EXHIBIT A

ADVANCED METERING INFRASTRUCTURE DEPLOYMENT PLAN

KENTUCKY-AMERICAN WATER COMPANY

ADVANCED METERING INFRASTRUCTURE DEPLOYMENT PLAN

Table of Contents

Summary of Plan

Kentucky-American Water Company ("KAWC" or the "Company") plans to deploy cellular Advanced Metering Infrastructure ("AMI") technology over the course of the next decade, as it completes normal, scheduled, periodic replacement of its existing Automated Meter Reading ("AMR") equipment throughout its service territory. Unlike some other proposed AMI deployments in the state, KAWC is not planning to accelerate the replacement of its entire meter reading system regardless of its age or condition. Rather, KAWC will transition to an updated technology for meter reading equipment as it completes meter and endpoint replacements in the normal course of business.

The Company's transition to AMI will provide both operational benefits and efficiencies and provide enhanced customer service to customers. The transition to an AMI program will enable strategic and permanent improvements in safety, customer experience, operational efficiencies, and environmental benefits. The Company looks forward to leveraging AMI to empower customers with timely consumption data to enable smart water use choices, enhance customer communication regarding customer water consumption patterns and unusually high-water use, and improve water system operations and management. Implementation of AMI will allow KAWC to realign its business processes and redeploy personnel previously focused on meter reading to other work, as discussed below. To best take advantages of these benefits and efficiencies, it is important that the Company begin deploying AMI as soon as possible, given the portion of the Company's metering infrastructure that is scheduled for normal periodic replacement between 2024 and 2026.

Overview of AMI Technology

AMI is not a single technology or piece of equipment, but rather an integration of many technologies that will provide KAWC an intelligent connection with its customers. AMI technology creates a network between customer meters and a utility's information system, with data capable of flowing bi-directionally, facilitating automated meter readings and the capture of interval consumption data.

As depicted below, a key difference between an AMI system and an AMR system is in the frequency that customer meters are read. AMI technology automates meter readings, so readings can occur multiple times per day rather than once a month. Because of the frequency of readings, AMI provides customers and customer service representatives the ability to view water consumption data within 48 hours of use and enables more timely detection of leaks and meter malfunctions.

Components of an AMI System

There are three primary components to an AMI system – meters, communication modules, and collectors and head end systems. A brief description of each component is provided below:

- Meters

AMI uses water meters that include technologies integrated into the meter register. How a specific meter functions to measure the amount of water going through the meter can vary depending on the metering application and the preferred technology of the utility. However, independent of the type of measurement technology used, the meters measure and record volume through electronic means and are capable of communicating daily or hourly data. Meters used for AMI may also include technologies that provide backwards flow indicators, tamper alerts and no flow alerts, but as technologies change more alerts will likely be available in the future. Meters used for AMI cannot only communicate outward but can also execute command signals sent to the meter from the utility back office systems. This can be useful when upgrading meter firmware versions or executing functions the meter can execute such as an on-demand meter read.

- Communication Modules/Endpoints

Communication modules or "Endpoints" go by several industry terms, but most are specific to a vendor's technology and marketing literature. Essentially, endpoints are two-way radios that are physically attached to the meter and which send and receive data from the head end system. The two most dominant technologies used across vendor platforms are a fixed-network based system and a cellular-network based system (described below).

- Collectors and Head End Systems

In an AMI fixed-network system, data is transmitted from the meter's endpoint to a network data collector ("collector"), which is typically mounted on an elevated structure. A single collector can collect data from upwards of 10,000 meters, with each meter reporting one read every 15 minutes, but the number of collectors required to support an AMI fixed-network system can be impacted by the size and topography of the utility's service territory.

Typically, the number of collectors needed is determined by conducting a propagation study performed by the vendor of the AMI equipment. This propagation study takes into account signal strength and the acceptable range of endpoints reporting to any collector. Topography and permanent structures can all have a negative effect on signal strength. A cloud-based "Head End System" can aggregate vast amounts of reads from multiple collectors deployed regionally.

In an AMI cellular system, collectors are not required, and data travels from the endpoints directly to the head end system. In this case, the network is operated by cellular network providers like AT&T or Verizon. A utility's meter data management system then aggregates meter reads from the head end system/vendor platforms and will normalize and act as the key interface between meter reading and a utility's business transactional systems, such as billing.

As noted above, there are two types of AMI systems:

- **Fixed-Network System** – With fixed-network systems, meter reading is accomplished by endpoints installed on each meter. The endpoints collect real-time water use readings from the meter and transmit them via radio signals to collectors that are owned by the utility. The collectors are physically installed throughout the service area. The collectors relay the collected data to a central location, where the data is organized within a vendor's head end system, then transferred to the utility. Fixed-network systems require the utility to purchase, build and maintain the infrastructure to support the data collection process.

- **Cellular-Network Systems** – With cellular-network systems, cellular endpoints are installed on each meter to transmit the meter data via an existing cellular infrastructure to a central location, where the data is organized within a vendor's head-end system, then transferred to the utility. Cellular networks do not require the use of collectors, so unlike a fixed-network system, no new infrastructure needs to be purchased, built or maintained by the utility to support the data collection process in the field.

Cellular AMI as the Preferred AMI Technology

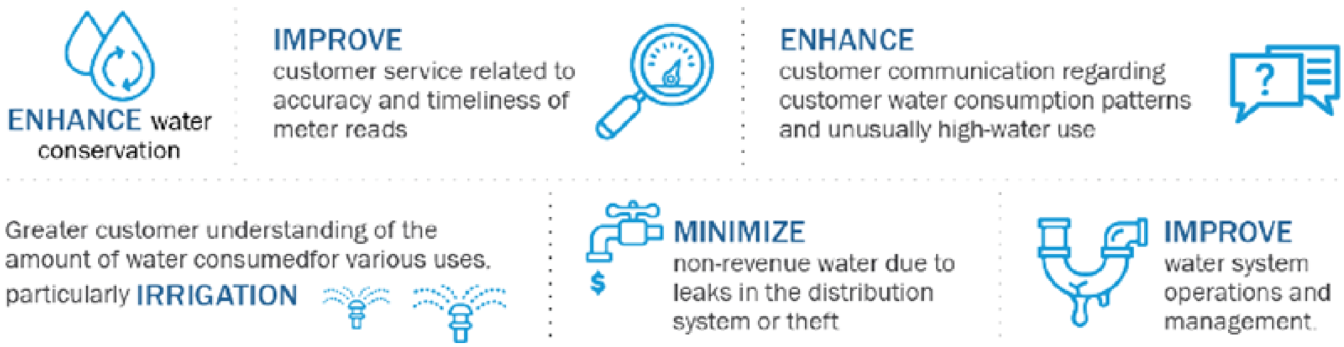
The key differentiator of a cellular-network system is the ability to leverage an existing communications network that regularly evolves its technology without increased capital costs.

Cellular networks are regularly updated to keep up with the latest technologies and provide greater coverage, reliability and security than fixed-network systems. A fixed-network system requires that a utility maintain and periodically update the system, leading to increased and ongoing capital costs. A cellular-network system also provides the following advantages over a fixed-network system

- gaps in coverage are addressed by the cellular provider;
- ability to leverage robust security programs and cellular connectivity;
- access to the same disaster recovery systems used by emergency services;
- limited ongoing maintenance related to security reviews, hardware refreshers and changes in technology; and
- protections from liabilities related to the physical structure, such as damage caused by storms, security patches, and equipment failures.

Benefits of AMI Technology

The principal objectives for considering transitioning to an AMI system include improving the effectiveness of KAWC's operations and customer service, meeting customers' expectations, as well as increased water conservation. A critical pathway to changing customers' water use behaviors is informing customers about their water in a way that empowers them to make changes.



Improved Operations and Customer Service

The implementation of an AMI system can achieve great benefits for the customer and utility operations.

Key Operational and Customer Service Benefits of AMI include, but are not limited to:

- ✓ <u>Safety Improvement:</u> Having employees in the field reading meters creates an exposure to potential injuries and accidents due to potentially unsafe environments, inclement weather, and exposure to vehicular traffic, animals, and the like. Being able to read meters remotely through AMI reduces this potential risk, both for injuries to our employees and injuries and damage to third parties.

- ✓ <u>Customer Service:</u> The implementation of AMI will enhance the Company's existing efforts to increase billing accuracy and reduce the likelihood of estimated bills (e.g., due to weather events, or temporary obstructions of endpoint signals) by automatically providing timely, frequent, accurate reads through the network. In addition, manual re-reads will be reduced through access to real time meter data. In addition, an AMI enabled account will assist customers with identifying leaks in a more timely manner, which can save customers significant money. AMI technology would also improve the customer experience by identifying issues early, allowing customers to address potential issues on their end in a timely manner, likely reducing the number of high bill complaints and leak adjustments as a result, and generally avoiding customer frustration associated with such challenges.

- ✓ <u>Operational Efficiency:</u> AMI data can be used to uncover irregularities that may signal a leak, meter issues or tampering or water theft. By doing so, the Company can more timely address those issues to further improve its meter reading and bill accuracy, as well as leak detection and non-revenue water reduction efforts. In addition, as AMI technology is deployed, KAWC anticipates reductions in service orders associated with estimated bills and move-in/move-outs that will free up some of the work currently performed by field service representatives. Further, as AMI is deployed, the need to do drive by periodic meter reading will decline and be nearly eliminated altogether upon full deployment, ultimately allowing for the redeployment of meter reading resources to higher value work as well.

Increased Water Conservation

For customers, understanding the scale of individual water use activities can be difficult, especially when provided with only monthly billing statements. This limited insight creates barriers for customers trying to identify inefficiencies or excessive use in their behavior. By providing customers with more granular water usage data (daily, hourly, etc.), customers are empowered to understand and make changes in their habits and behaviors.

Customers' Expectations

Today, people live in a world dominated by speed and access to information. For example, if you want to check your checking account balance and transfer funds to your savings account, you can do so immediately using an App on your phone or by logging into your bank account via the internet. If you want to pay your utility bill, again, you can quickly do so by logging into your account or calling the utility directly to make payment. Quick access to information is now an expectation, and information related to water service should not be an exception. The AMI technologies described above will enable KAWC to provide its customers with timely access to their water usage.

Redeployment of Resources

While some of the above benefits present opportunities for labor-related efficiencies, these efficiencies are not necessarily anticipated to result in a workforce reduction. Rather, AMI presents an opportunity for KAWC to have affected labor resources refocus their efforts on other high value work, such as achieving meter reading and other service order targets in the near term, accommodating the demands of a growing customer base in the long term, and on a continual basis, seeking operational and customer service improvements.

KAWC's Current Metering Infrastructure

KAWC has almost 142,000 meters and endpoints in service as of May 2023. As shown in Figure 1 below, the vast majority of these are smaller than 2". Additionally, more than 99% of these are "outside" set meters.

Figure 1

Meter Size	Population	% of Total
5/8"	133,218	94.0%
1"	5,343	3.8%
1.5"	239	0.2%
2"	2,726	1.9%
3"	30	0.0%
4"	96	0.1%
6"	49	0.0%
8"	23	0.0%
Total	141,724	100.0%
2" and smaller	141,526	99.9%

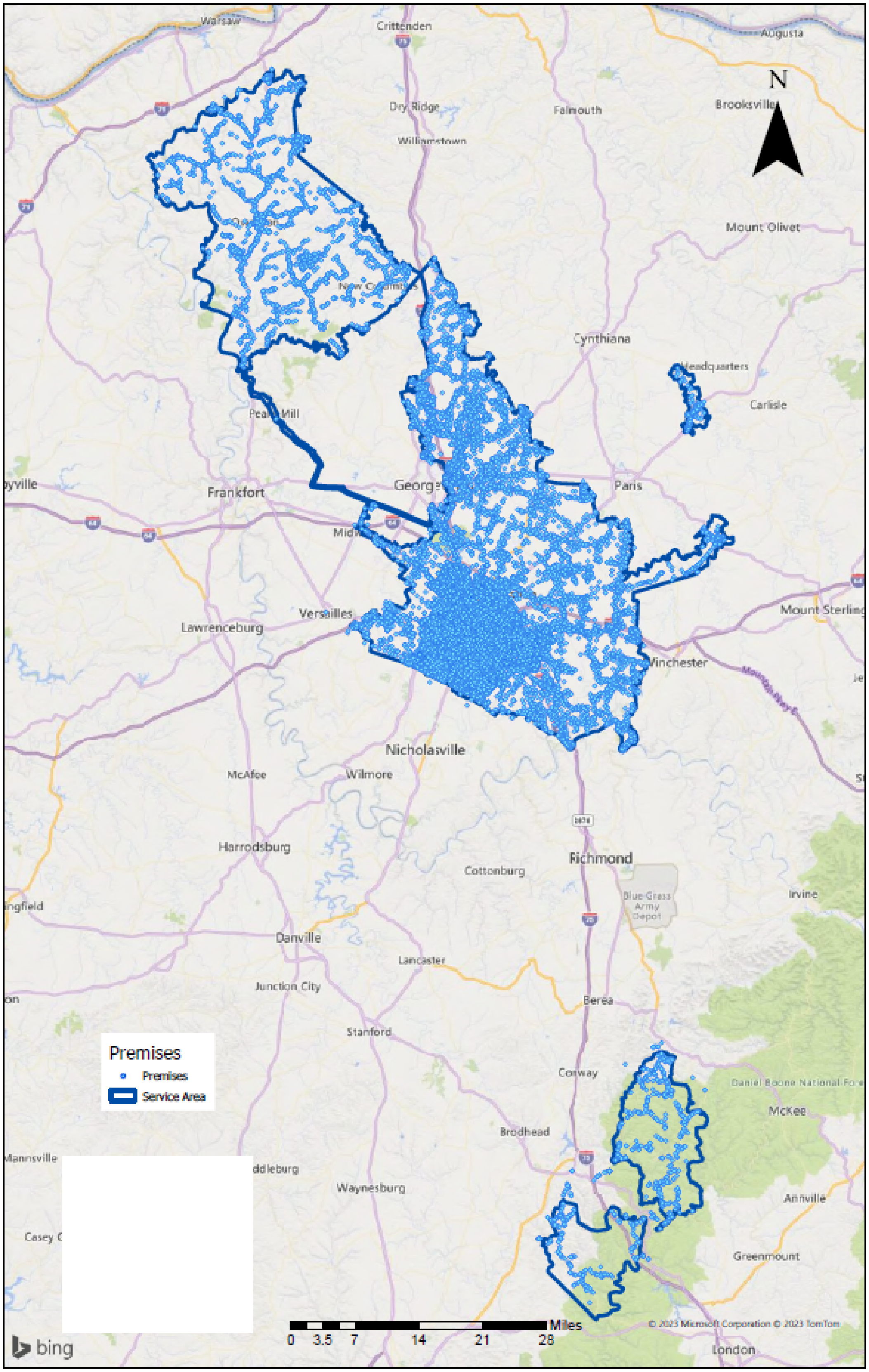
Almost all of KAWC's meters are equipped with AMR endpoints. AMR endpoints enable automated meter reading when the Company's personnel bring a data receiver within proximity of the endpoint, typically by driving by with a receiver-equipped vehicle. The exception is approximately 248 meters which are equipped with Badger cellular AMI endpoints. These endpoints were installed to provide enhanced customer service capabilities to major accounts.

Prior to 2017, the AMR endpoints were generally hardwired to the installed meters, making the meter and endpoint particularly difficult to separate and resplice successfully. Approximately 82,000 of the Company's 142,000 meters were installed prior to 2017, including almost all of the meters which would be scheduled for replacement in the near term. Additionally, a portion of the meters installed since 2017 were integrated units, where the AMR endpoint and meter are "all-in-one" and not at all separable.

The AMR endpoints generally have antennas that protrude through the Company's current cast iron meter pit lids. However, approximately 35,000 of KAWC's 5/8-inch meters are Hersey / Mueller brand meters with AMR endpoints that sit below the meter pit lids.

Figure 2 provide a visual depiction of meter installations across the Company's service territory.

Figure 2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Augusta
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Dry Ridge
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Brooksville
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Mount Olivet
Cynthiana
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KAWC's Scheduled Periodic Meter Replacement Program

Background and Upcoming Schedule

KAWC follows a periodic meter replacement program, as part of its normal course of business, in order to renew aging meters and endpoints. The schedule is in part informed by meter testing regulations found in 807 KAR 5:066 Section 16(1). Since late 2011, the schedule has also been informed by the deviation granted in Case No. 2009-00253, permitting the Company to keep its 5/8-inch meters in service for 15 years without testing for accuracy.[1] To respond to these regulations and operate efficiently, KAWC has varying practices for meter testing and replacement depending on the frequency of required testing, as well as the size and cost of the meters. These are shown in Figure 3 below.

Figure 3 – KAWC Practices for Scheduled Meter Testing and Replacement

Meter Size	2023 Price of Meter Material Alone (Confidential)[2]	Frequency of Required Testing	KAWC Operational Practice for Scheduled Testing and Replacement
3" and larger	[redacted][3]	1-2 years	KAWC tests and maintains the meters in the field, and conducts meter and endpoint replacements on a case-by-case basis.
1.5" – 2"	[redacted]	4 years	KAWC replaces the meters when testing is required, tests the removed product in the lab, and will reuse these meters and their endpoints if they pass testing and are in good working order.
1"	[redacted]	10 years	KAWC replaces the meters and their endpoints as they reach their testing limit.
5/8"	[redacted]	15 years per approved deviation	KAWC replaces the meters and their endpoints as they reach their testing limit.

In an effort to optimize efficiency, KAWC had been targeting replacement of 5/8-inch meters and their hardwired endpoints based on a 15-year maximum field life, at least since the deviation was granted in Case No. 2009-00253. However, KAWC has observed an increase in meter reading challenges and an increase in corresponding unscheduled meter and endpoint replacements, triggered by equipment that was no longer performing well. As part of the Company's efforts to address and prevent meter reading challenges, KAWC plans to move back to a 10-year target for 5/8-inch meter and endpoint replacement.

[1] *In the Matter of Kentucky-American Water Company's Request for Permission to Deviate from 807 KAR 5:066, Section 16(1)*, Case No. 2009-00253, Order October 5, 2011.

[2] Prices are estimates based on currently available data.

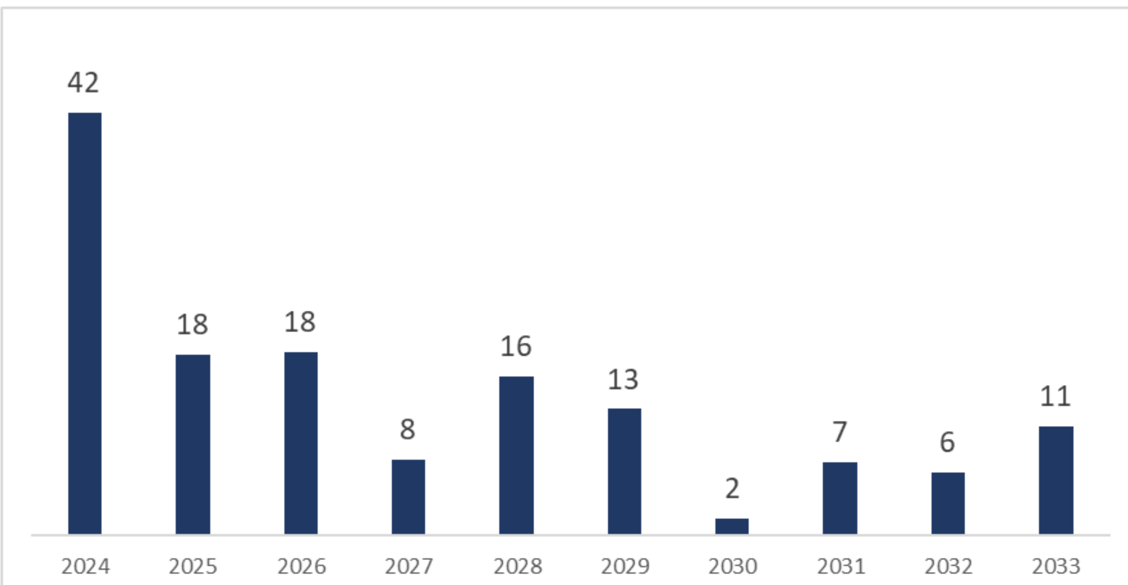
[3] Figures are approximate. Larger meters vary substantially in price depending on functionality and purpose.

For at least the meters installed prior to 2017 (meters more than 6 years old), as well as for any integrated all-in-one units, the endpoint generally can't be replaced on a different cycle than the meter, due to the hardwired or embedded nature of the endpoint. For newer products, the meter and endpoint are typically attached by a plug, allowing the meter and endpoint to be more easily separated. The Company has found it important to keep the brand of the meter and endpoint aligned, and most efficient to keep the replacement of both units on the same cycle. However, with some of the more modern meters, there is at least the practical possibility in the future of changing only the meter or the endpoint if it would be efficient to do so.

As of May 2023, KAWC assesses that more than 71,000 of its 5/8-inch meters are now at or past the 10-year mark. Due to the operational infeasibility of replacing all of these at once, KAWC has developed a plan to replace these meters, along with other meters coming due for replacement, over the next three years. The planned schedule would include replacing approximately 42,000 in 2024, 18,000 in 2025, and 18,000 in 2026. KAWC will target replacing the remaining 5/8-inch meter stock as the existing meters reach year 10. For meters other than 5/8-inch meters, KAWC will continue to test and replace in accordance with the schedule shown in Figure 3.

Figure 4, below, shows the quantity of 2" and smaller meters planned for periodic scheduled replacement over the next 10 years.[4]

Figure 4 - Upcoming Forecast for 2" and Smaller Meter Replacements, in 000s



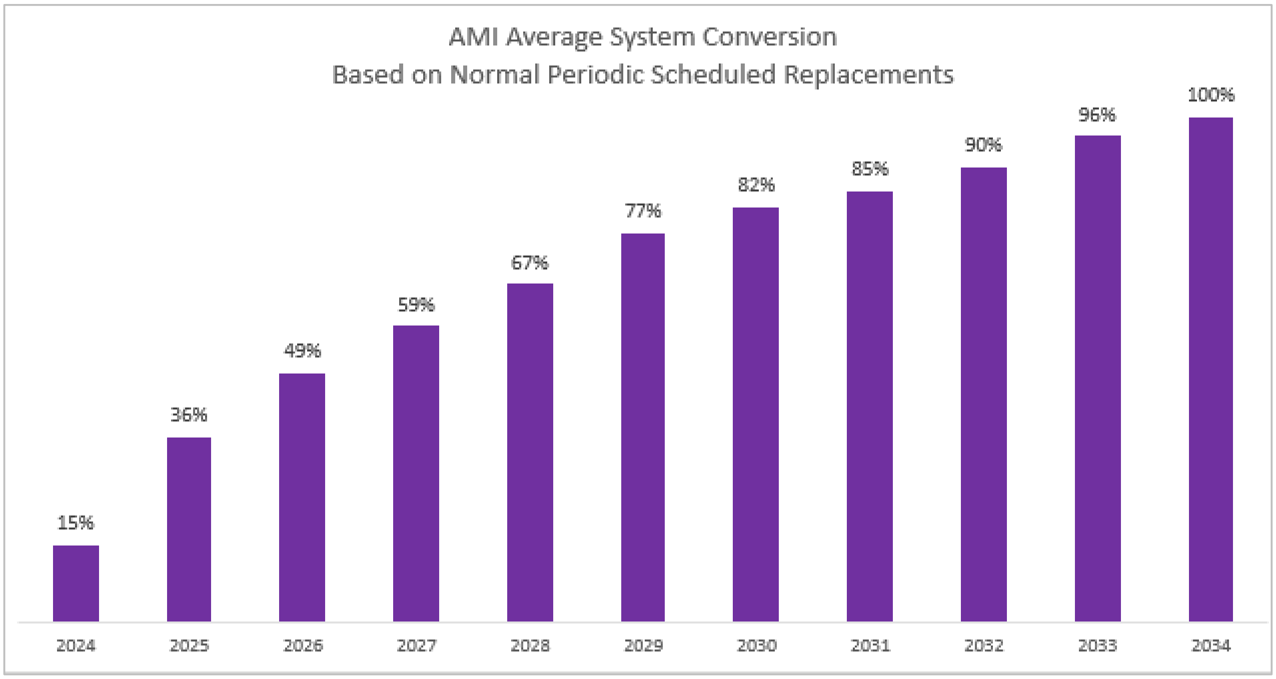
*Meters/endpoints replaced by thousand, per year over the next 10 years.

In addition to replacing meters and endpoints, other parts are also sometimes replaced at this time as needed. One upcoming example is meter pit lids. The 35,000 5/8-inch Mueller meters with hardwired endpoints do not have holes in the lids for antennas. If these meters were replaced with AMR technology, new lids would be required for the antennas. Likewise, regardless of current brand, if KAWC installs AMI endpoints as it completes meter replacements, new composite lids will be installed on all meters, to replace the current cast iron lids. Composite lids are transparent to radio and cellular signals, reduce battery usage, and optimize coverage.

[4] For purposes of a simplified presentation, 1.5-inch and 2-inch meters are shown as replaced at the 4-year mark. However, these meters and endpoints may in fact be reused if they are found to be in good working order, as noted in Figure 3.

The resulting pace of transition to AMI would look approximately as shown below in Figure 5:

Figure 5



Geographic Distribution

Because the Company's scheduled meter replacement program is based on length of service, and not location, the distribution of meter replacements over time is scattered geographically.

Some benefits of AMI will not be sensitive to this geographic distribution and will happen gradually throughout the 10-year meter replacement schedule as the number of AMI meters/endpoints increases. For example, each AMI meter installed will increase the number of customers who have access to timely usage data. Likewise, the Company will have increasing access to timely data to enhance customer service and increase work force efficiency as fewer resources are consumed for meter reading related field service work.

Some benefits however, will be sensitive to the geographic dispersion of meter replacements. KAWC expects that monthly meter reading benefits may not fully begin until the system is nearly completely converted to AMI, sometime between 2033 and 2034.

The appendix to this exhibit features maps to help visualize the geographic dispersion of the periodic meter replacement program. Figure 14, shown in Appendix A, represents meter replacements by year of completion. Note the distribution of colors across the geography. Likewise, Figures 15-18 (Appendix A) illustrate the anticipated transition to AMI technology under a scheduled meter replacement approach and show a snapshot of AMI saturation in 2023, 2026, 2029, and 2033.

Other Potential Replacements

In addition to scheduled periodic meter replacement, the Company also sometimes replaces meters and endpoints off-cycle, when metering equipment is no longer performing well, thus unexpectedly reaching the end of its useful life. The Company would use the same AMI enabled equipment and technology for these replacements as it would for the scheduled periodic program.

Metering Technology Considered & Selected

Alternative Metering Technology Considered

As the Company considered the potential transition to AMI, KAWC evaluated a variety of metering technologies in terms of functionality and costs. These alternative technologies included continuing with AMR technology, deploying AMI cellular technology, and deploying a blend of AMI cellular and AMI Fixed-Network technology.

Alternative 1: Continuing with AMR Technology

As KAWC currently uses AMR technology, this alternative consists of replacing KAWC's existing AMR equipment with new AMR equipment. Under this alternative, KAWC would replace all existing meters and endpoints with new AMR meters and endpoints over the course of the next 10 years, and replace approximately 35,000 meter pit lids in 2024. As this alternative essentially maintains the status quo, customers would not gain the incremental benefits discussed above. Under this alternative, KAWC has identified two preferred vendors, Badger and Neptune, that provide the AMR components necessary to replace the existing AMR system with new AMR components.[5]

Alternative 2: Deploying AMI Cellular Technology

This alternative consists of replacing KAWC's existing AMR equipment with new AMI equipment. Under this alternative, KAWC would replace all existing meters and endpoints with new AMI meters, lids, and endpoints over the course of the next 10 years. KAWC identified two preferred vendors that provide both meters and AMI cellular components: Badger and Neptune.

Alternative 3: Deploying AMI-Hybrid Technology

This alternative consists of deploying cellular AMI, along with a near-term supplemental fixed-network. The solution would entail replacement of meters 2" and smaller, as they come due for testing, with Neptune meters and cellular AMI endpoints. New composite meter pit lids would be installed for all affected meter pits. Some supplemental Neptune fixed-network collectors would also be installed in the near-term on Company assets, to pick up reads from existing Neptune AMR endpoints.

Alternative 4: Deploying AMI Fixed-Network Technology

This alternative consists of full deployment of AMI technology, but instead of utilizing cellular, meter reading is accomplished by meter endpoints transmitting radio signals to collectors that are permanently located strategically across the service area. The collectors relay the collected data to a central location, where it is organized within a vendor's head-end system. From there the data is transferred to the utility.

[5] The other vendors initially considered only offered end points. As functionality is best when the meter and endpoint is from the same vendor, KAWC determined to move forward with evaluating the functions and costs of the two vendors that could provide both meters and endpoints.

Upon consideration of the potential of ongoing and increasing capital costs associated with building out and maintaining a fixed-network, without any corresponding benefit beyond what AMI Cellular technology provides, KAWC rejected this alternative as a potential option for replacing its existing meter reading system.

KAWC prepared a cost benefit analysis for Badger cellular AMI, Neptune cellular AMI, Badger AMR, Neptune AMR, and Neptune AMI-hybrid, which is discussed below in the Cost Benefit Analysis section.

Metering Technology Selected

KAWC has considered the differences between cellular and fixed-network AMI technology and determined that using cellular technology is the preferred approach. As explained above, an AMI cellular system avoids ongoing and increasing costs associated with installing, owning and maintaining the additional infrastructure required to operate an AMI fixed-network system. AMI cellular technology also provides the added benefits of being routinely updated to keep up with the latest technologies, provides greater coverage and security over fixed-network systems. AMI cellular technology also protects KAWC from liabilities related to damage to the physical structures caused by storms, security patches vulnerabilities, and/or equipment failures.

The Badger AMI cellular system also has functional advantages over Neptune, such as more options related to cellular carriers and can provide superior coverage in key areas. KAWC also has had a favorable experience with Badger cellular AMI, as it has approximately 248 endpoints in the system currently, deployed primarily to provide improved customer service to major accounts. Badger AMI cellular is also less costly then Neptune AMI cellular. Based on both cost and functionality, KAWC selected the Badger AMI cellular system as the replacement for its existing AMR system.[6]

Cost Benefit Analysis (“CBA”)

KAWC analyzed the costs and benefits of the various potential meter reading technologies and associated meter, endpoint, and lid replacements for a period of twenty years. The time period is adequate to observe two, ten-year cycles of meter replacement, and to realize the benefit of initial lid investments, which are expected to create value beyond the 10-year mark. A customer type view of the costs and benefits was compared for various potential technology solutions in both nominal dollars by year as well as in net present value.

Scenarios Modeled for Cost and Benefit

The potential investment scenarios modeled include the following:

1) **“Badger AMI”**- This scenarios considers replacement of meters 2” and smaller, as they come due for testing (but no more than once in a 10-year period). Badger Orion cellular AMI endpoints would be installed, along with Badger ultrasonic meters for sizes 1.5” and above and Badger nutating disc mechanical dial meters for 5/8”-1” meters. New composite meter pit lids would be installed for all affected meter pits.
2) **“Neptune AMI”** – This scenario considers replacement of meters 2” and smaller, as they come due for testing (but no more than once in a 10-year period). Neptune cellular AMI endpoints would be installed,

[6] Specification sheets for the Badger AMI cellular equipment selected are attached as Appendix B.

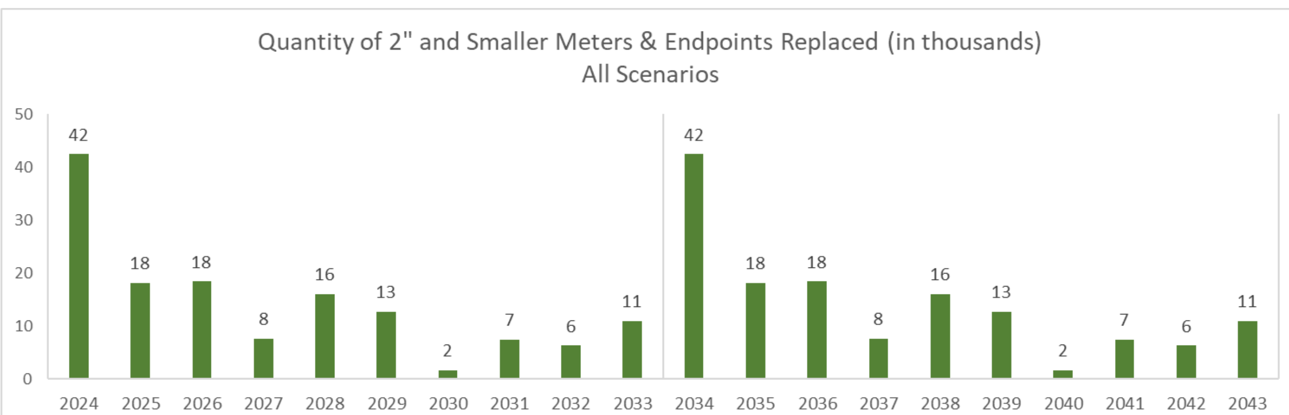
along with Neptune ultrasonic meters for sizes 1.5” and above, and Neptune nutating disc LCD meters for 5/8” – 1” meters. New composite meter pit lids would be installed for all affected meter pits.

3) **“Neptune Hybrid AMI”: cellular AMI with near-term supplemental fixed network** – This scenario is the same as option 2, but with the additional of some supplemental Neptune fixed network collectors installed in the near-term on company assets, to pick up reads from existing Neptune AMR endpoints.
4) **"Badger AMR” or “Badger Existing Tech”**[7]- This scenario considers replacement of meters 2” and smaller, as they come due for testing (but no more than once in a 10-year period). Badger AMR endpoints would be installed, along with Badger ultrasonic meters for sizes 1.5” and above and Badger nutating disc mechanical dial meters for 5/8”-1” meters. New composite meter pit lids would be installed in instances where Mueller / Hersey meters are being replaced (approximately 35k meters in 2024).
5) **“Neptune AMR” or “Neptune Existing Tech”** – This scenario considers replacement of meters 2” and smaller, as they come due for testing (but no more than once in a 10-year period). Neptune R-900 AMR endpoints would be installed, along with Neptune ultrasonic meters for sizes 1.5” and above, and Neptune nutating disc LCD meters for 5/8” – 1” meters. New composite meter pit lids would be installed in instances where Mueller / Hersey meters are being replaced (approximately 35k meters in 2024).

Cost Drivers

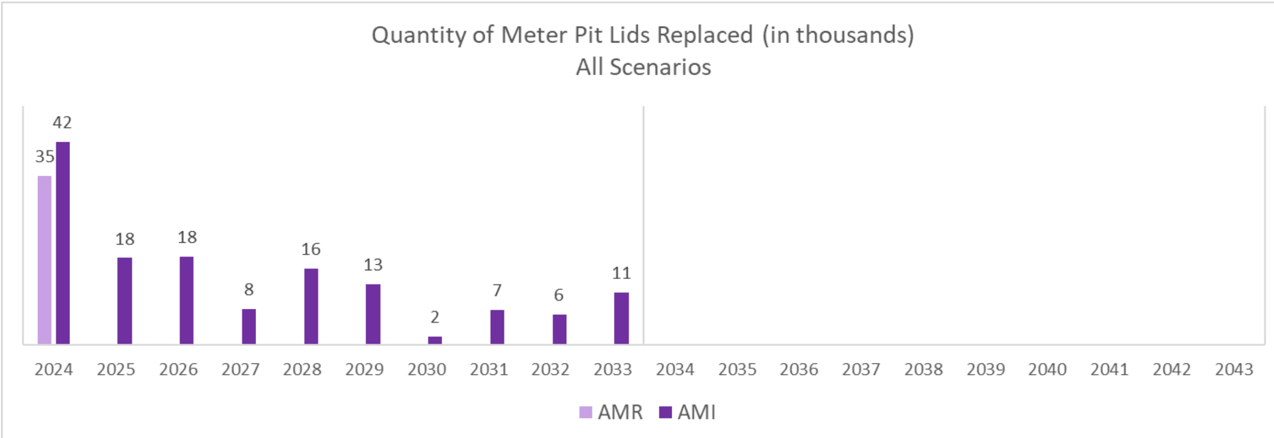
The quantities of meters and endpoints to be replaced, by year, is shown below in Figure 6 and the quantity of lids to be replaced is shown in Figure 7, by year and technology type. The quantities shown below for meters, endpoints and lids were used to prepare the cost / benefit scenarios.

Figure 6



[7] In the “Existing Tech” scenarios (scenarios 4 and 5), equipment was replaced with like. For 99% plus of the 2” and smaller meters, this means replacing AMR with AMR. For the 136, 2” and smaller meters with an existing AMI endpoints, however, the like replacement was AMI, and this immaterial nuance exists in the model.

Figure 7[8]



Starting 2024 prices for materials and installation are shown below. These were increased by 2.6% annually starting in 2025. This 2.6% annual increase is equal to the ten-year CAGR for the Bureau of Labor Statistics all-goods Consumer Price Index as of December 2022.[9]

Figure 8 – 2024 Material and Installation Prices (CONFIDENTIAL)

Items	Badger Cellular AMI	Badger AMR	Neptune Cellular AMI	Neptune AMR	Neptune Hybrid
Installation Labor	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Meter	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Connected AMI Endpoint	[redacted]		[redacted]		[redacted]
AMR Endpoint		[redacted]		[redacted]	
Composite Lids	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Fixed Network					[redacted]

The capital expenditures associated with each scenario, based on these quantities and prices, were forecasted for the 20 year period in nominal dollars by year. The totals vary primarily due to different pricing for meters and endpoints, as well as the varying quantities of lids. In the case of Neptune Hybrid AMI, there is also some initial investment in fixed network receivers.

For the purposes of comparing costs and benefits over time, revenue requirement type calculations were used to reflect the cost of the capital expenditures. The annual cost recognition for each program reflects depreciation,

[8] For the purposes of cost / benefit modeling, a conservative assumption is made that lids are replaced 1 to 1 with applicable meter replacements. In reality, many meter pits in Kentucky are dual set, meaning there are two meters in one pit. In these instances, only one lid would need to be purchased.
[9] The Series ID is CUUR0000SA0.

property taxes, pre-tax rate of return, and in the case of Neptune Hybrid, the expense associated with the fixed network. Key capital-related cost assumptions are shown in Figure 9 below.

Figure 9

Common Assumptions for All Scenarios	
Annual inflation for meter materials[10]	2.6%
Depreciation Rate[11]	10%
Property Tax Rate	1.39% of net plant
Pre-Tax Rate of Return	Debt ratio, equity ratio and equity cost based on the forecasted values requested in this proceeding. Equity gross-up based on federal tax rate of 21% and state tax rate of 5%
Uncollectible expense and utility regulatory assessment fees	0.75%

Benefit drivers

The largest and most readily measurable financial benefits of AMI (new technology) relative to AMR (existing technology) were modeled to include:

- Field service representative ("FSR") labor and related benefits:
    - Reduced demand for approximately 27.5k field service orders, or approximately 12.7k annual hours of meter reading related work outside of the periodic read cycle, once AMI is fully installed.
    - Benefits modeled to increase over time with increasing concentration of AMI meters.
- Meter reading labor and related benefits:
    - Eventual eliminated need for periodic meter reading labor, once AMI is fully installed.
    - Benefits modeled to begin when the system is nearly fully converted to AMI after a full 10-year normal periodic replacement cycle.
- Vehicle benefits associated with labor benefits
    - Reduced demand for vehicles and associated fuel, fleet and rate base return, corresponding to reduced field service and meter reading labor demand.

Key quantity and price related assumptions related to meter reading, and field service labor are shown below in Figure 10.

Figure 10

Labor Related Price and Quantity Assumptions	AMI	AMR
<u>Meter Reading</u>		
Meter reading full time employees (current)	7	7
Meter reading full time employees (after full replacement cycle)	0	7
Meter reading hourly wage 2023	$28.65	$28.65

[10] 10-year CAGR for CPI all goods, as of December 2022.
[11] To avoid undue refinement, the capital investment was not broken out into the portion charged to Utility Plant in Service "UPIS" and the portion charged to Accumulated Cost of Removal "ACOR". Rather, all capital expenditure is recorded as UPIS and the depreciation reflects a 10-year life.

Labor Related Price and Quantity Assumptions	AMI	AMR
Quantity of benefit recognized	Begins when AMI saturation averages 95% of system (year 10)	
Field Service Work		
FSR orders completed 2022	79k	79k
Reduction in FSR order demand	(27.5k)	-
Field service work hourly wage 2023	$31.61	
Quantity of benefit recognized	% of benefit achieved aligns with average % of AMI saturation achieved	
Common Labor Assumptions for Meter Reading and Field Service Work		
Annual union wage increase assumption (3-year CAGR for average FSR and meter reader wage changes, 2020-2023)	2.5%	
Overhead/overtime rate (overtime, group insurance, retirement, and other benefits as a % of wages)	53% + 3% union APP	

Key vehicle-related benefit assumptions are shown in Figure 11 below. Vehicle-related benefits were calculated in line with labor benefits, with the assumption that one vehicle is needed for a full-time equivalent quantity of labor, using 2088 hours as a basis.

Figure 11

Vehicle Related Price and Quantity Assumptions	Amount for 2024
Annual mileage & mpg for vehicle	13,155 miles / 12.2 mpg
Fuel cost per gallon 2023 (remaining years as forecasted by Energy Information Administration)	$2.78 /gallon
Annual maintenance per light truck	$2,669
Average net book value per light truck (as of Mar. 2023)	$30,380
Current annual depreciation per vehicle	$3,320

The benefits are recognized over time, as AMI is deployed eventually throughout the system. The twenty-year nominal totals were forecasted based on the pace of AMI deployment.

Cost Net of Benefits

When annual capital related expenses are netted against annual operating expense benefits, AMI Badger is the least cost solution in the long term. For the first 10 years, when meter reading benefits are not yet accrued, Existing Technology for Badger has the most favorable annual figure. Once meter reading benefits fully begin in year 11, the Badger AMI cost net of benefits line becomes and stays a least cost solution for all the years that follow. Please see figure 12 below.

Figure 12 (CONFIDENTIAL)

[redacted]

The annual costs net of benefits can also be discounted to a net present value ("NPV") for the twenty-year period.[12] Please see Figure 13 below. Existing technology for Badger has the least cost NPV and AMI Badger has the second least cost. The gap between these is $3.1mm over 20 years, or approximately $150k / year in 2024 NPV. For context, this is just over 1/10 of a percent of the Company's annual February 2024 - January 2025 revenue requirement of $142mm, as shown in Exhibit 37A of the rate case.

Figure 13 (CONFIDENTIAL)

[redacted]

[12] A discount factor equal to Kentucky American's requested rate of return in this case, or 7.87% is used for the purpose of calculating net present value.

Summary of Findings

Based on all of the foregoing, the Company believes that deployment of AMI technology utilizing a cellular network is in the long-term best interest of customers. AMI provides significant benefits to customers through improved metering, operational efficiencies and enhanced customer service, among others. While many of these benefits may not be explicitly quantifiable, they still provide tangible benefits to customers. Badger AMI does so while delivering a solution that is among the least cost of the reasonable alternatives evaluated by KAWC.

Unlike other AMI deployments in the state, KAWC is not planning a discreet project to accelerate the replacement of its existing metering equipment. Rather, KAWC is merely planning to transition to an updated technology for meter reading equipment as it completes meter and endpoint replacements in the normal course of business. As such, it is clear that, whereby cellular AMI will be installed for normal, scheduled, periodic replacements or in instances of damaged or broken equipment, that there is a need for the investment and no wasteful duplication.

It is critical that the Company begin AMI implementation as soon as possible in order to maximize the benefits and cost effectiveness of AMI implementation, and KAWC plans to begin doing so upon approval of this Plan.

CPCN Filing Requirements

Below are a list of the CPCN specific filing requirements set forth in 807 KAR 5:001 Section 15 (2):

(a)	The facts relied upon to show that the proposed construction or extension is or will be required by public convenience or necessity.	See Exhibit A.
(b)	Copies of franchises or permits, if any, from the proper public authority for the proposed construction or extension, if not previously filed with the commission.	Not applicable. No new franchises or permits are required for the deployment of cellular AMI technology.
(c)	A full description of the proposed location, route, or routes of the proposed construction or extension, including a description of the manner in which same will be constructed, and the names of all public utilities, corporations, or persons with whom the proposed construction or extension is likely to compete.	KAWC plans to install AMI at all premises in KAWC's service territory. See Exhibit A, Appendix A, Figure 15 through Figure 18, for maps depicting the proposed locations and deployment timeframes.
(d)(1)	Three (3) copies (one (1) in portable document format on electronic storage medium and two (2) in paper medium) of maps to suitable scale showing the location or route of the proposed construction or extension, as well as the location to scale of like facilities owned by others located anywhere within the map area with adequate identification as to the ownership of the other facilities.	See Exhibit A, Appendix A, Figure 15 through Figure 18, for maps depicting the proposed locations and deployment timeframes.

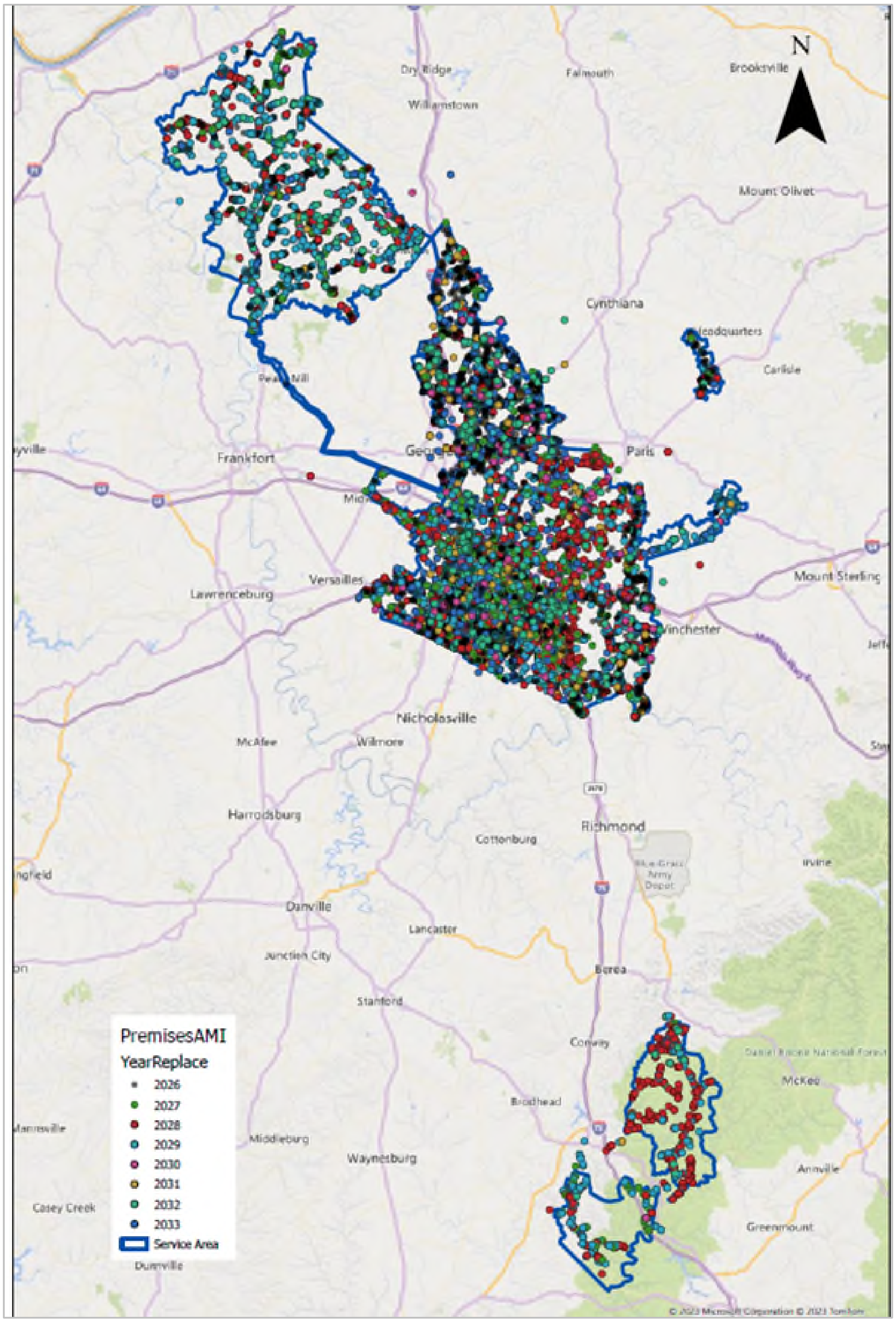
(d)(1)	Plans and specifications and drawings of the proposed plant, equipment, and facilities.	See Appendix B for the selected metering option's equipment specification sheets.
(e)	The manner in detail in which the applicant proposes to finance the proposed construction or extension.	This construction will be funded in the ordinary course of business, using the same mix of debt and equity as utilized to fund the remainder of its capital investment program.
(f)	An estimated annual cost of operation after the proposed facilities are placed into service.	In year 10, after nearly 1 full replacement cycle, the cost for selected metering option is forecasted to be \$3,873,858. In year 20, the cost for the selected metering option is forecasted to be \$5,590,216. The costs net of benefits for the selected metering option, for the same years respectively, are \$2,408,761 and \$3,073,234.
	Engineering plans, specifications, drawings, plats and reports for the proposed construction or extension prepared by a registered engineer, must be signed, sealed, and dated by an engineer registered in Kentucky.	See Cover Page of Exhibit A containing the sign and seal of an engineer registered in Kentucky

Conclusion

KAWC's implementation of cellular AMI technology over the course of the next decade is in the long-term best interests of customers. The investments will be made as part of the normal periodic meter equipment replacement cycle, when meters and endpoints would normally be replaced anyway; thus, there will be no wasteful duplication. Further, replacing equipment with AMI as this replacement cycle goes forward will enable significant enhancements in customer service, employee safety, and operational efficiency. A variety of alternatives for meter reading technology were considered, with costs and benefits measured across brands and solutions. Badger cellular AMI is the proposed solution due to both its customer service advantages as well as its favorable proposition for costs net of benefits.

Appendix A

Figure 14 – Meter Replacements by Year of Completion[13]



13 Dots shown as 2026 refer to all meters replaced between 2024 and 2026.

Figure 15 – May 2023 (248 premises)

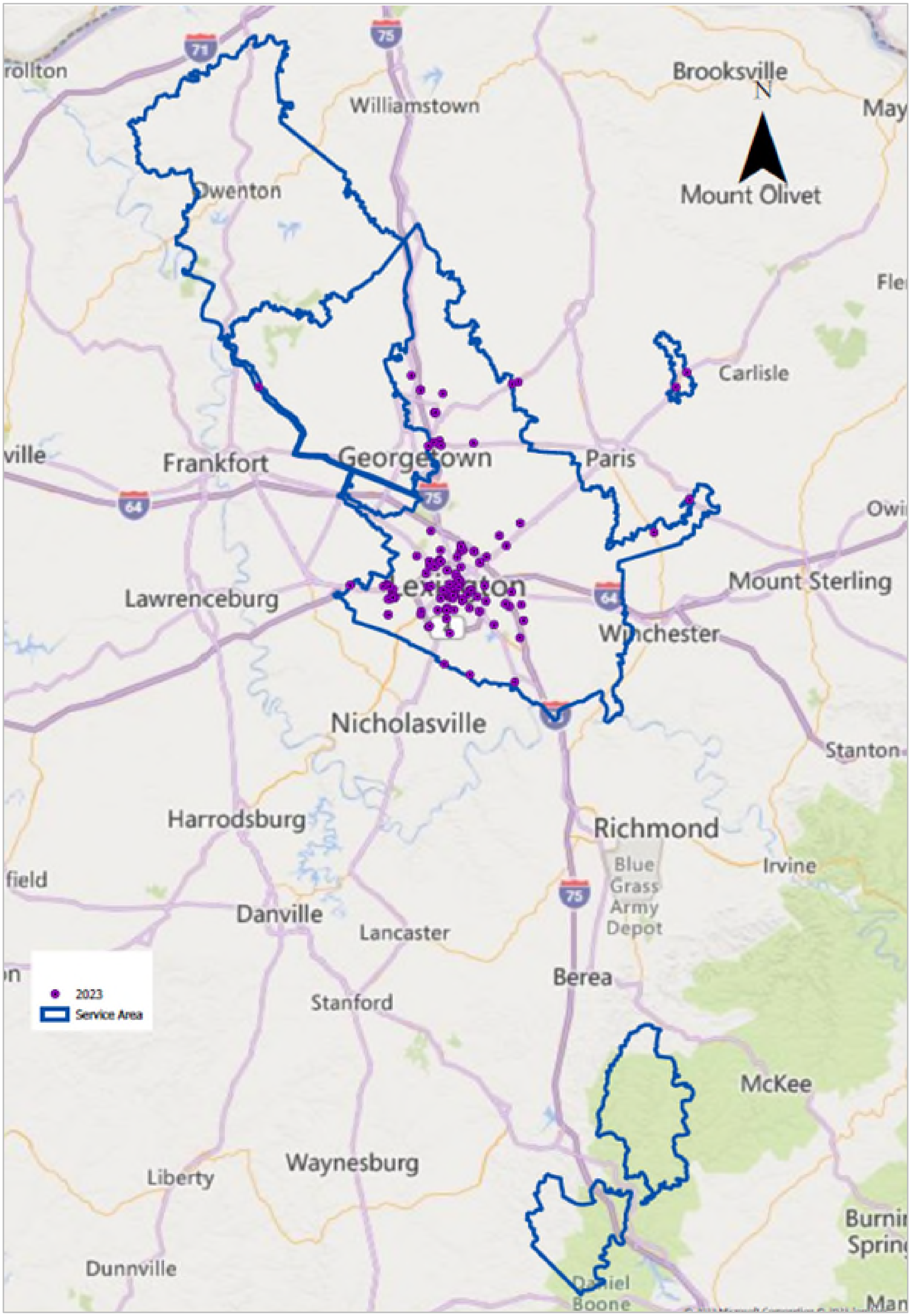


Figure 16 – End of 2026 (~81k premises)

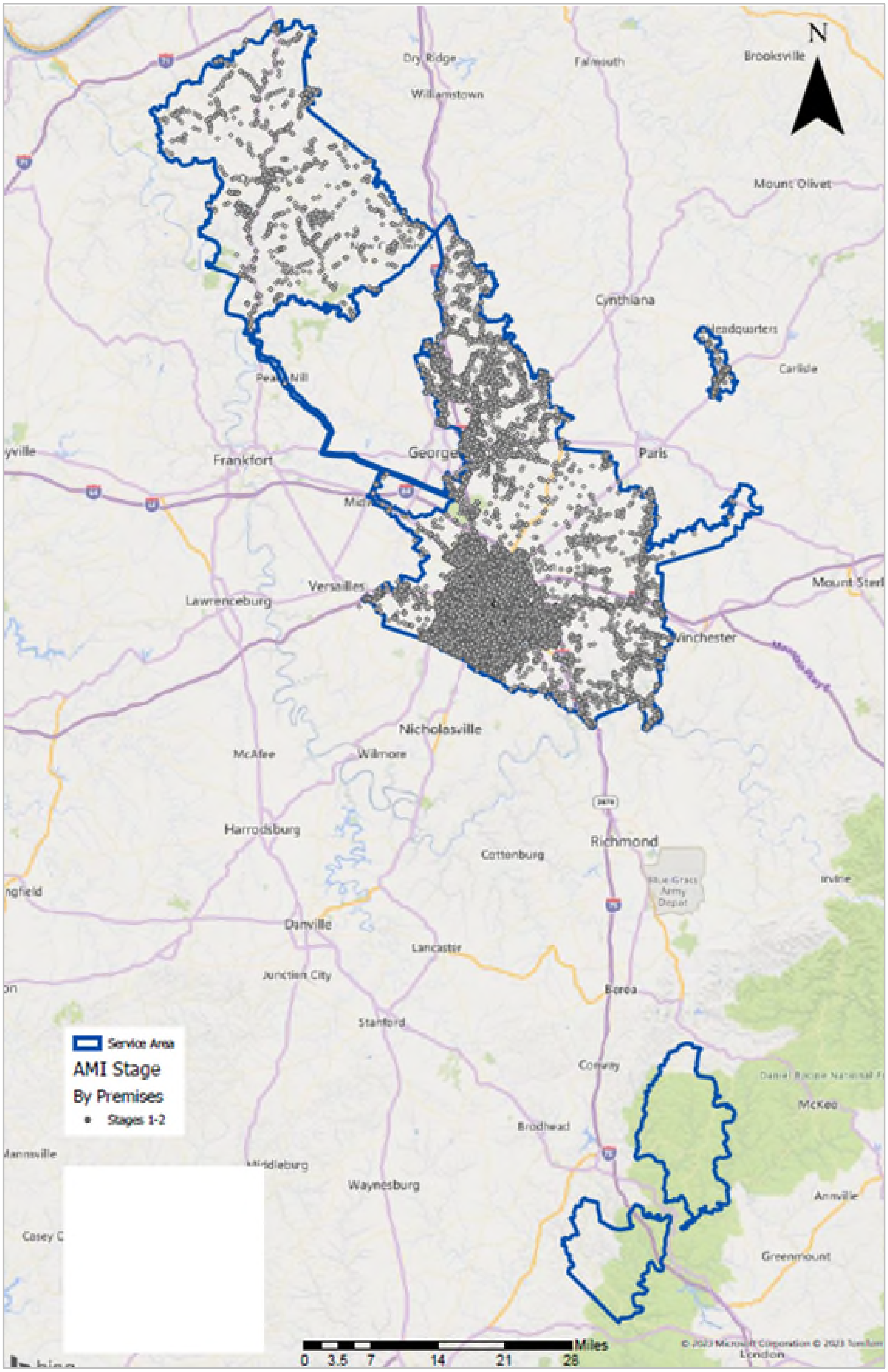


Figure 17 – End of 2029 (~117k premises)

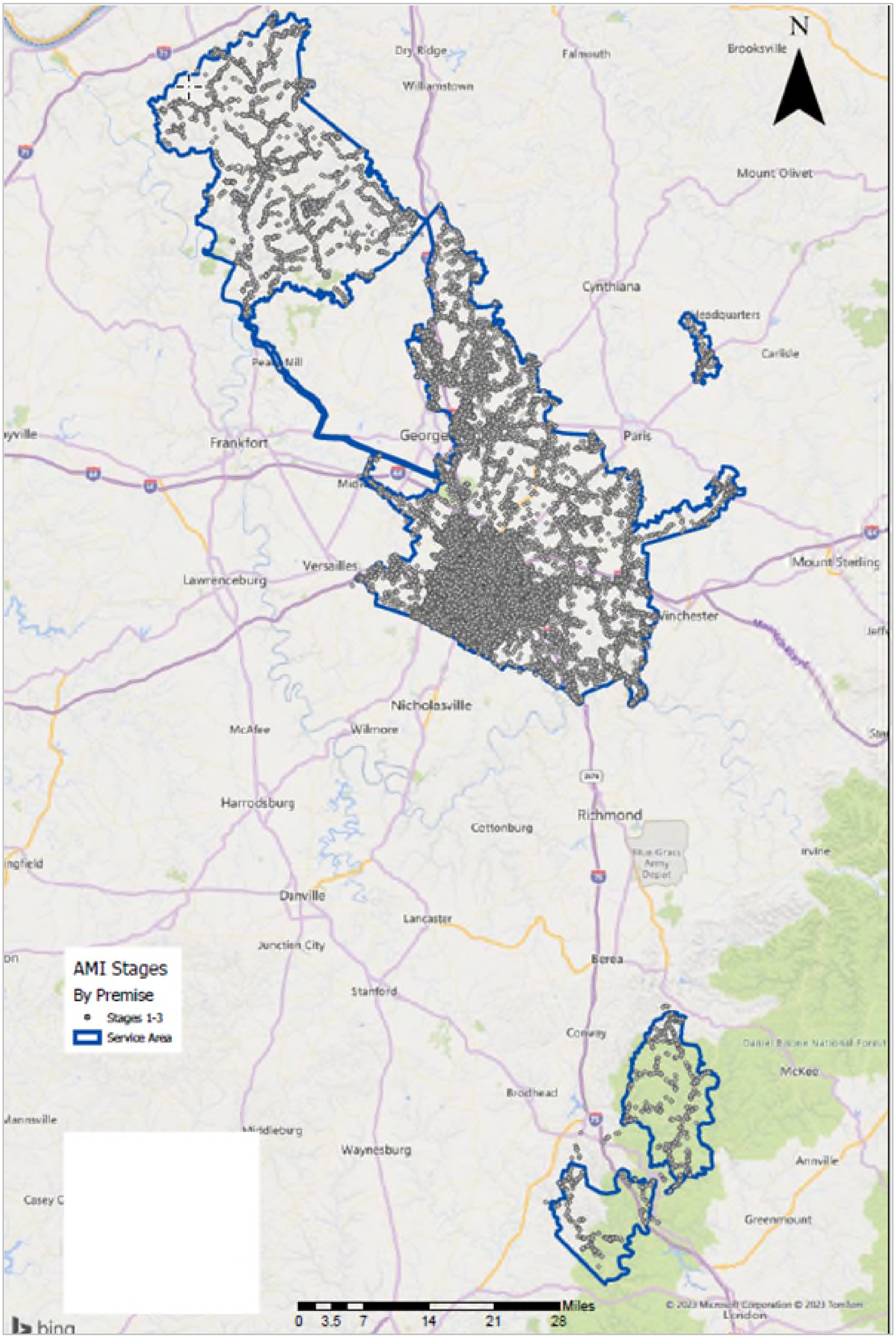
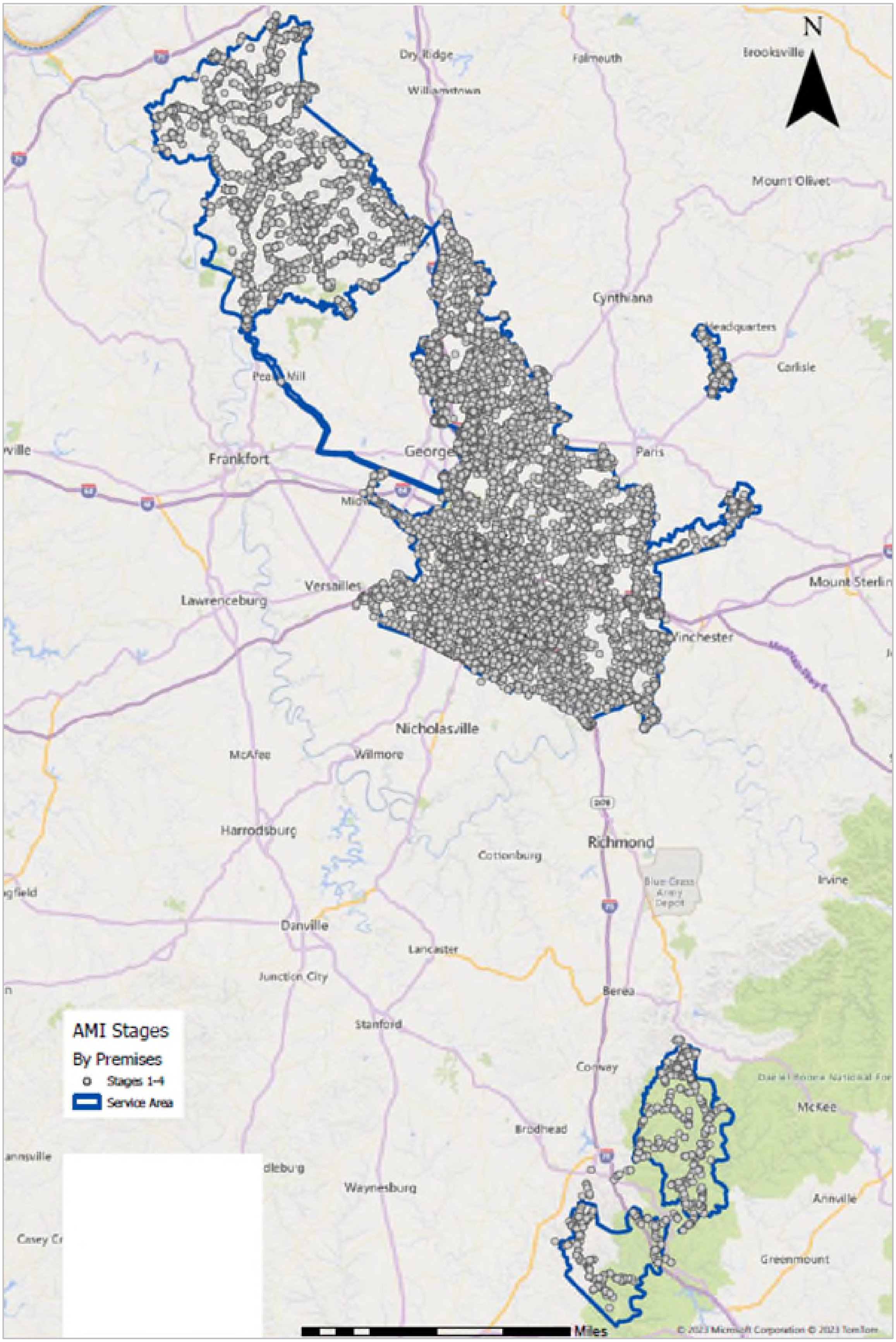


Figure 18 – End of 2033 (142k premises)



Appendix B

E-Series® Ultrasonic Flow Meters

E-Series® Ultrasonic Meter

Cold Water Stainless Steel Meter, 1-1/2 and 2 inch

DESCRIPTION

The E-Series® Ultrasonic meter uses solid-state technology in a compact, totally encapsulated, weatherproof, and UV-resistant housing, suitable for residential and commercial applications. Electronic metering provides information—such as rate of flow and reverse flow indication—and data not typically available through traditional, mechanical meters and registers. Electronic metering eliminates measurement errors due to sand, suspended particles and pressure fluctuations.

The Ultrasonic 1-1/2 and 2 inch meters feature:

- Minimum extended low-flow rate lower than typical positive displacement meters.
- Simplified one-piece electronic meter and register that are integral to the meter body and virtually maintenance free.
- Sealed, non-removable, tamper-protected meter and register.
- Easy-to-read, 9-digit LCD display presents consumption, rate of flow, reverse-flow indication, and alarms (empty pipe, temperature, exceeding max flow, sensor error, reverse flow, suspected leak, 30 day no usage, end of life).
- High resolution industry standard ASCII encoder protocol sends alarms and data to ORION® Cellular endpoints and BEACON® SaaS* suite to establish a smart water solution.

The Ultrasonic meter is available with an in-line connector for easy connection and installation to AMR/AMI endpoints. It is also available with a flying lead for field splice connection.

* Software as a Service

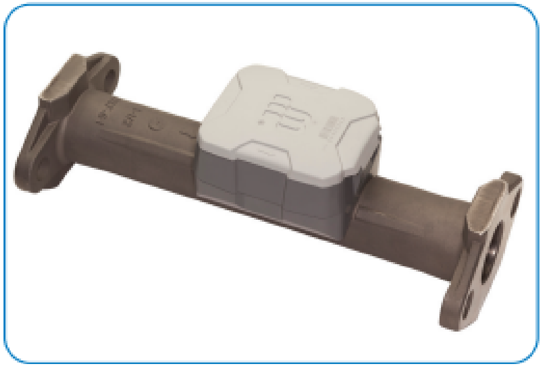
APPLICATIONS

Use the Ultrasonic meter for measuring potable cold water in residential, commercial and industrial services. The meter is also ideal for non-potable, reclaimed irrigation water applications or less than optimum water conditions where small particles exist.

E-Series Ultrasonic meters meet and exceed ANSI/AWWA C715 standards. The meters comply with the lead-free provisions of the Safe Drinking Water Act, are certified to NSF/ANSI/CAN Standards 61 and 372 and carry the NSF-61 mark on the housing.

OPERATION & PERFORMANCE

As water flows into the measuring tube, ultrasonic signals are sent consecutively in forward and reverse directions of flow. Velocity is then determined by measuring the time difference between the measurement in the forward and reverse directions. Total volume is calculated from the measured flow velocity using water temperature and pipe diameter. The LCD display shows total volume and alarm conditions and can toggle to display rate of flow.



In the normal temperature range of 45…122° F (7…50° C), the Ultrasonic "new meter" consumption measurement is accurate to:

- ±1.5% over the normal flow range
- ±3.0% from the extended low flow range to the minimum flow value

CONSTRUCTION

E-Series Ultrasonic meters feature a stainless steel, lead-free meter housing, an engineered polymer and stainless steel metering insert, a meter-control circuit board with associated wiring, LCD, and battery. Wetted elements are limited to the pressure vessel, the polymer/stainless steel metering insert and the transducers. The electronic components are housed and fully potted within a molded, engineered polymer enclosure, which is permanently attached to the meter housing. The transducers extend through the stainless steel housing and are sealed by O-rings.

The metering insert holds the stainless steel ultrasonic reflectors in the center of the flow area, enabling turbulence-free water flow through the tube and around the ultrasonic signal reflectors. The metering insert's patented design virtually eliminates chemical buildup on the reflectors, ensuring long-term metering accuracy.

METER INSTALLATION

The meter is completely submersible and can be installed using horizontal or vertical piping, with flow in the up direction. The meter will not measure flow when an "empty pipe" condition is experienced. An empty pipe is defined as a condition that occurs when the flow sensors are not fully submerged.

SPECIFICATIONS

E-Series Ultrasonic Meter Size	1-1/2 in. (40 mm)	2 in. (50 mm)
Normal Test Flow Limits	1.25…100 gpm (0.28…22.7 m^3/hr)	1.5…160 gpm (0.34…36.3 m^3/hr)
Minimum Test Flow Limits	0.40 gpm (0.09 m^3/hr)	0.50 gpm (0.11 m^3/hr)
Safe Maximum Operating Condition (SMOC)	100 gpm (22.7 m^3/hr)	160 gpm (36.3 m^3/hr)
Typical Pressure Loss	3.8 psi (0.26 bar)	5.2 psi (0.36 bar)
Reverse Flow – Maximum Rate	12 gpm (2.73 m^3/hr)	18 gpm (4.09 m^3/hr)
Operating Performance	In the normal temperature range of 45…122° F (7…50° C), new meter consumption measurement is accurate to: • ±1.5% over the normal flow range • ±3.0% from the extended low flow range to the minimum flow value	
Storage Temperature	– 40…140° F (– 40…60° C)	
Maximum Ambient Storage (Storage for One Hour)	150° F (66° C)	
Measured-Fluid Temperature Range	34…140° F (1…60° C)	
Humidity	0…100% condensing; meter is capable of operating in fully submerged environments	
Maximum Operating Pressure of Meter Housing	175 psi (12 bar)	
Register Type	Straight reading, permanently sealed electronic LCD; digits are 0.28 in. (7 mm) high	
Register Display	• Consumption (up to nine digits) • Rate of flow • Alarms (empty pipe, temperature, exceeding max flow, sensor error, reverse flow, suspected leak, 30 day no usage, end of life) • Unit of measure factory programmed for gallons, cubic feet and cubic meters	
Register Capacity	• 100,000,000 gallons • 10,000,000 cubic feet • 1,000,000 cubic meters	
Totalization Display Resolution	• Gallons: 0.X • Cubic feet: 0.XX • Cubic meters: 0.XXX	
Battery	3.6-volt lithium thionyl chloride; battery is fully encapsulated within the register housing and is not replaceable; 20-year battery life	

MATERIALS

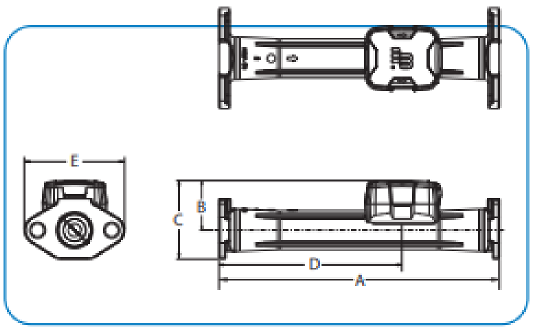
Meter Housing	316 stainless steel
Measuring Element	Pair of ultrasonic sensors located in the flow tube
Register Housing & Lid	Engineered polymer
Metering Insert	Engineered polymer & stainless steel
Transducers	Piezo-ceramic device with wetted surface of stainless CrNiMo

CONFIDENTIAL INFORMATION REDACTED

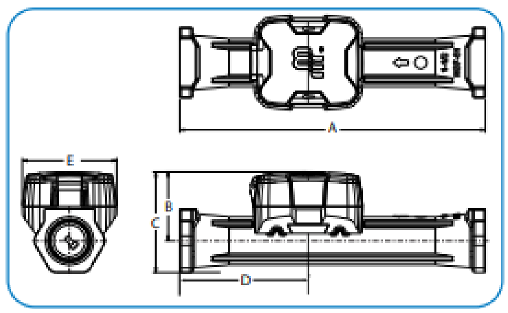
PHYSICAL DIMENSIONS

E-Series Ultrasonic Meter Size	1-1/2 in. (40 mm)	1-1/2 in. (40 mm)	2 in. (50 mm)	2 in. (50 mm)
Housing	**Elliptical**	**HEX**	**Elliptical**	**HEX**
Size Designation X Lay Length	1-1/2 x 13 in. (38 x 330 mm)	1-1/2 x 12.62 in. (38 x 321 mm)	2 x 17 in. (51 x 432 mm)	2 x 15.25 in. (51 x 387 mm)
Weight (without AMR)	8.2 lb (3.7 kg)	6.5 lb (2.9 kg)	11.9 lb (5.4 kg)	8.9 lb (4.0 kg)
See illustration below for Measurement Designations.				
Length (A)	13 in. (330 mm)	12.62 in. (321 mm)	17 in. (432 mm)	15.25 in. (387 mm)
Height (B)	2.80 in. (71 mm)	2.84 in. (72 mm)	3.01 in. (77 mm)	3.06 in. (78 mm)
Height (C)	4.55 in. (116 mm)	4.15 in. (105 mm)	4.76 in. (121 mm)	4.68 in. (119 mm)
Length (D)	7.10 in. (180 mm)	5.31 in. (135 mm)	11.10 in. (282 mm)	5.05 in. (128 mm)
Width (E)	5.50 in. (140 mm)	3.90 in. (99 mm)	6.08 in. (154 mm)	3.90 in. (99 mm)
Bore Size	1-1/2 in. (40 mm)	1-1/2 in. (40 mm)	2 in. (51 mm)	2 in. (51 mm)
Two-Bolt Elliptical Flange (AWWA)	1-1/2 in. (40 mm)	—	2 in. (51 mm)	—
Bolt Hole Diameter	0.69 in. (17.53 mm)	—	0.81 in. (20.57 mm)	—
Companion Flange	1-1/2 in. (40 mm)	—	2 in. (51 mm)	—
Internal Thread Size	—	1-1/2 in. NPT	—	2 in. NPT

Elliptical Measurement Designations

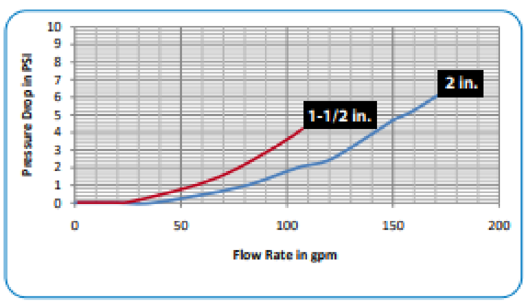


HEX Measurement Designations



PRESSURE LOSS CHART

Flow rate in Gallons Per Minute (gpm)

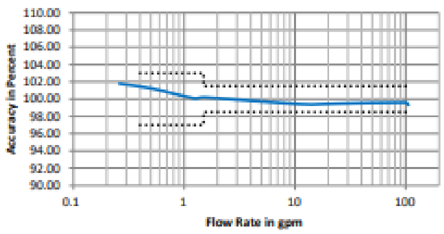


E-Series® Ultrasonic Meter

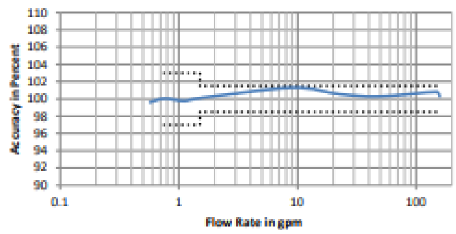
ACCURACY CHARTS

Rate of Flow in gallons per minute (gpm)

1-1/2 in. Meter



2 in. Meter



SMART WATER IS BADGER METER

www.badgermeter.com

Legacy Document Number: ESM-T-10-EN

Badger Meter

Recordall® Disc Meters

Lead-Free Bronze Alloy, Sizes 5/8, 5/8 x 3/4, 3/4 & 1 inch
NSF/ANSI Standards 61 and 372 Certified


Model 25—5/8 in., 5/8 x 3/4 in.


Model 35—3/4 in.


Model 55—1 in.


Model 70—1 in.

DESCRIPTION

The Recordall Disc Series meters meet or exceed the most recent revision of AWWA Standard C700 and are available in a lead-free bronze alloy. The meters comply with the lead-free provisions of the Safe Drinking Water Act, are certified to NSF/ANSI Standards 61 and 372 (Trade Designations: M25-LL, M35-LL, M55-LL, M70-LL) and carry the NSF-61 mark on the housing. All components of the lead-free bronze alloy meter (housing, measuring element, seals, and so on) comprise the certified system.

Applications: For use in measurement of potable cold water in residential, commercial and industrial services where flow is in one direction only.

Operation: Water flows through the meter's strainer and into the measuring chamber where it causes the disc to nutate. The disc, which moves freely, nutates on its own ball, guided by a thrust roller. A drive magnet transmits the motion of the disc to a follower magnet located within the permanently sealed register. The follower magnet is connected to the register gear train. The gear train reduces the disc nutations into volume totalization units displayed on the register or encoder face.

Operating Performance: The Recordall Disc Series meters meet or exceed registration accuracy for the low flow rates (95%), normal operating flow rates (100 ±1.5%), and maximum continuous operation flow rates as specifically stated in AWWA Standard C700.

Construction: Recordall Disc meter construction, which complies with ANSI/AWWA standard C700, consists of three basic components: meter housing, measuring chamber and permanently sealed register or encoder. The meter is available in a lead-free bronze alloy with externally threaded spuds. A corrosion-resistant engineered polymer material is used for the measuring chamber.

Magnetic Drive: Direct magnetic drive, through the use of high-strength magnets, provides positive, reliable and dependable register coupling for straight-reading or AMR/AMI meter reading options.

Tamper-Proof Features: Unauthorized removal of the register or encoder is inhibited by the option of a tamper detection seal wire screw, TORX® tamper-resistant seal screw or the proprietary tamper-resistant keyed seal screw. Each can be installed at the meter site or at the factory.

Maintenance: Badger Meter Recordall Disc Series meters are designed and manufactured to provide long-term service with minimal maintenance. When maintenance is required, it can be performed easily either at the meter installation or at any other convenient location.

To simplify maintenance, the register, measuring chamber, and strainer can be replaced without removing the meter housing from the installation. No change gears are required for accuracy calibration. Interchangeability of parts among like-sized meters and meter models also minimizes spare parts inventory investment. The built-in strainer has an effective straining area of twice the inlet size.

Connections: Tailpieces/Unions for installations of meters on various pipe types and sizes, including misaligned pipes, are available as an option.

Meter Spud and Connection Sizes

Model	Size Designation (in.)	×	"L" Laying Length (in.)	"B" Bore Dia. (in.)	Coupling Nut and Spud Thread (in.)	Tailpiece Pipe Thread (NPT) (in.)
25	5/8	×	7-1/2	5/8	3/4 (5/8)	1/2
	5/8 x 3/4	×	7-1/2	5/8, 3/4	1 (3/4)	3/4
35	3/4	×	7-1/2	3/4	1 (3/4)	3/4
	3/4	×	9	3/4	1 (3/4)	3/4
	3/4 x 1	×	9	3/4	1-1/4 (1)	1
55	1	×	10-3/4	1	1-1/4 (1)	1
70	1	×	10-3/4	1	1-1/4 (1)	1

RDM-DS-00467-EN-06 (July 2019)

Product Data Sheet

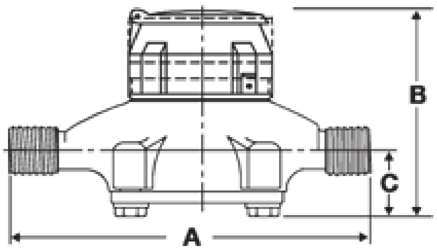
SPECIFICATIONS

	Model 25 (5/8 in. & 5/8 × 3/4 in.)	Model 35 (3/4 in.)	Model 55 (1 in.)	Model 70 (1 in.)
Typical Operating Range (100% ± 1.5%)	0.5…25 gpm (0.11…5.7 m³/hr)	0.75…35 gpm (0.17…7.9 m³/hr)	1…55 gpm (0.23…12.5 m³/hr)	1.25…70 gpm (0.28…16 m³/hr)
Low Flow	0.25 gpm (0.057 m³/hr) Min. 98.5%	0.375 gpm (0.085 m³/hr) Min. 97%	0.5 gpm (0.11 m³/hr) Min. 95%	0.75 gpm (0.17 m³/hr) Min. 95%
Maximum Continuous Operation	15 gpm (3.4 m³/hr)	25 gpm (5.7 m³/hr)	40 gpm (9.1 m³/hr)	50 gpm (11.3 m³/hr)
Pressure Loss at Maximum Continuous Operation	**5/8 in. size:** 3.5 psi @ 15 gpm (0.24 bar @ 3.4 m³/hr) **5/8 × 3/4 in. size:** 2.8 psi @ 15 gpm (0.19 bar @ 3.4 m³/hr)	5 psi @ 25 gpm (0.37 bar @ 5.7 m³/hr)	3.4 psi @ 40 gpm (0.23 bar @ 9.1 m³/hr)	6.5 psi @ 50 gpm (0.45 bar @ 11.3 m³/hr)
Maximum Operating Temperature	80° F (26° C)			
Maximum Operating Pressure	150 psi (10 bar)			
Measuring Element	Nutating disc, positive displacement			
Meter Connections	*Available in NL bronze and engineered polymer to fit spud thread bore diameter sizes:*			
	5/8 in. size: 5/8 in. (DN 15 mm) **5/8 × 3/4 in. size:** 3/4 in. (DN 15 mm)	3/4 in. (DN 20 mm)	1 in. (DN 25 mm)	1 in. (DN 25 mm)

MATERIALS

	Model 25 (5/8 in. & 5/8 × 3/4 in.)	Model 35 (3/4 in.)	Model 55 (1 in.)	Model 70 (1 in.)
Meter Housing	Lead-free bronze alloy			
Housing Bottom Plates	Cast iron, lead-free bronze alloy, engineered polymer	Cast iron, lead-free bronze alloy		
Measuring Chamber	Engineered polymer			
Disc	Engineered polymer			
Trim	Stainless steel			
Strainer	Engineered polymer			
Disc Spindle	Stainless steel	Stainless steel	Engineered polymer	Stainless steel
Magnet	Ceramic	Ceramic	Ceramic	Ceramic
Magnet Spindle	Engineered polymer	Stainless steel	Engineered polymer	Stainless steel
Register Lid and Shroud	Engineered polymer, bronze			

DIMENSIONS



Meter Size	Model	A Laying Length	B Height Reg.	C Centerline Base	Width	Approx. Shipping Weight
5/8 in. (15 mm)	25	7-1/2 in. (190 mm)	4-15/16 in. (125 mm)	1-11/16 in. (42 mm)	4-1/4 in. (108 mm)	4-1/2 lb (2 kg)
5/8 in. × 3/4 in. (15 mm)		7-1/2 in. (190 mm)	4-15/16 in. (125 mm)	1-11/16 in. (42 mm)	4-1/4 in. (108 mm)	4-1/2 lb (2 kg)
3/4 in. (20 mm)	35	7-1/2 in. (190 mm)	5-1/4 in. (133 mm)	1-5/8 in. (41 mm)	5 in. (127 mm)	5-1/2 lb (2.5 kg)
3/4 in. (20 mm)		9 in. (229 mm)	5-1/4 in. (133 mm)	1-5/8 in. (41 mm)	5 in. (127 mm)	5-3/4 lb (2.6 kg)
3/4 in. × 1 in. (20 mm)		9 in. (229 mm)	5-1/4 in. (133 mm)	1-5/8 in. (41 mm)	5 in. (127 mm)	6 lb (2.7 kg)
1 in. (25 mm)	55	10-3/4 in. (273 mm)	6 in. (152 mm)	2-1/32 in. (52 mm)	6-1/4 in. (159 mm)	8-3/4 lb (3.9 kg)
1 in. (25 mm)	70	10-3/4 in. (273 mm)	6-1/2 in. (165 mm)	2-5/16 in. (59 mm)	7-3/4 in. (197 mm)	11-1/2 lb (5.2 kg)

REGISTERS / ENCODERS

Standard—Sweep-Hand Registration

The standard register is a straight-reading, permanently sealed magnetic drive register. Dirt, moisture, tampering and lens fogging problems are eliminated. The register has a six-odometer wheel totalization display, 360° test circle with center sweep hand, and flow finder to detect leaks. Register gearing is made of self-lubricating engineered polymer, which minimizes friction and provides long life. The multi-position register simplifies meter installation and reading. The register capacity is 10,000,000 gallons (1,000,000 ft^3, 100,000 m^3).

A Model 25 register is used in the following example:

Model	Gallon	Cubic Feet	Cubic Meter
25 (5/8 in.)	10	1	0.1/0.01
25 (5/8 × 3/4 in.)	10	1	0.1/0.01
35	10	1	0.1
55	10	1	0.1
70	10	1	0.1

Optional—Encoders for AMR/AMI Reading Solutions

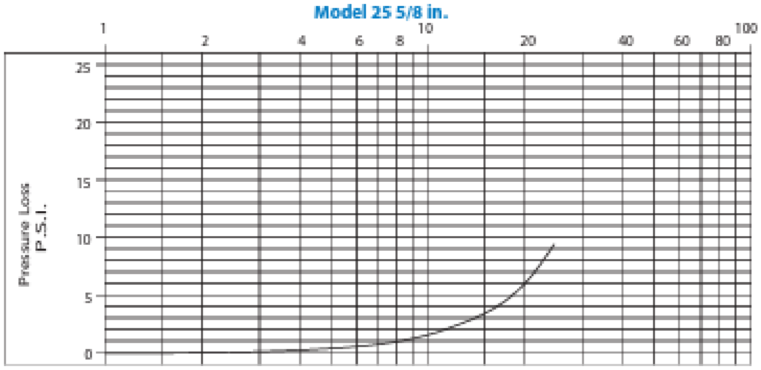
AMR/AMI solutions are available for all Recordall Disc Series meters. All reading options can be removed from the meter without disrupting water service. Badger Meter encoders provide years of reliable, accurate readings for a variety of applications. See details at ***www.badgermeter.com***.

CONFIDENTIAL INFORMATION REDACTED

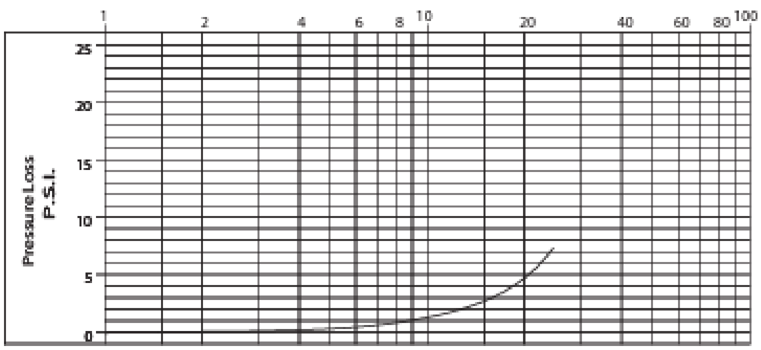
PRESSURE LOSS CHARTS

Rate of Flow in Gallons per Minute

Model 25 5/8 in.



Model 25 5/8 x 3/4 in.



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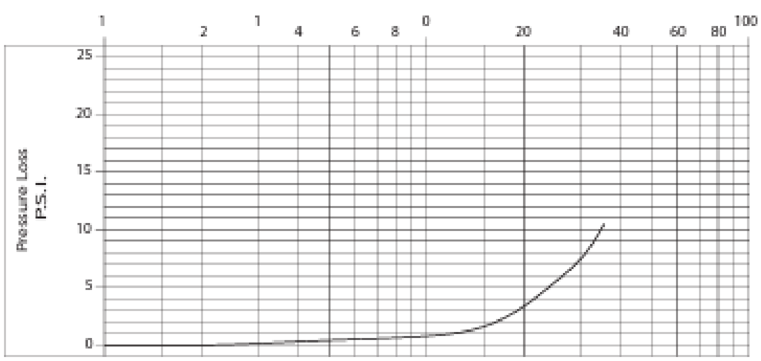
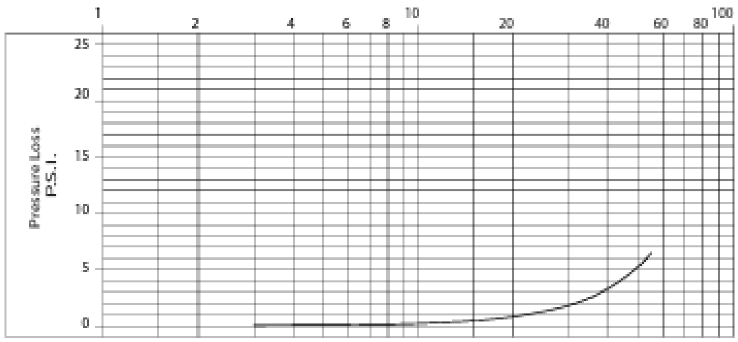


CONFIDENTIAL INFORMATION REDACTED

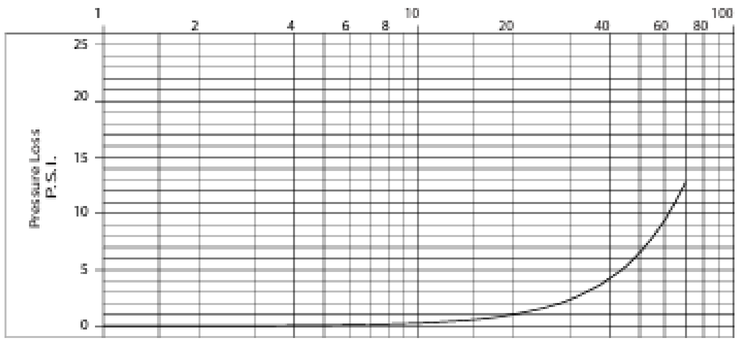
PRESSURE LOSS CHARTS (CONTINUED)

Rate of Flow in Gallons per Minute

Model 55 1 in.

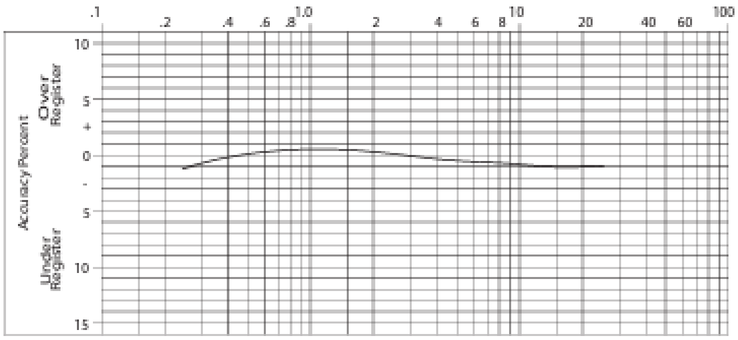


Model 70 1 in.

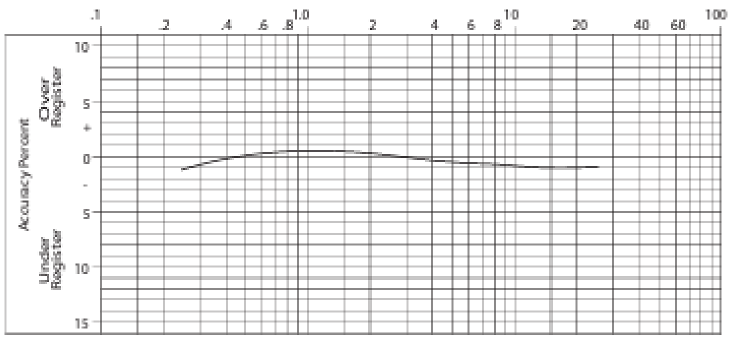


ACCURACY CHARTS

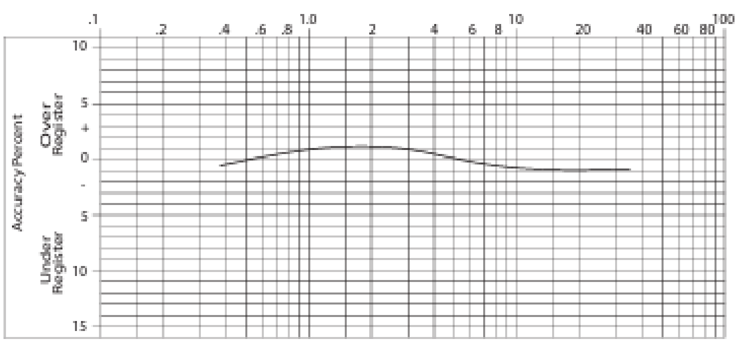
Model 25 5/8 in.



Model 25 5/8 × 3/4 in.



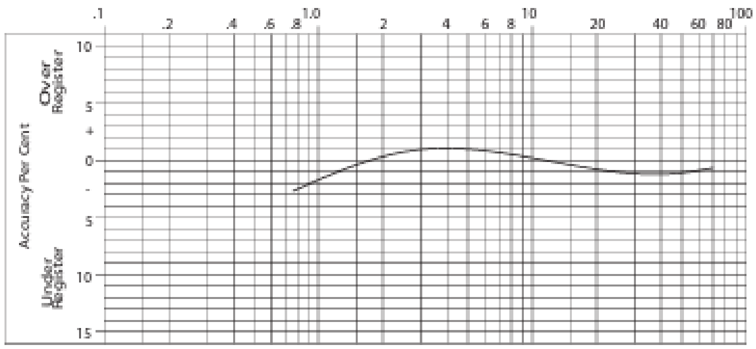
Model 35 3/4 in.



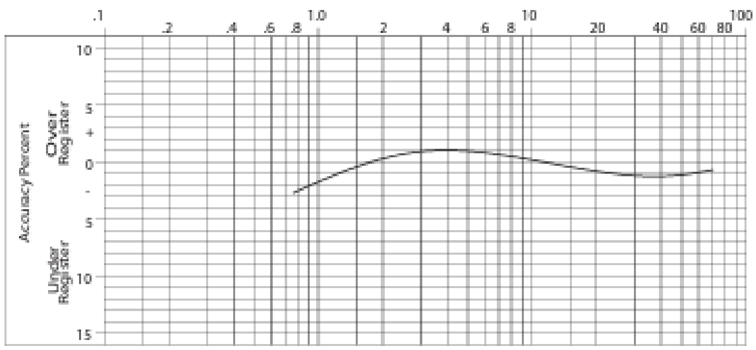
CONFIDENTIAL INFORMATION REDACTED

ACCURACY CHARTS (CONTINUED)

Model 55 1 in.



Model 70 1 in.



SMART WATER IS *BADGER METER*

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Legacy Document Numbers: RDM-DS-00062, 63, 64, 65, 66, and 74

ORION® Cellular/Fixed Network Solutions

ORION® Cellular Water Endpoints

DESCRIPTION

ORION® Cellular water endpoints are innovative, two-way endpoints for smart water applications. The endpoints utilize existing IoT (Internet of Things) cellular infrastructure to efficiently and securely deliver meter reading data to the utility in a Network as a Service (NaaS) approach. Leveraging existing cellular infrastructure, the NaaS solution offers all the performance benefits of AMI, while eliminating network-related maintenance and technology concerns and enhancing deployment flexibility.

Cellular endpoints are members of the time-tested ORION family of products from Badger Meter, designed for maximum flexibility. Since 2002, the ORION product family has provided comprehensive Advanced Metering Analytics (AMA) for interval meter reading and data capture using both one-way and two-way communications.

FUNCTIONALITY

Operation: ORION Cellular water endpoints communicate with the encoder and capture 15-minute interval read data and meter status information. The endpoints then automatically broadcast the information, including endpoint status information, via the cellular network to BEACON® Software as a Service (SaaS). ORION NaaS is powered by the proven ORION system for interval data capture and two-way communication. The solution employs cellular endpoints which, as they leverage the public cellular network and require no proprietary gateways to operate, dramatically reduce infrastructure requirements compared to a traditional fixed network. This speeds installations and simplifies expansion as a system evolves.

The endpoints are designed to call in four times each workday and feature a configurable schedule that enables utility customers to select call-in times that best support their processes.

Activation: ORION Cellular water endpoints are shipped in an inactive, non-transmitting state. The Badger Meter IR Communication Device can be used to activate the endpoints and verify the encoder connection. Successful endpoint function can be confirmed through a web app demonstrating that communication has been verified to both the encoder and the network.

Alternatively, the endpoints offer a Smart Activation feature. After installation, the endpoints begin broadcasting data when the encoder senses the first usage of water. No field programming or special tools are required.

Broadcast Mode: ORION Cellular water endpoints broadcast fixed network reading data through the secure cellular network within the service area.

Specific configurations also transmit a radio frequency (RF) message to facilitate troubleshooting in the field. See *"Configurations" on page 2.*

Data Storage: The endpoints store 42 days of 15-minute data.

ORION Cellular C endpoint (pictured)

Output Message: ORION Cellular water endpoints broadcast a unique serial number, meter reading data, and applicable status indicators. As an advanced data security measure, each message is securely transported to BEACON SaaS only via private network and never over the public internet.

APPLICATION

Configurations: ORION Cellular water endpoints are multi-purpose endpoints that can be deployed in indoor, outdoor and pit (non-metal pit lid) applications. The electronics and battery assembly are fully encapsulated in epoxy for environmental integrity. The endpoint is available with a connector assembly for ease of installation.

Meter Compatibility: When attached to a Badger Meter High Resolution Encoder, the ORION Cellular water endpoint is compatible with all current Badger Meter Recordall® Disc, Turbo Series, Compound Series, Combo Series and Fire Service meters and assemblies, and with E-Series G2® Ultrasonic, E-Series® Ultrasonic, E-Series® Ultrasonic Plus, and ModMAG® electromagnetic flow meters.

Encoder Compatibility: The ORION Cellular water endpoint is suitable for use with a Badger Meter High Resolution Encoder as well as the following Badger Meter approved three-wire encoder registers that have a manufacture date within 10 years of the current date as long as the encoder has three wires connected to it and is programmed into the three-wire output mode for AMR/AMI: Honeywell® (Elster) ScanCoder® encoder with Sensus® protocol module and evoQ4 meter (encoder output); Master Meter® Octave® Ultrasonic meter encoder output; Metron-Farnier Hawkeye; Mueller Systems 420 Solid State Register (SSR) LCD; Neptune® ProRead, E-Coder®, ARB-V®, and ProCoder; and Sensus iPerl®.

Badger Meter

ORI-DS-02957-EN-09 (September 2022)

Product Data Sheet

SPECIFICATIONS

Dimensions	5.125 in. (130 mm) (H) 1.75 in. (44 mm) Diameter at top 2.625 in. (W) x 2.875 in. (D) at base (67 mm (W) x 73 mm (D) at base)
Broadcast Network	LTE-M cellular network (primary communication technology)
	NB-IoT (secondary communication technology for certain variants)
RF Message for Troubleshooting	Where available (see table below) frequency is FCC-regulated 902…928 MHz frequency hopping modulation
Operating Temperature Range	
• Storage, Meter Reading and RF Message (for troubleshooting)	–40…60° C (–40…140° F)
• Cellular Communications	–20…60° C (–4…140° F)
Humidity	0%…100% condensing
Battery	One (1) lithium thionyl chloride D cell (nonreplaceable)

Construction: All ORION Cellular water endpoints are housed in an engineered polymer enclosure with an ORION RF board, battery and antenna. For long-term performance, the enclosure is fully potted to withstand harsh environments and to protect the electronics in flooded or submerged pit applications.

Wire Connections: ORION Cellular water endpoints are available with in-line connectors (Twist Tight® or Nicor®) for easy installation and connection to compatible encoders/meters. The endpoints are also available with flying leads for field splice connections. Other wire connection configurations may be available upon request.

FEATURES

Smart City Ready	Future-proof technology
Communication Type	Two-way
Application Type	Control/Monitor
Endpoint Communication	Configurable call-in schedule, up to four times each workday
Reading Interval Type	15-minute
Encoder Compatibility	Absolute
Fixed Network Reading	✓
Cut-Wire Indication	✓
Encoder Error	✓
Low Battery Indication	✓
Remote Clock Synchronization	✓
Firmware Upgrades	✓

CONFIGURATIONS

Endpoint	**Notes**
ORION Cellular C	Includes RF and IR messages for troubleshooting
ORION Cellular CS	Secondary carrier; includes RF and IR messages for troubleshooting
ORION Cellular LTE-M	Includes RF and IR messages for troubleshooting
ORION Cellular LTE-MS	Secondary carrier; includes RF and IR messages for troubleshooting
ORION Cellular HLA	Includes IR message for troubleshooting

NOTE: For the ORION Cellular LTE-MP endpoint, see the *ORION Cellular LTE-MP Endpoint product data sheet*, available at *www.badgermeter.com*.

License Requirements: ORION Cellular water endpoints comply with Part 15, Part 22, Part 24, and Part 27 of the FCC Rules. No license is required by the utility to operate an ORION meter reading system. This device complies with Industry Canada license-exempt RSS standard(s).

Transportation: **WARNING**: The operation of transmitters and receivers on airlines is strictly prohibited by the Federal Aviation Administration. As such, the shipping of radios and endpoints via air is prohibited. Please follow all Badger Meter return and/or shipping procedures to prevent exposure to liability.

Warning: To reduce the possibility of electrical fire and shock hazards, never connect the cable from the endpoint to any electrical supply source. The endpoint cable provides SELV low voltage limited energy power to the load and should only be connected to passive elements of a water meter register.

Caution: Endpoint batteries are not replaceable. Users should make no attempt to replace the batteries.
Changes or modifications to the equipment that are not expressly approved by Badger Meter could void the user's authority to operate the equipment.

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