loss upon the financial and operational viability of ACWD by following AWWA Water Audit software.
- Identify opportunities for improvement to reduce water loss in standard operating procedures, administration activities, operational activities and maintenance activities.
- Present the recommended actions to reduce water loss and the costs associated with those actions.

SECTION 3: EXISTING WATER DISTRIBUTION SYSTEM

I. Water Distribution System

Allen County Water District was established in 1974 and has expanded their distribution system to serve approximately 95% of Allen County residents within their territorial boundaries. ACWD purchases all of the potable water supplied to their customers from Glasgow Water Company (GWC) and the City of Scottsville. GWC is the primary source of potable water for ACWD. A few areas of ACWD's distribution system are fed directly from Scottsville via master meters. The distribution system operates under a pump and fill cycle with booster stations pumping into the next pressure zone to fill storage facilities.

The water distribution system is divided into pressure zones. Pressure zones are defined by the facilities that provide the pressure within it's boundaries. ACWD currently has six (6) pressure zones. These pressure zones take the name of the storage facility that provides the pressure (i.e. KY 98 pressure zone is served by the KY 98 storage facility). Figure 3.1 displays the physical boundaries of the pressure zones. Figure 3.2 shows a generalized schematic of how water flows throughout ACWD's system.

Table 3.1
Summary of Distribution System

Pressure Zone Name	Hydraulic Grade Line (feet)	# of Customers	Length of Waterlines (miles)
Glasgow	920	154	25
KY 98	979	1,817	145
KY 1421	1070	1,521	100
Amos	964	235	51
Walkers Chapel	940	789	124
US 231	930	1,258	50

Allen County Water District purchases the majority of their water from Glasgow Water Company via master meters located just past the northeast county line of Allen/Barren County at Barren River Lake. Water enters the Glasgow PZ via two master meters (Glasgow and Billy Hurt) and serves the rest of ACWD system with the exception of the two areas where water is purchased from the City of Scottsville (Walnut Creek and Maysville Road). From the Glasgow PZ the US 31-E booster station pumps water to the HWY 98 PZ. Currently, the HWY 98 PZ flows water via gravity to the US 231 PZ filling the US 231 tank and supplying the Maysville Road BPS that transports water to the 1421 PZ and Amos PZ filling their respective storage facilities.

The distribution system is in overall good operating condition. The topography of ACWD's distribution system is rolling to hilly with lower elevations in valleys and near creek crossing. The varying topography leads to a wide range of pressures 40 – 200 psi within the distribution system. This wide range of pressure can lead to a higher than desired water loss, as with higher pressures will lead to higher water loss.

The ACWD distribution system has very limited sources of emergency connections with surrounding utilities. ACWD has a total of 5 purchase points with the City of Scottsville, with only the Walnut Creek connection is utilized on a daily basis for regular service. Beyond the connections with the City of Scottsville, ACWD does not have any other connections to other water utilities.

II. Storage Facilities

ACWD operates five (5) storage facilities within their distribution system. The ground storage tanks are glass lined tanks with the exception of the Amos Tank and have had repair work conducted to address leakage at the seams. Based upon the latest tank inspections it has been determined that the Walker's Chapel and KY 1421 should be scheduled for replacement or major rehabilitation due to previous attempts to address corrosion and coating failures. ACWD has discussed the desire to replace the ground storage tanks with elevated tanks due tank turnover, improving pressures and address the leakage.

Table 3.2
Summary of Storage Facilities

Storage Facility Name	Facility Type	Volume (MG)	Overflow Elevation (feet)
KY 98	Elevated	0.300	979
KY 1421	Ground	0.230	1070
Amos	Ground	0.165	964
Walkers Chapel	Ground	0.179	940
US 231	Elevated	0.500	930

All of the tanks are in good operating conditions, with the exception of Walkers Chapel and KY 1421, as discussed above. HWY 98 tank received a new coating system in 2018. The US 231 tank has been in service less than two years. Tanks are inspected and cleaned according to PSC regulations by a third-party contractor.

III. Booster Station

ACWD currently operates four (4) booster stations: 31-E, Halfway, Red Hill and Maysville Road. Each of the booster stations has telemetry and are controllable remotely if necessary.

The 31-E and Halfway booster stations are in good condition. The Red Hill and Maysville Road booster stations are below grade stations and are in fair operating condition. The Halfway BS is currently be utilized to transport water to the Walkers Chapel tank with Red Hill BS only be placed into service during high usage time periods.

In 2017, ACWD had improvements made to the 31-E BS to allow for the HWY 98 storage facility to be recoated. 31-E has the ability to operate as a constant run booster station or pump and fill booster station, as conditions warrant.

ACWD staff has expressed a desire to replace the below grade booster stations with above grade stations for easier preventative maintenance and safety in egress/ingress.

Table 3.3
Summary of Booster Stations

Booster Station Name	Booster Station Type	Pumping Rate (GPM)	Total Head (feet)	Ground Elevation (feet)
31-E	Above Ground	1,200	200	651
Halfway	Above Ground	300	160	750
Red Hill	Below Ground	###	###	964
Maysville Road	Below Ground	350	235	940

IV. Customers

The vast majority of customers of Allen County Water District are citizens of Allen County. The majority of the ACWD customer base is a mix of primarily residential with agricultural farms and commercial customers. ACWD averages approximately 5,800 customers. Figure 3-2 displays the customer base in relationship to the pressure zone that supplies water service.

ACWD also sales water to Scottsville at two sources where the city can not supply adequate pressures and is in close proximity to ACWD's distribution system. Figure 3-3 displays the purchase/sale points of the ACWD system. The average monthly usage for a customer in ACWD's distribution system is approximately 4,200 gallons per month.

V. Water Usage

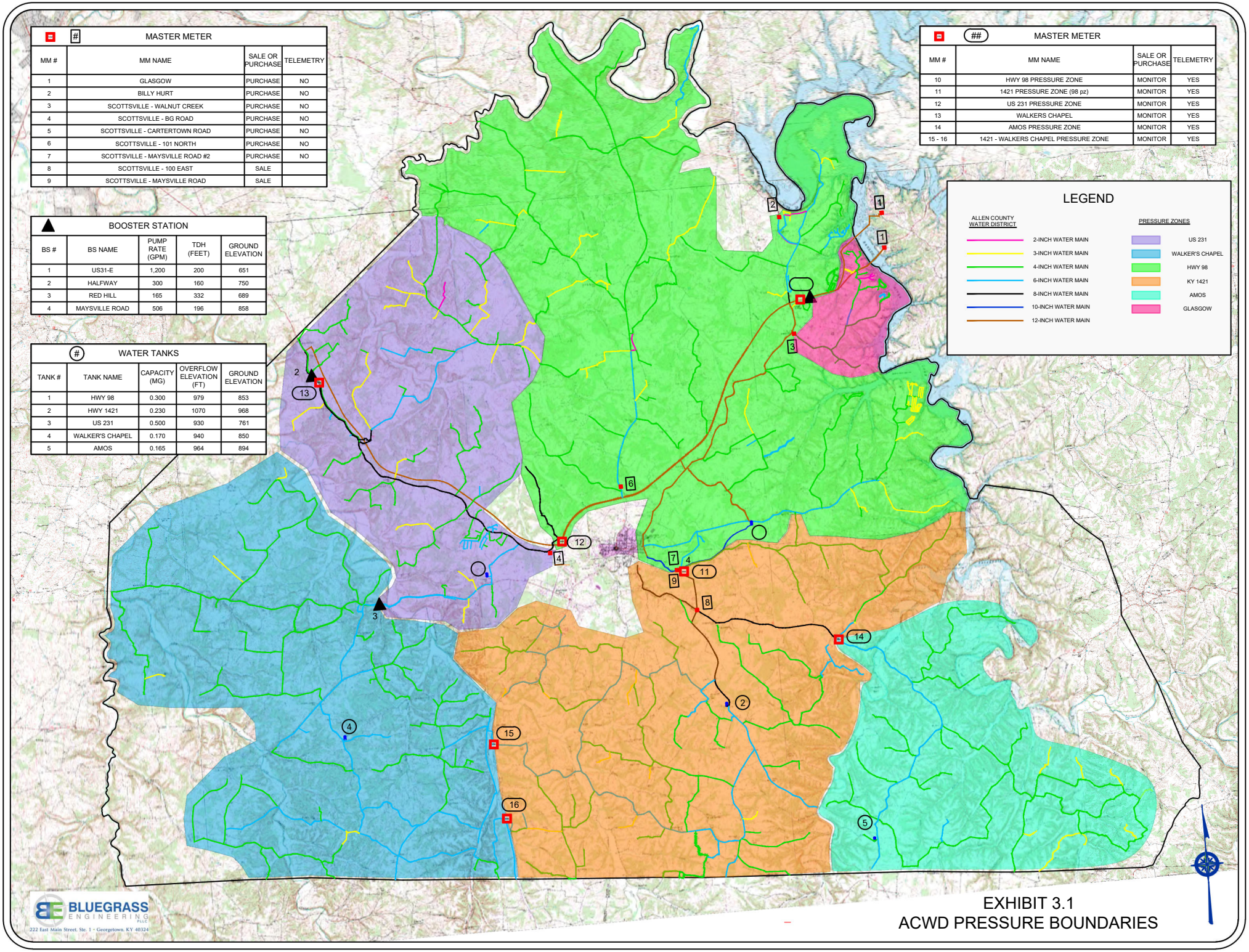
Allen County Water District purchases all of the water that is supplied to their customers either from Glasgow Water Company or the City of Scottsville. Being a non-producer of water each gallon of water that is registered at the purchase point must be paid for. This forces the staff of ACWD to focus on breaks on an immediate manner to reduce lost revenue.

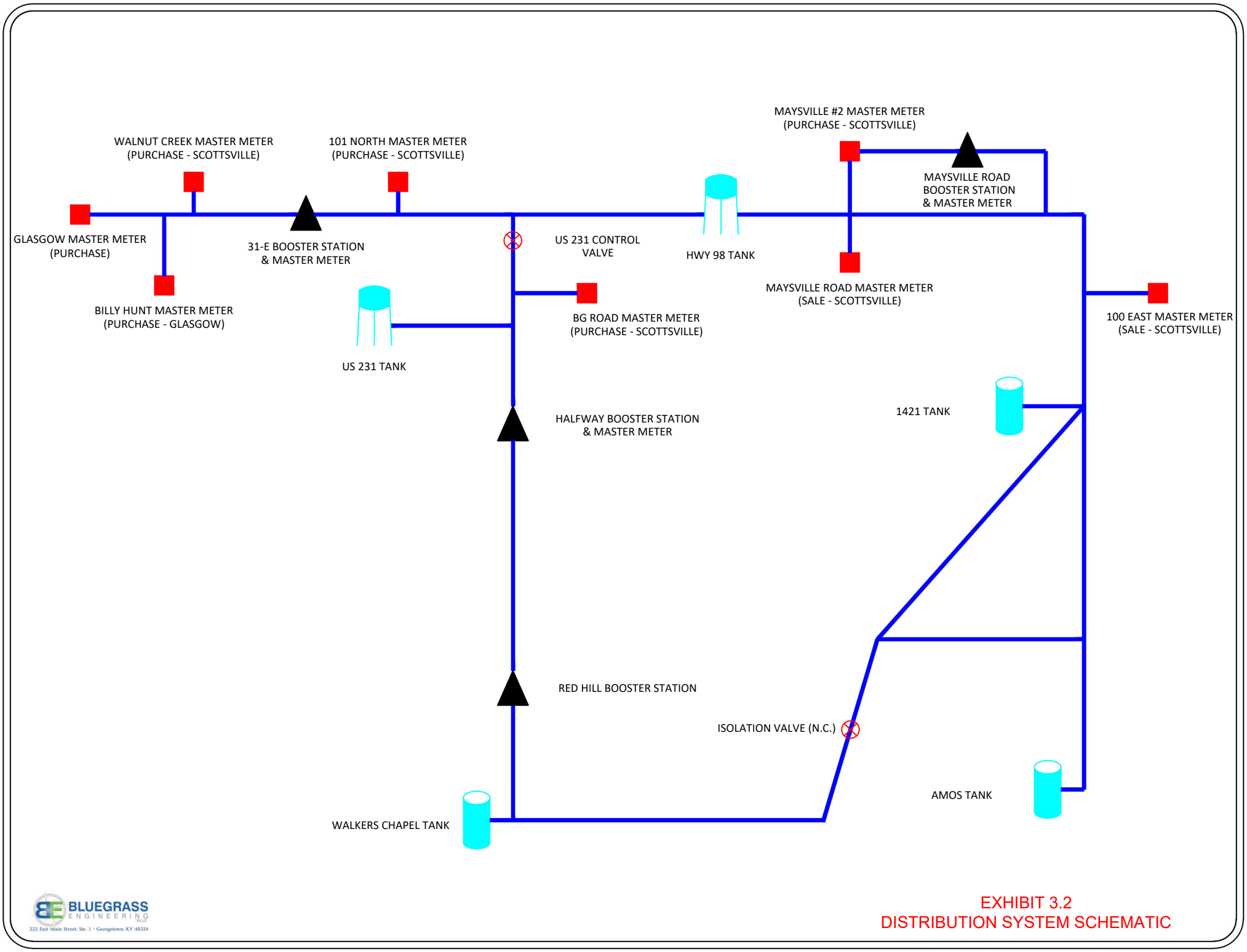
Previously ACWD was reading two separate master meters (GWC purchase points and at the 31-E booster station) that had a large discrepancy that greatly altered the water loss calculation. Looking at MORs (GWC and ACWD) and water consumption for the previous two years (2018-2017) and are summarized in Table 3.4. For a month to month comparison see Appendix B. As discussed elsewhere within the report, it has been determined that the discrepancies between the master meters of ACWD and GWC are significant and can greatly affect the water loss percentage. This discrepancy was determined to be a non-sealing by-pass valve at the 31-E booster station. This valve was replaced during the installation of the new 12-inch transmission main. Since it's repairing the discrepancy has fallen within tolerances between the two meters, once consumption between the two points is considered.

Table 3.4
Summary of Discrepancy of Water Purchase

Year	Glasgow Water Company Master Meter	ACWD 31-E Master Meter	Difference
2017	363,918,600	393,878,800	29,960,200
2018	364,668,800	387,377,700	22,708,900
Total	728,587,400	781,256,500	52,669,100
Average	364,293,700	390,628,250	26,334,550

Water loss should be calculated based upon the total gallons purchased and the total gallons sold. Although there will be authorized unmetered uses (flushing, fire department uses, tank overflows, etc) they should be accounted for a utilized to the advantage of ACWD for reporting purposes to PSC as long as PSC allows such usages to reduce the water loss percentage. A further trend will be examined and amended to this report at a later date to further determine the trend of water loss.


MASTER METER
MM # | MM NAME | SALE OR PURCHASE | TELEMETRY
1 | GLASGOW | PURCHASE | NO
2 | BILLY HURT | PURCHASE | NO
3 | SCOTTSVILLE - WALNUT CREEK | PURCHASE | NO
4 | SCOTTSVILLE - BG ROAD | PURCHASE | NO
5 | SCOTTSVILLE - CARTERTOWN ROAD | PURCHASE | NO
6 | SCOTTSVILLE - 101 NORTH | PURCHASE | NO
7 | SCOTTSVILLE - MAYSVILLE ROAD #2 | PURCHASE | NO
8 | SCOTTSVILLE - 100 EAST | SALE |
9 | SCOTTSVILLE - MAYSVILLE ROAD | SALE |
BOOSTER STATION
BS # | BS NAME | PUMP RATE (GPM) | TDH (FEET) | GROUND ELEVATION
1 | US31-E | 1,200 | 200 | 651
2 | HALFWAY | 300 | 160 | 750
3 | RED HILL | 165 | 332 | 689
4 | MAYSVILLE ROAD | 506 | 196 | 858
WATER TANKS
TANK # | TANK NAME | CAPACITY (MG) | OVERFLOW ELEVATION (FT) | GROUND ELEVATION
1 | HWY 98 | 0.300 | 979 | 853
2 | HWY 1421 | 0.230 | 1070 | 968
3 | US 231 | 0.500 | 930 | 761
4 | WALKER'S CHAPEL | 0.170 | 940 | 850
5 | AMOS | 0.165 | 964 | 894
MASTER METER
MM # | MM NAME | SALE OR PURCHASE | TELEMETRY
10 | HWY 98 PRESSURE ZONE | MONITOR | YES
11 | 1421 PRESSURE ZONE (98 pz) | MONITOR | YES
12 | US 231 PRESSURE ZONE | MONITOR | YES
13 | WALKERS CHAPEL | MONITOR | YES
14 | AMOS PRESSURE ZONE | MONITOR | YES
15 - 16 | 1421 - WALKERS CHAPEL PRESSURE ZONE | MONITOR | YES
LEGEND
ALLEN COUNTY WATER DISTRICT
2-INCH WATER MAIN
3-INCH WATER MAIN
4-INCH WATER MAIN
6-INCH WATER MAIN
8-INCH WATER MAIN
10-INCH WATER MAIN
12-INCH WATER MAIN
PRESSURE ZONES
US 231
WALKER'S CHAPEL
HWY 98
KY 1421
AMOS
GLASGOW
BLUEGRASS ENGINEERING PLLC
222 East Main Street, Ste. 1 • Georgetown, KY 40324
EXHIBIT 3.1
ACWD PRESSURE BOUNDARIES



BLUEGRASS ENGINEERING PLLC
222 East Main Street, Ste. 1 • Georgetown, KY 40324

EXHIBIT 3.2
DISTRIBUTION SYSTEM SCHEMATIC

SECTION 4: WATER LOSS

I. Introduction

Water losses occur as two different types: Real losses and Apparent losses. Real losses are the physical losses from the distribution systems and include leakage and overflows of treated drinking water from storage tanks. Apparent losses are the nonphysical losses that occur when water is successfully delivered to a water user but is not measured or recorded accurately.

Water losses exert further financial strain on ACWD by reducing the revenues generated necessary to make improvements, maintenance and upgrades on their distribution system. These strains can lead to unnecessary rate increases due to lower than expected revenues.

ACWD system has routinely monitored and reported water loss to PSC. However, recently the board has determined that a closer look at water loss is necessary. In recent years the annual financial audit has shown that there are signs of concern in regards to water loss and the impact on the financial stability of the district. This section will examine the different types of water loss and the sources of such losses.

II. Apparent Water Loss

Apparent losses under record the volume of customer consumption of water due to different factors. Apparent losses are viewed as a higher revenue loss than real losses because the water lost at the point of delivery (apparent loss) is valued at the retail rate schedule instead of the wholesale rate or purchase rate.

Apparent losses are considered nonphysical losses in that no water is physically lost form the water distribution system due to pipeline, equipment or operator error/failure, which are the causes of real, or physical losses. However, the metering, accounting and data handling inefficiencies that constitute apparent losses of the water district can have a significant, measurable impact upon the financial and operational functions of ACWD. Apparent losses fall within three primary components:

1. Data Handling Errors
2. Metering Inaccuracies
3. Illegal Consumption

Data Handling Errors – Data handling errors are errors associated with the transferring of the recorded volume from the meter to the billing software system. It is assumed that the water meter, whatever the size or type, are accurate to record the volume of water passing through it itself but at times errors are encountered.

Meter Inaccuracies – The water meters are the sole source of revenue for ACWD and any inaccuracies are lost revenue. It is assumed that meters are accurate throughout their useful life, but that is not always the case. Meter accuracy can be influenced in four primary manners: the physical accuracy of the meter as flow-measuring device, the appropriate

sizing of the meter to fit the customer's consumption profile, the appropriate type of meter to best record the variations in flow and proper installation of the meter.

A meter itself is a mechanical piece of equipment that will slow as it ages due to wear and tear on the mechanisms that register flow. ACWD currently is replacing meters at the recommended interval from PSC, every ten years. Accuracy of all meters, even new meters can have varying degrees of accuracy.

Unauthorized Consumption – Unauthorized consumption occurs to some extent throughout all water utilities. Although, unauthorized consumption is not believed to be a large source of water loss for ACWD but to what extent it is occurring is unknown. Unauthorized consumption can occur in many ways, such as illegal connections, bypassing installed meters, misuse of flushing/fire hydrants, meter tampering or opening intentionally closed valves.

Unauthorized consumption can be recognized by diligent observation of ACWD staff. ACWD personnel are tasked with observing signs of illegal connections: recent excavation around water lines and/or meter boxes.

Apparent water losses can account for a large source of loss of revenue. All water loss is actually revenue loss, as every gallon of water not registered as sold is costing ACWD not only the price per gallon but is costing ACWD the purchase price paid to GWC or Scottsville.

Some suspected sources of apparent water losses within the ACWD operations could possibly be meter inaccuracies, meter reading errors,

III. Real Water Loss

Real losses are losses of water via leakage, breaks or overflowing a tank. Leakage and breaks largely are unseen and often times go unattended to for an extended time period. Overflowing a tank can be visual checked and is infrequent.

Leakage occurs for many differing reasons:

- Defective/inferior materials
- Poor construction methods
- Operational errors
- Corrosion
- Poor quality of repair work
- Environmental stresses (freeze/thaw cycles, soil expansion, temperatures, etc.)

In time leakage losses increase, thus increasing the percentage of water loss and reducing the revenue received by ACWD.

Real losses are typically attributed to the following three categories:

1. Characteristics of the water distribution system.

2. Environmental stresses (weather, geologic conditions and/or traffic loadings)

3. The level of proactive leakage management utilized by the utility

ACWD has little if any control over the environmental stresses and in the short-term cannot change the characteristics of the water distribution system. ACWD staff can affect the proactive leak management its employees in day to day operation. Water loss across the ACWD system on a yearly basis is dependent upon the number of leaks occurring, their magnitude, operating pressure and perhaps most importantly, the total time that the leak occurs.

The large leaks, main line breaks garner the most attention but a lot of times those leaks lead to lesser lost water as the small leaks due to the time to repair the leak is significantly shorter than a leak that is unreported or noticed. To reduce the length of time a leak is allowed to occur MUST be reduced.

Pressure can exacerbate the rate of water loss. Simply put, the higher the pressure, the greater the rate of water flows out of a pipe break. ACWD topography dictates that high pressures are necessary to be able to meet pressure requirements set forth by Division of Water and Public Service Commission, and can not be reduced significantly.

Real water losses can be reduced through adjusting operations and standard protocol. ACWD should implement metered zones or pressure zones and designate the customers served within the pressure zone(s). This information in time of monitoring and review can direct the attention of ACWD's staff to a break or leakage due to a varying flow rate. Pressures within each pressure zone could be examined to determine if there is a possibility to reduce the pressure within each pressure zone, without causing low pressure for customers.

Real losses are the first type of loss that we all think about when it comes to water loss but the cause(s) of water loss can vary greatly. Water loss can be caused by a large main break, service line, rolled gasket or over pressurization of a section of the distribution system. There is not a single fix for all of the causes of real losses but a series of steps necessary to collect information that allows for a process of elimination to occur to further locate the source of water loss.

IV. Recommendations

The following recommendations are based upon providing the necessary tools for ACWD's staff to identify and then locate sources of water losses at a quicker time period than waiting till the end of the billing period. Having the ability to identify sources of water losses is critical to being able to remove the sources of water loss from the distribution system as quickly as possible. Time is critical to reducing water loss. A small leak over several weeks will yield more water lost than a main line break that is repaired in a few hours.

The following recommendations are based upon review of the consumption, operational procedure(s), SCADA information and comparison of water purchased and sold. Each recommendation will help locate or identify sources of water loss. Some of these recommendations are simple procedural changes while others would require a significant capital contribution to implement.

The following recommendations would address potential apparent water losses:

1. Determine the accuracy of the existing water meters at different ages. Begin pulling meters, randomly at the age of 3, 6 and 9 years of service and comparing them to new meters in relationship to water recorded.

2. Determine if beginning to install AMR/AMI water meters to allow for additional time for ACWD crews to search and repair leaks.

3. Determine if a different style of meter will increase the accuracy of usage and reduce water loss via better low flow accuracy.

4. Monitor customers who use large amounts of water (greater than 10,000 gallons per month) and consider replacing their meters more frequently. Based upon information provided from some meter companies, a meter should be switched out when the total flow has exceeded 500,000 gallons as the mechanics have slowed due to the usage.

5. Large commercial, institutional or industrial meters should be read weekly to monitor usage and any changes. These users tend to be some of the larger ones and can have the greatest effect upon revenue to failure of the meter.

These recommendations could produce sources of water loss that has previously been unrealized and a simpler solution than replacing section of water mains with a high repair history.

Residential meters typically record usage down to 0.25 gallons per minute but with many newer low flow fixtures within homes, meters could be misregistering a lot of flow that is commonly overlooked as minimal but across the entire system could be significant.

The following recommendations would address potential real water losses:

1. Installing master meters within all points of entry and exit of each pressure zone and have the output (totalized flows, instantaneous flow rates) delivered via the existing telemetry system.

2. Categorizing all customer accounts based upon the pressure zone that supplies their water.

3. Compare flows entering a pressure zone against water sold to determine where the water loss is occurring within the distribution system.

4. Based upon the comparison of usage to volume entering a pressure zone, step valve closing can further isolate the location of leakage that is occurring.

5. Implement utilizing spreadsheets in lieu of hand written logs to better trend indicators of the distribution system's usage demands (tank water levels, time to drain to low water level, pump run time and flow rates of pumps).

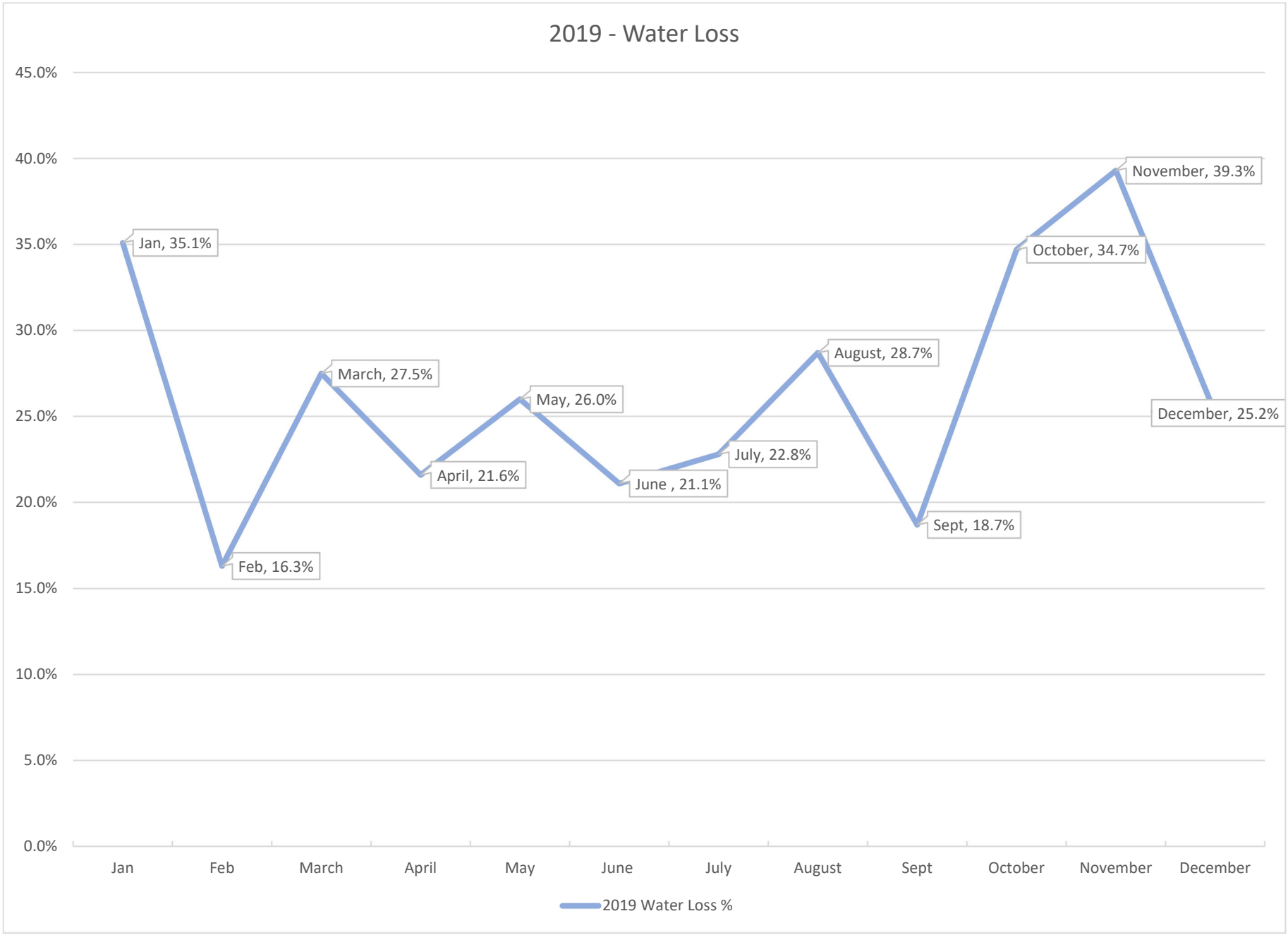
6. Utilize a third party to implement an acoustical listening program for leaks that have not been located by step valve closing.

7. Examine if pressure within the distribution system can be lowered to reduce the average operating pressure.

8. Determine if during low flow conditions (nighttime) if pressures could be reduced.

ATTACHMENT 3
RECENT WATER LOSS

Attachment 3



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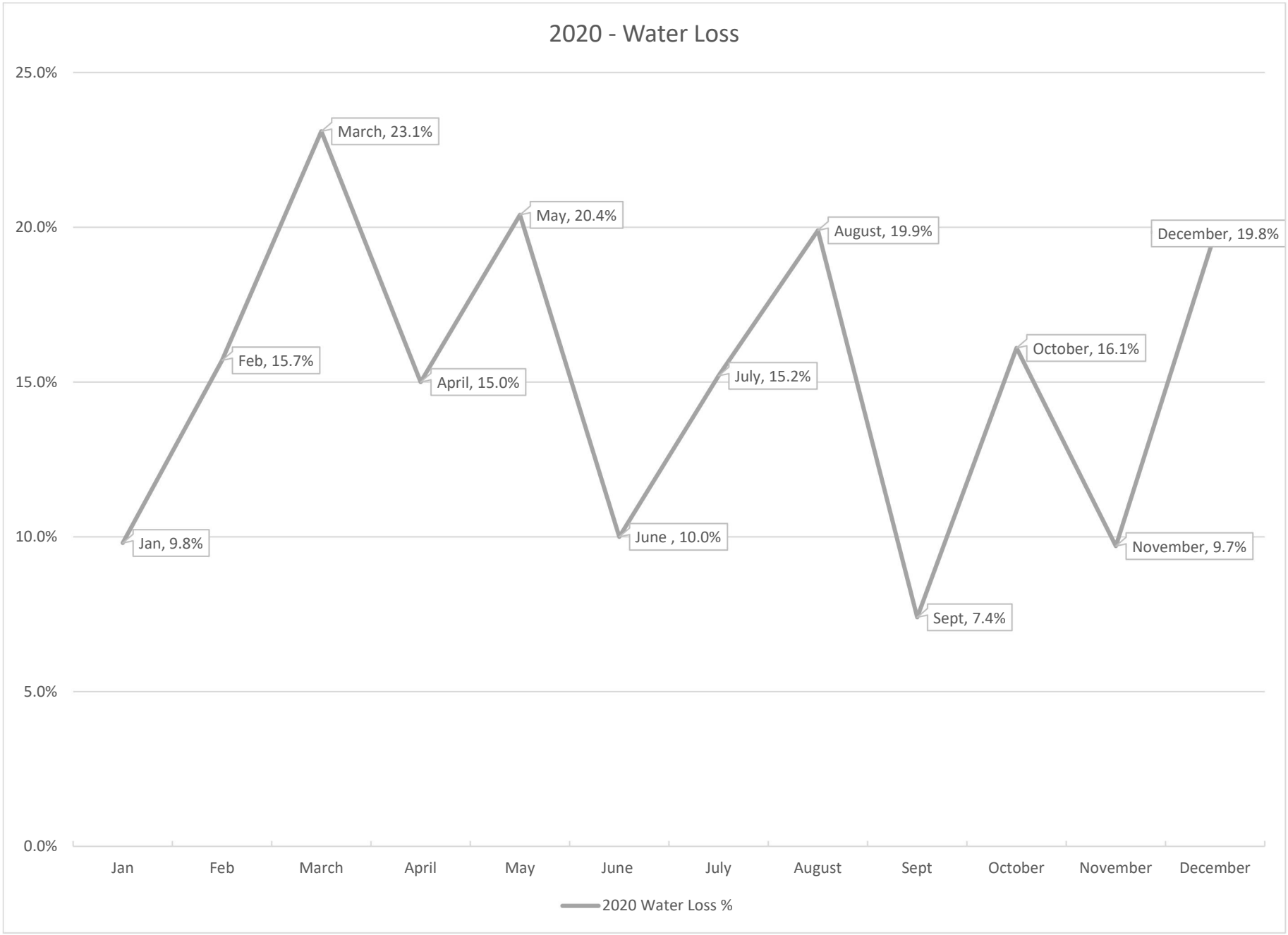

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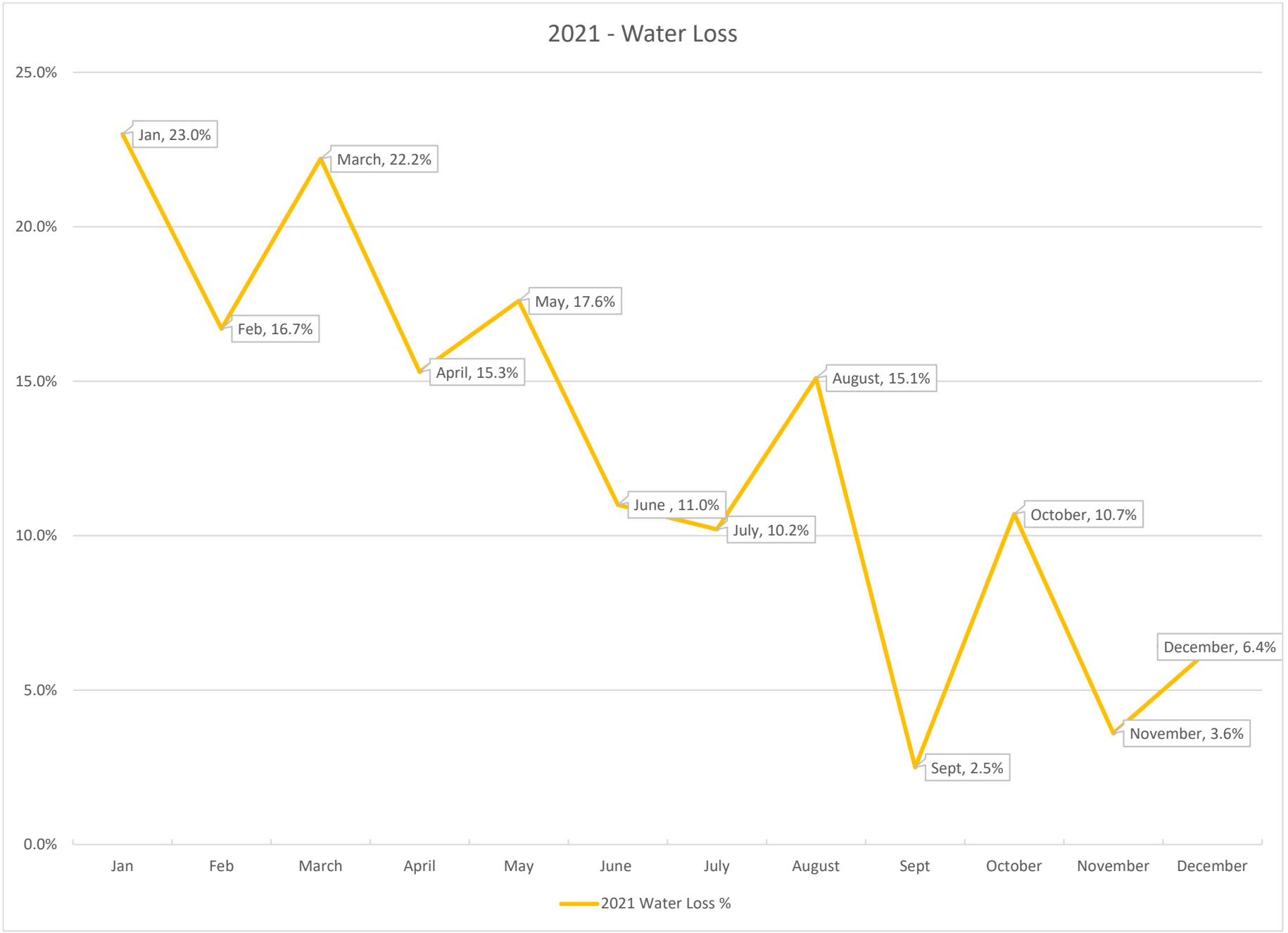

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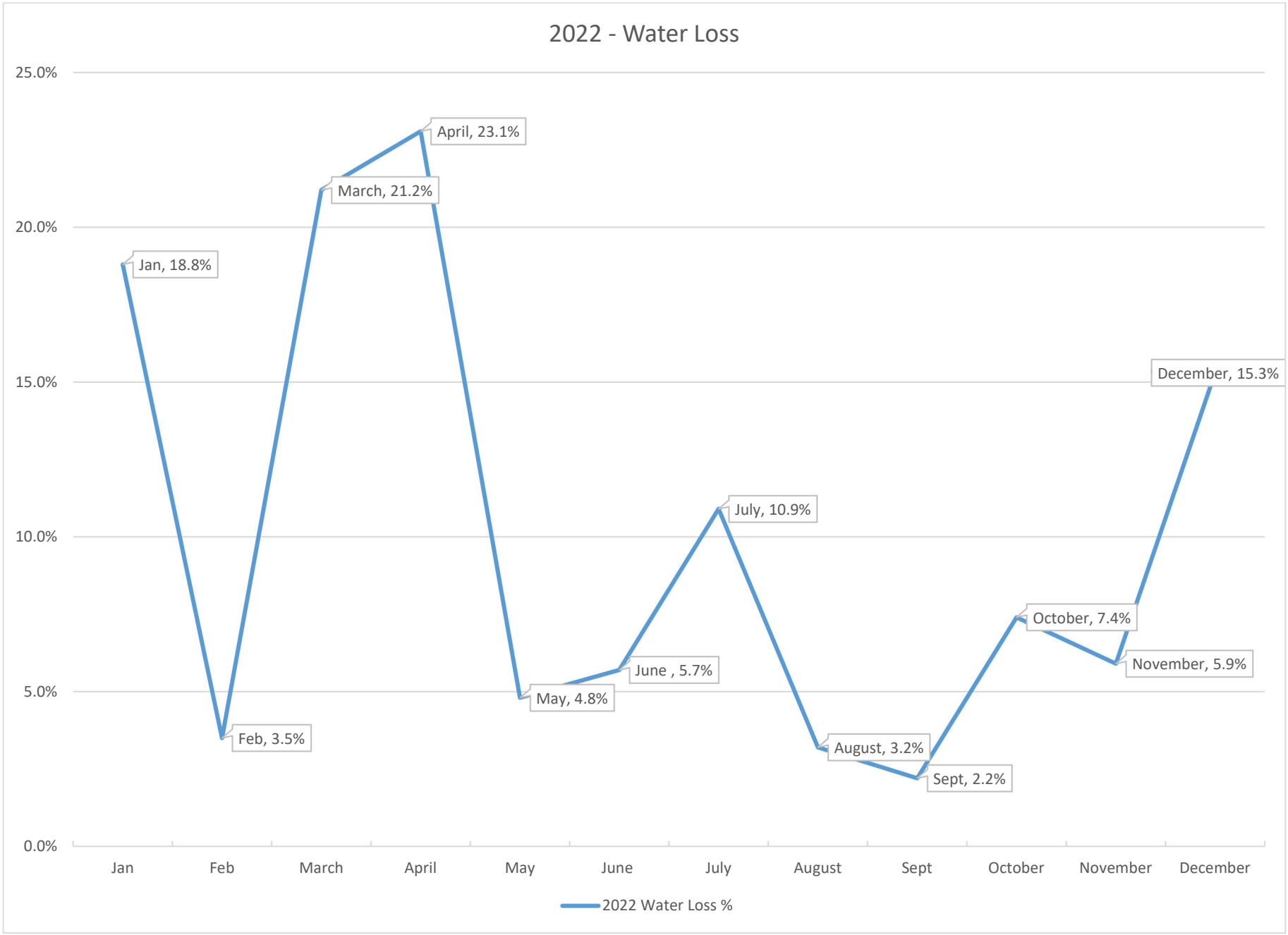

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