UNION COUNTY, NC

ADVANCED METERING FEASIBILITY ANALYSIS

Evaluating meter technology contributions to operations, finance and customer service

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Executive Summary

Union County Public Works (UCPW) initiated the Automated Meter Reading (AMR)/Advanced Metering Infrastructure (AMI) Feasibility Study in 2017 to evaluate current metering and billing operations for its water utility operations. Through this study, the County has developed a defined roadmap for metering and billing operations based on the need for improved customer service, greater water resource conservation management, expanded operational efficiencies, and improved utility system data. These operational enhancements through properly configured metering technology should serve UCPW reliably over the anticipated 15-20 years of useful life from the system.

Summary of Current Environment: UCPW collects meter reads on average every 30 days using a mobile data collector from technology commonly referred to as Automated Meter Reading (AMR) since 2004. UCPW is currently replacing failed Elster/AMCO C700 and Itron encoded receiver transmitters (ERTs) if either unit has failed to collect or transmit consumption reads to be received by the mobile data collector. Of the approximately 52,000 meters in the County system, more than 21,000 meters are greater than 10 years, over 10,000 of these meters are greater than 15 years, and over 6,000 meters within the group are beyond the 20 years considered maximum useful life. The failures experienced by the County are exponentially increasing due primarily to moisture intrusion into the electrical components of the register thereby placing a substantial challenge on both metering and billing staff to maintain read performance of the system.

In recent years, the County has allocated funds for the replacement of approximately 2,800 meters and ERTs in addition to the 1,300 new meter sets due to system growth each year. At the current rate of replacement, it will take more than six years to complete and require more than $4.7 million in additional funds allocated to replace meters and transmitters up to 3” in size and does not include internal labor costs associated with installation. The County has a range of Itron ERT models that span from the most recent 100W model to the original 50W ERT. Older meter transmitter versions are only compatible with AMR meter reading and contribute the most to high failure rates. While an estimated 23,000 Elster AMCO meters remain operational at just under 98% water flow measurement accuracy, the failure rates and contributing issues with moisture intrusion into the registers present an unpredictable and unreliable read environment for metering and billing operations. Both the Elster/AMCO legacy meters and the variations of Itron ERTs present UCPW with a decaying platform for its operations.

The current process of meter and ERT replacement has created a “continuance intention” for the County utility metering infrastructure that is defined with no practical ability to expand to newer metering technologies for the 15-20 years of useful life for meters and transmitters. Contributing to the challenges faced by UCPW with the existing metering environment is the end of support for the County’s Itron integrated metering software, MV-RS, in 2021 which will be replaced by Itron Field Collection System (FCS) software built for AMR and AMI applications. The current 100W ERTs currently being installed by UCPW will not fully communicate on OpenWay Riva, Itron’s newest AMI network platform and the new OpenWay Riva ERT (500W) will not communicate on ChoiceConnect, the legacy AMI platform from Itron.

UCPW possesses an operational culture of continual improvement through its infrastructure investments, technology utilization, and high-quality workforce, but is significantly constrained by the lack of data available from the existing AMR system to support operational efficiencies, water resource management and proactive customer service. The growth rate for utility customers is exceeding 3.4% per year and work order data trends present a continued significant increase in required tasks across both metering and billing operations. High customer growth rates have

defined a clear need for additional staffing, so it will be vitally important for the County to leverage technology in areas where automation works effectively to re-allocate resources to operations that cannot be automated.

The physical and organizational separation between key business processes within metering and billing contributes to systems utilization challenges, limited data governance and standardization, operational/workflow silos, minimal or absent KPI/operational performance measurements, and prioritization alignment of budgetary and capital plans. The operational separations within metering and billing may be most attributable to the lack of integrated systems serving in a coordinated manner both field and back-office staff resulting in manual-heavy work order management, limited water conservation program management capabilities, and virtually no data for water customer inquiries and historical consumption needs. A properly designed and applied Meter Data Management System (MDMS) would exponentially improve key work processes in utility billing and metering and would automate many of the activities of operations through integration with the County's new Lucity work order management system.

AMR is a meter reading technology introduced in the mid- 1980s and is limited to only collecting reads one time each billing period. AMI, however, has been the preferred technology for utilities and, since 2014, has surpassed AMR in new units sold and will continue to outpace AMR making it functionally obsolete moving forward. The capital cost of AMI network infrastructure above the necessary replacement of end of useful-life meters and transmitters for AMR is only 12.5% ($1.8 million) of the total estimated capital expenditure of $13.5 million for equipment, labor, software, and professional services to convert the entire County system yet the net present value (NPV) is more than $2.6 million higher utilizing AMI when compared to AMR.

Metering Technology Recommendations: We recommend the County consider meter and endpoint replacement a matter of necessary maintenance of utility infrastructure and the AMI network investment for its financial viabilities and contributions to customer service, operational efficiencies, and County water resource conservation initiatives. Considering the noted limitations of the existing AMR meter reading platform for Union County, it is recommended the utility convert the remaining Elster/AMCO meters to new encoded meters compatible with AMI systems and covert the meter reading infrastructure to a preferred vendor selected through competitive bidding.

AMI for Union County Public Works will:

- Eliminate "Drive-by" and 98% of Manual "Direct Read" Labor Costs
- Balance Work-load Across the Service Territory for Greater Operational Predictability
- Reduce Billing Staff Meter Reading Resource Costs by 98% and Up To 80% of Manual Disconnects/Reconnects
- Improve Metering/Billing/Utility Data Quality
- Improve Customer Responsiveness Through Increasing Reads from 1 Per 30 Day to 720 Per 30 Days
- Eliminate Meter System Work Order Management by Customer Service
- Establish Customer Self-Service through Access to Consumption Data
- Shift from Conservation Information to Conservation Management for Compliance with the Water Shortage Response Plan
- Expand Distribution Monitoring and Sensing (Upstream/Downstream Pressure, Water Quality, Pump Status, Liquid Chemical Levels and Facility Protection
- Monitor and Manage Non-Revenue Water (NRW) Through District Metering Areas (DMAs)
- Reduce Consumption Supporting Plant Capacity

Next Steps: Upon authorization to proceed, the project team will finalize business requirements for AMI metering technology and issue to qualified vendors. The solicitation and award process should take 6 months from initiation and full conversion of AMI should be completed within 24 months from award. Through this process, the County will have access to expanded meter technology functionalities, infrastructure standardization and economies of scale.

Section 1. Advanced Metering Feasibility Analysis Summary

1. Background

Union County Public Works (UCPW) affirmed its priority for defining a roadmap for metering and billing operations through issuance of its RFQ #2017-042 for Automated Meter Reading (AMR)/Advanced Metering Infrastructure (AMI) Feasibility Study. MeterSYS entered into a professional services agreement on September 13, 2017 with an approved scope of work to evaluate the current metering and billing operations within UCPW and establish a clearly defined roadmap in coordination with the project team. Utility staff recognizes that maintaining the current course of action within metering and billing eliminates options for innovation and expanded functionalities within the current AMR (also known as drive-by) replacement environment over other options for metering and billing, specifically AMI (also known as fixed-base) technology. UCPW wanted to consider all options that would accomplish the key goals of establishing a return on investment (value proposition) from a viable and sustainable metering solution that supports improved operations, greater revenues, and better customer service.

The key tasks of the analysis included: (1) evaluating current state operations, policies, procedures, and assets; (2) outlining future operational state recommendations, including the operational and financial business case for a metering technology project with solution goals and objectives; (3) identifying the financial feasibility of both AMR and AMI technologies through Operational Expenditure (OpEx) and Capital Expenditure (CapEx) modeling and; (4) establishing a recommendation, in detail, for implementation of the preferred solution and presenting the findings of the study to the project team and UCPW leadership.

Table 1. Project Scope of Work

RFQ Goals and Objectives	MeterSYS SOW Objectives and Project Deliverables
Current State Analysis	▪ Meter Performance Analysis ▪ Policy/Ordinance Review ▪ Key Process Mapping ▪ System and Software Interface Mapping ▪ SCADA Masterplan/Hydraulic Modeling Synergy Evaluation
Future State Analysis	▪ Technical Memoranda ▪ Network Design Analysis and Multi-Vendor Propagation Analysis ▪ Process/Procedure/Policy Recommendations ▪ Solution Recommendations/Alternatives
Development of AMI Goals/Objectives and RFP Requirements	▪ Communications Plan ▪ County Asset Field Inventory (Future Collector Site Assessment) ▪ Procurement Requirements ▪ RFP Planning

RFQ Goals and Objectives	MeterSYS SOW Objectives and Project Deliverables
Financial Analysis	▪ Full Economic (CapEx/OpEx) Analysis ▪ Feasibility Modeling (AMI/AMR/Hybrid) ▪ Risk Analysis ▪ Implementation Analysis
Project Planning and Implementation	▪ Vendor Management ▪ Data Analysis, Document Retention and Review ▪ Project Team Coordination (Scheduling) ▪ Project Plan Development ▪ Procurement Compliance and Process Management

UCPW operates with a team of dedicated and high-performing professionals focused on the continual improvement culture clearly established within the utility. As with most all large public utilities, the physical and organizational separation between contributing key business process owners contributes to some level of systems utilization challenges. When contemplating a future state metering system, implications to stranded assets, utilization synergies, staff training, system reliability and performance, risks, and costs must be contemplated to arrive at a validated recommendation for moving forward. It should be noted that the project team was very intentional about considering all options within both AMR and AMI read technologies and there were no forgone conclusions on what the Feasibility Assessment would identify as the recommended system, software or operational improvements for UCPW. This analytical approach allowed the MeterSYS team to collaboratively and objectively work with staff to uncover pain points and identify the best course for resolution and optimization.

If the County considers replacement of end-of-life infrastructure to be a normal component of water system management, then the business case for metering technology may be considered only to involve additional costs associated with mobile (AMR) or fixed (AMI) gateways and related software costs.

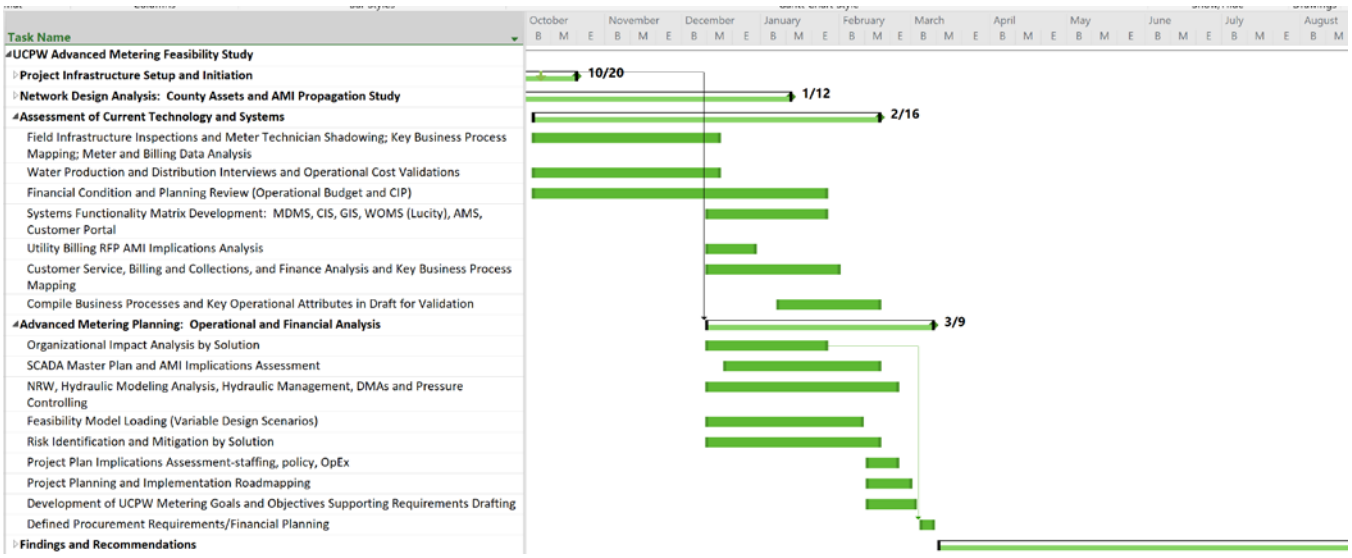


Figure 1. Feasibility Project Milestone Timeline

2. AMR and AMI Technologies Comparison

A primary task associated with the UCPW Metering Feasibility Analysis was the contemplation of continuing the existing approach to meter reading and its associated business processes against the practicality of advancing the County's metering solution for greater efficiencies and customer service. Specifically, UCPW must first consider the advantages and disadvantages of AMR and AMI reading systems among the major manufacturers.

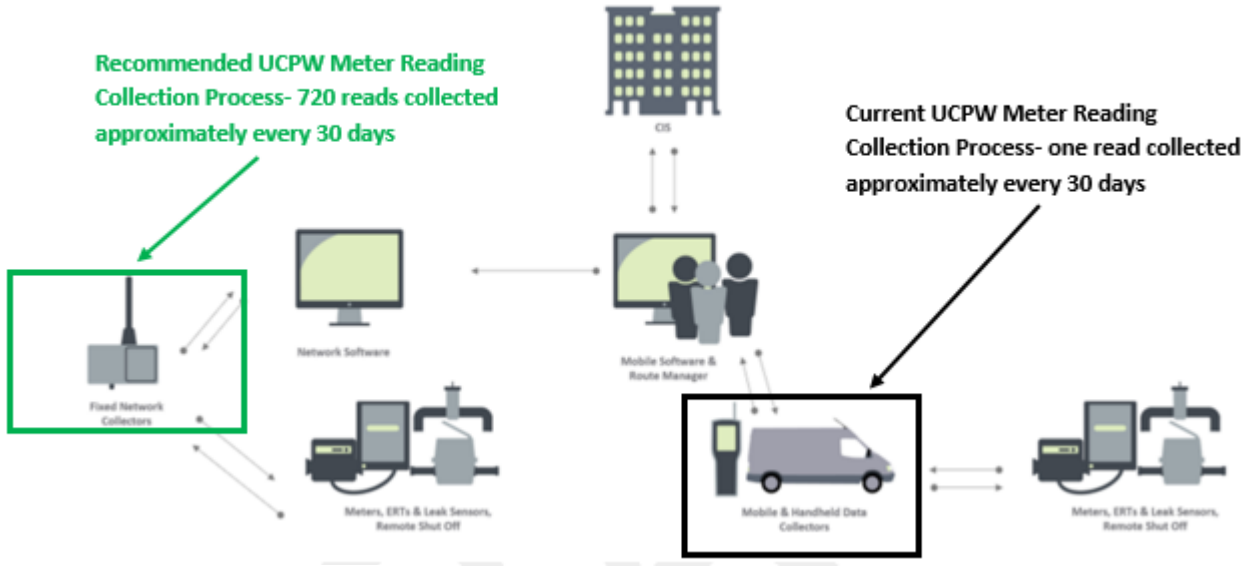


Figure 2. Itron AMR and AMI Data Flow

Automated Meter Reading: UCPW currently utilizes Itron AMR read technology for collecting monthly reads from the approximately 52,000 meters within the water utility. AMR is a mobile reading system in which a meter is read by a gateway that is either in a laptop or handheld device, allowing the meter reader to collect reads by walk-by or drive-by methods. These methods are one-way communications, simply transferring read data from the meter to the utility's billing system to generate a monthly bill. Reads are collected on-the-go and the meter reader downloads the meter data onto a memory card or a laptop computer that is connected to the reading device. Then, the meter data is transferred to the billing system and the consumption is converted into a bill for that customer.

Advanced Metering Infrastructure: AMI read technology provides for the collection of consumption and other reporting data to be transmitted continuously at one hour and even down to 15-minute intervals to a Meter Data Management System (MDMS) in support of historical usage profiling across the entire system, leak alerts, meter "health", and other valued data. This data would be available to UCPW staff and customers, thereby increasing the responsiveness of CSSs, improving field operations and customer service through near real-time read data and leak detection. More information on the differences, advantages, and disadvantages of AMR and AMI are noted in the Appendix of this report.

3. The Future of Metering for UCPW - Technology Goals and Design Scenarios

Successful metering technology projects establish well-defined utility solution goals early in the evaluation process then proceed to build requirements into the project approach and technology selection. The project team identified

goals for the project focused within infrastructure, customer service, and financial improvements through operational efficiencies and revenue. These goals provide the criteria by which the project team evaluated the scenarios for future state design within water metering. They include:

- Optimize meter reading, customer service, and water-use efficiency
- Accurate registration and reporting of customer consumption
- Effective metering analytics through qualified MDMS
- Customer engagement and usage conservation through Customer Portal
- Supportive of distribution operations (sensing and leak detection)
- Aligned with County systems; Customer Information System (CIS), Work Order Management (WOM), hydraulic modeling, SCADA reporting
- Long-term viability and expandability of solution by the Internet of Things (IoT)
- Cost effective and reliable meter reading technology

Other important contributing factors included avoiding increasing costs of maintaining and repairing aging infrastructure (break-fix model), minimizing risks of safety to meter readers, improving data quality concerns from manual entries, systems interfacing design, and the resource implications of manual read environment.

Once metering and billing goals were established, the project team worked collectively to identify solution requirements to help shape the design scenarios of AMI or AMR for the County. These requirements provide direction for the project team to begin assessing metering and billing options and the implications of each against UCPW's established goals. The metering and billing solution requirements established during the feasibility analysis foundationally is based upon AMI technologies each with a connection to the three elements of value - operational efficiencies, revenue, and customer service.

AMR and AMI technology solutions provided by qualified vendors were evaluated against the design goals of UCPW for identifying, to what extent, each potential manufacturer could provide the greatest level of current and forward-looking goals for the utility. Of the standard performance specifications considered, there are certain functionalities deemed critical for successful system-wide implementation of advanced metering. In consideration of all elements of the Feasibility Assessment, the project team identified feasibility of various options for meter reading technology through the evaluation of current utility operations and costs, comparing future network design options, and providing a cost-benefit analysis of Advanced Metering Infrastructure (AMI) technology.

By its design, AMR technology has limited functionalities by which to compare as its purpose is to automatically retrieve monthly meter reads through a mobile gateway (drive-by). Therefore, evaluation of functionality is most relevant when considering AMI (fixed-base) technologies.

AMI Technology Functionalities	Aclara	Badger	Itron	Master Meter	Mueller	Neptune	Sensus
Remote Disconnect Meter	**N/A**	✗	✗	✗	✓	✗	✓
Badger Meter Compatibility	✓	✓	✓	✗	✓	✓	✓
AMR/AMI Read Capability	✗	✓	✓	✓	✓	✓	✓

AMI Technology Functionalities	Aclara	Badger	Itron	Master Meter	Mueller	Neptune	Sensus
Open Source Network Alliance	✗	✗	✓	✗	✓	✓	✗
Distribution Sensor Capable Product Lines	✓	✗	✓	✗	✓	✓	✓
Pressure and Temperature Measured at Meter	N/A	✗	✗	✗	✗	✗	✓
Network Design Utilizes Only Existing Infrastructure	✗	✓	✗	✗	✗	N/A	✗
>30 Days of Read Held at Meter	N/A	✓	✓	✓	✓	✓	✓

Table 2. Vendor Functionality Comparison Summary Matrix

While the electric utility industry has been utilizing both AMR and AMI for several years, AMI has emerged as a significant tool for water utilities for keeping pace with rising customer expectations, water conservation initiatives, distribution management, rising operational costs, and flow measurement accuracy. Through enhanced data, utilities are now populating operational performance measurements and gaining greater insight to the key drivers of the water enterprise.

Scenarios for Water Metering Technology: From the onset of the project, the UCPW project team established its critical objectives to be the development of a metering technology roadmap derived from analysis and contemplation of all possible design scenarios beyond status quo. Considering the existing Itron AMR technology is layered on top of several meter types throughout the County service territory, predominantly end-of-life AMCO (now Elster) and replacement meters from Badger, there are four design options (referred to as "scenarios") the County may choose for future metering technology solutions other than continuing to replace failing meter infrastructure by the break-fix model (**Status Quo**). Scenarios most appropriate for UCPW involve: **1. Retro-fit Existing AMR by RFP:** replacing existing Elster/AMCO meters and Itron ERTs other than 100W models; **2. Full AMR Replacement by RFP:** implementing full program meter and AMR transmitter replacement including contracted labor and updated software; **3. Full AMI Replacement by RFP:** replacing all meters and the existing Itron read technology with AMI through a new, integrated solution; and **4. Retro-fit AMI by RFP:** retrofitting the approximately 25k Badger meters with AMI compatible endpoints, network, and applications through an open (vendor solicited) solution. MeterSYS and the County project team evaluated options and complexities of each solution design and their implications to existing operations, capital funding, operational benefits and risks, and influences on customer service.

Scenario comparisons allow the project team the ability to compare varying functionalities among potential metering solutions for Union County and how these variations contribute to the required capital and ongoing operational expenditures by the utility to maintain sustainable performance of the system.

Status Quo Replacement: Continuation of County Repair and Replacement (AMR): Maintaining current replacement plan using internal labor for meter sizes up to 4" with estimated completion by March 2025.

Scenario 1 – Retro-fit Replacement(AMR) Through RFP: Replacement of remaining Elster/AMCO meters and associated ERTs including labor.

Scenario 2 – Full Meter Replacement (AMR) Through RFP: Full AMR deployment to completely replace all legacy meter infrastructure with Badger meters and Itron transmitters. In this scenario, Union County may consider the benefit of replacing the legacy AMR solution with a new AMR technology that presents the best option for conversion from AMR to AMI at a point in the future while achieving standardization of infrastructure and economies of scale.

Scenario 3 – Full Meter Replacement (AMI) Through RFP: Replacement of all metering infrastructure with singular, integrated metering solution including standardized transmitters and MDMS/customer portal with network for AMI solutions. For a full meter replacement, the County would benefit from its infrastructure operating in the same life-cycle for assistance with capital planning, system maintenance, system performance, infrastructure standardization, and gaining economies of scale.

Scenario 4 – Retro-fit Through RFP (AMI): Utilizes existing Badger water meter infrastructure with procurement of new compatible water transmitters, AMI network, and preferred MDMS and customer portal.

Specific Vendor Options for Scenario 4: Considering the goals of UCPW for its long-range metering and billing strategy, MeterSYS conducted several design reviews with vendors to compare OpEx and CapEx solution costs and determining, in detail, the network design plan of potential vendors for AMI. By leveraging existing Badger meters purchased and installed by the utility through retro-fitting, UCPW will avoid costs associated with the meter and installation labor valued at over $2,870,000.

Also evaluated were compatibility factors between various manufacturers to determine if utilization of existing meter equipment would effectively be applied in a new, open source design for water and utilities. UCPW's existing Badger water meters are compatible with a variety of endpoints (transmitters) including Aclara MTU, Itron ERT, Mueller Systems Mi.Node, and Sensus MXU for continuity of operation as well as Master Meter's Allegro under the Glass (UTG) register and Neptune R900. Beyond meter and endpoint compatibility, UCPW must consider specifically the various AMI network designs since AMR collects data through a mobile gateway that has only minor variations across manufacturers. The network design summary for UCPW is summarized in Section 4.

MeterSYS modeled Aclara, Badger, Itron, and Sensus for their estimated capital and operational costs to provide UCPW with a concept of the variations of each vendor solution over the useful-life of the solution. Neptune was not modeled since they did not respond to the request for network design and Master Meter was not modeled due to their recent entry into the AMI market, limited pricing data, and range of potential cost variations with their UTG design associated with UCPW's widespread use of cast iron meter box lids.

Summary of Scenario 4 – Retro – fit Open Solution AMI by *Vendor Estimates for AMI Planning*

Vendor Estimate 1 – Aclara AMI: Application of Aclara Star 3400 MTU and associated network layered on existing and newly installed Badger metering with MDMS and customer portal. Utilizes existing Badger water meter infrastructure with procurement.

Vendor Estimate 2 – Badger Hybrid AMI (Cellular): Installation of endpoints utilizing cellular networking. The County would not be required to own or operate network infrastructure but would have higher OpEx costs associated with monthly per transmitter service fees.

Vendor Estimate 3 – Itron Conversion: Leveraging existing Itron 100W ERTs for total build-out of Itron network and analytics. Utilizes existing Badger water meter infrastructure with procurement.

Vendor Estimate 4 – Sensus AMI: Retro-fitting Badger meter infrastructure and deploying Sensus metrology, networks, and gateways for metering and distribution solutions. Utilizes existing Badger water meter infrastructure with procurement.

Certifications and authorizations for meter and endpoint compatibility between manufacturers changes often and should be validated by vendors prior to making any specific determinations for utilization of meters and endpoints by different companies. The impacts to compatibility include the quality and type of data transmitted to the Headend System (HES), product performance, warranty coverages, and firmware updates. UCPW will need to have all solution compatibilities and coverages included in the contractual language with the selected vendor.

Compatibility for the Badger HRE, currently the preferred meter by UCPW, is detailed in the table below:

Table 3. Badger HRE Compatibility Summary Chart

	Aclara	Itron	Sensus	Master Meter	Neptune	Kamstrup
Badger HR-E and Encoder (Radio replacement only)	MTU compatible w/all major brands	Itron 100W compatible with all Badger	Smartpoint only compatible with Badger ADE	UTG is incompatible	R900 Wall or Pit Unit Interface (MIU)	UTG is incompatible

4. Network Design Summary - AMI

To determine the viability of AMI covering 100% of the ~632 square miles of service territory of Union County, MeterSYS invited companies with experience in AMI technology delivery to develop an engineering frequency propagation analysis for their solution, utilizing 8 UCPW-owned elevated storage tanks and 76 other County controlled properties for collectors/base stations at varying heights.

Figure 3. Union County Controlled Potential Network Asset Locations

Each AMI vendor has unique solutions and designs related to network design. For water utilities that have pit-set water meters, the conditions are far less favorable for operation and requires a focus on meter data transmissions to the network to maximize the value of the infrastructure. MeterSYS places a high value on limiting the amount of infrastructure required to achieve a read rate performance level of 98.5% of all available reads, the ongoing operational expenditures required to support the network, and the risks/exposures of network assets considering their expected useful life.

The propagation analysis summary provides an overview of the network characteristics of seven market-leading advanced meter vendors invited to

participate in the design analysis – Aclara, Badger, Itron, Master Meter, Mueller Systems, Neptune, and Sensus with only Neptune electing not to issue a response (Neptune currently offers information on their Network as a Service offering. All companies have expressed interest in providing an advanced metering solution for UCPW, and each company provides similar yet unique solution characteristics to UCPW's metering network.

Table 4. Summary of Vendor Network Design

Vendor	System and Frequency	Collector Design	Integration Details
Aclara	Traditional AMI; Licensed 450-470 MHz	21 Collectors (DCU's) on Water Tanks and Substations	Network and software by Aclara; meter type open
Badger	Hybrid Cellular	9 Collectors (NGT's) serving 6,700 endpoints plus 42,225 cellular endpoints	Third-party cellular network; software and meter by Badger
Itron	Traditional AMI; Unlicensed 902-928 MHz band	106 Collectors (CCU's); 89 Repeaters	Network and software by Itron, and meter type open
Master Meter	Traditional AMI; Licensed 450-470 MHz	18 Base Stations (DCUs); 53 Repeaters	Network, software, and meter by Master Meter
Mueller Systems	Traditional AMI; Unlicensed 900 MHz band	10 XR-R Collectors on Towers; 96 XR Collectors at various locations; ~100 possible Repeaters	Network, software, and meter by Mueller
Neptune	Traditional AMI; Unlicensed 910-920 MHz	Did not submit	Network, software, and meter by Neptune
Sensus	Traditional AMI; Licensed 433 or 868 MHz	18 Collectors on Tanks/Tower	Network, software, and meter by Sensus

A numerical break-down of the UCPW network design outlines the substantial differences between AMI vendors and establishes a concept of the variations of influence on the Utility's operational and financial responsibilities.

Table 5. OpEx Summary of Vendor Network Components

Network Design	Gateway	Repeaters	Cellular Endpoints	New Locations	Estimated Annual Network OpEx
Aclara	21	0		5	$44,940

Network Design	Gateway	Repeaters	Cellular Endpoints	New Locations	Estimated Annual Network OpEx
Badger	9	0	42,225	0	$442,188
Itron	106	89		111	$140,400
Master Meter	18	53		50	$78,716
Mueller Systems	106	~100		80	$125,710
Sensus	18	0	0	10	$63,160

5. Financial Modeling

Through data gathering and inputs, the feasibility of AMR and AMI among various scenarios was determined by financial modeling within a *Discounted Cash Flow (DCF)* valuation approach as well as a *realized cash flow model* to evaluate the costs and benefits of various operational assumptions and capital cost scenarios within UCPW. The model incorporates the cost of AMI/AMR capable meters, radio transmitters and data collectors, software, project management, and ongoing operation and maintenance.

For comparison of differences between various scenario costs, MeterSYS summarized the detailed cost estimates into the categories of network, meters, labor, and professional services. The elements of these categories are as follows:

Table 6. Feasibility Model Category Elements

Network	Meters
AMI/AMR Head End Software	5/8 X 3/4 Meter and Register
Mobile Gateway	1 inch Meter and Register
Fixed Gateway	1 1/2 inch Meter and Register
Repeater	Retro-fit Meter
New Tower Location	2 inch Meter and Register
Field Deployment Tool	3 inch Meter and Register
Water Meter Endpoints	4 inch Meter and Register
Network Installation	6 inch Meter and Register
Pit Mount Hanger Bracket	8 inch Meter and Register

Software Applications and Professional Services
MDM Software

Labor	Customer Portal
Water Meter Exchange (5/8" - 1")	Professional Services - AMI MDM
Water Meter Exchange (1 1/2")	Bonding, Mobilization and Training
Water Meter Exchange (2")	Professional Services - Systems Integration
Water Meter Exchange (3")	Program Management - AMI / AMR
Water Meter Exchange (4")	
Water Meter Exchange (6")	
Water Meter Exchange (8")	
Water meter lid retrofit (Drill)	
Lid Bracket Installation	

The key elements for determining financial feasibility involve estimating capital (equipment, labor, and professional services), ongoing operational costs (data/backhaul, software/applications, gateway maintenance, and power), debt, and depreciation against the benefits of technology through efficiencies, increased revenues, and avoided costs.

The model calculates the Net Present Value (NPV) of the costs and savings for each alternative over 15 years using a discount rate tied to UCPW's estimated borrowing costs, as well as the Internal Rate of Return (IRR). For both AMR and AMI, the actual life-cycle of the infrastructure is between 15 and 20 years and the model applies a 15-year term for debt and 15-year term for depreciation.

Model Metrics Summary

Net Present Value: Provides the net present value of the investment based on a discount rate of 3.5% and the sum of capital expenditures (costs) and revenues and savings (income) over the entirety of the investment. It is a function applied to the discount rate and the sum of the total net value.

Internal Rate of Return: The annualized rate of return without consideration to external influences. It is a function applied to the sum of total net value.

Return on Investment (ROI): The percentage increase or decrease of the investment over a set period of time. It is calculated as the difference of metering technology benefits minus CapEx/OpEx costs divided by the CapEx/OpEx.

Payback Period: Calculated as the first year when total cumulative value is greater than the amount invested cumulatively.

The following financial summaries considered capital and operational costs of AMR and AMI and the benefits derived through full or partial new meter replacement including personnel, equipment, work order reductions, collection efficiencies, and the transition of annual budgetary allocations for meter replacement to debt service over 15 years.

When considering the current meter replacement approach (Status Quo), the higher IRR and ROI may be associated with the absorption of labor into operational expenses of the County that is fully burdened in all of the comparative Scenarios. Considering the differential costs associated with layering on AMI infrastructure (network/software) to existing AMR meters and transmitters, the capital costs add $1.769 million to the overall project and for the network presents a compelling business case with higher NPV and IRR with a payback period of 6 years for the AMI network infrastructure versus 10 years for the current replacement program approach.

Table 7. Financial Modeling Comparison Summary by Scenario

		NPV	IRR	ROI	Payback (DCF)	Total CapEx
Current	**Status Quo Replacement**	$2,996,186	14.6%	91.7%	10	$ 4,726,000
Scenario 1	**Retrofit AMR (RFP)**	$4,727,306	14.9%	92.1%	11	$ 7,566,000
Scenario 2	**Full Replacement AMR (RFP)**	$4,197,833	8.0%	66.8%	14	$12,760,000
Scenario 3	**Full Replacement AMI (RFP)**	$6,327,742	8.4%	66.8%	13	$16,540,000
Scenario 4	**Retrofit AMI (RFP) Average of Estimates**	$5,692,240	8.6%	65.9%	13	$13,447,000
Estimate 4.1	**Aclara AMI Retrofit**	$6,955,512	10.4%	86.9%	12	$12,858,000
Estimate 4.2	**Badger Retrofit (Cellular) AMI**	$2,380,567	5.6%	24.5%	16	$14,061,000
Estimate 4.3	**Itron Retrofit AMI**	$7,692,461	9.9%	81.2%	12	$12,676,000
Estimate 4.4	**Sensus Retrofit AMI**	$5,740,421	8.6%	70.9%	13	$14,194,000
AMI Network Only Comparison (Collectors/ Software)		$3,812,112	28.6%	88.6%	6	$1,769,000

Based on the final metrics, Status Quo Replacement has the greatest ROI and IRR but significantly lower NPV and operational value considering the functionality is limited to 30-day automated reading. Additionally, under this design, the County would be responsible for the installation labor coupled with the uncertainty of failures over the 6-year installation process. These factors along with system growth demands on staff present this Scenario as not viable operationally.

Should the County accept, as a matter of required maintenance and replacement, that the balance of aged meter infrastructure, including transmitters, has reached operational end-of-life, then financially, consideration of metering technology from a business case financial perspective may appropriately be limited to the feasibility of an AMI network separate and independent of the other capital costs. Should this be the case, the financial viability of AMI is far greater than modeling infrastructure in totality especially when considering NPV, IRR, and payback.

Should UCPW elect to apply all CapEx and OpEx costs in calculating the business case for metering infrastructure, Scenario 4- Retro-fit AMI through Competitive Bid is recommended for the contributing operational value to UCPW and the lowest entry into advanced metering infrastructure by leveraging existing assets of the County with remaining useful life.

Savings from an AMI system would come primarily from redirecting current meter replacement and operations funding, plus savings resulting from the proposed reductions in personnel and vehicle costs (by reassigning meter readers to other tasks and vacant positions), deferred costs due to not filling proposed new positions, and modest revenue gains in water and sewer from an estimated 2% improvement in meter registration.

In addition to capital cost considerations, ongoing operational budgetary impacts must be factored into the solution prioritization for UCPW. The operational costs of each scenario and vendor estimate is tied to variables primarily

related to network operations, network maintenance services, and software licensing. The outlier in operational costs is through a monthly Badger Beacon cellular cost modeled at $.84 per month per meter.

Table 8. OpEx Comparison Summary by Scenario

		OpEx
	Status Quo	$8,500* (Software Update, Mobile Collector Service)
Scenario 1	**Retro-fit AMR**	$36,800
Scenario 2	**Full Replacement AMR**	$36,800
Scenario 3	**Full Replacement AMI**	$160,253
Scenario 4	**Retro-fit AMI**	$173,227
Estimate 4.1	**Aclara AMI**	$119,940
Estimate 4.2	**Badger Hybrid AMI**	$ 517,188
Estimate 4.3	**Itron Conversion AMI**	$ 236,505
Estimate 4.4	**Sensus AMI**	$138,160

Modeling Benefits of AMR and AMI: To determine the cost-benefit of AMI investment across water utilities, MeterSYS applied data gathered through the current state analysis to allocate costs for various meter to billing functions and then assign predicted benefits, either direct savings or revenue along with indirect efficiency gains. Indirect benefits include meter reading and service order efficiencies, reduction in repair and replacement labor costs, and customer service and collections efficiencies. Direct benefits include water and wastewater revenues associated with more accurate meter registration, direct fleet costs, and staffing reductions through established set points during the metering automation process. A breakdown of benefits considering AMI automation is as follows:

OPERATIONAL COST SAVINGS AND REVENUES	SCENARIO 4 – RETRO-FIT AMI	STATUS QUO AMR
1.0 METER READING	$ 33,084	$ 4,417
2.0 SERVICE ORDERS- RE-READS, CUSTOMER COMPLAINTS, DISCONNECT/RECONNECT SERVICE	$ 96,479	$ -
3.0 REPAIR AND REPLACEMENT	$ 318,503	$ 163,335
4.0 SERVICE TERMINATION AND RESTORATION	$ 3,891	$ -
5.0 CUSTOMER SERVICE ACCOUNT MANAGEMENT	$ 95,591	$ -
6.0 CUSTOMER SERVICE BILLING EXCEPTION AND PAYMENT PROCESSING	$ 82,245	$ 32,465
7.0 ASSET MANAGEMENT AND CONSERVATION	$ (96,137)	$ -
STAFFING REDUCTIONS: CUSTOMER SERVICE	$ 87,155	
STAFFING REDUCTIONS: METER READING	$ 59,942	
ACCOUNT DELINQUENCY AGED COLLECTION	$ 105,506	$ 17,584

OPERATIONAL COST SAVINGS AND REVENUES	SCENARIO 4 – RETRO-FIT AMI	STATUS QUO AMR
REVENUE CAPTURE FROM WATER METERS	$ 154,191	$ 77,096
WASTEWATER REVENUE RECOVERY	$ 169,745	$ 84,872
THEFT AND METER TAMPERING	$ 10,440	$ -
METER SCRAP VALUE	$ 81,770	$ 85,625
FLEET COSTS (METER READING)	$ 86,263	$ -
ANNUAL METER REPLACEMENT BUDGET (NEW METERS INCLUDED IN CAPEX)	$ 369,443	
COMPARISON OF ANNUAL BENEFIT (FIRST FULL YEAR 2022)	$ 1,658,111	$ 465,394

Table 9. Detailed Breakdown of Benefits

KEY BUSINESS PROCESSES: UCPW METERING AND BILLING

Benefits of AMI and AMR were determined through data gathering, evaluation of the seven key business processes and the influence of both technologies on operations as well as considerations of revenue and avoided costs.

1.0 Initial Meter Reads

1.1 Initial Meter Reads (AMR): Collection of meter readings via AMR only

1.2 Initial Meter Reads (Manual/Direct): Collection of meter readings via manual entry

2.0 Service Orders

2.1 Service Orders - Re-reads: Field revisits to verify reads - utility issued

2.2 Service Orders - Disconnect/Reconnect Service: Disconnection and reconnection for non-payment

2.3 Service Order - Reconnect Site Revisit: Site revisit for reconnection of service due

2.4 Service Orders - Customer Complaints: Customer requested rereads, meter checks, high-bill complaints

2.5 Verify No Service: Site visit to verify zero flow for vacant properties

3.0 Troubleshooting and Repair

3.1 Troubleshooting and Repair/Replacement Meter repair and replacement (AMR ERT failure, zero readings)

3.2 Meter and Box Repair - other

4.0 Customer Service

4.1 Customer Service Account Management - Setup and Maintenance: Verifying new service availability, validating proper receipt of forms and payment from customer, setting up account in CIS

4.2 Customer Service Billing Exception: Review of initial read data for high/low parameters and field re-checks

4.3 Customer Service Billing and Presentment: Preparing final read data within utility billing module; transferring read file for printing

4.4 Customer Service Payment Processing/Collections:Receiving and processing payments through various channels including bank draft, lock box, mail, counter, and web payments (including shared Tax resource)

4.5 Customer Service Work Order Management: Creating, issuing, and closing out work orders within CIS /Lucity

4.6 Customer Service Account Delinquency Management: Management of accounts within 30, 60, 90, 90+ delinquency including internal collections, debt setoff, and 3rd party collections (including shared Tax resource)

5.0 Theft and Meter Tampering: Response to damage of meters and ERTs due to customer tampering or removal

6.0 Asset Management Activities: Meter location, stock management, and tracking

7.0 Water Loss and Conservation: Account and field activities supporting leak management, conservation programs

Realized Cashflow and Debt Obligations Comparison of AMI and AMR: For practical consideration of affordability and value, MeterSYS includes expected capital costs and considers the practical encumbrance of annualized operational expenditures (OpEx) and debt service. These expected costs are modeled against direct benefits (realized cost reductions and additional revenues) and in-direct benefits (realized through resource efficiency gains). The following model reflects direct estimated capital costs of Scenario 4, Retrofit Open Vendor and does not include recommended contingencies or any applicable sales tax.

Table 10: Realized Cashflow Comparison- Scenario 4 and Status Quo

REALIZED CASHFLOW CONSIDERING DIRECT BENEFITS, OPEX, AND DEBT SERVICE	SCENARIO 4: RETRO-FIT AMI	STATUS QUO AMR
100% DEBT FINANCING	$ 13,447,250	$ 4,725,710
TERM (YEARS)	15	15
RATE	3.5%	3.5%
DEBT PAYMENT	$ 1,153,584	$ 405,396
ANNUALIZED OPEX COSTS	$ 173,227	$ 20,300
TOTAL DIRECT ANNUALIZED COSTS	$ 1,326,811	$ 425,696
DIRECT BENEFIT VALUE	$ 926,739	$ 431,596
NET ANNUAL CASH BENEFIT	$ (400,072)	$ 5,900
INDIRECT BENEFITS- RESOURCE EFFICIENCIES	$ 621,818	$ 200,217
NET ANNUAL OPERATIONAL VALUE	$ 221,746	$ 206,116

The AMI and AMR realized cashflow analysis for UCPW compares the direct and indirect influences of each solution based on cashflow and soft cost (efficiencies). The realized cash flow shows a direct cost outflow for debt and OpEx of $1,326,811 for Scenario 4: Retro-fit AMI compared to the comparative outflow of cash for Status Quo AMR of $425,696 attributable to significant differences in debt service fees and on-going operational costs.

When considering the totality of both direct and indirect benefits of both solutions, AMR presents a greater value to UCPW annually but does not apply monetary value on improved customer service, operational performance management, distribution monitoring, water conservation, and future cost avoidance that are not quantifiable to the extent that those benefits could be accurately modeled. This realized view of infrastructure costs and benefits provides a practical assessment of the viability of various design scenarios and contemplates the financial metrics of the Discounted Cash Flow Model which applies depreciation to the financial business case.

6. Data Management and Systems Summary

Currently, the main systems utilized by UCPW include Harris NorthStar CIS, Munis, ESRI Geographic Information System (GIS), and Crystal Reports. The County is working through a phased deployment of Lucity, which will automate the manual work order process and interface with NorthStar, ESRI, and Crystal Reports. UCPW systems supporting metering and billing remain functionally isolated with limited data exchange. The shift in approach to treat information as an asset will require the adoption of standards that will drive efficiency and effectiveness between workgroups, and those changes, along with the automation of data workflow from Lucity and recommended approach to governance for future system change consideration, evaluation, and implementation to be more holistic, will improve the enterprise architecture and system design.

UCPW will need to make foundational improvements and adopt a more formal governance structure to support the deployment, integration, and improved business operations alignment of the existing systems and applications.

Data Governance

- Establish data governance program to be overseen by new AMI Systems and Technology Administrator position
- Adopt and deploy a customer portal in advance of AMI implementation
- Align systems and interfaces to accommodate operations workflow, standardize data entry, streamline data sharing, and facilitate report generation

Data Standardization

- Establish creation, assignment, and resolution standards for Work Orders in Lucity
- Create terms and definitions for key words (data dictionary)
- Delay CIS change; scrub CIS database and leverage AMI data and systems
- Empower the Planning and Resource Management Division to be responsible of managing UCPW systems architecture design and databases

System Performance and Reporting

- Evaluate historical data reporting options (Crystal Reports, NorthStar)
- Create test scripts in Crystal Reports
- Designate Work Orders to serve as KPIs for operations insight

Establishing a formal data governance program will create a stable information architecture to serve as a foundation for AMI and the pursuit of an analytics-driven business environment. Increasing standardization and removing departmental silos that currently curtail shared use and access to data will increase the effectiveness and accuracy of reports. Empowering the Planning and Resource Management Division of Public Works to address and implement these initiatives should provide UCPW with more business-aligned IT support, and we recommend creating an AMI Systems and Technology Administrator position that will be dedicated to data and systems maintenance and oversight.

7. Consultant Recommendations

The UCPW project team recognizes that meter infrastructure and related technology replacement will require a significant monetary and internal resource investment to support sustainable and measurable change within the metering and billing key processes. The current AMR replacement program is neither operationally sustainable nor the best use of utility resources and presents ongoing and prevalent risks to customer service, utility revenues, and utility operations. UCPW, at a minimum, will have to undertake significant additional costs to simply continue to meet departmental demands of the AMR read system and stopped/aged meter replacement estimated greater than $4.7 million for completion of the current replacement program over a period of more than 6 years to complete.

AMI utilizing Scenario 4, Retro-fit AMI, far beyond AMR, provides significant benefits for UCPW and meets the three elements of viability- operations, finance, and customer service.

The recommended scenario for utilization of Badger water meters and installing selected solution meters, transmitters, and network along with converting the current reading application from Itron MV-RS to a new integrated water MDMS solution provides a significant shift forward in automation, data access and accuracy. Scenario 4 presents the best overall operational return on investment when compared to the other scenarios and their combined direct and indirect benefits.

Capital Planning: Implementing a multi-year project like an AMR to AMI conversion will require the Utility to plan for the impacts of capital costs over the life-cycle of implementation, as well as ongoing budget projections for annual operational expenditures. The capital drawdown schedule is anticipated to reflect these allocations considering implementation will begin in FY2018-2019. Any shifts in implementation will obviously shift the assumed allocations by year. It is generally accepted as a preferred approach for AMI implementation to do so at a pace that the Utility can manage both operationally and financially…and not any longer. The presented implementation scheduled is based on project initiation by April 2019, network construction through November of 2019, full deployment in 2020 and concluding by March of 2022. This schedule may be accelerated should the project team identify both need and ability to assume change management of systems and infrastructure.

	FY 2019-2020	FY 2020-2021	FY 2021-2022
ESTIMATED SPEND BY FISCAL YEAR	$6,073,361	$6,837,328	$536,561

Table 11. Estimated Capital Drawdown by Fiscal Year

MeterSYS recommends UCPW pursue fixed-base AMI, over the current AMR replacement program. Specifically, we recommend UCPW proceed with completion of the replacement of its water metering infrastructure retrofitting newer installed and compatible Badger meters with a solution selected through the procurement process. AMI for Union County has predictable costs of $14.3 million, a useful life of 15-20 years, comprehensive and proactive meter data analytics, and will provide improved revenues through meter registration accuracy. A breakdown of the annual estimated spend by network, meters, labor, software and professional services, and contingency is in Section 7.4. Recommended Metering Solution for UCPW.

Organizational Change: Through analysis of the current state of operations and the future state key business processes, organizational changes within metering and billing were evaluated and opportunities were identified to adjust personnel to more accurately reflect the requirements, only for an AMI technology deployment, as there would be no material change to operations should the County continue collecting meter reads through AMR.

To fully leverage the exponential benefits of meter technology, more specifically AMI, the County should support the development of a comprehensive change management program of work that encompasses the many aspects of utility metering and billing influenced by the new technologies.

MeterSYS worked with project team members to chart the efforts of staff contributing to metering and billing key processes, to determine current allocation of resources to those efforts. In doing so, we also considered the implications of AMI to those processes and the resulting efficiencies gained within the organization. These efficiencies contribute to organizational redesign and conceptual staffing changes to reflect new meter reading automation. Ultimately, organizational changes will be defined by the level of training, technology adoption, and performance measurements across the key business processes. Done correctly, UCPW should experience no greater resource demands while achieving greater management and delivery of key utility objectives within billing and metering through:

BUSINESS OPERATIONS DIVISION	**METERING SERVICES**
Reduce: ▪ 1 FTE Billing Customer Service Specialist ▪ 1 FTE Customer Service Specialist ▪ .5 PTE Customer Service Specialist	Reduce: ▪ 2 FTE Meter Technicians ▪ .5 PTE Meter Technician
Authorize: ▪ New Position for Communications/Conservation Specialist	Authorize: ▪ New Position for AMI Systems and Technology Analyst (*Planning & Resource Management Division*) ▪ New Position for Metering Systems Quality and Compliance Technician
	Avoid: ▪ 1 Meter Technician 1 Meter Technician (Meter Testing)

Table 12. Conceptual Future State Organizational Change Summary

Included in this proposed organizational redesign is a Communications and Conservation Specialist position, AMI Systems and Technology Analyst, and Utility Systems Quality and Compliance Technician position. These positions will enhance UCPW's operational leverage and benefits output of AMI technology with focus on customer engagement, resource management, and utility systems data quality.

8. Management Summary

Union County Public Works is operated by a highly dedicated and skilled workforce supporting a broad and adapted culture to customer service and continual improvement and maintains a commitment to analysis and data-driven decision making especially when considering investment of public resources. Through its partnership with MeterSYS, the County now has a detailed understanding of both current and future state operations that will support decisions for its investments in meter reading infrastructure, systems, and organizational change management.

With technology solutions, the lowest cost is not always an indication of the best option. The lowest cost solution for Union County is to maintain the current replacement strategy and fully deploy AMR across the system, but UCPW will

not accomplish the goals established for metering and billing and there are significant risks in converting metering infrastructure in the future to fixed-base technology. Water meter costs and installation are the highest unit costs within the conversion of a system from AMR to AMI. By leveraging the estimated 25,000 existing Badger meters, UCPW will maintain protection of more than $2.9M in infrastructure investment, both equipment and the value of labor, already installed.

General Findings and Recommendations for Metering- UCPW:

- Automation and standardization of meters will reduce read labor costs. Multiple re-reads and work orders will be alleviated by on-demand reads. Access to reports and improved data quality will result from conversion from AMR to AMI.
- Organizational resource re-design will be an important contributor to the value of AMI investment.
- Internal and external communication and education will be necessary to gain project support and confidence.
- Policies and procedures should be evaluated for opportunities to leverage AMI features and functionality including disconnection procedures, leak adjustments, and customer communication practices.
- Utility customers will gain improved access to data (leak detection, consumption monitoring, and customer portal) and improved lead times on service orders/requests.
- UCPW should pursue interface options to enhance functionality of work order management, GIS, and customer account management systems. UCPW should engage the next phase of technology conversion, procurement, to define costs and detailed solution specifications.

Key Detailed Recommendations for Metering - UCPW:

Category	Key Action
Meter Infrastructure	▪ Maintain current specification and installation of Badger meters with HRE registers for new services or replacement of stopped meters ▪ Continue installation of Itron 100W ERTs for new services and failed ERTs ▪ Apply AMI solution selection standards for new service installs and replacements ▪ Install or replace (as needed) composite (RF friendly) lids
Network	▪ Analyze network design of preferred solution for areas requiring new elevated asset locations for alternatives ▪ Revisit planning and cooperation opportunities between SCADA master plan, hydraulic data, and AMI network and gateway devices for expansion of distribution system sensor monitoring and seek authorization of agreed synergies
Systems and Data Management	▪ Authorize and fill AMI System and Technology Analyst Position ▪ Establish internal Metering and Billing systems governance team to support MDMS and Customer Portal requirements development in cooperation with procurement efforts ▪ Activate and properly configure Lucity WOM for Meter Reading and Meter Services ▪ Defer systems ERP or CIS change activities until post-deployment of AMI and related MDMS and Customer Portal systems ▪ Activate Customer Portal at onset of AMI implementation as part of the customer service overall strategy and in support of customer participation goals

Category	Key Action
Organizational Structure	▪ Develop key performance metrics (KPIs) in support of the seven primary business processes utilizing Lucity WOM ▪ Develop and gain approval of recommended new positions including job duties and pay/classification ahead of deployment ▪ Develop management oversight of KPIs and align with organizational redesign concepts of the future state design and adjust according to shifting operational parameters
Organizational Finance	▪ Authorize CapEx allocation for AMI of $13.5M plus $561K in CapEx project contingency for a total authorization of $14.1M (excluding tax) ▪ Finalize source of funds for total expected capital spend of $14.1M and authorize Procurement for solution selection by February 1, 2019 ▪ Allocate drawdown of funds by FY upon approved project timeline

Table 13. Actions for Metering and Billing

Both procurement and AMI implementation is best achieved by utilizing the experiences and focused support of an AMI solutions company like MeterSYS with a defined and targeted plan of work. Applying proven methodologies for solution selection and deployment, UCPW will benefit from proper specifications development, transparent and compliant procurement actions, and broad oversight throughout the anticipated deployment phase.

With authorization to procure, Union County is further defining the capital and operational costs of advanced metering in comparison to consultant estimates and the modeled business case while having at any point following receipt of vendor bids. This ensures the County is properly prepared to manage both capital and operational expenditures of AMI over the technology useful life.

Concurrently, with requirements development ahead of formal authorization to proceed, it is recommended UCPW work with the County budget office and the capital planning team to identify funding sources and drawdowns as well as any implications with rate planning or setting. Should the County seek funding through conventional lending sources, an RFP will be necessary to identify the loan sources as well as LGC approval for most projects and debt amounts related to metering and AMI. If authorized to award, it is anticipated that under Scenario 4, UCPW will complete conversion of its current meter reading technology to full AMI operations within a 24-month implementation period.

Figure 4. UCPW Advanced Metering Vendor Bid Milestone Chart

Effective advanced metering is the result of detailed requirements determination specific to the operational and financial requirements of the County. Requirements define the unique functionalities of meter equipment, AMI networking, meter data management, and detailed customer data access applied to utility goals and is detailed in Section 9.

Section 2. Metering and Billing/Customer Service Operational Analysis

Overview: The County performs meter reading and billing professionally and consistently across its large service territory with virtually no scheduling tolerances or flexibility within the reading and billing monthly deadlines to account for staffing or weather interruptions. Given the complexities of the read design, the County will not be able to sustain the level of service expected internally and by utility customers.

Recognizing that the current state environment is not ideal and with the desire to improve operational efficiencies across all the major components of the utility, from meter reading, to customer service and billing, in addition to improving customer service and water conservation management, the County has engaged in this Feasibility Analysis to identify the current state issues and opportunities. Through evaluation of the current state of operations for metering and billing, the benefits of expanded meter reading technologies may be accurately applied to the cost/benefit analysis and supports the Future State opportunities for the County.

MeterSYS assembled a project team for the Feasibility Analysis that was comprised of representatives from all major workgroups of the utility. The current state analysis was compiled by MeterSYS based on the data requested and provided by staff, through onsite interviews and observations of staff, and through targeted meetings. All elements of the current and future state analysis, including the assumptions and inputs in the financial model have all been discussed and verified by utility staff. The following sections summarize the results of the current state analysis and future state analysis, including key findings and recommendations for meter reading, customer service, and finance functions.

1. Current State Metering Operations

Organization: The existing metering operational environment is maintained to a high degree of performance despite troubleshooting demands due to failures between the Elster C700 Invision meters and Itron Encoder Receiver Transmitters (ERTs). The meter reading group is tasked with AMR "drive-by" read data collection, manual "direct reading" of meters that do not transmit data, and related service order support. As these meters fail due to end-of-useful life, the utility is replacing meters at high percentages. Customer service staff must assign reread work orders to Meter Technicians for meter rechecks to confirm questionable reads, stopped meters, and other field validation work orders. As of today, the utility is still operating in a reactive environment while the metering services organization has expanded to support the high volume of work orders and the significant growth rates of the utility. Still, the 10.5 Full-time Employment (FTE) metering services staff, including the Metering Services Supervisor, is not able to manage the true volume of work orders thereby creating a

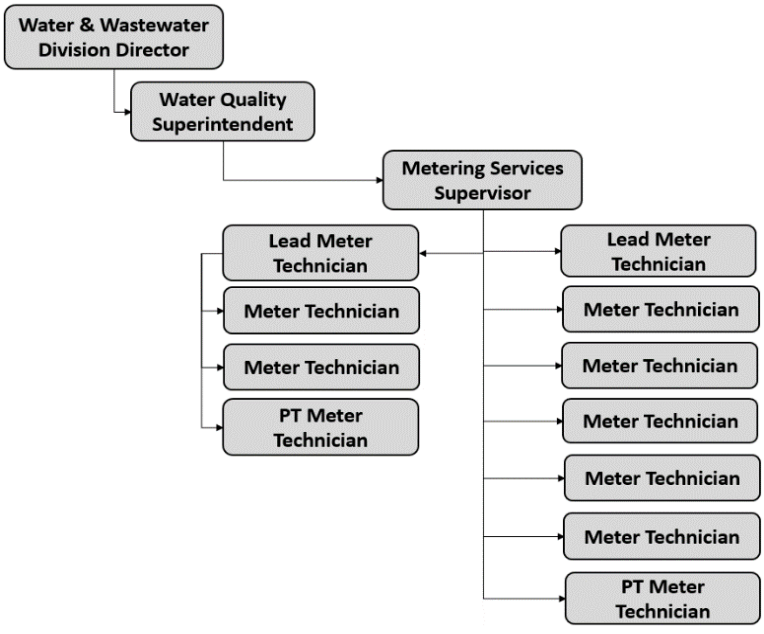


Figure 5. Current Metering Services Organizational Chart

need for additional staffing. The Metering Operations Group has recently added a part-time Meter Technician and requested funding to add one more Meter Technician next year. The following section provides greater detail on the labor-intensive work processes that the metering services organization operates under and the high work demands associated with the existing metering environment.

Reading Environment: The drive-by reading environment that the County operates under creates significant drag on utility resources. The operational challenges and inefficiencies of a system with a complex read design, expansive service territory, and manual heavy work processes creates pressure on metering and billing staff to collect reads, manage exceptions and work orders, and bill on time. Despite these challenges, the metering services group is cross-trained to be knowledgeable of the work order processes and the complexities of the read system and maintains a strict read accuracy rate of at least 98.5% each month.

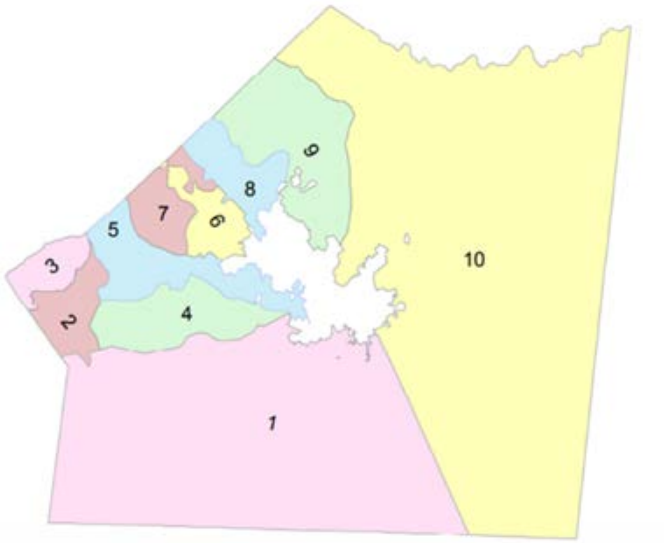


Figure 6. County Read Cycle Map

The County's read design mimics that of a clock and the 10 cycles follow a clockwise pattern. The system is comprised of about 100 routes and approximately 51,000 meters. In 2006, the number of cycles increased from 4 to 10 cycles to accommodate for rapid growth in new development and the related high work demands. The redesign was helpful in flattening out the high-volume of work orders, evenly distributing the work load, and alleviating pressure on staff. However, population growth hasn't subsided since then, and as a result, the cycles greatly vary in size.

Figure 7 illustrates the variance in cycle sizes, from a few hundred to a couple thousand, with the largest cycles being 6 through 9. Staff are consistently burdened by the heavier workload associated with the larger cycles because it creates a compressed reading window, and regardless of cycle size, staff are expected to finish and submit reads and rereads within the standard reading window of only a few days.

Metering and Billing Operations Schedule: About half of the meter reading group are also responsible for reading the 10 cycles. Each cycle is billed once a month and to push bills out 10 times a month, Meter Technicians are required to read and finish a cycle every other day. In between meter reading days, they're tasked with route maintenance and reread work orders. Rereads are issued as soon as meter reading is done and the turn-around time to complete rereads is usually 1-2 days from when they were assigned. Overall, Meter Technicians are finishing reads and rereads within 1-3 days. Immediately thereafter, the process begins all over again

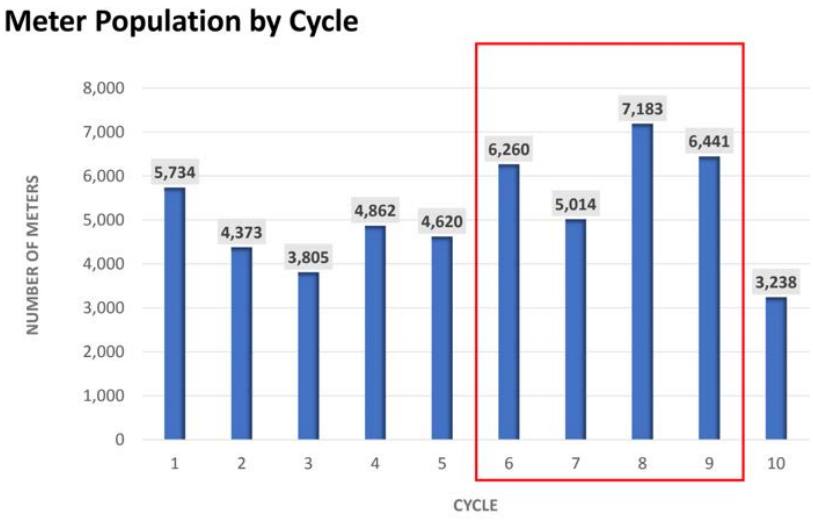


Figure 7. Estimated Number of Meters per Cycle (Point in Time)

for the next cycle. Meanwhile, the remaining Meter Technicians are disconnecting and reconnecting service multiple times a week.

Figure 8 highlights a normal month of operations with the key dates for metering and billing activities. Metering and Billing operations function in a very strict monthly schedule to generate monthly bills for its 50,000 customers. This creates strains on operations considering the unpredictable nature of water distribution operations and weather uncertainty influencing overtime and deadlines. Approximately 160 hours are spent per month reading meters and in the past few years, distribution staff were pulled from another division to support reading allowing more time for Meter Technicians to respond to service work orders.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
	1	2	3	4	5
C1 begin night reads	C1 finish reads C1 start re-reads C1 disconnects Reconnects	C1 finish re-reads C2 begin night reads Reconnects	C2 finish reads C2 start re-reads C2 disconnects Reconnects	C2 finish re-reads C3 begin night Reconnects	C3 finish reads C3 start re-reads Reconnects
7	8	9	10	11	12
C4 begin night reads	C3 finish re-reads C4 finish reads C4 start re-reads C3 disconnects Reconnects	C4 finish re-reads C5 begin night reads Reconnects	C5 finish reads C5 start re-reads C4 disconnects Reconnects	C5 finish re-reads C6 begin night reads Reconnects	C6 finish reads C6 start re-reads Reconnects
14	15	16	17	18	19
C7 begin night reads	C6 finish re-reads C7 finish reads C7 start re-reads C5 disconnects Reconnects	C7 finish re-reads C8 begin night reads Reconnects	C8 finish reads C8 start re-reads C6 disconnects Reconnects	C8 finish re-reads C9 begin night reads Reconnects	C9 finish reads C9 start re-reads Reconnects
21	22	23	24	25	26
C10 begin night reads	C10 finish reads C10 start re-reads C7 disconnects done Reconnects C1 bills due	C10 finish re-reads C1 begin night reads Reconnects	C1 finish reads C1 start re-reads C8 disconnects Reconnects	C2 begin night reads C1 finish re-reads Reconnects	C2 finish reads C2 start re-reads Reconnects

Figure 8. Metering and Billing Operational Calendar

Meter Reading Process*:* The County relies on nine full-time Meter Technicians and two part-time Meter Technicians to meet the work demands related to reading meters and service work orders. The designated meter reading group consists of the part-time Meter Technician who is dedicated solely to collecting AMR reads and another Meter Technician who spends half of their time reading meters, and half of their time troubleshooting rereads and performing route maintenance. Meter Technicians are assigned routes and after finishing reads and they perform route maintenance to identify meter issues, more specifically reporting stopped or failing meters, and ensuring that those issues are resolved in a timely manner.

To relieve some pressure on staff, the part-time Meter Technician was hired to begin the reading process at night. Deploying a night-time reader enables the utility to operate more efficiently because it allows for quicker collection of reads when traffic is at its lowest and without safety concerns due to high-volume traffic areas. Remaining reads are recorded the next day, typically in the morning, and the rest of the day is dedicated to “cleaning up” the reads from the route by troubleshooting meters with read anomalies and rereading meters for billing. A best practice noted within the organization is the sharing of responsibility among all Meter Technicians to maintain the highest read accuracy percentage as possible each month. The utility meets the high percentage of automated reads by instilling accountability among the Meter Technicians to maintain their assigned routes and using

a team approach for issue resolution. Two additional Meter Technicians support meter reading, troubleshooting rereads, and performing route maintenance. The designated meter services work group consists of six Meter Technicians who spend most of their time on service work orders, including disconnect/reconnect activities, troubleshooting meter issues, and meter setting and repair/replacement.

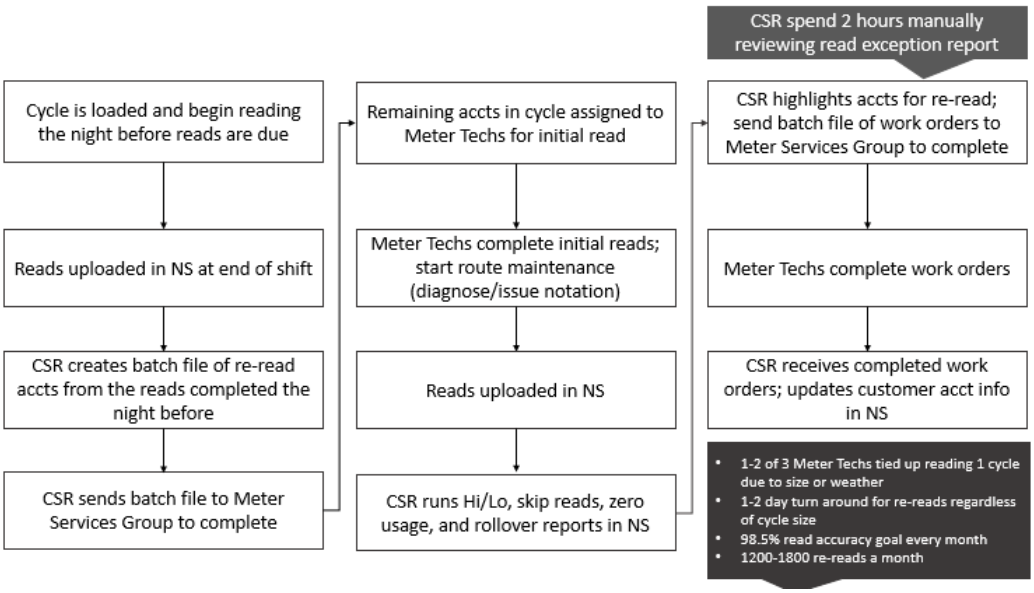


Figure 9. Flowchart of Meter Reading and Rereading Process

Meter Rereading Process: As reads are uploaded into the Utility's CIS system, Harris Northstar, CSSs are generating and printing multiple reports from Northstar to manually investigate accounts for rereads. Rereads are done for any reads that were flagged by the system as being too high or low based on the system's algorithm, to obtain final reads for move-in/move out accounts, any reads that were missed, or any that are deemed unusual by the Customer Service Supervisor. The utility will also reread meters upon customer request. A single batch file of exception accounts is sent to the Meter Services Supervisor, who distributes and assigns the work amongst the meter reading group. New reads are collected and returned to the CSS for her to update customer account information in Northstar. Figure 9 displays the workflows of the initial read and reread processes.

Contributing to the aggressive reread list is the utility's history of failing meters, creating a sense of mistrust in the metering infrastructure amongst utility staff, and results in the rereading of meters for accuracy. There are still approximately, 20,000-25,000 meters remaining in the ground that has aged out, producing unreliable reads. About 300-400 of these meters (Elster brand) fail each month, and as a result, these meters are automatically pulled when they are found in the field and replaced with a new meter.

Disconnect/Reconnect Process: Close to one-third of each of the six Meter Technician's time is utilized performing disconnect and reconnect activities. They are disconnecting multiple times a week and reconnecting service every single day. The CSSs create a batch file of accounts that are eligible for disconnect every morning. Five Meter Technicians report to one cycle and work together to complete the disconnect list. Meanwhile, the sixth Meter Technician is reconnecting service as requests are trickling in throughout the day from CSSs. Currently, the CSSs will informally send a text message or call Meter Technicians to reconnect service.

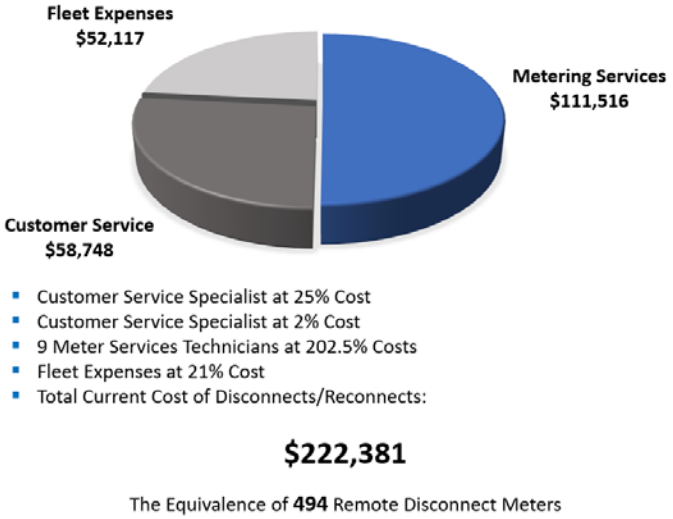


Figure 10. Cost-Benefit of Disconnect/Reconnect Operations

Additional challenges for metering staff are the batch auditing process of reread and disconnect/reconnect accounts, which makes it difficult for staff to complete the long list of work orders that are issued to them at a single time, while more work order assignments are trickling in throughout the day, adding to the workload. Consequently, work levels fluctuate, and bottlenecks occur. This is evidenced in the metering/billing calendar when Meter Technicians are at one end of the County recording rereads in Cycle 1 and simultaneously cutting off service in Cycle 8, which is the largest cycle and is located across from Cycle 1 at the other end of the service territory. The peak work demand that falls between these 2 cycles creates a strain on utility resources and added pressure to meet the quick one to three-day turn-around time of work orders for billing.

The utility's current expense on disconnect and reconnect activities among the metering services group is $111,516 and the fleet expenses to support these activities is $52,117. The total cost of disconnect and reconnect service activities for metering and customer service staff is $154, 415. This correlates to 343 average priced remote disconnect (RDM) meters which more than covers 293 of the utility's chronic offenders, who were disconnected three times in the last year for non-payment. The graphic above provides a detailed breakdown of the current disconnect and reconnect costs and net benefits). Remote disconnect meters until recently were only offered by one manufacturer, Mueller Systems, but now is emerging on the market through solutions from Sensus and Badger for devices built within the existing lay-length of the meter setting. Itron offers remote disconnect functionality as a separate device in a separate pit installed box.

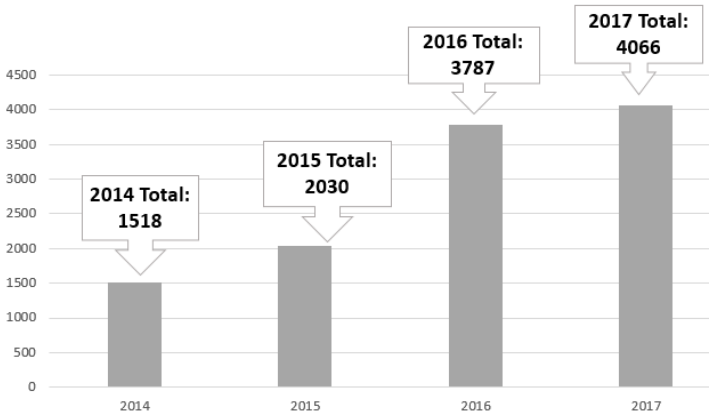


Figure 11. Annual Meter Replacement Totals

Meter Replacement: Since 2012, the County added about 8,000 new meter sets for an average of 1,300 a year. While new meters were being installed, old meters that were beyond their useful life were failing. Within the past 4 years, around 11,000 meters were replaced due to failure (see bar graph of annual meter replacement totals). In between the year 2016 to 2017, the County experienced its highest failure of meters and ERT components. As a result, the County's expected number of new meter purchases doubled from about 3,000 to 6,800 meters to meet both the replacement rate of failing meters and new meters due to new development. Currently, the utility is managing the challenging pace of meter replacements as quickly as they are failing. However, operating under the current break-fix model of replacing meters, while recognizing the need to plan for new growth, will exhaust utility resources and is not sustainable.

2. Key Findings and Recommendations – Metering Operations

A significant amount of data from the UCPW project team provide the details necessary to comprehensively understand the current metering operational conditions so that opportunities for automation and contributing value of metering technologies could be determined. Through this current state evaluation, key findings were discovered, and subsequent recommendations were developed to support the proper solution requirements/specification planning of a preferred metering solution.

Table 14 summarizes the key findings and recommendations that supports the County's goals to enhance operational efficiencies, invest in sustainable metering infrastructure, and benefit customer service excellence.

Key Findings	Recommendations
Variability of meter age, type and body/radio pairing creates inconsistency in field replacement and failure point Lack of standardization presents variation in useful life predictions and capital planning	▪ To retrofit recent installs to capture full remaining useful life of meters ▪ Full transition utilizing standard meter, endpoint, read collection infrastructure, and applications
Cycle growth disparities and route designs present pressure periods each month and creates uneven workloads and operational inefficiencies	▪ Automate reads with AMI technology to free up staff capacity for other tasks ▪ Dissolution of current cycles and routes through AMI deployment and creation of balanced read cycles
Batch assignment creates uneven workload Reactive scheduling creates bottlenecks, overtime, and outside department support	▪ Leverage enhanced advanced metering system-generated alerts that can be assigned based on responsibilities; this is auto division of labor for work order
Repeat site visits for re-reads, verity off-service, zero read, and high/low read validation	▪ Leverage on-demand reads and interval read data to allow for more insight into consumption trends, as well as soft-disconnect function for disconnect/reconnect services
Having the ability to perform only limited preventative maintenance and managing loss of efficiencies through travel time and manual and redundant business processes	▪ Automate reads with AMI frees up staff to perform proactive system maintenance (backflow prevention, meter testing, system health monitoring)
Failures due to old age, stopped meters, compatibility issues, and mix of versions complicate the creation of a more formal replacement program; currently a break-fix model	▪ Convert to full AMI system to: o Create standardization in metering infrastructure o Obtain “Clean slate” of asset management data, which allows for scheduled and planned maintenance o Leverage system alerts and alarms that notify staff of meters approaching end-of-useful life for replacement; more proactive system maintenance and health monitoring
Revenue loss is certain given the age of the meters and estimating for predictable loss of accuracy performance over time	▪ Leverage AMI technology to allow for system leak alerts and trending of data to detect leaks early and minimize NRWL ▪ Leverage AMI system reporting and functionalities to monitor system health
Data logging on request/troubleshooting Pilot of 10 participants showing value of interval read for customers	▪ Employ to have the ability for scheduled and planned maintenance to free up staff for same-day service provision ▪ Leverage AMI to obtain Interval reads for issue resolution trending and customer “self-service” via customer portal

Table 14. Key Findings and Recommendations in Metering Operations

It is recommended that the utility consider implementing these recommendations to support the migration away from a reactive and manual operating environment to one that is more proactive and operationally sustainable. By standardizing metering infrastructure and automating the labor-intensive work order processes, the metering services organization should be able to focus on more strategic service needs. The following section describes the future state impacts to metering operations that should occur in an AMI environment.

3. Future State Impacts to Metering

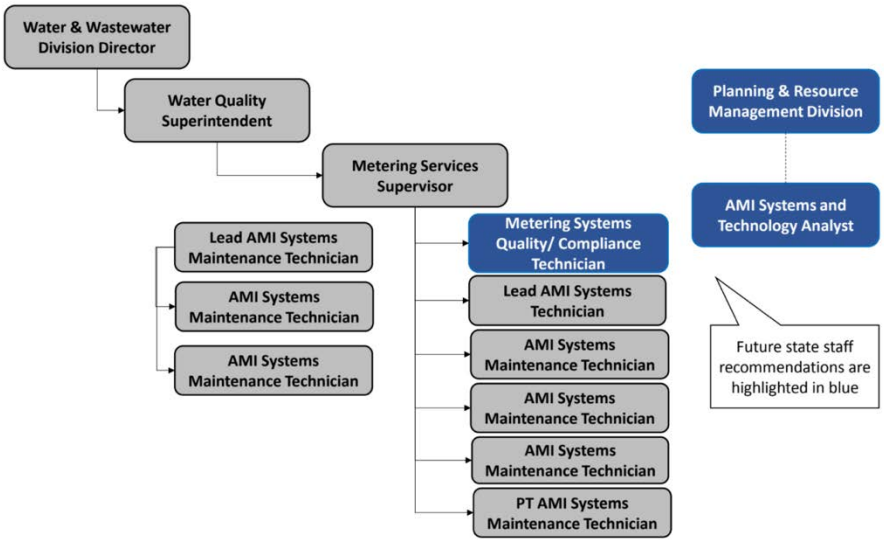


Figure 12. Future State Metering Services Organization Chart

Organization: The efficiency gains from implementing an AMI system are the basis of its appeal. Issues that currently plague meter readers, from safety concerns to visiting meters that are failing to read, will no longer be an impediment to collecting reads. Since meter reading will be the process most affected by AMI, it will require a redesign of the roles and responsibilities of the County's Meter Technicians. Leveraging AMI technology will automate the reading process and the related metering work order processes, which should result in operational improvements and efficiency gains. Additionally, the utility should require less staff, creating greater capacity for new positions that will fill the existing resource void of much needed preventative system maintenance functions (see Section 9 for detailed information on new AMI roles and responsibilities). The following section describes the future state changes to metering operations, which allows for the metering services organization to use their time more strategically and perform as "true" Meter Technicians.

Reading Environment: The utility's existing AMR read technology significantly enhances and expedites the reading process over manual read technology using a touch wand. However, by automating the reads with AMI read technology, frustration to manage reads and related service work orders associated with a complex and expansive service territory should subside, and only a small portion of an employee's time will be required to read meters, mostly to collect the reads of any meters having issues reporting for whatever reason. Although, the utility is not currently using the profiling of metered data. Doing so will allow the profiling of interval read data by selected meters, but not as a batch of the entire system. Currently, the utility has limited access to interval consumption data and significantly less trending and analysis data for proactive system monitoring and insight. In contrast, AMI technology allows for continuous hourly consumption recordings. With the copious amount of data and the functionalities made available by an AMI system, the metering services organization will have the luxury of remotely troubleshooting communication in the future.

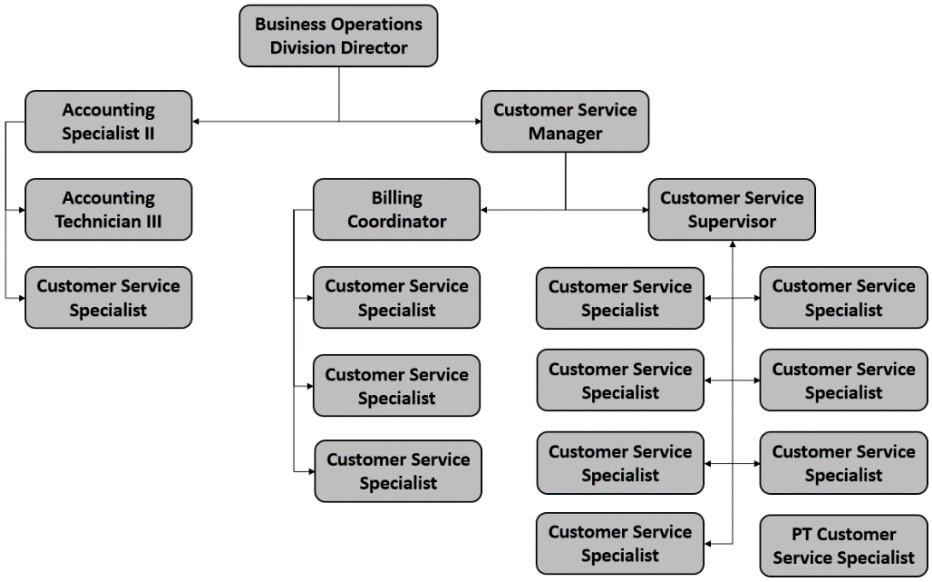
Disconnect/Reconnect Process: This process involves unscheduled and informal communication between metering and customer service staff throughout the day, creating repeat site visits, and requires extensive traveling across the large service territory to the same cycles multiple times a day due to customer service mobile requested work orders

that are trickling in throughout the day. This resource-intensive process can be automated by having the CSS's flag eligible accounts for disconnect and applying a "soft disconnect" until payment is received. This will reduce the need to roll a truck to confirm zero usage and is especially helpful for chronic delinquent accounts. In addition, the selective deployment of Remote Disconnect Meters (RDMs) will alleviate the time and effort spent on disconnecting and reconnecting service. The convenience of remotely turning service on, off, or reducing flow to perpetual non-payment offenders should limit the subsequent field requests of Meter Technicians.

Asset Management: The metering services organization continually strives to manage metering assets and operations under key performance indicators related to various work orders, meter and ERT component repair and replacement, existing metering brands and count that is in the ground, and other performance objectives. However, the tracking process is manual intensive, involves managing printed work orders that can get lost in the field, and the manual keying in of data can create misinformation. The change to electronic management of the field orders should enable staff to better manage service requests. Errors should occur less frequently, automation of key entry values as defaults should further increase efficiency and accuracy, and minor modifications to record keeping procedures should round out the change process. Another impactful functionality to the work order process is the use of codes in lieu of writing comments into the work order. Codes will allow for expediency in work order generation and reduce confusion around wording or phrasing.

4. Current State Billing/Customer Service Operations

Figure 13. Current State Business Operations Organization Chart



Organization: Union County continually strives to provide excellence in customer service account support and utility management. This is evidenced in the merging of billing and customer service functions under one program within the Business Operations Division of the utility about three years ago, to optimize business operations and improve customer service responsiveness. The assigned tasks for each position varies from service work order creation and pre-billing activities, to customer account management. Aside from assigned tasks, all staff are expected to be knowledgeable of the key business processes, including the complexities of the meter reading and billing system. By working together under one arm of the utility, there is now greater capacity to support the labor-intensive activities associated with exception reporting, service work order creation, and the processing of billing 10 times each month. The work demands associated with a strict billing window creates a high level of pressure on staff, in addition to operating by informal and manual heavy processes, to deliver accurate reads and bill on time. Recognizing that staff are working at maximum capacity to maintain the current meter reading environment, the utility has recently added on a full-time Customer Service Specialist (CSS) to alleviate some of the stress on existing staff.

Operational Capacity and Staffing: The low salary and high-performance standards expected of the CSS positions presents exposure for employee turnover. The CSSs are an integral part of the utility as the front line of defense to provide quality customer service support and responsiveness. Recently a class study was conducted to evaluate opportunities for promotion and increased pay and retention.

Newly hired CSSs are trained by an informal and best practices approach. A CSS will rotate between various utility workgroups to gain a general understanding of the related business processes and become familiar with the technical terminology necessary to successfully perform a composite of billing, customer service account management, and service work order functions, amongst other responsibilities. It is evident that the County is investing a significant amount of time, effort, and resources to properly train CSSs who can support the manual heavy business processes that is associated with the existing metering and billing environment, while providing quality customer service.

Exception Reporting: The manual work processes that billing and customer service staff is currently operating under is a product of system settings that are not properly utilized. This limits the effectiveness of the read exception reports and instead of being able to identify legitimate read exceptions, the current CIS system is pulling a high number of accounts with normal readings. This leads to staff printing and manually reviewing several exception reports at a time, including the high/low, skipped reads, rollover, and zero usage reports, to identify legitimate rereads. Another system issue is the limitations for data entry and available field options that CSSs can populate and use for improved customer account information management. Since Harris Northstar is the predominantly used system for account management and customer service/billing issue investigation, a deeper dive into the system settings is critical to leverage the system to its full potential. Section 5 analyzes the utility's current system settings in greater detail.

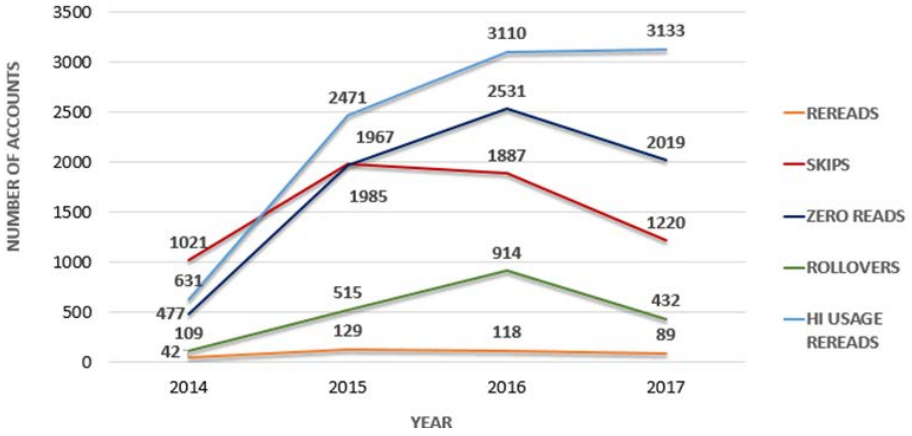


Figure 14. Annual Reread Accounts by Type

The lack of system flexibility has led to manual workarounds. For instance, CSS's are reviewing individual accounts for exceptions (edits/rereads). In addition, reading a cycle every other day requires staff to immediately tend to reread exception list creation, to keep pace with the read schedule, and not fall behind in billing customers on time. A CSS spends up to 2 hours a day creating the reread list and according to the reread data tracked in billing, reread work order creations due to various reasons has exponentially increased since 2014. For accounts with new reads that are still high, CSS's will contact the customer to notify them of the high usage and attempt to troubleshoot the issue with the customer. However, beyond asking issue resolution questions, CSS's are limited with monthly reading data and does not have the ability to investigate and pinpoint when the high usage occurred.

Disconnect-for-Nonpayment Process: Customer service and field staff spend a significant amount of their time on disconnect/reconnect activities. A CSS spends about 2 hours on this process almost every single day. The process requires the CSS to create a disconnect-for-nonpayment list by manually reviewing a report listing all customer accounts for those that have made bill payments. Then, the list is provided to the Meter Reader Supervisor for assignment amongst the meter services group. Once disconnect work orders are completed, they are returned to the CSS to update customer account information. Accounts are eligible for disconnection service when they are 2 months behind in payment and owe more than $30. A disconnect processing fee of $50 is applied to their account and their

account must be paid in full prior to 4pm for same day service. Two CSSs are currently spending a combined total of 27% of their full-time job on disconnect and reconnect activities at an expense of $58,748 to the utility.

A significant challenge for both Meter Technicians and CSSs is the reconnection of service process. As soon as customers make payment, the CSS calls or sends a text message of the customer's account information for field staff to turn service back on. However, the CSS is unaware of the Meter Technician's availability and that they are busy juggling disconnect work orders that come in a batch instead of discrete packets and other service work orders.

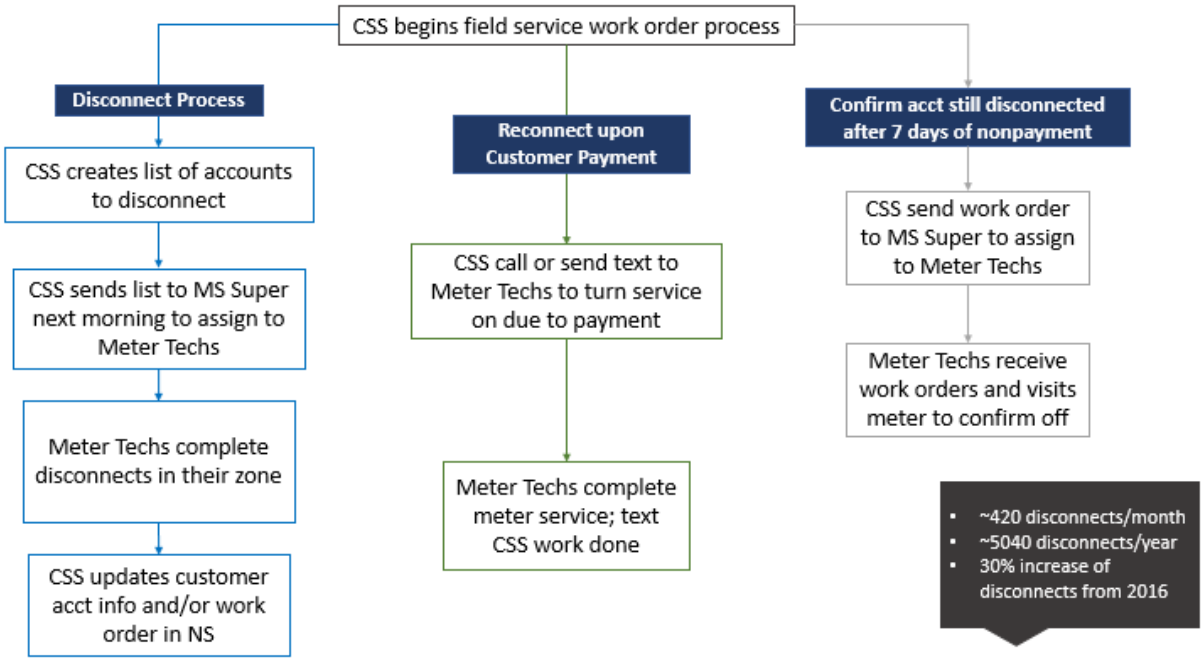


Figure 15. Flowchart of Disconnect/Reconnect Process

This creates a substantial load of work on the frontend and is a constant daily struggle for Meter Technicians to complete work orders as quickly as they come in and on time for bill processing. Reconnect service requests are constantly trickling in throughout the day, which adds to the Meter Technician's workload and further exacerbates the situation. When reconnect work orders are completed, CSSs are unaware of the time of completion or any comments or special concerns from the meter technician. The lack of communication between staff has resulted in multiple repeat site visits for zero usage validation. Additionally, the utility still loads and reads disconnected meters, which contributes to unnecessary site visits and inefficient use of staff resources. According to data provided by staff, there were 2,927 disconnect-for-nonpayment customers last year, 749 customers were disconnected at least twice in a year, and 293 were disconnect three times in a year, while some larger customer accounts have been disconnected up to 16 times a year. Finally, the utility is averaging 159 repeat visits for accounts that were never reconnected due to indicators still spinning.

Leak Adjustments: For 2013 to 2017, the County received 10,421 customer complaints about a leak. Of those customers, 2,886 requested for the County to verify if the leak has been repaired, and the remaining 7,535 requested for leak checks. CSS are limited with monthly read data to confidently verify a leak and rely on field visits to inspect for any signs of a leak. The County will grant a billing adjustment for suspected leaks according to the leak credit policy, which is demanding on staff time to determine the amount of credit due. Between 2014 to September of 2017, the County issued 2,895 leak credits, costing the County an estimated $647,809. With AMI, utilities can receive leak alerts and hourly interval consumption data to trend and identify customer side leaks, thus eliminating the need of truck rolls for investigation and the leak credit policy to adjust customer bills.

Billing and Customer Service Support: UCPW takes a very customer-centric approach to utility billing management and customer account support. The County offers a diverse channel of payment acceptance options, from online payments and automatic bank draft options, to personal check payments. The pie chart shows a detailed percentage breakdown of the payments received by payment channel. Currently, about 39% of the County's customer base still prefer to pay their water bill by check. Bank draft payments are highly promoted by the County to ensure prompt payment by the customer. However, only about 9% of the County's customer base is utilizing bank draft payment. As a best practice to promote ACH, the utility should consider developing key performance indicators and performance objectives to meet target performance initiatives (see section 10.2 for KPI development for billing and customer service).

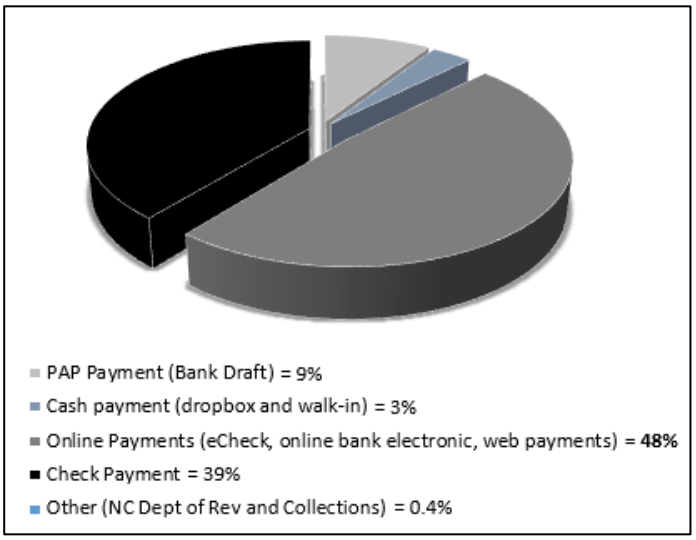


Figure 16. Breakdown of UCPW's payment channels

Most customers are using some form of electronic payment, such as electronic check payments, electronic bank payments, and web payments using the Paymentus payment portal either online or by mobile phone. Around 48% of the County's customers are using some form of electronic payment, which makes the County a great candidate to expand customer service support through a customer portal. Although the County is not doing any meter profiling for its water customers, trending consumption and the complex algorithms built into an MDMS will significantly reduce the impact of leaks. The County could consider doing data logging, that is, pulling interval read data for the 100w radios for those eligible meters, recognizing that it is limited to a 30-day time frame and, while usually that would be too short to see when a leak or an issue arose, it can start to highlight the helpfulness of interval read data and help make the case for AMI for all customers.

The desire to provide the best customer service is a driving motivation of utility policy and customer-facing features. For example, the County provides customers with a packet of information on Paymentus, and customer can sign-up for an account after receiving their first bill. This initiative has been extremely successful and has resulted in an estimated 4,200 e-bill customers. It is this customer-first approach that permeates the organization which makes the County a prime candidate for AMI adoption to provide improved services and support to their end users.

5. Key Findings and Recommendations – Billing/Customer Service

In cooperation with utility staff, a detailed analysis of the County's data was completed, and key findings of the current operational conditions within utility billing and customer service were identified. The table below highlights the key findings and recommendations. Findings are followed by recommendations that were developed specific to the County's goals to improve customer service excellence, streamline business operations, and enhance system capabilities for operational efficiency gains.

Key Findings	Recommendations
System settings and exception thresholds are not tailored to account designations or seasons Exception reports are manually reviewed	Meter replacement allows for "clean-slate" data Leverage account designation and robust reporting in MDMS
Batch review and audit of reads creates bottlenecks due to route/cycle read process (field work done, submitted, then reviewed)	Ability of field staff to maintain read rate % Ability to segment work by region and cycle for service orders with MDMS – GIS integration
Batch process due to hybrid read process creates fluctuation of workload	Automation of reads frees up staff for other tasks Full system monitoring removes cycle/route
Don't trust reads High number of re-reads and repeat site visits	On-demand reads and alerts/alarms for repeat visits and improved WOM
Limited ability for customer self-service High adoption rates by customers of online and remote payment features	Customer Portal allows for SSO and robust self-service functionality User sets notification; education and conservation
Read cycles and route designs present pressure periods each month and creates operational inefficiencies	Automation of reads frees up staff for other tasks Dissolution of cycles and routes in AMI
Customer service is the highest priority for the County, and attempts at providing increased support for the end user, through online payment, is a best practice supporting that goal	Customer portal allows for hourly interval consumption data/trending and "self-service"
Many of the pain points and high cost of service provision due to the current read environment can be alleviated	Enhance customer service features and functionality through the adoption of AMI technology

Table 15. Billing/Customer Service Key Findings and Recommendations

The key recommendations should be considered by the utility to alleviate the high work demand and pressure that is related to meeting a strict billing window and for a large customer base, while operating under a failing metering infrastructure environment that requires significant utility resources to investigate and manage service work orders. The existing manual and time intensive work processes takes way from providing superb customer service support that is a standard for UCPW. By automating reads and leveraging enhanced AMI functionalities, the billing and customer service staff should gain operational efficiencies, thereby, being able to redirect their time, efforts, and focus on more strategic service needs. The following section describes the future state impacts to billing and customer service operations that should occur in an AMI environment.

6. Future State Impacts to Billing/Customer Service

Organization: Leveraging technologies through business process adjustments is the most challenging and opportunistic component of an AMI deployment. Billing and customer service staff currently spend the majority of

their time adjusting bills or processing payments, with limited time dedicated to troubleshooting or actively managing customer accounts. In an AMI environment, staff will have the ability to leverage consumption data and enhanced functionalities to more proactively resolve customer service calls. A CSS's time can be redirected to identify issues, allowing for more preventative or at least responsive customer issue resolution and customer education. Additionally, automating the reading process will relieve time spent manually reviewing exceptions reports for rereads and disconnect services. This will in turn reduce the volume of service work order creation and result in operational improvements and efficiency gains. By automating and streamlining business operations, the utility should require less staff support. The creation of new positions that will fill the existing resource void of customer service communications support and management, communications and business operations performance management through KPI establishment, conservation management, and direct collaboration with the County's Media and Relations organization for enhanced customer service engagement efforts (see Section 9 for detailed information on new AMI roles and responsibilities). The following section looks at the future state changes to the County's current metering and billing functions which will achieve higher levels of efficiency for customers and operations.

Reading Environment: AMI offers convenient services, such as specific service start/stop scheduling through on-demand reads. The on-demand read functionality will greatly benefit customer service efficiency because currently, CSS's final bills for move in/move out by creating 1 work order that is actually tied to 2 work orders, one for move in and one for move out. This process is time consuming and the complexities of the 2 work orders that is packaged into one makes it difficult to track and monitor over time. Especially, when this type of work order is created for rental properties that have a high turn-over rate. Problems arise when there is consumption between when the account was designated as active and then made inactive, and the CSS has no ability to pinpoint when the usage occurred. AMI will allow the CSS to get an on-demand read to final the account, and if it is setup as a rental with a landlord already assigned, the account can be automatically reverted to them, upon which another on-demand read can be generated as the start read for the new bill. If no consumption is expected, a "soft disconnect" can be set to flag usage.

Exception Reporting: By deploying AMI, customer service staff will see immediate relief of the time spent managing service work orders and reviewing exception reports to create reread and disconnect-for-non-payment lists. Due to enhanced reporting functionalities, CSSs can print reports by exception in a single file and issue service work in less time than it took before. In addition, the capabilities of the MDMS to validate reads and identify issues with complex algorithms, and the system flags to provide alerts by exception will further alleviate strain on staff.

Disconnect-for-Nonpayment Process: An expanded functionality of AMI is RDM technology that conveniently allows staff to turn off, turn on, or reduce flow to meters. This is advantageous to utilities like UCPW with a high degree of chronic non-payment offenders. The current and manual heavy process of creating the disconnect list multiple times a week and the immediate reconnection of service almost every single day by Meter Technicians is inefficient use of utility resources and staff time that can be better spent on other tasks. This process can be automated by flagging eligible accounts and applying a "soft disconnect" function until payment is received or the utility can deploy RDMs and remotely turn off or reduce flow to eligible accounts. The CSSs will also have the ability to automate the reconnection of accounts for faster restoration of service. Modifying the existing manual process to one that is more streamlined will increase operational efficiencies by reducing the time and resources it takes to service accounts or check meters for unauthorized or suspicious usage.

Billing and Customer Service Support: A professional customer service culture is very evident throughout the County, as is the frustration with the current meter reading environment and its negative effects impacting responsiveness to the customer. With AMI, reads are automated and hourly consumption data is available to customer service staff, who can access this data and provide more information to customers on their account with the data from the system. The flowchart displayed in this section depicts the potential process by which a CSS can leverage the functionalities offered by an AMI and MDMS to troubleshoot a high bill complaint call. Currently, the CSSs spend the majority of

their time managing customer accounts, with limited time dedicated to troubleshooting customer service calls and proactive customer service engagement efforts.

By operating in an AMI environment, Customer Service staff will have the ability to:

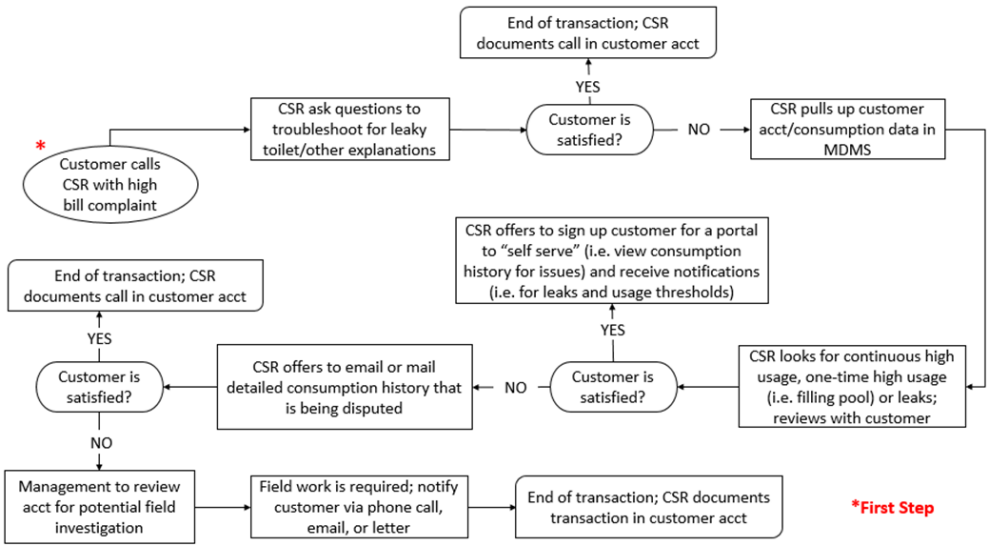


Figure 17: CSR Customer Complaint Process

- Perform extensive troubleshooting through exception and diagnostic reporting options, which allows for more preventative measures and improved customer responsiveness
- Monitor high consumption for all accounts on a continuous basis by the MDMS and through leak alerts and alarms
- Provide prompt customer notification when a constant consumption alert is triggered, as opposed to after they receive their bill for an inordinate amount of usage
- Promote customer education during support calls and register customers to view consumption history and "self-serve" through the customer portal
- Leverage RDM technology to flag eligible accounts for disconnect service by applying a soft disconnect function until payment is received; CSSs will receive a notification if usage occurs

Empowering customers to take action for their services behind the meters is critical to change their behavior around water consumption and conservation. System automation and leak alerts and alarms will notify customers within 24 hours of continuous flow that a potential leak has occurred thereby providing opportunities to address potential high-bill issues before they happen. This will also empower customers to be accountable for their water usage and monitor consumption that is available through a customer portal.

Customer Portal: Currently, the County offers no self-service options, outside of online or automatic bill payment. In an AMI environment, customer-facing tools such as the customer portal allows customer to benefit from more detail into their consumption, reducing the need to contact customer service for information. Additionally, the customer portal option for AMI systems provides for automation, billing, and usage data access by the customer through an on-line site designed to provide customers with all relevant information about their account and consumption. This data access provides the County with the ability to adopt and promote customer service policies that help customers manage and conserve water resources, minimize subsidization among customers for leaks and service orders, and create opportunities for pre-payment of accounts, and aid commercial customers that value utility billing and consumption as part of their operations. Lastly, a customer portal would provide an additional platform to communicate and educate, increasing positive customer behavior management, on top of the benefit of allowing the customer to better monitor their consumption and "self-serve."

Through AMI technology, customer service and billing staff will have the ability to provide greater insight into consumption data, thus reducing calls or call length to customer service, field visits and clerical time. The enhanced

system capabilities provide the ability for CSSs to get near real-time data to troubleshoot issues, field staff to respond quicker to meter alerts and equipment issues and improve customer accountability through transparency of a portal. These system advantages should provide increased operational management and system oversight. Ultimately, an AMI system will improve business operations and procedures, provide efficiency gains, and enhance customer service across all aspects of the organization.

7. Procedures, Policies, and Ordinances – Current vs. Future State

One of the most overlooked aspects of change management when a utility implements an AMR program of work is the influences of reading technology, more specifically AMI, to the existing procedures, policies, and ordinances of the utility. The County should consider adoption of internal procedures that support operational performance indicators aligned with Utility goals in the areas of customer service, finance, and operations. The current state and future state policies and procedures recommendations are presented in the following section.

Current: The disconnect policy the County currently has is flexible and designed to be customer friendly. Accounts are eligible for disconnection when they are 2 months behind in payment and owe more than $30. Recommendation: In the future, it is recommended that the utility notify the customer via phone call or send an email to pay the first month's late bill within 48 hours or be penalized in the form of a $50 disconnect processing fee that will be applied to their account. It would be in the utility's best interest to try to collect payment after accounts are in one-month delinquency, instead of 2 months. This will limit financial liability on the utility and encourage customers to make payment for one month, which is financially easier on the customer, than struggling to pay off two months' worth of bills. It is also recommended that the disconnect processing feed be changed to be called a Disconnect Eligibility Fee, as the charge is to cover the costs the County incurs which occurs even if the customer is not physically shut-off.

The County should consider enacting a tamper policy that reflects the replacement costs of each of the smart meter components. This would require creating an itemized pricing schedule to identify the per unit replacement costs. We recommend this be done immediately following solution selection, so the County can educate customers on the change during the project communications. The County can then determine if they want to cover the first replacement, with any additional replacement due-to-damage being added to a customer's bill. It is also recommended that the County enact a policy dictating that customers must keep the area surrounding the meter box clear of all gardens, including mulch or shrubbery that might interfere with signal transmittance.

Customer Service Specialists are the front-line for dealing with customers and resolving their account issues. When a customer calls to ask the CSS to address high usage on their bills, the CSS is limited with the information available to troubleshoot or to resolve the issue. Most commonly, the CSS will create a work order to have a technician go out and inspect the meter for any obvious signs of a leak, such as water in the meter box or a constantly spinning dial. If a leak is suspected, a billing adjustment can be granted according to the leak credit policy. Since utility staff will have the ability to obtain more accurate and timely information from the AMI system, the County should discourage no-cost field investigations.

When the data is available for consumption management, there is an ability to understand where water consumption is occurring and better anticipate patterns of consumption from the perspective of a customer or the municipality. These are all key in water conservation due to the need to better understand the nature of consumption rather than simply documenting the resulting consumption.

Water Conservation: UCPW should be commended for their pre-emptive action in water conservation through the current conservation program, including the irrigation plan. Currently, Union County has a Soil and Water

Conservation Plan as well as a Water Resources Plan to encourage both residential and industrial customers to conserve resources in the County. These have a proven record with the County and offer customers the opportunity to be more informed about the limitations on water consumption under varying consumption as well as being informed on opportunities to limit consumption whether under water consumption limitations or not.

More effective communication was noted in the Water Resources page due to its direct call to action to customers in posing and answering the question of 'How can I help conserve?'. These are the moments where education can occur, and customer behavior can be changed. AMI takes this type of educational opportunity to the next level by providing responsive data to the back office and to the customers the County is trying to influence. AMI customer portals would allow customers to keep track of their own water consumption with more frequent feedback than monthly bills with engaging water consumption programs. Seeing consumption displayed in this manner allows customers to set goals for consumption, budget for bills based on consumption, and stay within County ordained water consumption limits in times of water stress. Interactive and engaging data results in stronger customer response to water conservation needs and sustain continuous behavior augmentation.

Additionally, the County would have numerous opportunities with the implementation of AMI to support the already present County campaign for general conservation. AMI can assist in the following areas:

- Increasing water consumption data to the back office to allow for inquisition on questionable consumption patterns limiting consumption discrepancies.
- Acoustic Leak detection capabilities allow the utility to know where leaks are occurring to protect water resources and limit Non-Real Water Loss (NRWL). District Metering Areas (DMAs) allow for the deployment of Acoustic leak detection in only high value areas as well as simply throughout the entire water system.
- By receiving metering data, truck roll-out can be limited which lowers carbon dioxide release and has the added benefit of lowering the cost of monthly meter reading. Truck roll-out would be limited to special cases such as a zero read or meter maintenance.
- AMI allows the opportunity to better monitor and manage pressure to prevent blow-out events to maintain water quality and distribution system health while saving on water consumption.
- The ability for an AMI network to notify the utility of Reverse flow or no flow events allow for better management of the water quality in the distribution system to prevent water contamination and for better conservation of potable water.

All of these AMI capabilities can easily be added into an advanced metering system to meet the ever-growing demands of conserving water, lowering financial expenditure, and limiting negative environmental impacts. Additionally, this influx of data allows the utility to focus on higher level management rather than in the current state of County operations. For example, meter readers would be able to troubleshoot meter management in the field rather than being highly focused on simply reading meters and new roles such as a Communications and Conservation Specialist can be created to keep customers engaged in the conservation effort as well as effectively inform and communicate with them to encourage action. New roles and innovations in current roles in an advanced metering networks bring new value dynamics to the utility (Reference Section 10.2 for more information).

As the utility works toward better functionality, AMI offers the opportunity to monitor water consumption in real-time, trend water usage between neighborhoods for comparative studies, and would allow for a faster response due to abnormal and high water usage. UCPW's current policies and procedures require the water utility to function as a patron of the County's water resources. This has manifested in the County procedures as:

- The water utility maximizing water usage all year round for the County's water supply with conservation practices
- Reducing seasonal peak day demands to eliminate expansion of the water treatment facilities

- Implementing voluntary and mandatory water reduction measures
- Minimizing the adverse impacts in the event of a drought
- Complying with the CW-LIP (Catawba Water Low Inflow Protocol) to not allow complete depletion of natural water resources and allow precipitation renewals [Active since December 2006]
- Complying with the Water Shortage Response Plan (WSRP) [Active since May 2015]

In times of drought, the County has five stages of varying standards that customers should comply with. AMI helps in the management of these stages by identifying irrigation use outside of authorized times (8pm-8am), limit leaks with acoustic leak detection technology, and allow customers the ability to review their personal water consumption through the customer portal. A direct benefit AMI brings to drought management is the ability to monitor irrigation usage by leveraging the threshold functionality. Customers and CSSs can set threshold levels to limit water consumption and, when usage is over the threshold setting, customers and CSSs will receive notifications. The utility can encourage customers to use the threshold functionality by using rewards and rebates and will also publicly demonstrate the efforts taken to support sustainability initiatives and leverage AMI technology to provide improved public education, engagement, and conservation.

Section 3. Meter Infrastructure Summary

UCPW currently has several variations of meters and AMR transmitters, with about half of the systems still using legacy Elster Invision C700 Positive Displacement (PD) mechanical meters and the other half of the system using Badger M25 PD meters with High Resolution Encoder (HR-E) registration.

For read data transmission, UCPW utilizes Itron Encoder Receiver Transmitters (ERTs) for all reporting AMR reads with the exception of a small number of industrial accounts that are transmitting data through a Badger Beacon AMI program utilizing cellular networking. UCPW installs around 140 new meters each month in response to system growth which creates a continuation of the current meter and transmitter specification. All Elster meters are considered to have reached end of operational life due in large part to moisture/condensation within the encoded registers despite the accuracy performance of these meters.

The County maintains a variety of systems and data points related to asset management including CIS, GIS and spreadsheet work order tracking. Each of these systems have discrepancies in asset types and counts, so quantities for figures such as the number of retro-fit eligible meters, the number of 100W and non-100W Itron ERTs, meter asset ages, and other critical meter attributes are estimated.

Union County serves primarily residential accounts with a small percentage of Commercial and Industrial (C&I) services. Recent large meter upgrades have utilized Master Meter Octave ultrasonic

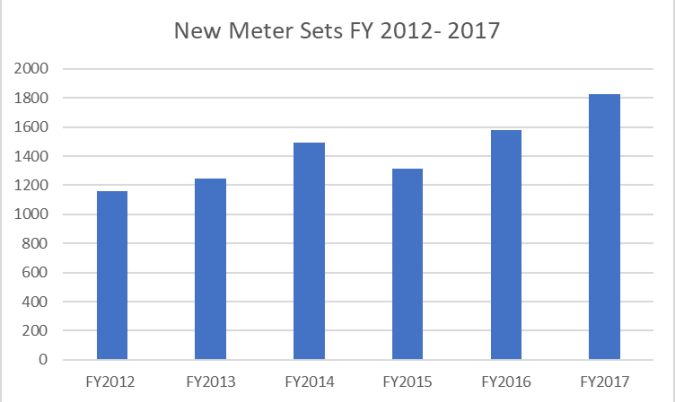


Figure 18. New Meter Sets FY2012-2017

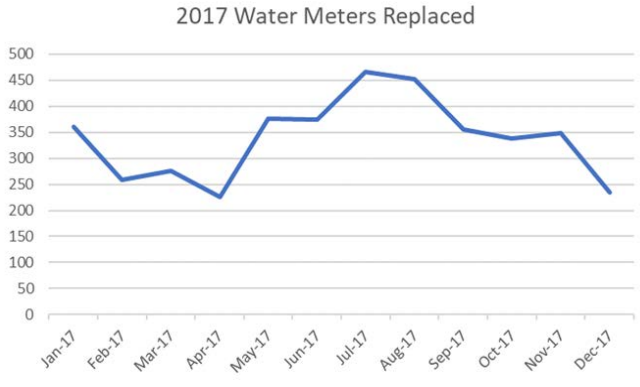


Figure 19. 2017 Water Meters Replaced

technology considered exceptional for read accuracy at both low and high flow conditions with an acceptable level of operational maintenance.

The incredible growth of the County creates resource strains for completing new meter set work orders. This accelerated growth enables the continuation of the status quo meter replacement program due to the investments made for current standards and the lack of time for considering alternatives. Meters replaced each year coupled with new meter sets requires significant annual investments by UCPW without the benefit of refined specifications or long-range technology planning.

Meter Testing: As a matter of data validation, MeterSYS issued ten test meters to MARS, Inc., a certified meter testing company based in Florida, to determine the read accuracy performance of the existing Elster/AMCO meters. Although UCPW has internally testing capabilities, it is a good exercise to have certified results to support modeling estimates and ensure objectivity. The results of the testing were consistent with the 2% weighted inaccuracy determination by County staff and is a credit to both the methodology and professionalism within the UCPW Metering Services group.

The Weighted Percentage Measurement for purposes of determining a single percentage of accuracy is based on 15% low flow (.25 gpm), 15% high flow (15gpm) and 70% mid-range flows (2gpm).

Figure 20. MARS, Inc. Testing- UCPW Meters

Table 17. MARS, Inc. Testing Results - UCPW Meters

METER BRAND	SIZE	SERIAL#	FLOWRATE	ACTUAL VOLUME	PERCENTAGE	WEIGHTED PERCENTAGE
AMCO C700 METERSYS M-2323	5/8"	17368957	15 GPM	100.26	98.64%	98.60%
			2 GPM	9.7	98.97%	
			.25 GPM	10.02	96.81%	
AMCO C700 METERSYS M-2323	5/8"	16558865	15 GPM	100.26	98.84%	99.35%
			2 GPM	9.7	100.00%	
			.25 GPM	10.02	96.81%	
AMCO C700 METERSYS M-2323	5/8"	16579535	15 GPM	100.26	99.24%	99.53%
			2 GPM	9.7	101.03%	
			.25 GPM	10.02	92.81%	
AMCO C700 METERSYS M-2323	5/8"	15429023	15 GPM	100.26	98.44%	97.40%
			2 GPM	9.7	97.94%	
			.25 GPM	10.02	93.81%	
AMCO C700 METERSYS M-2323	5/8"	15429649	15 GPM	100.26	98.84%	96.11%
			2 GPM	10.02	95.81%	
			.25 GPM	10.02	94.81%	
					AVG Accuracy	98.20%

Section 4. Network Infrastructure Summary

1. Radio Frequency Analysis Summary

AMI networks, whether as a traditional gateway system or a cellular system, utilize radio signals and the frequency data transmission is influenced by many environmental factors including humidity and vegetation as well as man-made interferences like buildings and competing radio waves. RF propagation refers to the modeled analysis of radio signal reach at certain power outputs and frequencies. In order to determine the viability of AMI for Union County, a full understanding of the specific design criterias of potention solutions should be considered and evaluated for operational and financial implications.

MeterSYS collected data from UCPW on certain assets controlled by the utility as potential locations for AMI network infrastructure, then conducted a site survey of each of these locations to understand the requirements of each site to support a base station for data collection. The supplemental Propagation Summary Report, submitted as a complementary deliverable to this Feasibility Analysis Report, provides greater detail into the utility's network design and metering infrastructure options as proposed by the six network propagation studies that were received by the six interested companies. This analysis provides a detailed summary of the network propagation characteristics of six market-leading smart meter vendors – Aclara, Badger, Itron, Master Meter, Mueller, and Sensus. All six companies have expressed interest in providing a smart metering solution for Union County and each company provides similar yet unique solution characteristics to the County's metering network.

2. Data Validation

The County provided an initial list of available assets, which included the address, site name, and tower height for 84 potential collector locations. The MeterSYS Field Lead was accompanied by a designated County employee to physically inspect all locations over the course of several days. Through this exercise, it was found that 38 locations were inaccurately described, as the tower at the sight either did not exist or was much smaller than presented in the database. In addition to height discrepancies at several locations, the field audit was able to verify the availability of power, access requirements, backhaul, and other elements that are important, both for identifying any connectivity issues and for accurately assessing future capital and operational network costs. It is recommended that, as part of the procurement process, an updated propagation study be ran using this updated asset information, ensuring that any variation to the network design from what is presented in the Propagation Summary Report is understood and that the final design is certified by the proposing vendor.

3. Infrastructure Comparison

VENDOR	COLLECTORS	AVERAGE SQ. MILE PER COLLECTOR	REQUIRES NEW POLE SET	REPEATERS	REQUIRES NEW POLE SET	REQUIRES CELLULAR SERVICE
ACLARA	21	30	5	0	0	0
BADGER	9	N/A	3	0	0	42,225
ITRON	106	6	22	89	89	0

VENDOR	COLLECTORS	AVERAGE SQ. MILE PER COLLECTOR	REQUIRES NEW POLE SET	REPEATERS	REQUIRES NEW POLE SET	REQUIRES CELLULAR SERVICE
MASTER METER	18	35	12	53	38	0
MUELLER	106	6	80	~100	0	0
SENSUS	18	35	10	0	0	0

Table 18. Vendor Prop Study Infrastructure Comparison Summary

4. MeterSYS Recommendation

Network planning is a critical aspect of developing an AMI project implementation strategy and is a significant element in vendor solution selection specifically related to capital and operational costs aligned with performance reliability. UCPW's expansive service territory creates network design challenges that create a separation in total infrastructure required significantly between 1-watt and 2-watt output solutions. The ability to essentially double total power output from the endpoint provides for a substantial reduction in base station infrastructure and directly influences CapEx and OpEx over the life-cycle of the network. Significant infrastructure creates greater opportunities for failure even with system redundancy and remains a weak point in the network for vandalism or cyber-attack. Nonetheless, the ability to expand functionality of the network through Smart City initiatives, LoRA, WiSUN, and other IoT enabled networks create greater potential for new technologies and network leverage.

Network as a Service, like solutions offered through Neptune and Mueller Systems, is emerging as an alternative to traditional utility-owned networks and should be considered as an alternative for any solicited vendor responses for Requests for Proposals. Under NaaS, the utility would partner with its preferred vendor through a service agreement that eliminated any operational or capital expenditure responsibility for the network and would transfer network costs to an annual service agreement based on performance standards determined by the Utility and accepted by the vendor. If this option is considered viable, UCPW would need to carefully evaluate the impacts of transitioning capital costs over to operational expenses and the indirect influences to costs that solutions requiring greater amounts of network infrastructure would require.

For vendors that propose utilization of utility poles or other electric utility assets, careful evaluation of the ability to for co-location (joint use agreements) should be applied as part of the solution due diligence. Joint Use Agreements can be challenging to get approved depending on the provider (Investor Owned Utility or Electric Cooperative). While the propagation study results provided by vendors during this Feasibility Study phase are not binding or certified by the vendors, these initial designs allow for more accurate network costing and should serve as an introduction into the top tier vendors and their respective smart metering solutions.

Section 5. Data and Systems Infrastructure and Management

This section will depict the current state software environment as understood through several onsite meetings with key staff and work to make recommendations to allow the County to make foundational improvements to main applications, including increasing the adoption and functionality of key systems and improving data governance to help prepare for a future AMI implementation. The key objectives of this analysis are as follows:

Conduct a Systems Assessment	Formalize System Governance and Data Standardization Efforts
Identify opportunities to enhance the effectiveness of existing systems	Identify “scrubbing/clean-up” needs for key databases
Recommend actions to improve functionality and usability	Improve information exchange/interfaces between systems and work groups
Understand drivers for changing CIS and consider options	Facilitate data-driven decision-making across the organization

Table 19. Data and Systems Analysis Key Objectives

Actionable data insights, when applied to management and operational decisions, will allow the utility to better plan for long-term financial investments like infrastructure replacement and water supply planning. In the near-term, practical application of data analytics will allow for informed resource allocation, increasing the efficiency of customer service provision and system maintenance efforts. Aligning systems with operations and allowing the data to move unrestrained between the various systems for the full field-to-finance workflow will ensure that manual work-arounds or information roadblocks no longer hinder the process or paint an incomplete picture, but instead, support staff in their work and provide data that is accurate, verifiable, and comprehensive regardless of the particular system of record. The following assessment will seek to identify the issues and opportunities within the key applications to provide UCPW with specific interface and database changes that should be made to improve information flow, data governance and standardization efforts.

1. Systems Assessment

The figure below depicts the County’s current enterprise architecture of applications and platforms used by utility billing, customer service, and metering field groups. Manual work-arounds are frequently used, and the underlying data is deemed unclean and in need of scrubbing and standardization. The lack of interoperability, indeed, the current incompatibility of the main databases used by the main workgroups, has a negative impact on efficiency of the organization and undermined report accuracy.

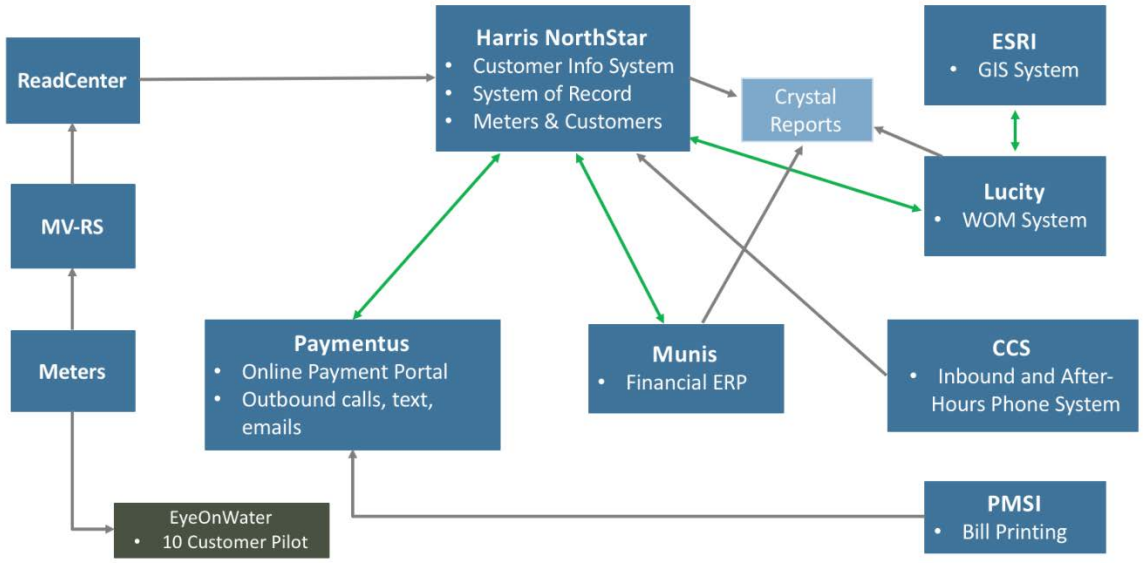


Figure 21. System Summary - Billing and Metering

NorthStar: The system of record for customer accounts is the CIS, which is Harris NorthStar. This is where customer account information, payment and consumption history, and account details and contact information are stored. Deployed in the early 2000's, it is mostly used by the Business Operations Department, which includes customer service and utility billing staff. Implemented over 15 years ago, a major limitation of this system is the accuracy of the data within it. Currently operating on version 6.4, the County is behind on updates. The lack of features and functionality has fostered a culture of using manual work arounds to accomplish daily operations. Based on feedback from key users, the main challenges with NorthStar are as follows:

- It is a legacy system with dated technology that is not user friendly
- The data entry and field limitations restrict functionality
- Screen navigation is not intuitive
- Data considered un-clean creating errors and inconsistencies in reporting and analysis
- Inability to run historical reports
- Limited interoperability due to expensive interface requirements
- Lack of customer portal or self-service capabilities

The 15 billing and customer service representatives that mainly use NorthStar are at the mercy of its limitations, which in turn hinders the service they are able to provide customers. Serving as the source for financial metrics and water use data, this is arguable the most important database UCPW has to keep accurate and up-to-date. One of the most profound pain points identified during interviews and onsite meetings with key users is the lack of confidence staff have in the system and the accuracy of the data. This further reduces the effectiveness of the already limited canned reports and makes the utilization of customized reports from Crystal Reports much more difficult. An example of the limitations of the reporting feature is that NorthStar can't run historical reports. Pulling a report to display old transactions or billing records is a common practice for issue resolution and customer service for billing representatives. It is recommended that the County consider pulling SQL server back-ups to retain and archive this data independent of the constraints within NorthStar.

The County recognizes the opportunity to adopt a more robust CIS and recently published a Request for Information (RFI) to test the market and receive input from interested vendors on the availability of other solutions that may better meet the organization's requirements. The various scenarios of Maintaining Status Quo, Leveraging AMI Systems, or Adopting a Different CIS are presented later in Section 5.4.

Munis: Tyler Technologies' software, Munis, serves as the County's financial software. Munis contains all the purchasing, sales, and finance data and interfaces with NorthStar. The daily flat file exchange between NorthStar and Munis keeps the systems in sync and updates the account balance and payments made on customer accounts. The specific version and interface requirements will need to be included in an RFP for validation of a vendor's experience aligning their MDMS with Munis.

Lucity: Lucity was recently purchased to be UCPW's work order management tool, automating what has traditionally been a very manual and paper-heavy process. The Planning and Resource Management Division was heavily involved in the implementation planning process, including conducting the business process mapping with the key users since the point of award. In July 2017, the Warehouse component of Lucity was launched, followed by Facility Maintenance and Inspections Departments adoption for work orders.

Currently, CSSs create a work order in NorthStar and print that. The Metering Supervisor then assigns these work orders to the Meter Technicians based on territories. The work is completed, and the Tech writes the information, like the current read and other relevant details, on the work order and turns that back into a CSS, who then types the information into the account and closes the work order. Automating the work order process between field and customer service staff will expedite the exchange of necessary information, should improve the efficiency of field staff in the distribution of work, in addition to locating and completing assigned work orders, and will allow CSSs insight into the status of a work order without having to call technicians or wait for them to turn in the paper work orders upon completion.

The Metering and Utility Billing/Customer Service work groups have not adopted Lucity yet, although the interface work necessary to automate the work flow for work orders is currently under development. An API proposed by NorthStar to import Lucity files is currently under review and pending approval, will then be tested and launched. This API will allow for service requests, customer requests to be opened and closed within NorthStar and Lucity. The close interface with ESRI is a major benefit of the Lucity system and will allow for location information to be provided on a work order (as available), which will help field technicians quickly navigate to an address.

In an AMI environment, Union County should include an interface with Lucity as a requirement of an MDMS. This will allow field technicians to export network and meter alarms to Lucity to be assigned as work orders and should update the CIS with account-specific changes like meter or radio change-out, disconnects, reconnects, etc. As the Lucity application is adopted, UCPW should ensure work order types are created and tracked following standards for entry, assignment, and resolution. These can then be tracked as Key Performance Indicators (KPIs) and serve as benchmarks for tracking and trending work load, system health, and staff efficiencies.

Crystal Reports: Crystal Reports is interfaced to pull data from Munis, NorthStar, and Lucity. The County should consider developing test scripts to validate reports. In addition, standardizing the report design (creating common headers, footers, logo, etc.), using database views and applying common filters and formula fields can create additional structure that would benefit users not as familiar with these features. Creating a data dictionary that has common or business critical reports, attributes, standards, and contacts will help promote standardization across business groups (although this should be done in conjunction with scrubbing the databases it pulls from to increase the effectiveness). Monitoring and measuring the impacts of these standards should be the responsibility of an AMI Systems and Technology Analyst, ideally that would be a new position within the Planning and Resource Management Department.

Paymentus: This is an online, browser-based payments application that allows UCPW's customers to create an account and pay their bill online. With an API to NorthStar, account balance and amount owed updates an account, so Customer Service and Billing staff can see which customers have paid online and create a list of customers eligible for a late fee or disconnect for non-payments after accounting for those online payments. PMSI, the County's bill print vendor, provides a PDF of customer bills to Paymentus to post within a user's account, which allows customers to see a copy of their current and past water bills within the Paymentus portal. Over 8,000 customers currently use the Paymentus portal to pay their water bill.

Upon applying for service, customers are given a packet of information that explains how to access Paymentus after they receive their first bill. The high adoption rate of the Paymentus portal, plus an increase in the use of online or automatic payments like automatic bank drafts, bodes well for future usage of a customer portal. A best practice that was recently launched by UCPW is that CSSs are now collecting a customer's email and phone number allowing the utility to leverage the ability to communicate through Paymentus and the outbound IVR system and will also facilitate the future deployment of a more robust customer portal. Increasing a customer's self-service options and allowing them increased insight into their consumption patterns and usage stands to improve customer satisfaction and the success of conservation initiatives.

In summary, applications should be easy to use and almost blend in to the tasks, enabling staff to accomplish their work rather than consider how their task needs to be translated to execute within a particular application. The lack of flexibility, interoperability, and ease-of-use are noted as limiting factors of NorthStar but seem to be an overall byproduct of piecemeal system adoption, evidenced through the disparate architecture. One way to alleviate some of the frustration is to improve the standards of the data being used and improving the channels whereby the data can move between systems. Actionable recommendations on how to treat information as an asset will require the adoption of governance and standards but will allow staff to have confidence that a term or status in one application is comparable with that designation in another system and drive efficiency and effectiveness.

2. Data Governance

Creating common terminology will allow for data to be used by more than the department that is responsible for creating or uploading it, increasing the effectiveness and diversifying the application and analysis potential. This terminology can be maintained in a data dictionary with a glossary of key terms; the Systems and Technology Administrator should oversee the routine maintenance of this document. After the key terms are established, creating a common set of standards for updating and accessing the data will help regulate information management and promote better usage, increase the accuracy, and promote sharing. Read-only access should be assigned to staff that would benefit from having the data but do not need to modify or edit the data; common information access guidelines will help staff know what data exists and how to retrieve it.

Information sharing implies a significant cultural shift that is necessary if UCPW wants to take full advantage of its future AMI system. The current lack of governance and disparate systems with legacy data will inhibit the adoption of data sharing and stifle analysis and interfacing efforts. The original source of information must be protected against unauthorized or accidental modifications, fraud, disaster/failures, or disclosure, and proper backup and recovery protocols should be established, with current data retention and archival procedures reviewed and updated as necessary. The exercise of establishing data governance measures is an undertaking with implications that are both technical and organizational. As UCPW continues to expand its data sources and inputs, and due to the fact that the data entry points are spread across the organization, the need to establish data governance measures is a necessary pursuit for the County at this level in maturity.

The following are several key elements MeterSYS recommends be considered when implementing data governance standards.

Data Quality: The impetus for implementing standards is to increase trust in that the database is accurate and that any reports and analytics utilizing this data will therefore be using accurate data

Integrated and Planned Systems Architecture: Data and systems silos follow organizational silos. When staff create work-arounds (e.g. emailing or texting instead of creating a work order), it further complicates efforts of standardization and breaks up the workflow. Standard protocols should be developed to drive data export/import/integration between systems so that business processes are seamless. For instance, a well-integrated system would allow customer service and operations to move a work order through the process of identifying a repair need, executing a request for the work, completing the work in the field, and updating the customer account with the relevant data, allowing authorized staff to view the status of the work order as it progresses towards completion.

Data Quality and Operational Optimization: UCPW rightly places a premium on system reliability, and this is supported by the allocation of meter technicians and readers to maintaining such a high read rate. With system reliability always recognized as being important, data reliability should now be the focus, which will further enhance and optimize system reliability, especially in an AMI environment. Data quality can be maintained through properly built and maintained integrations and interfaces, adequate management of standardization efforts, such as the data dictionary, to ensure individual elements and entry points can be melded with

Align Data and Analytics with Business Strategy: Aligning systems with operations creates efficiency benefits. For example, translating reports that are critical to utility operations and management and designating system alerts that should drive field activities or work orders will help make data actionable. Databases and key information should be identified as “mission critical” where that designation is accurate. If the utility wants to quantify the efficiency gains, we recommend using designated performance indicators to track and trend or identify outliers or anomalies. Identifying the value drivers for management will allow data to drive decision making and will allow for over-time trending and the adoption of targets and goals for operations, ensuring the utility maintains its culture of continual improvement.

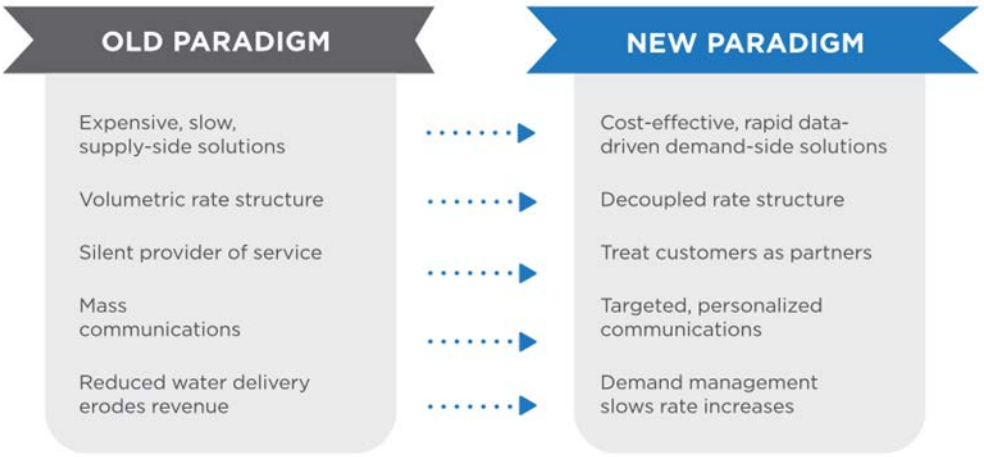
In addition to the above recommendations, the ability for UCPW to truly optimize a future AMI system is dependent on the creation of stable system architecture and underlying data consistency. The lack of system integrations and legacy data compartmentalized within and between departments has created redundancy, inconsistency, and inaccuracy. By focusing on data management through a formalized governance strategy, the County will be able to rely on the data and benefit from increase data-driven decision-making opportunities. Establishing standards for the availability and integrity of data will improve reporting, compliance, and operations in ways that were not previously possible.

3. Systems Governance and Oversight

The current governance of software and systems has recently become more concentrated within Public Works. While network and hardware support remain under the domain of County IT, the Planning and Resource Management Division, comprised of a systems analyst, GIS specialist, and AMI Systems and Technology Administrator, provides planning and software support specific to Public Works and reports to the Utilities Director. As Public Works continues to require more IT support to increasingly complex applications, it makes more sense to have the Planning and Resource Management Division support these, with continued facilitation by the County’s IT Department. The County IT Department maintains the network and domain responsibility, including backups, recovery, and basic help-

desk function. As the utility continues to adopt advanced technology, the role of the Planning and Resource Management Division will become increasingly involved and necessary. Open lines of communication should be maintained with County IT staff to ensure collaboration continues and that responsibilities and issue escalation protocol are clearly defined.

Figure 22. WaterSmart Paradigm Shift on Water-use Efficiency



As UCPW looks to identify IT opportunities to manage and in efforts to create a closer alignment of technology and utility management strategy, two key areas the Planning and Resource Management Division should consider establishing responsibility and oversight accountability for are integration and business process management systems and business intelligence and reporting systems. Serving as the conduit between Public Works' business needs and technical support for the systems they use and providing necessary system operations, maintenance, and support functions should be a function primarily assumed by the Planning and Resource Management Division. A key area where collaboration with County IT will be prudent is the exercise of considering migrating away from Harris NorthStar. The various scenarios available to UCPW are presented in the following section, with the perceived risks and benefits of each briefly outlined. The feasibility from a technical perspective, that is, the IT-level analysis of sunsetting NorthStar and rolling out a new CIS in terms of system requirements like server and hosting responsibility should be discussed between a steering or selection committee comprised of all stakeholders, to include Finance, IT, Planning and Resource Management, Utility Billing, Customer Service, and Public Works.

UCPW is right to recognize the trend of technology becoming a necessary component of all utility operations and management functions and to create the Planning and Resource Management Division to help. The next major change management element that will be required of UCPW is to remove the barriers to the data flow between and across systems. Now that the governance structure is in place to provide support, the effort of improving the data, specifically, cleaning up key databases, and improving the connectivity, allowing data to pass between or be pulled from specific applications, will provide dividends. Being able to glean accurate, point-in-time snapshots of a utility by sourcing data from CIS, WOM, and AMI will allow management to trend, benchmark, and model. The graphic above is from a white paper by WaterSmart, a customer portal provider, that depicts the impact data-driven-decision-making has had on water-use efficiency.

4. CIS Scenarios for Consideration

Maintain the Status Quo: If the County chooses to maintain the current CIS, NorthStar's inability to designate a premise ID will need to be addressed early on by MDMS vendors, as a standard AMI software field requirement is a constant, non-repeating unique ID for each service location (separate from an account ID, which can be shared by

multiple meters). The pros of maintaining the status quo include the lack of change and requisite change management that would accompany a wholesale shift to another platform and the comfort and familiarity that existing staff have with NorthStar. Also, the County is spending $35,000 to build a custom API between NorthStar and Lucity so migrating away to a new CIS would make this a sunk cost. The cons of this scenario center on the lack of change, although there are some changes that should be adopted immediately, such as:

- Retain historical data (copy back-ups or work with Harris to resolve inability to archive)
- Conduct training session with Harris on NorthStar to improve competency
- Implement data governance to promote standardization and clean-up database
- Facilitate sharing of responsibility and system support so IT Director is not the only technician able to provide troubleshooting and issue resolution help

Leverage AMI: This scenario would direct UCPW to delay a CIS change until after implementing an AMI system. By implementing AMI, the data requirements of the MDMS and Customer Portal can then help drive CIS requirements and value proposition. Additionally, a well-designed and implemented MDMS and Customer Portal would alleviate most of the pain points associated with NorthStar. For instance, a top-tier MDMS will offer robust reporting, allowing CSSs to see consumption history and trends, and at hourly read increments as opposed to once-per-month read intervals. MDMS offers multiple account designation fields where a CSS can assign groups based on rate (outside, inside), account type (residential, commercial, industrial), status (non-billable, vacant), or description of usage (irrigation) that can't be accommodated within NorthStar.

Customer-facing options are offered by AMI vendors and third-party companies. An industry leader, WaterSmart, has a pre-existing integration with Paymentus that the County could consider adopting in advance of an AMI deployment. This would allow WaterSmart to serve as a customer information platform in addition to having Paymentus embedded, giving customers the ability to create an account to receive updates on the meter replacement progress, see their usage, and pay their bill, even before the full functionality of AMI is realized, which would then include the ability to receive leak alerts and notifications among other information.

Adopt an Alternative CIS: The wheels are already in motion for this, as an RFI was issued in February 2018 to test the marketplace and initialize the search for a replacement for NorthStar. No easy undertaking, the decision to migrate to a new Utility Billing platform will require staff to operate in dual environments throughout the transition period. A risk to any new software is that the system is dependent on the quality of the underlying data ("garbage in, garbage out"). Without allocating resources to improve the standardization and "scrub" the database, the County stands to limit the benefits a new CIS would offer. If UCPW decides that NorthStar truly can no longer meet the business needs and needs to be replaced, MeterSYS would recommend the selection be delayed until after deployment of AMI so that the utility can see if the MDMS and Customer Portal resolve enough issues or that those requirements should be factored into the interface standards and help drive selection.

Section 6. Distribution Systems Infrastructure and Operations

The County has invested in both infrastructure planning and applications significantly through hydraulic modeling and SCADA systems design. The intersection of distribution operations and advanced metering networks is now a reality as utility operators and AMI manufacturers are seeking opportunities to increase the contributive value of capital investments and integrate data access and utilization through better systems coordination. As an element of feasibility analysis, MeterSYS reviewed both the most recent updates of the County's Black & Veatch Water Systems Update (2016) and the HDR Radio Path Study (2017) to find correlations between the UCPW capital strategy for

hydraulic planning and the supporting expansion of the County's SCADA infrastructure and a potential AMI network. Any possible correlations or operational synergies presents opportunities for greater data access and reduced network costs (both OpEx and CapEx) and increases significantly the investment leverage of all distribution monitoring systems. Surprisingly neither the B & V Water Systems Master Plan nor the HDR Radio Path Study considered metering technology within future designs for water distribution or SCADA systems. It is recommended UCPW require the technical specifications of AMI to be included in future planning initiatives related to water production, distribution and SCADA systems.

MeterSYS is working collaboratively with hydraulic engineering and AMI technical developers to broaden the opportunities for greater leverage of utility-controlled networks for access to a global view of operational data that thereby feeds systems planning, management, and automation. While still in early phases of development and deployment, UCPW must consider expandability of an AMI system for distribution data as an important technical requirement when considering selection of a specific metering solution.

1. Hydraulic Management

With continued growth of new connections on the UCPW water utility system, the County has taken great efforts to properly plan for proper and sustainable delivery of water to the approximately 50,000 connections. The Black & Veatch (B&V) Water System Planning Update (2016) considered resource demands, resource capacities, resource production, emergency plans, and capital investments for UCPW during a planning period of 15 years which, coincidentally, aligns with the typical useful life of most metering technologies. The innovation of metering data for two-way communications between the meter and the HES presents utility operators with access to field information like customer-side leak detection, tampering, reverse-flow, no-flow, battery health, and district metering areas along with recent additions to monitoring for pressure and temperature at the meter.

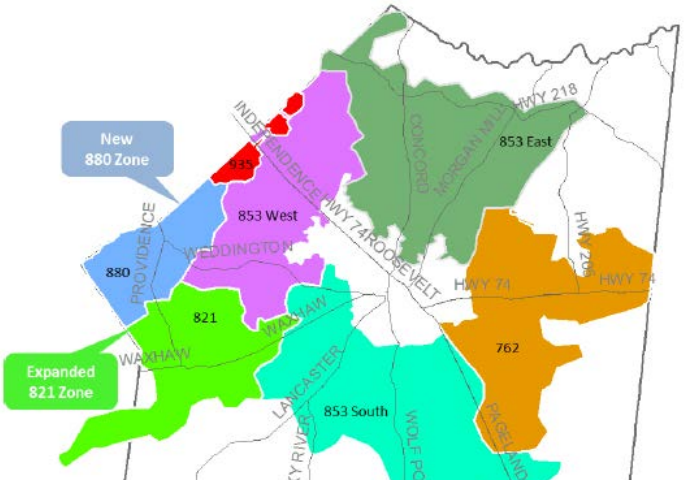


Figure 23. B&V Pressure Zone

According to B&V, UCPW has altered its pressure zones by expanding 821 Zone and adding new 880 Zone from construction of a Booster Pumping Station and Elevated Storage Tank within the 880 Zone. Important to managing future demand and required infrastructure, it is important for non-revenue water (NRW) to be properly calculated and understood at a sub-system (zone) level. Since the County does not have flow metering between pressure zones, the NRW calculations were applied across the system evenly based on their source of supply.

Recommendation: The County should consider, as part of its metering strategy, to add distribution flow metering and the use of District Metering Areas (DMAs) to improve its ability to determine more granular NRW percentages and its correlation to zones and infrastructure.

There is also operational interest in managing high and low pressures throughout the UCPW service area with a specific priority on low pressure areas understandably for regulatory compliance, public health protection, and quality of service to customers. Low Pressure Area 1 is recommended, according to the B&V report for evaluation of the 935 Pressure Zone boundary while Low Pressure Areas 2 and 3 will require significant capital investments for new loop distribution lines in these areas. Analysis from the B&V hydraulic monitoring identified two areas have a predicted pressure above the maximum performance criteria of 150 psi and high pressure areas are considered lower priority to that of low pressure areas by UCPW staff.

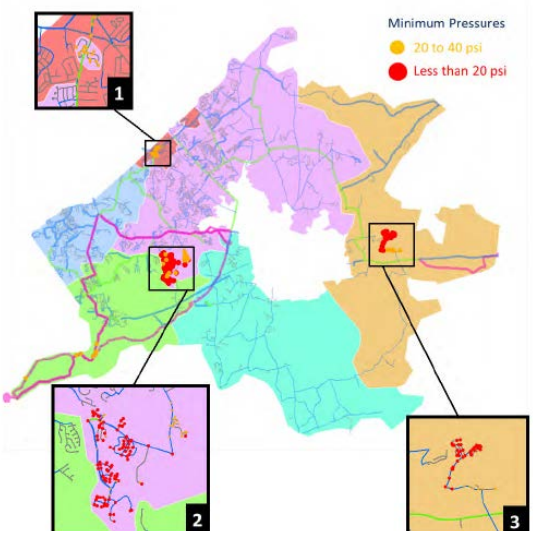


Figure 24. Low Pressure Zones- Source Black & Veatch Water Report

Recommendation: Capital investments for water distribution lines may be determined with a greater level of confidence through utilization of pressure monitoring at the point of delivery in addition to mainline pressure data to determine the areas of greatest concerns, the realized impacts of pressure fluctuations, and trending data to aid with prioritization of funding. Pressure monitoring at the service level along with tracking water temperature at the point of delivery provides critical data contributions for management of water and service quality. Lastly, AMI networks have the capability of applying sensors for upstream/downstream pressure, water quality (chlorine, pH, conductivity, temperature), pump status, liquid chemical levels and facility protection (door status) for low cost options to more traditional SCADA devices.

2. SCADA and AMI

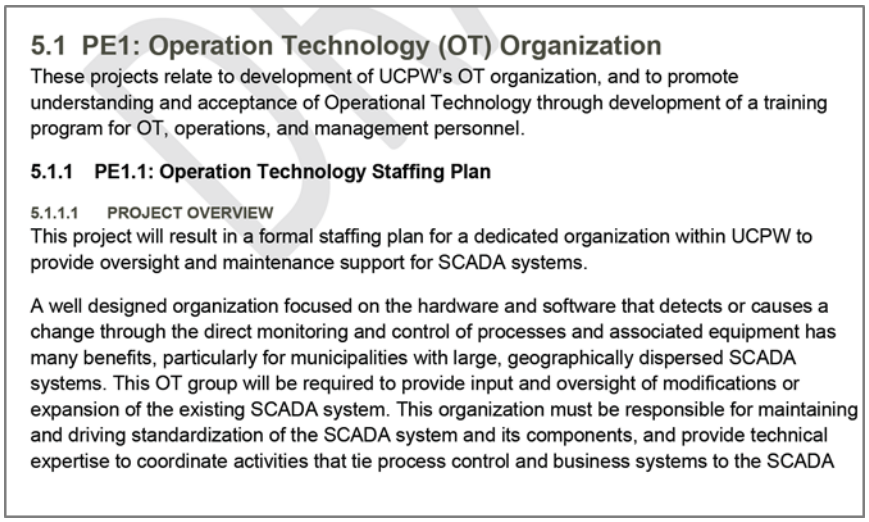
During the study of feasibility for metering, UCPW, in cooperation with HDR, completed the Radio Path Study in support of SCADA enhancements for water production and distribution and is the initial task required for completing design of telemetry system updates. Like AMI technologies, SCADA operates on a Radio Frequency (RF) network and the Radio Path Study establishes options for network frequencies and the assets associated with the SCADA design connected to either a County-owned and controlled network or utilization of existing cellular networking for data and process command transfers. Similar to most AMI network frequencies, the HDR study recommends that the preferred alternative to cellular networking would be through a County controlled 900MHz frequency band with utilization of repeaters to gain effective coverage across the expansive service territory

The HDR Radio Path Study also provides certain capital improvement recommendations as part of the master plan strategy for the County's SCADA system. The two largest projects are responsible for design and replacement of the existing RTUs at 75 sites. Smaller improvements projects provide for incorporating new monitoring points for flow metering, vibration/temperature, water quality, power and Catawba River WTP supply. Because of the close alignment between the SCADA Master Plan and functionalities associated with AMI networks, MeterSYS, UCPW, and HDR entered into discussions about the development of synergies between the two systems. While cooperation was identified, there is a clear desire by HDR engineers to maintain broad separation between AMI and the proposed SCADA initiatives on the basis of critical infrastructure. Specifically, HDR has issued a response to the planning concept of technology leveraging by stating:

"We are recommending physical segregation of the AMI and SCADA networks because shared communications (radios) would greatly increase the attack surface available to bad actors for entry into the SCADA system. AMI is business critical and far more tolerant of interruption than SCADA. By incorporating segmentation, we are able to create a manageable number of zones which prevent devices from communicating with each other if they do not need to communicate as is the case with AMI and SCADA systems and help mitigate interruptions to SCADA.

We understand that there may be opportunities to add pressure monitoring locations near AMI data collectors and share this information with operations (SCADA). In this case, we recommend pulling the AMI data from Meter Data Management (MDM) head end system (most likely a cloud service) and push that information down from the business network into the DMZ and integrate the data with the process control historian in this zone. This would allow users on the business and SCADA networks to benefit from combined data."

Recommendations: For the concept of leveraging infrastructure between similarly designed networks, it is understood that synergies would not include process controls and that SCADA must be protected from outside threats. Nonetheless, we believe there are specific actions that UCPW SCADA and AMI technicians may take cooperatively to expand distribution monitoring and data sharing in addition to the physical infrastructure that may be shared such as towers, electrical services, installation, and backhaul depending upon schedule of construction implementation between the AMI and SCADA projects. It is recognized that there are design challenges associated with linking the two systems, but there is a responsibility to collectively explore options for cost savings and reduction of functional duplication. Program elements of the HDR Report related to Operational Technology Organization, SCADA network improvements, distribution improvements, and system operational enhancements all have potential for cost-effective augmentation and expansion of sensors and monitoring through coordination with AMI planning.



5.1 PE1: Operation Technology (OT) Organization

These projects relate to development of UCPW's OT organization, and to promote understanding and acceptance of Operational Technology through development of a training program for OT, operations, and management personnel.

5.1.1 PE1.1: Operation Technology Staffing Plan

5.1.1.1 PROJECT OVERVIEW

This project will result in a formal staffing plan for a dedicated organization within UCPW to provide oversight and maintenance support for SCADA systems.

A well designed organization focused on the hardware and software that detects or causes a change through the direct monitoring and control of processes and associated equipment has many benefits, particularly for municipalities with large, geographically dispersed SCADA systems. This OT group will be required to provide input and oversight of modifications or expansion of the existing SCADA system. This organization must be responsible for maintaining and driving standardization of the SCADA system and its components, and provide technical expertise to coordinate activities that tie process control and business systems to the SCADA

Figure 25. HDR OT Organization Recommendation

Ideally, each pump station in the distribution system would be equipped with a flow meter which would allow flows to be measured, recorded, and utilized in the calculation of zone-specific demands and peaking factors for use in model calibration. The Union County pump stations, however, (with the exception of the Watkins BPS) are not currently equipped with flow meters that are tied into the SCADA system. In order to estimate pump station flows at the Waxhaw-Marvin BPS and New Stallings BPS for use in calibration, SCADA records reporting pump status and suction and discharge pressures were used in conjunction with the available pump curves to estimate flows during the calibration period. Because the combined 853 West / East Zone was the focus of this calibration and the 821 Zone was not active, suction pressures at the Watkins BPS and Waxhaw-Marvin BPS were modeled as varying hydraulic grade lines based on the SCADA data. (B&V Water Master Plan 2016 1.2.4 Pump Station Flows)

With the HDR recommendation under OT Organization, we believe there is an opportunity to capture the critical importance of data governance, systems standardization, and technical expertise to more global utility data and systems oversight. The continuance of AMI sensing and reporting for distribution operations requires planning initiatives to balance the importance of systems security with the responsibility of expanding data and data driven decisions that protect public health and safety in a dynamically-changing water utility environment.

UCPW should consider establishing the staffing recommendations of Section 9 of this report in the development of an Operation Technology Organization suggested by HDR that encompasses hydraulic modeling, SCADA design and operations, AMI operations, LIMS, Lucity WOMs, and GIS for proper management of systems, controls, and data.

Section 7. Future State Risk Mitigation for AMI Adoption

UCPW is taking appropriate risk management measures through conducting a feasibility study. This data-driven approach recognizes that first the business case must be made prior to the pursuit of funding or adoption and will prevent unnecessary risk due to rushed decision-making or lack of information. This measured approach is to be commended and should continue through implementation, using the same mitigation measures such as soliciting expertise; involving all stakeholder groups; establishing quality assurance and rigorous QA/QC checkpoints with strict "go/no-go" approvals; providing appropriate safeguards to secure sensitive customer and utility information; implementing detailed project control procedures; and adopting comprehensive project management and communications plans. The most high-profile risks that the County faces in moving forward with AMI are identified here, along with the recommended actions and strategies to minimize or avoid the chance of occurrence.

Procurement Phase Risk and Mitigation Recommendations:

Risk: Narrowly defined scope requirements limit competitive bid responses received

Mitigation Actions: RFP draft is product of continued refinement and input from vendors to reduce exclusionary language; when possible, consider alternative bid options; ensure proper advertisement of RFP

Risk: Network and meter compatibilities have unforeseen display issues/data inconsistencies in MDMS or other software applications

Mitigation Actions*:* Include language in RFP to have vendor disclose any limitations to compatibilities, including any data loss or corruption experienced; request references be provided for instances of similar compatibility for due diligence

Risk: Limited competitive bid responses received influence cost

Mitigation Actions: MeterSYS is familiar with itemized pricing across vendors and is experienced in negotiating the best cost solution for utilities

Risk: OpEx costs vary from model estimates or are more than anticipated

Mitigation Actions: Require vendors to certify propagation results, making network infrastructure variance costs their responsibility and protecting UCPW from unforeseen network cost increases

Risk: New collector site location requirements contingent upon external authorization outside of UCPW control

Mitigation Actions: Reduce number of new pole sets for collectors; work with UCPW to expedite site authorization as required

Risk: Aligning utility growth to procurement

Mitigation Actions: Ensure appropriate due diligence, especially large meter field audits, is conducted in advance of equipment ordering to improve accuracy of ordering; work with Planning Department to ensure any approved developments are factored into meter order; per-unit contract allows flexibility in ordering as needed and contingency funds should be inflated to accommodate high growth

Implementation Phase Risks and Mitigation Recommendations:

Risk: Funding is not properly aligned or authorized with capital spend estimates

Mitigation Actions: Include estimated spend schedule provided as a deliverable of the Feasibility Analysis; work with Finance to ensure appropriations follow modeled capital and operational project requirements

Risk: Network design fails to achieve modeled performance

Mitigation Actions: In contract documents, MeterSYS includes language requiring vendor warranties performance of network to achieve 98.5% read rate with any required costs due to infrastructure additions or deviations be covered by the vendor; the Alpha Phase/Pilot will test network reach to all edges of the service territory

Risk*:* Software vendor cooperation is limited; integration issues create project delays

Mitigation Actions*:* Creating a sub-team focused on Systems and comprised of key UCPW staff will ensure issues are identified and resolved accordingly; MeterSYS SME will facilitate all software integrations, managing each as its own program of work with milestones, testing, and UCPW approval/acceptance to maintain appropriate timelines and accountabilities

Risk: UCPW experiences significant shifts in organizational priority, resulting in challenges to balance utility responsibilities and implementation requirements

Mitigation Actions: Having MeterSYS as a trusted advisor to serve as Project Manager will provide continuity and allow for measured use of UCPW staff and resources to manage the project; adopting a long-term project plan and ensuring appropriate funding allocation will provide confidence and will protect against any future unplanned redirections

Risk: Vendor supply chain disruptions create unexpected and extended equipment lead times

Mitigation Actions: A well-designed project plan will accommodate expected lead times; working closely with the distributor and manufacturer will ensure any impacts to production or fulfillment are quickly identified and accommodated

Risk: Political or customer interference threaten the project

Mitigation Actions: Stakeholder engagement and customer communication are key elements of implementation; identifying potential risks and roadblocks will be a critical exercise for the project team to undertake at the beginning of implementation

Deployment Phase Risks and Mitigation Strategies:

Risk: Network crash or collector failure

Mitigation Actions: Ensuring the network is designed with redundancy in mind offers built-in backup in case of system or network device failure; a network maintenance contract with the distributor of choice will provide extra support and service to rely on

Risk: Business case assumptions are misaligned or proven inaccurate

Mitigation Actions: MeterSYS has taken every effort to ensure the data used as inputs were accurate and confirmed all inputs and assumptions with utility staff. The model used conservative estimates, but it is a predictive model based on estimates and assumptions, and therefore should be used as a guideline. The Return on Investment (ROI) as predicted by the model, is dependent on the County implementing some policy and procedure changes post AMI deployment; not adopting the recommendations as presented in this report may cause the County to not reach the ROI as proposed.

Risk: Cybersecurity threat or breach; data loss or corruption

Mitigation Actions: Properly designing network security (firewalls), and creating disaster recovery/backup plan and procedures, and ensure monitoring, oversight, and testing measures are in place are critical to addressing this area of risk. Currently, all top-tier vendors provide the necessary encryption of data at the endpoint and collector, and the MDMS has built-in access restriction and permission settings that can be assigned and customized by the utility. As for cybersecurity breaches or threats, water data is low-value target, but precautionary measures should be taken to secure data regardless

Risk: The software integration created or perpetuated errors in the database

Mitigation Actions*:* This is an area of the AMI project that is consistently the most painful part of the process, because it effects billing, is dependent on the involvement of multiple third-party vendors, and because it is very technical in nature. By starting the billing integration immediately after kick-off, assigning a sub-team of key staff and vendors to focus on this project with weekly communication and checkpoints, and by creating and following an integration plan with all interface standards clearly defined and described, much of the headaches of this process can be removed or controlled. Having standards for the file interfaces and established testing and approval timelines and procedures adopted from the beginning of this process helps assign accountability and predictability to the integration.

Risk: The project experiences significant public pushback

Mitigation Actions: "Advanced meters" have received some pushback from people who deem RF exposure to be hazardous, despite numerous studies denying that claim and the high regulatory and compliance standards required by the US Government. Additional concerns around privacy have been raised by people claiming the precision of the meters allows for an unnecessary insight into a person's water use or incorrectly believes that personally identifying information is included in the meter transmissions (it is not). The best way to prevent public pushback of AMI is to follow the Communications Plan, as created by the UCPW and MeterSYS project team, which addresses both internal (staff) and external (customers and public) components. The RF health and privacy concerns should be addressed and supported with facts clearly conveyed and sources sited.

Post Deployment Environment Risks and Mitigation Strategies:

Risk: UCPW experiences excessive or premature meter failure

Mitigation Actions: Battery life depends on transmission duration, power, and frequency (e.g., once per hour), as well as environmental conditions, such as fluctuations in temperature. Some early AMI installations, now more than ten years old, are still performing satisfactorily, such as Cary, North Carolina. A utility's greatest protection from obsolescence is to consider future needs in its design specifications, to insist on extended support from prospective vendors, and to create a reserve fund for planned replacement costs.

Risk: System maintenance and troubleshooting protocols are not applied

Mitigation Actions: Creating an AMI system maintenance plan and assigning components and routine activities to specific staff as part of their core job duties, along with routinely monitoring and tracking KPIs for system performance and goal achievement will ensure UCPW provides the appropriate level of upkeep and oversight to fully leverage and maintain the AMI system once deployed

Risk: Training on the AMI system is point-in-time and after a few years, new staff are unfamiliar; use of system is concentrated to a few key staff

Mitigation Actions: Establishing an ongoing training program, both for field staff and back office applications, is necessary for proper knowledge retention and transfer. Creating job aid instructional guides at the point of initial training will allow for improved task and system use support; "how-to" guides

Risk: UCPW service territory experiences such high growth, soon after installation is complete, new infrastructure is needed to support additional developments

Mitigation Actions: Because Union County is such a high-growth community, MeterSYS will work with the project team and the vendor of choice to establish an appropriate growth plan to accommodate pending developments; propagation studies can be used to identify additional network infrastructure needs to plan for growth

Risk: Customer facing policies and/or rates are not changed to accommodate or leverage AMI system

Mitigation Actions: The Feasibility Analysis highlighted some key procedural and policy changes that are recommended to allow UCPW to fully realize the benefits of the AMI technology and to share those service gains with customers through leak notifications. After the AMI vendor is selected and implementation is under way, the County should consider aligning specifications to the new equipment, along with the itemized equipment replacement costs for tamper and damage deterrence.

Risk: Lack of confidence in data from reports or database remains (or is created)

Mitigation Actions: Ongoing efforts to cleanup and standardize the CIS database are necessary to maintain, as the mass meter replacement will provide UCPW with basically a "clean slate" of data. Establishing the necessary governance, accountability, and oversight to maintain the database and to oversee the ongoing upkeep are critical to system operations.

The MeterSYS Project Manager will be well-versed in common project pitfalls and will help the County project team navigate around these issues and to avoid them when possible and mitigate them when they happen. While all of these risks mentioned above may seem alarming, the County will have the benefit of strong warranty language and standards written into the Request for Proposals, and MeterSYS will support unequivocal performance and quality demands with appropriate recompense measures to protect the County from worst-case scenarios.

MeterSYS recommends that the County pursue risk reduction measures that are cost- effective in comparison to the risk factors themselves, and the recommended procurement and installation project plan contains preventative measures and checkpoints, such as the Proof of Concept for Phase A installation, which directs the installation of a sub-set of meters to test signal strength and finalize the billing integration, prior to full scale replacement. This approach ensures the distributor, installer, and manufacturer are all parties to sharing the risk of the installation and integration, the components with the highest risk factors, which reduces the burden on the County and ensures the appropriate levels of performance are achieved before the project advances.

Section 8. Organizational Transition to Advanced Metering

Throughout the evaluation phase of this project, it has been apparent that customer service and continued improvement influence almost every aspect of utility operation for the County. It was the goal of the MeterSYS team to help design the future organizational structure that would best accommodate upward mobility and cross-departmental collaboration between Metering Services and Billing/Customer Service. The recommended organizational changes are aligned with the utility's interest in ensuring employee institutional knowledge is retained, continual learning and improvement are encouraged, and performance metrics are measured and managed against goals.

The current utility organizational structure has been evolving to meet the demands of a changing environment and to exceed customer expectation. However, the efficiencies of the organization are challenged by limited support or automation from technology and continual strain of resources. To capture a baseline for future comparison of the transitional change management process, MeterSYS conducted a deep analysis of the Metering Services and Billing/Customer Service to quantify resource allocations by key business process to compare against estimated resource and time allocations that will be required in a future AMI environment. The following section represents the key organizational changes and recommendations, including new staffing positions that are necessary to successfully operate in a post-AMI environment. Because these new positions would be much more technical in nature, the reassignment would require a planned training schedule in coordination to attain the necessary skills for proper maintenance of the AMI system, and strategic implementation of the organizational changes in coordination with the deployment phase of this project.

1. Metering Services Operation

Since meter reading will be the process most affected by AMI, it will require a redesign of the roles and responsibilities of the County's Meter Technicians. Currently, the County has staff dedicated to reading meters and other manual-heavy processes that will become automated in the future state AMI environment. However, automating these roles does not mean that these positions will not be needed, but that staff's internal knowledge of the system can be enhanced with the capabilities of AMI to offer more proactive activities, empowering them to operate as "true technicians." These activities should include proactively identifying and resolving leak issues, enhanced distribution system planning, enhancing customer responsiveness, and using system alerts and alarms to conduct proactive system maintenance. These changes would not be expected to occur until the County is past the deployment phase and fully operational.

By deploying AMI, the County should consider eliminating the part-time Meter Technician position plus 2 full-time Meter Technicians, as well as reconsider planning for the 2 additional full-time Meter Technicians (one position to support service work orders and the second position to support the meter testing program) in next year's fiscal budget. According to the Water and Wastewater's FY2019 requests for staff funding, the total avoided costs of adding on the new Meter Technicians is $124,827. Currently, the County's metering staff are cross-trained and knowledgeable of the read design and service work processes that are assigned to them daily. Since the 7 remaining Meter Technicians have valuable knowledge of the system, their experience should be retained and applied post-AMI deployment. MeterSYS recommends that the County reclassify three Meter Technicians as AMI Systems Maintenance Technicians and redirect their current responsibilities of meter reading and rereading to maintenance support

functions. Regarding the 4 remaining Meter Technicians, MeterSYS recommends that the County reclassify their positions as AMI Technicians to support proactive maintenance of meter assets and customer requested work orders.

Maintaining the integrity of the AMI system and metering assets is critical; therefore, MeterSYS recommends that the County redirect a portion of the cost-savings achieved by eliminating the 2.5 Meter Technicians at $125,528 to support a new position called AMI Systems Quality and Compliance Technician. Operating in an AMI environment allows for a significant volume of data for trending and analysis and will require someone to properly manage the data. It would be in the best interest of the County to redirect a portion of the staff cost-savings to support an AMI Systems and Technology position.

AMI System Maintenance Technician Role (3 FTEs): The main responsibility of the future AMI System Maintenance Technicians will be to maintain the entire AMI system by troubleshooting for communication or equipment failures. This includes manually reading meters in case the network is compromised for whatever reason. The technicians will have a general understanding of the AMI system to commission meter nodes, as well as be familiar with the MDM software as it relates to system alerts and alarms for field investigation. This group will perform some investigative functions relative to meter tampering and theft. AMI system alerts and alarms such as meter theft/tampering, leaks, and end of battery life immediately notify the utility of issues and to deploy field staff for issue resolution as is necessary.

AMI Technician Role (4 FTEs): The future technicians will support proactive system maintenance in the field to extend the useful life of the AMI system and metering equipment through improved asset management. This group will provide field support for the AMI System Quality and Compliance technician, regarding valve testing/exercising and meter testing/inspection. This role will change out meters for testing and repair due to any damage, as well as perform valve repair/replacement. Other key functions include new meter installs due to the increasing growth in new development and performing some leak root cause analysis and resolution for leak monitoring and control. Lastly, these technicians will be responsible for completing service work orders as assigned by customer service and billing staff.

AMI System and Technology Analyst Role: This person will possess the experience and skills to effectively analyze various data sets in near real-time, to mitigate potential problems, such as leaks, and perform much needed daily system health and maintenance for the County. Deploying this role will bring a level of objective assessment that is required of a robust AMI system and to manage a significant amount of data from varying software applications in order to make data-driven decisions where they can offer the greatest impact. The analyst can fill this resource void by applying the proper skills to maintain, track, organize and monitor the data for quality, as well as analyzing it to establish subsequent action. Additional responsibilities expected of this position will be system reporting and maintenance for performance purposes, identifying data patterns and investigating for anomalies, issue resolution analysis and issue ticket creation as necessary.[1]

The analyst will manage application configurations, as well as collect data between multiple software applications within the AMI system network. This is important because aside from managing the MDMS, this person will also be working in the AMI communication network where incoming metered data is received and transmitted to the MDMS. A core function of this position will be to establish standards for data consistency, standardize firmware for radios, and develop Standard Operating Procedures for ongoing maintenance and issue resolution of the meter data.

[1] https://www.governmentjobs.com/jobs/1317008/ami-senior-analyst-ooc-sr-management-systems-analyst/agency/seattle/apply

AMI System Quality and Compliance Technician Role: The majority of staff time and attention is spent on the substantial workload related to customer service generated work orders and meter replacement/repair of aged infrastructure. As a result, limited time is available to perform critical system and performance maintenance activities. By automating meter reading and leveraging enhanced AMI functionalities, the utility has the capacity now to support proactive system maintenance. A goal of the utility is to develop a more formal meter testing program as compared to the current condition of testing only upon customer request or to check meters for errors as they are found in the field. This person will allow the utility to perform in-house testing of a subset of residential meters and new meter installs. Testing results will allow the utility to make informed decisions and responsibly plan for meter replacement and maintenance. This will require the technician to have a general understanding of the methods and materials used in testing, calibrating, programming, and maintenance of meters.[2] Large meters would also be tested for optimal performance and this would be done at least every 3 years, adhering to AWWA standards.

Another goal of the utility is to better manage backflow which can be supported by this position. In support of developing a backflow prevention program, staff are currently identifying locations throughout the system with backflow by stamping work orders. This person will monitor pressure data produced by distribution pressure sensors to identify backflow events. Early detection of backflow events is critical to identify distribution line breaks, as well as limit customer concern over potential contamination of drinking water[3]. Other responsibilities include fire service inspection and meter box maintenance and change out as is necessary.

2. Billing and Customer Services Operations

Customer service and billing functions involve CSSs spending the majority of their time on customer support calls and issue resolution, billing exception functions that include reviewing customer account notes and read audit reports for rereads, work order creation, and following up on work orders for progress and completion in the CIS system. With AMI and the ability to print reports by exception in a single file, the utility should see immediate relief of CSS time spent manually reviewing reports to create reread lists and the issuing of service work orders in less time than it took before. We anticipate that the 2.5 CSS positions no longer being necessary after deploying AMI. Currently, the 1 FTE CSS spends the majority of the time supporting customer calls and service work orders. This person spends 50% of the time establishing customer accounts and facilitating new service, along with the part-time position who spends 75% of the time on the same functions. Through Lucity, this work process will be automated and streamlined and should reduce the time and resource dedicated to this current manual process. The CSSs are now equipped with robust customer service features and ample consumption data to be more proactive in customer support and manage customer support calls more efficiently.

The resource benefits in time and effort by eliminating the 2.5 CSSs should be redirected to creating a new Customer Service Communication/Conservation Specialist position. The current informal communication process between metering and billing should benefit from someone who can create standard operating procedures to streamline work processes and improve internal communications. Currently, communication with customers are dispersed across customer service staff, who are multitasking between customer support and email correspondence/inquiries.

Communications and Conservation Specialist: We anticipate that the Communications and Conservation Specialist should be able to support the majority of customer email and phone correspondence, and through consumption data and reporting and customer education to self-service. Centralizing communications under a single person should

[2] http://www.wcremc.com/userfiles/file/Meter%20Technician.pdf
[3] http://www.abpa.org/page/BackflowPrevention

streamline the current informal process and provide the capacity to develop standard operating procedures and templates to support and improve customer service correspondence and engagement. This person should be the key administrator to the customer portal to ensure that internal and customer facing dashboards are properly designed for customers to self-serve. In working with Media and Public Relations, this person should create customer/public campaigns and educational support materials and manage social media and press releases. By dedicating more time to customer service engagement efforts and leveraging a customer portal, this person should develop and execute conservation management programs to promote resource conservation and customer engagement initiatives. Lastly, this person will fill the resource void in developing and managing performance targets related to portal sign-up, email open rate, and webpage clicks.

Throughout the evaluation phase of this project, the organizational focus on customer service and continued improvement within operations influenced almost every aspect of utility operations for the County. In addition to optimizing the organizational structure, ensuring upward mobility and cross-departmental collaboration are encouraged between Metering Services and Billing/Customer Service. The recommended organizational changes that are presented in this section are aligned with the utility's interest in ensuring employee institutional knowledge is retained, continual learning and improvement are encouraged, and performance metrics are measured and managed against goals.

3. Utility Operational Performance Initiatives

KPIs should tell a story of the success of goal achievement and identify areas for improvement. By trending over time, management can determine the effects of policy and procedural changes have on operations. For instance, tracking customer service complaints can identify high-priority areas to improve the transactional experience of customers. KPIs should be used to establish performance standards and track the effectiveness of initiatives such as NRWL reductions and the achievement of conservation goals. While the below KPIs are based on best practice use cases, UCPW is encouraged to adopt measures that align with business operations. In the interim, UCPW should consider exploring existing data sets to understand the potential to establish baseline data to serve as a comparison post AMI deployment.

Business Process	**Description**	**Future KPIs**
Meter Reads	Interval read data; generate read file weekly from MDMS	▪ 98.5% read rate achieved ▪ SNR level >40 ▪ Number of stale meters
Service Orders - Re-reads	Field revisits to verify reads - utility issued	▪ Investigate stale meters ▪ Investigate alerts/alarms
Service Orders - Disconnect/Reconnect Service	Disconnection and reconnection for non-payment	▪ Frequent flyer list (RDM potential)
Service Order - Reconnect Site Revisit	Site revisit for reconnection of service due to water flow without customer on premise	▪ Number of repeat site visits for reconnection

Business Process	Description	Future KPIs
Service Orders - Customer Complaints	Customer requested rereads, meter checks, high-bill complaints, etc.	▪ Customer complaints by category
Verify No Service	Site visit to verify zero flow for vacant properties	▪ Investigate zero usage ▪ Soft disconnect ▪ Inactive list maintenance
Troubleshooting and Repair/Replacement	Meter repair and replacement	▪ Battery failure ▪ Failed communication ▪ Stopped meter
Service Orders - Other	Miscellaneous service orders	▪ Utility initiatives ▪ Ongoing maintenance ▪ Field audits
Customer Service Account Management- Setup and Maintenance	Verifying new service availability, validating proper receipt of forms and payment from customer, setting up account in CIS	▪ New accounts created ▪ Use of online forms ▪ Use of self-service features ▪ Customer portal sign-up rates
Customer Service Billing Exception	Review of initial read data for high/low parameters and field re-checks	▪ Pre-bill high consumption calls ▪ Number and amount of bill adjustments granted
Customer Service Billing and Presentment	Preparing final read data within utility billing module; transferring read file for printing	▪ 98.5% read rate maintained ▪ Number of field visits for bill creation
Customer Service Payment Processing/Collections	Receiving and processing payments through various channels including bank draft, lock box, mail, counter, and web payments (including shared Tax resource)	▪ Payment by channel type ▪ Customer portal use rates ▪ Online bill pay use rates
Customer Service Work Order Management	Creating, issuing, and closing out work orders within CIS and Lucity	▪ WO by type ▪ % WO closed within 48 hours
Customer Service Account Delinquency Management	Management of accounts within 30, 60, 90, 90+ delinquency including internal collections, debt setoff, and 3rd party collections (including shared Tax resource)	▪ Collection success rates ▪ Total accounts in 30, 60, 90, 90+ delinquency
Theft and Meter Tampering	Response to damage of meters and ERTs due to customer tampering or removal	▪ Tamper/theft instances ▪ Tamper fees charged/collected

Business Process	Description	Future KPIs
Asset Management Activities	Meter location, stock management, and tracking	▪ % meters geo-located ▪ # of meters by size in inventory
Water Loss and Conservation	Account and field activities supporting leak management, conservation programs, etc.	▪ Conservation goal achievement ▪ Irrigation usage trends

Table 22. Future Utility Key Business Processes KPIs

Marking progress and understanding where success is occurring and why while confronting shortcomings in the transition after deployment offer the opportunity for lasting change. County critical thinking as the future state takes hold may adjust these KPIs or add more and that is natural in a system growing into itself that will, ultimately, better serve the utility and its customers.

4. Communications Strategy (Internal and External)

MeterSYS and UCPW collaborated on developing an effective and robust communication plan for utility staff and the general population being served by UCPW. The communication plan serves to keep the utility customers informed throughout the metering project, the utility itself updated on performance and progress, and formalize the channels of communication internally amongst project team members. Goal setting was critical early on during communications planning and is important to provide strategic direction into the development of key communication initiatives and assessment of the varying levels of risk as it relates to the goals. The communications project team established the following County communications goals and it is summarized here:

- Educate our staff on the functionalities of AMR and AMI including the benefits analysis findings and metering program change plans
- Educate our customers on the benefits of metering technology investment supporting operations, finance, and enhance customer service
- Educate customers on costs associated with converting UCPW infrastructure to advanced metering
- Educate customers on the importance of utilizing the UCPW customer portal

A key to keeping the plan effective is identifying effective “champions” for the project that will be touchstones for the project management team and work to better communicate and engage with utility customers. Champions and the new Communications and Conservation Specialist position can introduce and implement the strategies of the customer communication plan. The communications project team can leverage various mediums with the intent to reach every type of customer by their preferred communications channel. Some of these mediums are:

- Employee networks and County intranet channels
- Monthly water bill inserts
- UCPW Twitter posts and NextDoor alerts
- GovDelivery emails

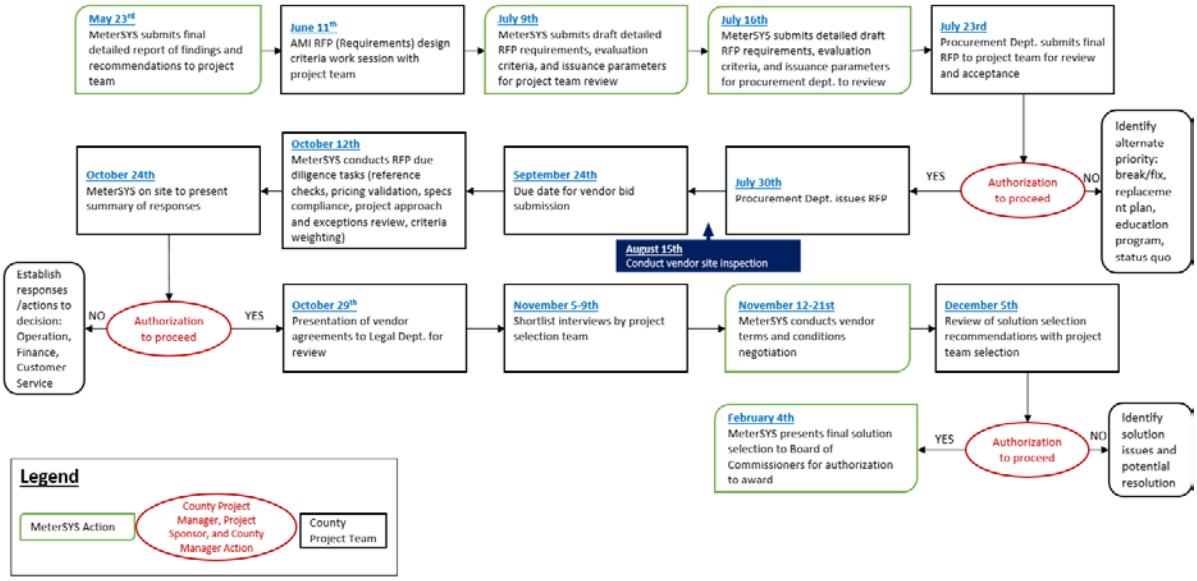
The communication plan brings value to all parties involved, particularly, to the County by focusing thoughts in the creation of the County communication plan to be shaped by the needs and concerns of its constituents and typical areas of concern in communication plans being noted. Additionally, the focus on educating staff on the functionalities

of the AMI system allows for not only training on system capabilities, but effective delivery of the AMI benefits for customers and UCPW as stewards of water conservation, as well as successful deployment of the AMI system to serve the utility and its customers.

Section 9. Solution Selection and Implementation Planning

1. Metering Technology Procurement

AMI specifications are connected to the dynamic technology environment and the utilization of data within utility metering and billing operations. By establishing multiple "off-ramps" during the evaluation phase, UCPW will have the ability to validate planning estimates and benefits against the industry's response before any capital commitments are required. At the point of proposal assessment, the County will have multiple "go/no go" opportunities as outlined in the Decision Action Diagram including controls ahead of the RFP issuance, in advance of issuing the responses and recommendations to County leadership staff, and at the elected official level before or after legal review of processes and contracts. By creating a roadmap for procurement as part of the feasibility analysis, the County will have direct market feedback to consultant estimates (cost validation), detailed specifications for infrastructure and technology (design validation), and broad understanding and support of the technology (user acceptance).



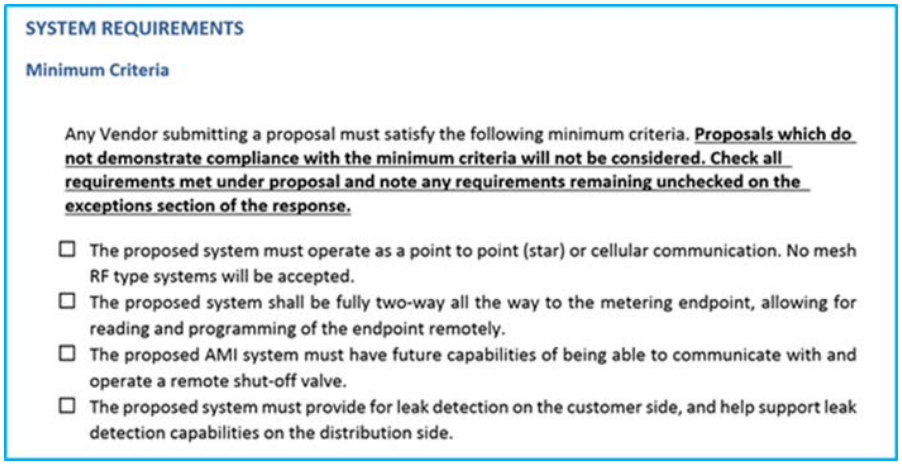
As either a matter of expanded feasibility analysis through market-based pricing or as manner of solution selection based on accepted feasibility and recommendations, the development of specific requirements for metering technology is an appropriate step in the evaluation and implementation process. A component of feasibility analysis included a discovery session with the County Procurement Office to review the process for advanced metering selection, confirm compliance with North Carolina General Statutes, and confirm the duration of the project against continual or renewable contracts. The Procurement Office confirmed utilization of the "best value" provisions of N.C.G.S. 143-135.9 as it relates predominantly to technology, acceptance of a four-year term for contracts as initial project implementation, and the potential to have a longer term contract (above the initial 4 years) which would address the long term metering costs along with any software maintenance costs and other ancillary annual

expenses. The County would have to develop a model or utilize consumer price indexing (CPI) for protections on a multi-year pricing structure.

Creation of detailed specifications based on UCPW metering and billing requirements will involve:

RFP Development: Effective advanced metering is the result of detailed requirements determination specific to the operational and financial requirements of the County. Requirements define the unique functionalities of meter equipment, AMI networking, meter data management, and detailed customer data access applied to utility goals. The actions of this step articulate County utility objectives for:

- Professional Services (Software and Systems Integration, RF Analysis, Site Access, Legal)
- Hardware (Water Meters, Radio Endpoints, AMI Network, Remote Disconnect, Leak Sensor, IoT)
- Labor (Network and Meter Installation, Large Meter Services)
- Software (Licensing, Servers, Storage, etc.)
- Annual Maintenance and Support



SYSTEM REQUIREMENTS

Minimum Criteria

Any Vendor submitting a proposal must satisfy the following minimum criteria. **Proposals which do not demonstrate compliance with the minimum criteria will not be considered. Check all requirements met under proposal and note any requirements remaining unchecked on the exceptions section of the response.**

- ☐ The proposed system must operate as a point to point (star) or cellular communication. No mesh RF type systems will be accepted.
- ☐ The proposed system shall be fully two-way all the way to the metering endpoint, allowing for reading and programming of the endpoint remotely.
- ☐ The proposed AMI system must have future capabilities of being able to communicate with and operate a remote shut-off valve.
- ☐ The proposed system must provide for leak detection on the customer side, and help support leak detection capabilities on the distribution side.

The main components to develop UCPW-specific requirements include the following:

- Business operations
- Systems and applications (software)
- Meter specifications
- Systems integration planning
- Installation and quality controls
- Meter Data Management functions and customer portal access

Task Descriptions:

Requirements Determination (Business Process, Operational Goals, Data Management, System Technology Needs)	Identification of key advanced metering/infrastructure requirements critical to meeting long-term operational goals of the utility. Integration opportunities with UB and WOM.
RFP Development and Authorization for Issuance	Building detailed specifications in cooperation with the County Procurement Office that represent the County's requirements for operations, performance quality, meter data management, training, implementation and service support.
Proposal Solicitation, Specifications Q&A Process, Compliance Oversight	In cooperation with the County Procurement Office, actively recruit qualified vendors responsive to requirements and bid specifications authorized by the County. Respond to bid inquiries and requests for clarification. Ensure bid process is successfully executed compliant with statutes and local purchasing requirements.

Response Evaluation, Scoring, Shortlist, Vendor/Design Due Diligence, Selection	Vendor Q&A, Evaluate RFPs, Cost Normalizing, Short List Interviews, Reference Checks

Table 23. Procurement Task Descriptions

The Vendor selection and due diligence process will include contacting vendor references, confirming compliance with all requirements, and validating information as presented in the vendor bid documents. Presenting summary documents with the results of these investigation efforts will allow for quick review of the

On June 11, 2018, the MeterSYS team will be onsite with the County project team to map out the requirements for procurement in support of:

- Refinement of contract stipulations consistent with County requirements and requests
- Development of requirements for software functionality and integration points
- Management of vendor communications and outreach
- Facilitation of site visits, vendor presentations, and other ancillary evaluation activities as directed by the County
- Development of grading matrix and evaluation procedures
- Negotiated cost and contract terms with selected vendor

As a component of the process, we will provide all coordination and support of requirements determination, RFP documentation, solicitation support services, as well as the review, shortlist processing, selection, and contracting with the preferred solution vendor. Our team will be coordinating with members of the Selection Committee.

	Task Name	Start	Finish
0	**UCPW Advanced Metering Vendor Bid Plan**	**Mon 1/7/19**	**Mon 7/29/19**
1	Develop preliminary planning requirements for metrology, network, installation, software	Mon 1/7/19	Fri 1/18/19
2	Conduct procurement specifications session with Project Team and refined based on input	Mon 1/21/19	Fri 1/25/19
3	Submit and receive feedback from Project Team on draft requirements	Mon 1/28/19	Fri 2/8/19
4	Submit accepted requirements to County Procurement for drafting	Mon 2/11/19	Fri 2/22/19
5	County Procurement submits final draft of Metering RFP to Project Team for review	Mon 2/25/19	Fri 3/1/19
6	County Procurement issues RFP for vendor response	Mon 3/4/19	Wed 3/6/19
7	Due Date for RFP vendor response	Thu 4/11/19	Fri 4/12/19
8	RFP tabulation, due dilligence, and analysis	Thu 4/11/19	Fri 4/26/19
9	Presentation of response summary and recommendations	Mon 4/29/19	Fri 5/3/19
10	Authorization to Proceed with Legal review	Mon 4/29/19	Fri 5/3/19
11	Shortlist vendor interviews with Project Team	Mon 5/6/19	Fri 5/17/19
12	Preferred vendor Terms and Conditions negotiation	Mon 5/20/19	Fri 6/7/19
13	Report to Project Team of final solution selection, terms, and final contract review	Wed 6/12/19	Fri 6/28/19
14	Authorization to Proceed with Board of Commissioners presentation	Mon 7/1/19	Fri 7/19/19
15	Present final solution selection to Board of Commissioners	Mon 7/15/19	Mon 7/29/19

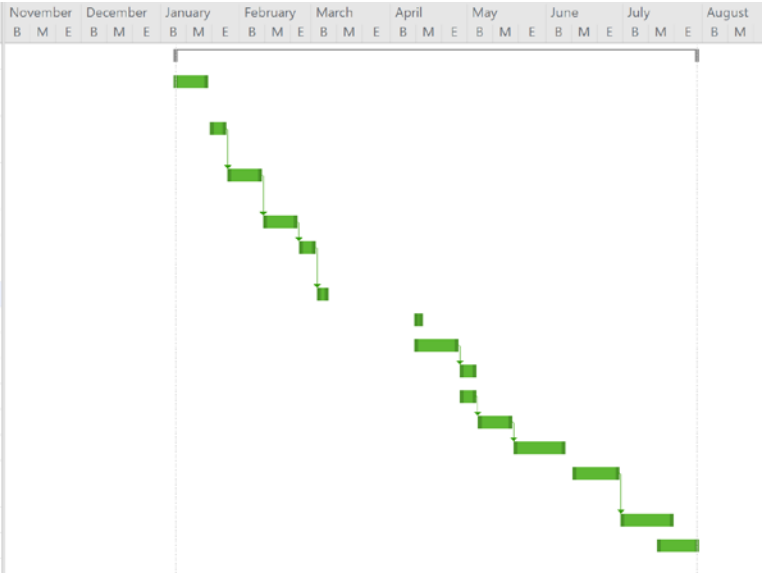


Figure 30. UCPW Sample AMI Procurement Project Plan

2. UCPW Advanced Metering Implementation Planning

While consistent in the basics of design and delivery, advanced metering technologies vary significantly when considering its deployment and integration into the existing business processes of the utility. Therefore, the solution process is a critical point in the development of detailed and technology specific implementation tasks based on how the infrastructure functions related to Union County network design, software implementation, and meter

integration. For purposes of considering the business case for AMI, the following table details the key action items that are aligned to the milestones of AMI implementation planning based on standard assumptions that generally apply to all potential solutions.

UCPW Initial Implementation Project Plan Sample		
Task Name	Start	Finish
	Mon 7/15/19	**Fri 10/30/21**
Project Initiation	**Mon 7/15/19**	**Fri 9/20/19**
Purchase Order Received	Thu 7/25/19	Tue 7/30/19
Project Tasks and Scheduling Refinement	Mon 7/29/19	Fri 8/2/19
Project Charter Completed	Mon 8/5/19	Fri 8/9/19
Kickoff Meeting	Mon 8/19/19	Thu 8/22/19
Project Management Infrastructure/Team Orientation	Mon 8/19/19	Fri 8/23/19
Site Walk and Large Meter Inspection	Mon 8/19/19	Fri 8/23/19
CIS data dump / import	Mon 8/26/19	Fri 9/6/19
Integration Review / Planning / Task	Mon 8/26/19	Fri 9/6/19
Receipt and Validation of Meter Sizes and Quantities	Mon 8/26/19	Fri 8/30/19
Order Infrastructure Devices	Mon 8/26/19	Fri 9/6/19
Billing Interface Tasks- Direct to AMI Conversion	Mon 9/2/19	Fri 9/13/19
Network Infrastructure survey and design	Mon 9/9/19	Fri 9/13/19
Network Infrastructure Permitting and Permissions	Mon 9/16/19	Fri 9/20/19
System Testing	**Mon 10/14/19**	**Fri 5/1/20**
Site Prep- AC Power and Backhaul	Mon 10/28/19	Fri 12/27/19
Establish and Test Meter Swap Interface	Mon 10/28/19	Fri 1/3/20
Delivery of C&I meters	Mon 11/25/19	Fri 12/27/19
Delivery of Infrastructure Product	Mon 11/4/19	Fri 11/22/19
Install Collectors	Mon 11/11/19	Fri 12/13/19
Network Test	Mon 12/30/19	Fri 1/17/20
Test Meters (C&I, Test Residentials) Installation	Mon 1/20/20	Fri 1/31/20
Mitigation work based on testing	Mon 2/3/20	Fri 4/3/20
Updated Interface Testing & Signoff	Mon 4/6/20	Fri 5/1/20
Full Deployment Phase	**Fri 5/1/20**	**Tue 7/13/21**
Critical Customer Identification and Management	Tue 5/5/20	Mon 5/18/20
Limited Production Install	Mon 5/11/20	Fri 6/26/20
Non-Standard Installation Management	Mon 5/18/20	Mon 8/17/20
Equipment RMA Process Check	Mon 5/25/20	Wed 7/1/20
Project Financials Final Reconciliation	Mon 6/14/21	Tue 7/13/21
System Substantially Complete	Mon 5/3/21	Fri 6/25/21
AMI Installation Project Closeout	**Tue 6/1/21**	**Fri 10/29/21**
Meter Punch list / Clean up	Tue 6/1/21	Mon 8/30/21
Network Optimization	Mon 6/7/21	Fri 9/3/21
Mitigation work based on Optimization	Mon 6/14/21	Thu 9/23/21
Sensus Analytics/Field Installation Final Training	Wed 6/23/21	Mon 9/20/21
Infrastructure Acceptance Quality Validation	Mon 7/5/21	Fri 10/15/21
Project Signoff Acceptance	Mon 8/30/21	Fri 10/29/21

Table 24. Sample UCPW Implementation Planning Key Actions

Section 10. Project Summary, Decision Points, and Next Steps

As UCPW seeks to streamline operations, leveraging technology to drive efficiency, the highest return on investment will be enhancing current applications through conducting a utility-wide database scrubbing effort. Once old, inactive, duplicative, and or erroneous data has been purged from the main systems of record, standards for key terms and definitions should be established. Either simultaneous to or immediately following data cleanup and standardization efforts, interfaces, either through APIs or FTP file exchanges, should be implemented between all major systems to facilitate the flow of data between work groups. Improving the data and systems architecture will provide UCPW with the strong foundation with which to implement AMI and leverage all the benefits of the technology and the data it provides.

A key decision UCPW should decide quickly is whether to deploy a customer portal in advance of AMI or to wait until after the meter replacement program is complete. By implementing a third-party portal soon, the County could maintain their online payments vendor, Paymentus, and simply embed that as a module within the portal to allow an integrated user experience for the customer. A major benefit of this approach would be to inform customers of the AMI project and allow them to gain immediate benefit of receiving leak alert notifications and become familiar with visiting the portal to receive notifications on consumption and to access self-service options like online bill payments or fill out forms for service requests or account changes. If the utility would prefer to utilize a vendor-specific customer portal, that would require the selection of an AMI vendor first and deploying the portal after the AMI implementation is complete. MeterSYS recommends the UCPW project team consider the early selection and award of customer portal to a qualified third-party vendor that will integrate with the future AMI system and MDMS of choice, allowing the portal launch to precede installation and providing improved service delivery to customers.

UCPW will need to assign key staff to the Systems Sub-Team and authorize the team to make important decisions and resolve issues independent, but in concert with, the full project team and UCPW leadership. MeterSYS will facilitate project management of sub-team operations through an established plan peppered with ongoing meetings, report-outs to the project team, document retention, and task tracking to maintain accountability.

Assign key staff to Communications Sub-Team:

- Implement actions outlined in communications plan
- Leverage customer portal as available
- Establish internal team communications process and escalation protocols
- Create internal County staff communications requirements; AMI information and educational materials

Assign key staff to Systems Sub-Team and:

- Identify key system interfaces; develop interface requirements
- Facilitate vendor file exchange; create integration standards
- Assign system access and permissions
- Establish interface project plan; identify testing and acceptance milestones
- Incorporate systems project plan into AMI project plan

Assign key staff to Installation Sub-Team and:

- Map out installation; zone mapping and route-by-route
- Conduct pre-install field audits; verify account data (meter size, location, etc.)
- Identify Special (commercial/water-dependent/large meters;) and Do Not Replace (vacant/inactive) accounts for install planning purposes and equipment ordering

Section 11. Appendices

SEE ATTACHED APPENDICES