PERFORMANCE AUDIT OF THE PUBLIC UTILITIES DEPARTMENT'S ADVANCED METERING INFRASTRUCTURE IMPLEMENTATION

Insufficient Project Planning and Management Caused Major Delays and May Lead to Cost Overruns

Office of the City Auditor

City of San Diego

OCA

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July 11, 2019

Honorable Mayor, City Council, and Audit Committee Members
City of San Diego, California

Transmitted herewith is a performance audit report on the Public Utilities Department's Advanced Metering Infrastructure Implementation. This report was conducted in accordance with the City Auditor's Fiscal Year 2019 Audit Work Plan, and the report is presented in accordance with City Charter Section 39.2. The Results in Brief are presented on page 1. Audit Objectives, Scope, and Methodology are presented in Appendix B. Management's responses to our audit recommendations are presented after page 86 of this report.

We would like to thank staff from the Public Utilities Department and the Department of Information Technology for their assistance and cooperation during this audit. All of their valuable time and efforts spent on providing us information is greatly appreciated. The audit staff members responsible for this audit report are Joseph Picek, Luis Briseño, Andy Hanau, and Danielle Knighten.

Respectfully submitted,

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Results in Brief

Advanced metering infrastructure (AMI) is a wireless technology that allows water utilities to monitor customer consumption remotely, rather than relying on periodic in-person reads by utility staff. AMI offers several benefits to both water utilities and their customers, including mitigating human error in meter readings; automatically detecting leaks; and allowing customers to monitor their own hourly water consumption, which enhances customer service and assists customers with water conservation.[1]

PUD Began the Citywide AMI Implementation in 2015

The City of San Diego's (City) Public Utilities Department (PUD) entered into a contract with a vendor to complete an AMI pilot project in 2012, which covered approximately 11,000 customer accounts. Following the completion of the AMI pilot in 2015, PUD began the Citywide AMI implementation, which was intended to cover the remaining 270,000 metered connections.

Why We Did This Audit

During our Performance Audits of Water Billing and Water Meter Cover Replacement, we identified risks related to the timely completion of the Citywide AMI implementation. As a result, this audit was included in the Office of the City Auditor's approved fiscal year (FY) 2019 Audit Work Plan. The objectives of this audit were to:

1. Evaluate PUD's management of the Citywide AMI implementation to-date and identify lessons learned to inform the remainder of the AMI implementation and any future major projects at PUD; and

2. Determine if the efficiency and effectiveness of the AMI implementation can be improved to reduce costs, improve the speed of the implementation, and ensure accurate and timely billing.

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[1] Our July 2018 Performance Audit of Public Utilities' Water Billing Operations outlines several issues we found that resulted in inaccurate water billing for some customers, including human error by meter readers. See https://www.sandiego.gov/sites/default/files/19-003_pud_water_billing.pdf

We found that significant management deficiencies, staffing issues, and implementation of a new work order tracking system, EAM, all contributed to delays in implementing AMI Citywide.

Finding 1: PUD Did Not Adequately Plan, Budget for, Or Manage the Citywide AMI Implementation, Leading to Major Delays and Potential Cost Overruns

AMI implementation is a complex undertaking that affects many different business areas of PUD. Therefore, careful planning, budgeting, and project management are essential to a successful AMI implementation and to avoid costly changes to the implementation later in the process. However, we found that PUD did not sufficiently plan, budget, or manage the initial attempt at a Citywide AMI implementation. Specifically, we found:

- The AMI project lacked a designated executive sponsor, a project manager with sufficient authority, and an executive steering committee to coordinate the AMI implementation effort;

- The project lacked a deployment plan; and

- The project budget and timeline were not based on realistic assumptions.

    o For example, the original project budget of $60 million, which was approved by the City Council, was based on a quote from a vendor to perform the installation work, even though PUD had already decided to perform the installation with in-house labor.

    o Additionally, another budget request used estimates of staffing availability that were higher than actual levels and required higher productivity for meter replacement than we observed. Finding 2 discusses staffing issues in more detail.

As a result of these issues, the Citywide AMI implementation has experienced severe delays and may incur cost overruns. The project was originally scheduled to be completed by December 2017, but was suspended by PUD in July 2018

while PUD re-evaluates its options for conducting the implementation. At that time, only six percent of PUD customers had their meters read remotely via AMI.

OCA Notified PUD of Project Management Issues in December 2018, and PUD is Taking Corrective Action

Many of the management issues outlined above became apparent early in the audit process, so we notified PUD of these deficiencies in December 2018 to facilitate immediate corrective action. We recommended that PUD designate an executive steering committee; assign a project manager with sufficient authority and resources; and develop a detailed deployment plan to guide the remainder of the implementation. PUD has undergone extensive management and structural changes since that time and is making a concerted effort to implement these recommendations and improve the Citywide AMI implementation. Specifically, PUD provided documentation indicating that it has designated an executive steering committee and a project manager with appropriate authority, and is in the process of developing a detailed deployment plan to guide the rest of the AMI implementation.

Since December 2018, we found that PUD lacked a policy or directive outlining appropriate project management practices for major projects that PUD conducts in-house. We recommended that PUD create and implement such guidance to help ensure that future major projects at PUD do not experience similar project management deficiencies as the Citywide AMI implementation. PUD created and issued this directive in June 2019.

Finding 2: PUD Needs to Address Several Staffing Issues to Improve the Performance of the Citywide AMI Implementation

Significant staffing issues in PUD's AMI meter replacement group, which was tasked with installing AMI-ready meters for the Citywide AMI implementation, have seriously hindered the project's progress. PUD anticipated completing the meter replacements needed for AMI within 30 months by using the equivalent of approximately 24 employees, each replacing about 12 to 15 meters per workday. We found that from July 2017 to March 2018, PUD actually had only about 15

employees in the field, each replacing an average of about 10 meters per workday. Combined, these two factors led to PUD's meter replacement pace to fall more than 50 percent below what PUD anticipated.

We found that staffing levels and productivity issues in the meter replacement group were the result of several factors. Issues that PUD management could have corrected or accounted for include:

- PUD management did not adequately consider potential staffing challenges prior to the Citywide AMI implementation;

- The AMI meter replacement group had an average vacancy rate of 22 percent from FY 2016 to FY 2019;

- The AMI meter replacement group had an average annual turnover rate of 44 percent between FY 2016 and FY 2019;[2]

- Approximately 25 percent of filled positions were "limited" Laborer positions, which may be less desirable to employees for a number of reasons and are typically filled by lesser-skilled employees;

- Management regularly reassigned staff based on competing priorities;

- Management instituted a 16-month hiring freeze while hiring practices in the department were improved; and

- Management did not adequately plan for meter site conditions, such as buried meters, prior to the Citywide AMI implementation.

In addition, we found several factors that potentially impacted staffing levels and productivity that were outside of PUD management's direct control, including:

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[2] This includes staff who left the City entirely, as well as staff who transferred to other positions within the City but outside the meter replacement group.

- Water Systems Technicians' pay was found to be 30 percent below the median of 15 benchmark cities in 2015 and has not been adjusted since that time. This may make it more difficult to recruit qualified employees; and

- Throughout the City, Laborers perform a variety of tasks, some of which may be less demanding than replacing water meters. This may lead Laborers to seek transfers out of the AMI meter replacement group.

In addition to installing AMI-ready meters, the Citywide AMI implementation also requires the installation of endpoints at each meter. PUD's initial plan was to have Field Representatives from the Meter Reading group perform endpoint installation. While endpoints are not yet being installed on a large scale, it appears that the Meter Reading group may be experiencing similar staffing issues to the meter replacement group. Therefore, we recommend that PUD develop staffing plans for the rest of the Citywide AMI implementation, which should include dedicating work groups for meter and endpoint installations, and/or outsourcing some or all of the installation work. In addition, PUD should analyze the factors contributing to staffing issues and request salary adjustments and changes in job classification descriptions from the Personnel Department, if necessary.

Finding 3:
PUD Should Accurately
Track Meter
Replacement Labor
Costs to Improve
Project Oversight

In addition to accurate budgeting, it is important for PUD management to accurately track actual implementation costs to improve financial accountability, enhance operational effectiveness, and promote citizens' confidence in their government.

We found that PUD is not accurately tracking labor costs for the Citywide AMI implementation. Specifically, between July 2017 and mid-March 2018, we estimated that meter replacement crews undercharged their time to the AMI project by about 27 percent. During this time period, we estimated the amount undercharged was approximately

$361,000. While this is a small portion of the project budget, it is important to note that we only reviewed labor charges for an 8.5 month period. Because the project began in 2015, the actual amount undercharged is likely higher.

Without capturing accurate labor charges, PUD management cannot monitor actual projects costs and identify whether they are aligned with the budget. Tracking labor costs accurately is important for transparency and oversight purposes, and accurate information would help better inform stakeholders involved in making critical decisions about the project.

We recommend that PUD provide timekeeping instructions to all employees working on the Citywide AMI implementation, including establishing supervisory review responsibilities. In addition, the AMI project manager, or an appropriate designee, should monitor labor charges to the project for reasonableness.

Finding 4:
EAM Work Manager
Controls Do Not
Effectively Prevent Data
Entry Errors, Leading to
Inefficiencies and
Billing Delays

Successfully replacing existing meters with AMI-ready meters involves more than just removing and installing the physical meters. Meter replacement crews must completely and accurately enter a variety of information into a mobile tracking system, the EAM Work Manager, to prevent future troubleshooting, billing delays, and possible billing errors.

We found that the EAM Work Manager's controls did not effectively prevent data entry errors, such as when staff inadvertently enter a duplicate meter serial number into the system. While PUD does have controls to detect such an error after the fact to prevent an inaccurate bill from being generated, correcting errors on the back-end is not efficient and has led to at least some customers receiving delayed bills, including some customers who have received multiple bills at once. It was not possible to quantify how often these issues have occurred because PUD does not track them.

In order to avoid time-consuming and inefficient troubleshooting and delayed customer billing, we recommend that PUD work with the Department of Information Technology (DoIT) to evaluate the EAM Work Manager control environment and ensure adequate controls are in place to prevent data entry errors. DoIT reports that sufficient controls are now in place and functioning, and we will verify this during our biannual recommendation follow-up process. In addition, we recommend PUD develop a process to track the causes, resolutions, and duration of all data entry errors that are caught and corrected on the back-end in order to monitor whether front-end data controls are effective.

Management Agreed to All Recommendations, and Some Are Already Implemented

We made a total of 13 recommendations to address the issues we identified, and PUD management agreed to implement all of them. Prior to issuance of this report, PUD provided evidence that three of these recommendations have already been implemented.

Background

What is Advanced Metering Infrastructure? Advanced Metering Infrastructure (AMI) is a system that uses radio technology to automatically collect consumption data (i.e., meter readings) from a utility meter. The City of San Diego's (City's) Public Utilities Department (PUD) had AMI meter reading for approximately 16,000 of its 281,500 metered water connections as of November 1, 2018 and it plans to install the technology at the remaining connections.

AMI consists of key additions to PUD's meter reading infrastructure. At each metered connection, an AMI-ready water meter is installed. Then, a radio transmitter called an endpoint is connected to the water meter's register and programmed to gather the current meter reading.[3] **Exhibit 1** shows a complete AMI meter and endpoint.

Exhibit 1:

A Complete AMI Meter and Endpoint

Source: Auditor generated from observations.

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[3] The endpoint is alternatively referred to as an Encoder Receiver Transmitter (ERT) or a Meter Interface Unit (MIU).

The endpoint encodes and transmits meter information over a radio frequency to the fixed network, which consists of hardware devices known as repeaters and collectors.[4] A collector uploads the meter read data received from the endpoints and repeaters in its area to the Network Collection Engine, which is hosted by Itron. Itron hosted services then exports the meter read data to the City's established read data collection system, Itron's MV-RS, which collects both AMI and in-person reads into a single upload to the City's utility billing system, SAP's Customer Care Solutions (CCS). **Exhibit 2** provides a visual representation of the City's AMI system.

Exhibit 2:

AMI Billing Process: From Water Use to Water Bill
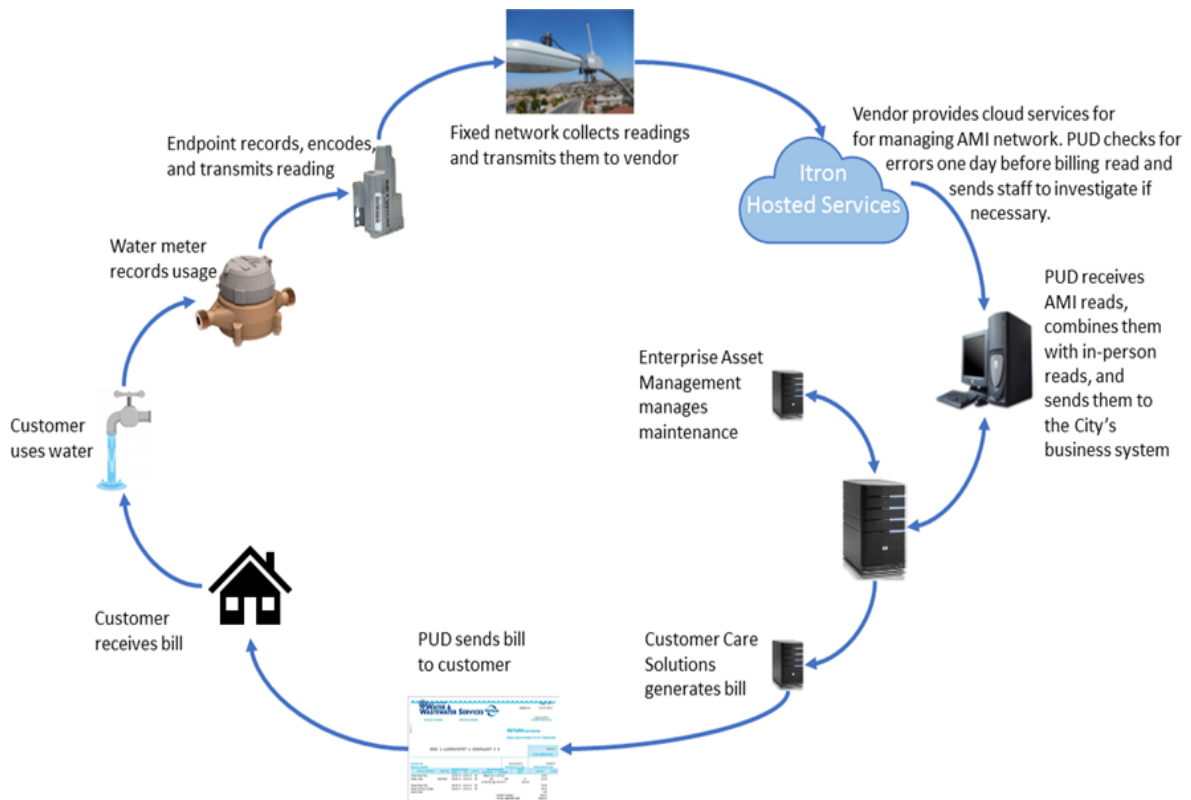
Source: Auditor generated based on observations and materials from PUD.

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[4] The City acquired its fixed network of repeaters and collectors from a vendor, Itron, as part of the AMI pilot project. Repeaters and collectors are typically installed on existing infrastructure assets, such as street lights. Endpoints transmit information directly to a collector if they are located within range. When this is not the case, repeaters relay the radio transmission from the endpoint to a collector. The fixed network is only compatible with Itron endpoints.

Why is AMI Important?

MyWaterSD lets customers view water usage, access their accounts, and pay their bills.
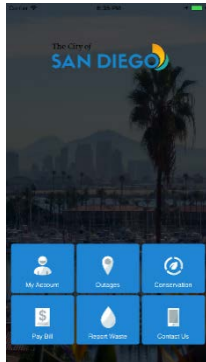
AMI can offer some significant improvements to PUD's meter reading operations. By using automated reads, AMI meter reading mitigates the potential for human error in meter reading.[5] Additionally, hourly reads will allow PUD to quickly investigate customer billing complaints and identify possible leaks. The hourly read data is also available to PUD customers through the MyWaterSD mobile app and website, which allows interested customers to monitor their water usage for conservation.

The AMI implementation is also a major financial investment and business process change for PUD. The project affects multiple work groups and will affect core business processes, including billing and customer service. AMI implementation requires advanced planning, complex management, and proactive monitoring; it requires coordination across many stakeholders, including multiple internal teams, external vendors, officials, and customers.

Why We Did this Audit

During our previous Performance Audit of the Public Utilities Department's Water Meter Cover Replacement Program and the Performance Audit of the Public Utilities Department's Customer Billing Operations, we identified risks related to the Citywide AMI implementation. As a result, and in accordance with the Office of the City Auditor's approved FY 2019 Audit Work Plan, we conducted a performance audit of PUD's Citywide AMI implementation. The objectives of this audit were to:

1. Evaluate PUD's management of the AMI implementation to-date and identify lessons learned to inform the remainder of the AMI implementation and any future major projects at PUD; and

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[5] The City Auditor's Performance Audit of Water Billing Operations found that meter reader error caused some billing issues while issues caused by AMI-read meters were resolved before billing. Additionally, PUD's consultant, West Monroe, found that transitioning to AMI reading would both decrease meter reader error and improve efficiency in resolving problems.

2. Determine if the efficiency and effectiveness of the Citywide AMI implementation can be improved to reduce costs, improve the speed of the implementation, and ensure accurate and timely billing.

History of AMI in San Diego

In the City of San Diego, the implementation of an AMR system for the water utility was first discussed in FY 2005 .[6] In 2012, the City Council approved PUD's AMI Pilot (Pilot), which was carried out by a contractor (Itron) between 2013 and 2015. In 2015, after completion of the Pilot, PUD proceeded with the Citywide AMI implementation. In their proposals for AMI, PUD identified several benefits of an AMI system, including enhancements to its water meter reading, customer service, billing, and water conservation capabilities. **Exhibit 3** shows a timeline of notable events within PUD's AMI project history.

Exhibit 3:

AMI Project Timeline
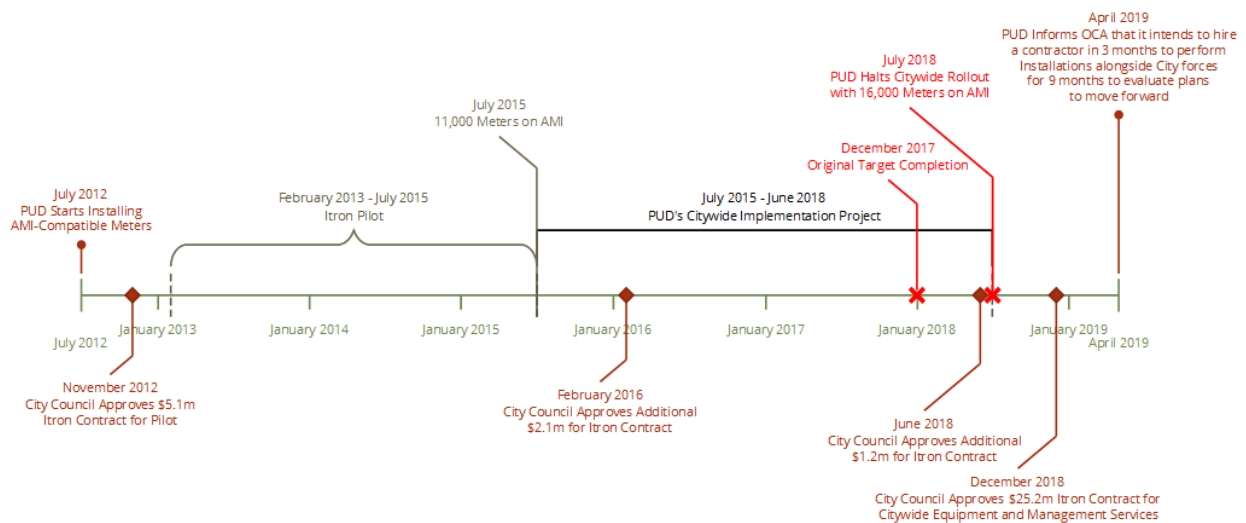
Source: Auditor generated based on materials from PUD, the City Council, City Council Committees, and the Independent Rates Oversight Committee.

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[6] Automated Meter Reading (AMR) collects more frequent readings and additional data, but it is collected by meter readers. AMI performs the same data collection function that an AMR system does, but instead of holding the collected data until a meter reader can collect it, AMI relays the data to the owner of the water meter in real time.

How is the Program Organized and Staffed?

PUD used several work units for the Citywide portion of the AMI implementation. The Meter Replacement group, part of the Water Construction and Maintenance Division (WCM), was responsible for replacing old meters with new, AMI-ready meters. The Meter Reading and Field Investigations group, part of the Customer Support Division (CSD) at the time, was responsible for installing and programming the endpoints.

The AMI Meter Installation Crew had 35 positions, 2 of which were vacant on February 28, 2019. The Meter Reading and Field Investigations group had 53 positions, of which 14 were vacant as of February 28, 2019.

In February 2019, PUD announced a restructuring that changed the responsibilities for the AMI project effective April 2019. The Meter Reading and Field Investigations group became part of WCM. PUD assigned the Assistant Director of System Management and Operations to act as the executive sponsor for the AMI project and dedicated a project manager to oversee the project. **Exhibit 4** shows PUD's organizational structure prior to April 2019, and **Exhibit 5** shows the announced restructuring that took effect in April 2019.

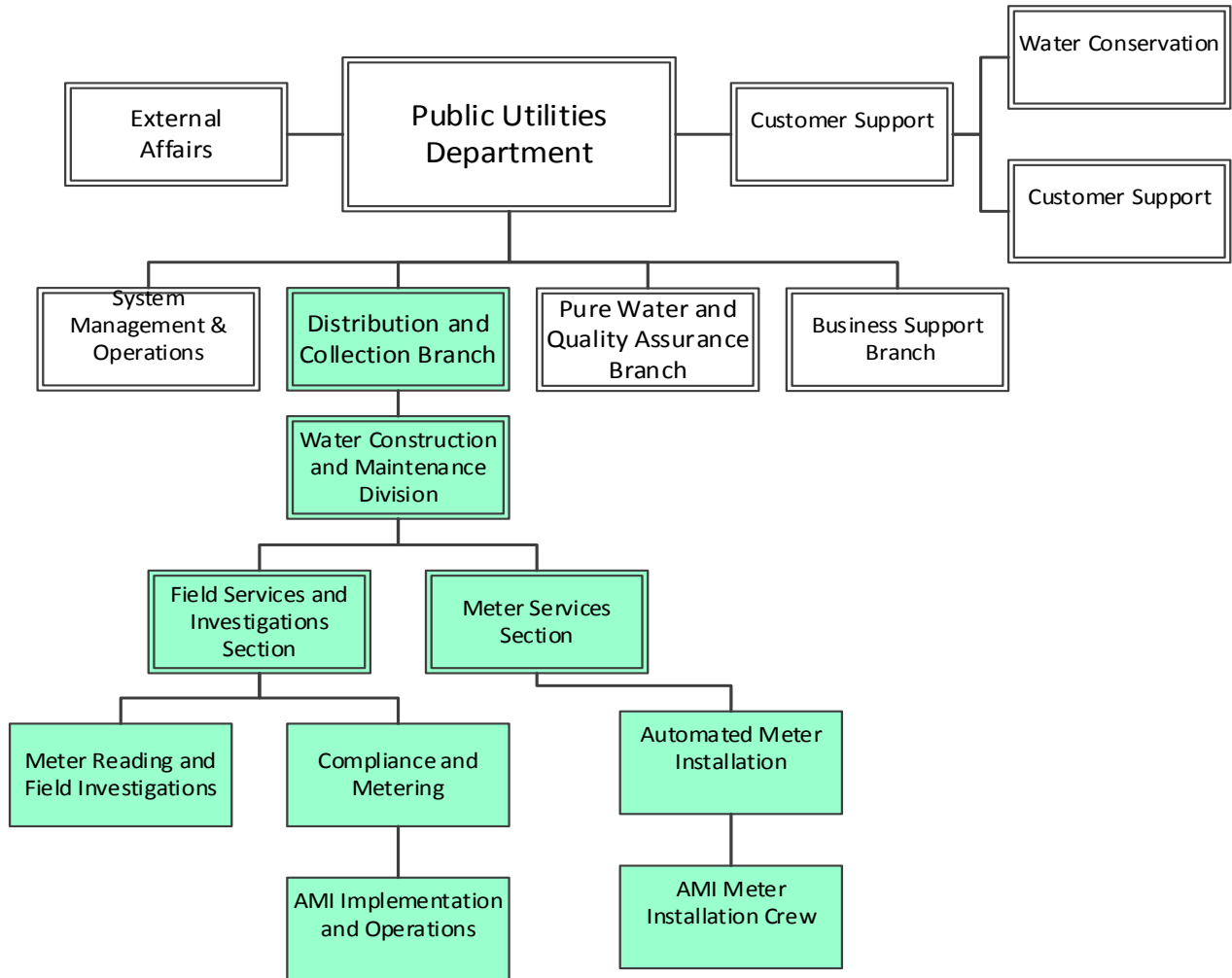**Exhibit 4:**

Prior to April 2019, Two Branches were Responsible for Citywide AMI Implementation

```
                          Public Utilities
                            Department
   ┌──────────┬──────────────┬──────────────┬──────────────┬──────────────┐
Department   Distribution   System        Pure Water and  Business       External
Management   and            Management     Quality         Support        Affairs
             Collection     and            Assurance       Branch
             Branch         Operations     Branch
                            Branch
                 │                                            │
          Water Construction                           Customer Support
          and Maintenance                              Division
          Division                                          │
                 │                                     Field Services and
          Meter Services                               Investigations
          Section                                      Section
                 │                                   ┌──────────┴──────────┐
          Automated Meter                      Meter Reading and    Compliance and
          Installation                         Field Investigations  Metering
                 │                                                         │
          AMI Meter                                                 AMI Implementation
          Installation Crew                                         and Operations
```

Source: Auditor generated based on Organization and Staffing Report from SAP.

Exhibit 5:

After April 2019, AMI Installations are Centralized in the Water Construction and Maintenance Division

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                              ┌─────────────────┐           ┌──────────────────────┐
                              │ Public Utilities │           │ Water Conservation   │
┌──────────────┐             │   Department     │──────────┐└──────────────────────┘
│  External    │─────────────│                  │  Customer │
│  Affairs     │             └─────────────────┘  Support   ┌──────────────────────┐
└──────────────┘                                            │  Customer Support    │
                                                            └──────────────────────┘

┌──────────────┐  ┌──────────────┐  ┌──────────────┐  ┌──────────────┐
│ System       │  │ Distribution │  │ Pure Water   │  │ Business     │
│ Management & │  │ and          │  │ and Quality  │  │ Support      │
│ Operations   │  │ Collection   │  │ Assurance    │  │ Branch       │
│              │  │ Branch       │  │ Branch       │  │              │
└──────────────┘  └──────────────┘  └──────────────┘  └──────────────┘
```

(organization chart)

- External Affairs
- Public Utilities Department
  - Customer Support
    - Water Conservation
    - Customer Support
  - System Management & Operations
  - Distribution and Collection Branch
    - Water Construction and Maintenance Division
      - Field Services and Investigations Section
        - Meter Reading and Field Investigations
        - Compliance and Metering
          - AMI Implementation and Operations
      - Meter Services Section
        - Automated Meter Installation
          - AMI Meter Installation Crew
  - Pure Water and Quality Assurance Branch
  - Business Support Branch

Source: Auditor generated based on information from SAP and PUD's updated organization chart.

What is the Process for Implementing AMI?

As part of the Pilot completed between FY 2013 and FY 2016, the City's contractor, Itron, installed a fixed network system to collect data from endpoints throughout the City. Itron also installed approximately 11,000 endpoints throughout the City. This pilot included large customers, such as commercial, industrial, and multi-family residential customers, as well as approximately 1,000 single family residential customers.

According to PUD, they have been installing AMI-ready meters for the Citywide AMI implementation since July 2012. Meter replacements involve a field crew turning off water to the customer, evaluating the condition of existing meter connections, removing the old meter from the water line, installing a new meter, turning the water back on, and checking for any leaks. In order to ensure accurate billing, the field crew must also record key information, including outgoing and incoming meter serial numbers, characteristics, and reads. **Exhibit 6** provides a visual representation of the process.

Exhibit 6:

Meter Replacement Process
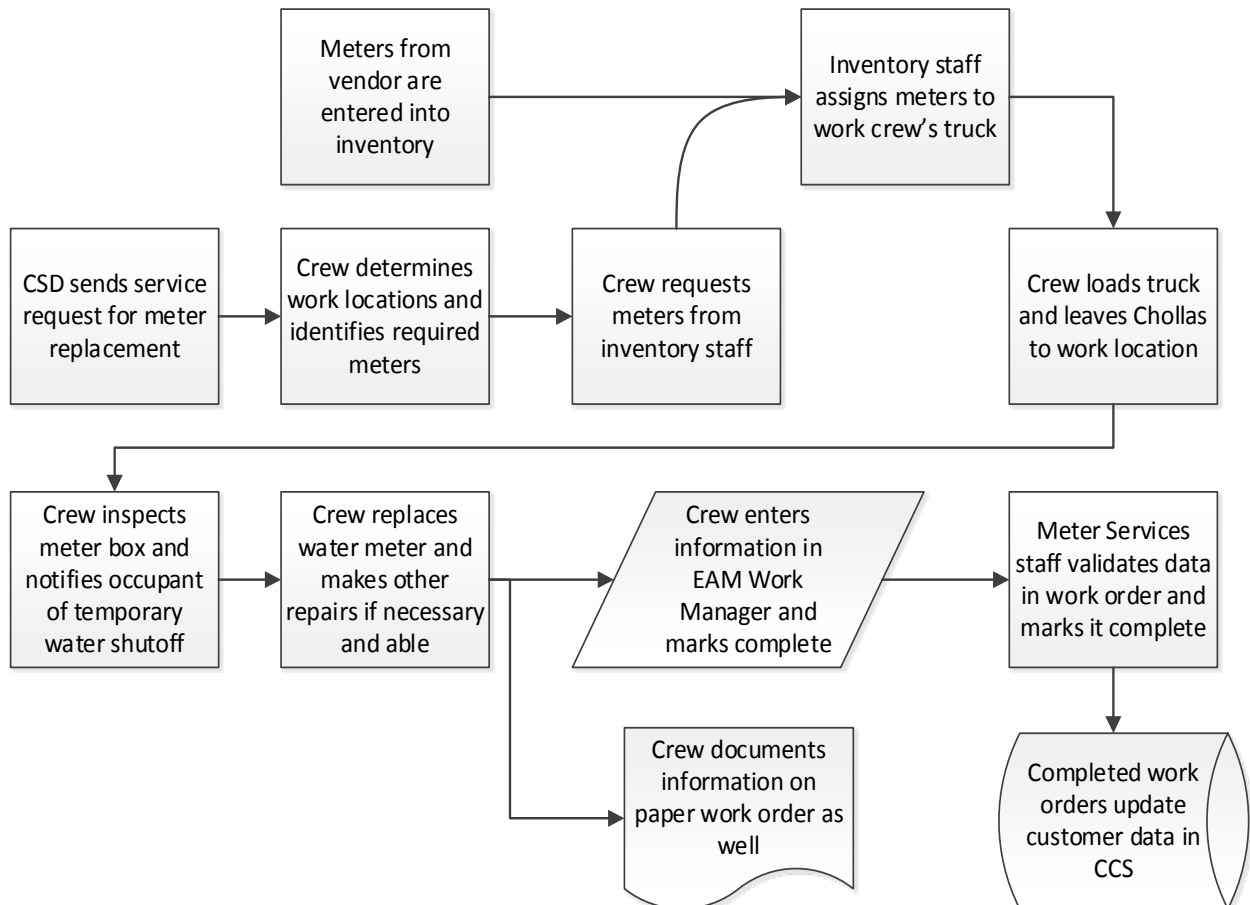
Source: Auditor generated based on field observations and interviews with PUD staff.

After an AMI-ready meter is in place, an Itron endpoint can be installed to allow the meter to connect to the fixed network. Registers from Badger Meters are directly compatible with Itron endpoints, and registers from other companies require an adapter cable. To install and activate an endpoint, a field representative checks the meter read, serial number, and key characteristics about the meter to ensure they are at the correct location. The field representative then connects the endpoint to the register's cable, installing an adapter cable if necessary; attaches a tamper seal; installs a fiberglass rod to mount the endpoint; activates and programs the endpoint with key information; checks for network coverage; and installs an external antenna, if necessary. This may require drilling through a concrete lid. As with installing the meter, the field representative must accurately record key information about the endpoint in order to ensure accurate billing. **Exhibit 7** provides a visual representation of the process.

Exhibit 7:

Endpoint Installation Process
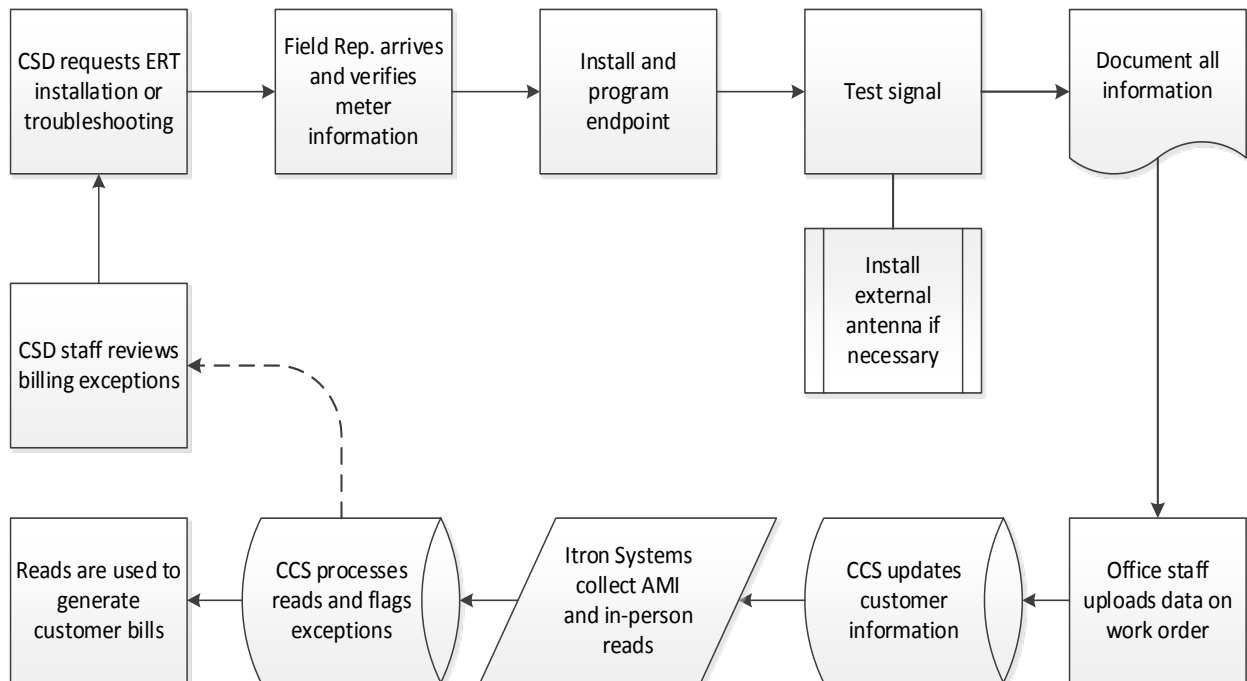
Source: Auditor generated from field observation and staff interview

According to PUD, after an endpoint is installed, office staff enter the information about the endpoint into CCS in order to connect it to the billing system. Once connected, an AMI meter transmits hourly reads that may be accessible to customers through PUD's MyWaterSD application. The AMI meter also transmits a daily read that PUD uses for billing. PUD will use an AMI read as long as the network received a daily read up to 72 hours before a customer's billing read date. If the endpoint has not successfully transmitted a daily read to the network within that time, PUD assigns the meter to a meter reader who will travel to the location in order to obtain a reading for that bill. In the event that the meter reader finds a problem with location—including inaccessibility or damage—the meter reader will enter a problem code for the meter to create a service notification for the Meter Shop to investigate and address the problem.

In an effort to improve the efficiency of the AMI implementation process, PUD reports that they are working with the Performance and Analytics Department to create a "one and done" meter box cleanout, meter replacement, and endpoint installation process.

What is the Project Budget, and how Much Money has Already Been Spent?

The AMI project budget, scope, and completion timeline have changed several times since the first iteration of the project was introduced to the City's Natural Resources and Culture Committee in October 2005. The City Council approved a $5.1 million agreement with Itron in November 2012 for the pilot phase of the project (Phase 1), which included 11,000 (mostly commercial) meters. PUD anticipated completion of Phase 1 by December 31, 2013. After a delay of about two years, in January 2016, PUD's Independent Rates Oversight Committee (IROC) reported that Phase 1 of the AMI project had been completed at a total cost of $6 million. However, since that time, PUD has requested—and the City Council has granted—contract amendments for additional services from Itron, including the development of Itron's Field Deployment Manager software, that bring the total Phase 1 budget to approximately $8.5 million.

Since the approval of Phase 1, PUD has requested additional funding and expenditure approvals from the City Council for the remainder of the AMI project, including the implementation of AMI technology to the rest of the water meters across the City (Phase 2). Currently, the total project cost—including the Citywide implementation—is budgeted at about $76 million. Phase 2 is fully funded through the City's Capital Improvement Program. PUD is partially financing the project with a $42 million 20-year loan from the State Water Board Clean Water Revolving Fund Program. As of May 31, 2019, total actual, cumulative expenditures for the project are estimated to be approximately $20.9 million, as shown in **Exhibit 8**.

Exhibit 8:

AMI Project Budget and Expenditures as of May 2019

Description	Budget	Actual Expenditures
Pilot (Phase 1)	$8.5 million	$6.8 million
Citywide Implementation (Phase 2)	$67.6 million	$14.0 million
Total	**$76 million**	**$20.9 million**

Source: Auditor generated based on materials from PUD and City CIP budget documents. Totals may not sum due to rounding.

PUD made its latest AMI expenditure request to the City Council in December 2018. That request was for $25.2 million, which will cover an agreement with Itron for equipment and project management services related to the Citywide AMI implementation. The costs associated with this agreement, which the City Council approved, is part of the $67.6 million budgeted for Phase 2.

Department Challenges   Our audit commenced in 2018, during a time of heightened scrutiny and considerable negative press coverage of PUD that resulted from concerns over billing and customer service. The following notable events provide additional, more recent context for the Citywide AMI implementation:

- In March 2018, PUD transitioned to the City's new Enterprise Asset Management system (EAM). This transition directly affected meter installation and consequently had a significant impact on the Citywide AMI implementation.

- In July 2018, PUD management made the decision to place the Citywide AMI implementation on hold while several reviews of the department were completed.

- In November 2018, PUD management reported the department was working to develop an implementation plan with deployment steps and project timelines for the remainder of the AMI implementation project.

- Multiple changes to PUD's management personnel and structure have taken place since 2018, with the latest taking effect in April 2019.

According to a February 2019 memo from the City's Chief Operating Officer, and in response to direction from the Mayor, City management dedicated a team in Summer 2018 to methodically analyze all aspects of water and wastewater operations, with specific attention paid to staffing, organizational structure, and key processes. Their goal was to ensure that staff and procedures are in place to support a customer-focused, mission-driven operation.

Audit Results

Finding 1: The Public Utilities Department Did Not Adequately Plan, Budget for, or Manage the Citywide AMI Implementation, Leading to Major Delays and Potential Cost Overruns

AMI implementation is a complex undertaking that affects many different business areas of The Public Utilities Department (PUD). Therefore, careful planning, budgeting, and project management are essential to a successful AMI implementation and to avoid costly changes to the implementation later in the process. However, we found that PUD did not sufficiently plan, budget, or manage the initial attempt at a Citywide AMI implementation. Specifically, we found:

- The AMI project lacked a designated executive sponsor, a project manager with sufficient authority, and an executive steering committee to coordinate the AMI implementation effort;

- The project lacked a deployment plan; and

- The project budget and timeline were not based on realistic assumptions.

As a result of these issues, the Citywide AMI implementation has experienced severe delays and may incur cost overruns. The project was originally scheduled to be completed by December 2017, but it was suspended by PUD in July 2018 while PUD re-evaluates its options for conducting the implementation. At that time, only 6 percent of PUD customers had their meters read remotely via AMI.

We made several recommendations to improve the management of the AMI implementation, as well as future major projects managed by PUD. These include assigning a project manager with appropriate authority, establishing an executive steering committee, developing a deployment plan, and issuing a directive for project management of any future major projects managed by PUD.

Many of the management issues outlined in this report became apparent early in the audit process. We therefore notified PUD of these deficiencies in December 2018 to facilitate immediate corrective action. PUD has undergone extensive management and structural changes since that time. PUD has already implemented some of our recommendations, and is making a concerted effort to implement the remaining recommendations and improve the Citywide AMI implementation.

Successful Project Management Requires Development of a Project Management Plan

According to *A Guide to the Project Management Body of Knowledge* (PMBOK Guide), project planning involves establishing the scope of the project, refining the objectives, and defining the course of action to achieve those objectives. During the planning stage, the project team, in collaboration with appropriate stakeholders, develops documents that will be used to carry out the project, including the Project Management Plan. These documents explore all aspects of the project's scope, time, costs, quality, communication, risk, and procurement. The Project Management Plan becomes the primary source of information for how the project will be planned, executed, monitored and controlled, and closed.

Planning Efforts May Help Avoid Costly Changes Later in Implementation

The PMBOK Guide suggests that the lifecycle of a project has the following characteristics:

- Cost and staffing levels are low at the start, peak as the work is carried out, and drop rapidly as the project draws to a close.

- Stakeholder influences, risk, and uncertainty are greatest at the start of the project. These factors decrease over the life of the project.

- Ability to influence the final characteristics of the project's product, without significantly impacting cost, is highest at the start of the project and decreases as the project progresses toward completion. The cost of changes and correcting errors typically increases substantially as the project approaches completion.

Therefore, significant effort should be put into planning upfront because the cost to change course becomes higher as the project progresses. **Exhibit 9** illustrates this idea. The black curve illustrates that the potential for adding value to the project is highest during the formulation or concept phase and lowest during the finishing phase while the red curve illustrates that the cost of making changes is lowest initially but rises steeply as the project progresses. The intersection of these curves represents the point at which a constructive opportunity changes into a destructive intervention, where changes are costlier than their added value.

Exhibit 9:

Early Planning Minimizes the Costs of Project Changes
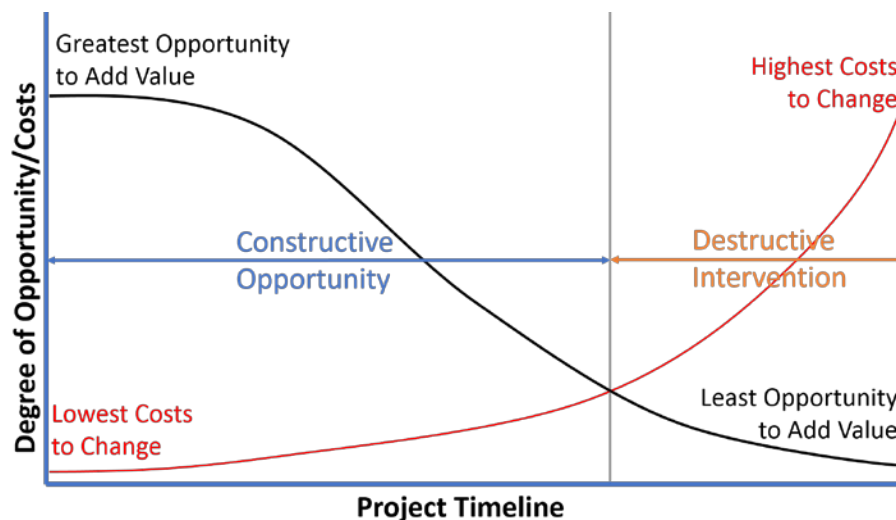
Source: Auditor generated based on *A Guide to the Project Management Body of Knowledge*, 4th Edition, and *A Framework for Project and Program Management Integration*.

Professional Guidance Describes Key Elements for Successful Implementation

The PMBOK Guide suggests that a project sponsor and a project manager are key roles in the execution of a project. The project sponsor is a champion for the project, serving as a spokesperson to higher levels of management for the purpose of gathering support throughout the organization. The sponsor also plays a significant role in the development of the initial scope and charter and may be involved in other important issues, such as authorizing changes in scope, phase-end reviews, and go/no-go decisions when risks are particularly high. The project sponsor should be at a level that is appropriate to funding the project; they will either create the project charter or delegate that duty to the project manager. The project manager is in charge of all aspects of the project and is responsible for its success. A project manager is identified and assigned as early in the project as feasible, preferably while the project charter is being developed and always prior to the start of planning. It is recommended that the project manager participate in the development of the project charter, as the project charter provides the project manager with the authority to apply resources to project activities.

According to the PMBOK Guide, the project charter documents initial requirements that will satisfy the stakeholders' needs and expectations. The project charter may include high-level and preliminary information about the project, such as the project's purpose or justification, potential risks, milestone schedule and budget, and project approval requirements. The project charter also documents the assigned project manager and their level of authority as well as the name and authority of the sponsor or other person(s) authorizing the project charter. The approved project charter formally initiates the project.

More specific to AMI implementation projects, *West Monroe's Guide to Water Utility AMI Deployment* suggests utilities establish an AMI steering committee with representation from field services, meter reading, engineering, technology, billing, customer service, and public affairs. Furthermore, it

specifies that it is critical for this group to meet regularly to make decisions, remove roadblocks, approve vendor contracts, hold teams and vendors accountable, and address program risks and issues. Additionally, utilities implementing AMI should create a detailed deployment plan, identifying work that needs to be done across each workstream, including who will complete the work, when it will be done, and what dependencies exist.

In addition, the PMBOK Guide suggests that determining a budget and developing a schedule are critical components of project planning. Determining a project budget involves aggregating the estimated costs of individual activities to establish an authorized cost baseline. A project budget constitutes the funds authorized to execute the project and is used to measure, monitor, and control overall cost performance on the project. Developing a project schedule involves analyzing activity sequences, durations, resource requirements, and time constraints. At a minimum, the project schedule includes a planned start date and planned finish date for each activity and can be used as a baseline to track progress. This process usually happens no later than completion of the project management plan.

Benchmarking Reinforced the Importance of Key Advice from Professional Guidance

To determine if PUD followed an approach similar to other water utilities when implementing their own AMI project, we conducted benchmarking interviews with nine outside agencies that had either already implemented or were in the process of implementing AMI. Our interviews reinforced the importance of some of the key advice laid out by professional guidance, including the use of a project manager, a working group of stakeholders, a project champion, and careful consideration of outsourcing the installation work.

The Citywide AMI Implementation Was Not Sufficiently Planned or Managed

However, we found that PUD did not sufficiently plan, budget for, or manage the Citywide project prior to the initial funding request or during the initial attempt to implement AMI Citywide. **Exhibit 10** summarizes key elements of project planning that we reviewed during our audit and notes whether PUD accomplished those tasks. The sections following the exhibit describe each element and what we found in more detail.

Exhibit 10:

PUD's Initial Project Planning for Citywide AMI Implementation Was Incomplete

Planning Task	Completed?
Designate an Executive Sponsor	No
Assign a Project Manager	Partially
Develop a Project Charter	No
Establish an AMI Steering Committee	No
Develop a Detailed Deployment Plan	No
Conduct Staffing and Productivity Analysis	Partially*
Perform Risk Assessment	No
Determine Project Budget	Partially
Develop Project Schedule	Partially

*This is discussed in more detail in Finding 2.

Note: The table reflects tasks that we reviewed as part of our audit. Therefore, some key planning tasks, such as a Communications Plan and a Quality Plan, are not included in the table because they are outside of our audit scope.

Source: Auditor generated based on review of documentation provided by PUD, *West Monroe's Guide to Water Utility AMI Deployment,* and *A Guide to the Project Management Body of Knowledge*, 4th Edition.

Lack of Executive Sponsor, Project Manager, and Steering Committee

Given the complexity of AMI implementation, project oversight is critical. However, the project lacked an executive steering committee with representatives from the various business units that were involved in the AMI implementation and did not have an executive-level sponsor championing the project or a project manager responsible for the overall performance of the project. Project management responsibilities were generally assigned to a supervising management analyst within PUD's Customer Support Division (CSD), who did not have the authority to direct the work of other business units critical to the AMI implementation.

Lack of Project Charter and Deployment Plan

Successful AMI implementation also requires development of a project charter and a detailed deployment plan to identify and assign specific roles and responsibilities and project milestones and deliverables. However, PUD's Citywide AMI implementation lacked such a charter or plan. In response to our requests for planning documentation related to the Citywide AMI implementation, PUD staff informed us in January 2019 that there was no planning documentation available for the Citywide AMI implementation because the full project had not yet kicked off and was still in the planning phase. This was, however, contradictory to PUD's staff report to the City Council's Environment Committee over 18 months earlier, in June 2017. At that time, PUD reported that the Citywide AMI implementation was "well under way," with the equivalent of about 30 percent of meters having been replaced as of May 2017 and the full implementation of meters and endpoints planned to be completed by March 2020. We observed from data in PUD's legacy maintenance management system, SWIM, that the meter replacement portion of the Citywide AMI implementation appears to have begun in earnest in late June 2015. The fact that planning documentation for the Citywide AMI implementation does not exist—even more than three years later—indicates that critical components of the project were likely not as carefully thought-out as would be necessary for a project of this scale and complexity.

Lack of Risk Assessment and Mitigation Plans

A key part of project risk management is assessing possible risks to the success of the project and developing potential mitigation measures to address them. However, PUD did not perform a comprehensive risk assessment to identify possible risks to project success or develop measures to mitigate them. Therefore, PUD did not anticipate or plan for challenges that arose during the initial implementation attempt. We learned of several examples of such possible risks, including staffing challenges, disruptions caused by the implementation of a new maintenance management system, challenges presented by existing site conditions, contract

oversight, and coordination between working groups. While not all of these risks materialized, several did, including staffing challenges and meter site conditions that may have affected productivity, as discussed in Finding 2.

Project Budget and Timeline Were Not Based on Analysis or Realistic Assumptions

While PUD did adopt a project budget and a timeframe for completion, these items do not appear to have been based on thorough analysis or realistic assumptions. For example, the original project budget of approximately $60 million matches—down to the dollar—a quote from a third-party contractor to perform meter and endpoint installation work for Citywide AMI implementation. However, despite having decided to complete the work using its own workforces, PUD appears to have simply assumed that the project cost would be the same as that proposed by the third-party contractor. Moreover, a year after the City Council approved the original project budget, PUD requested a budget increase of about $7.5 million to cover the cost of meter installation labor and additional meters needed for the project.[7] The fact that these costs were not included in the original project budget further indicates that project requirements were not thoroughly considered from the outset.

Similarly, the project timeline does not appear to factor in any kind of productivity analysis for meter and endpoint installation.[8] Instead, PUD's timeline for meter replacements meant that City forces would have to install about 7,665 AMI-ready meters per month.[9] This figure coupled with PUD's

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[7] PUD staff appears to have backed out the costs associated with non-productive time from the portion budgeted for meter installation labor (about $5.3 million). This includes time for vacations, holidays, training, etc. The meter installation labor budget would have been higher had these costs been included in the project budget.

[8] We received minimal documentation related to a project schedule for endpoint installation, which shows PUD anticipated installing almost 9,400 endpoints, on average, between October 2017 and January 2020. However, PUD was not able to provide an explanation as to how this would be accomplished, due to the loss of institutional knowledge; key personnel that developed this schedule had already left PUD by the time of our audit.

[9] PUD planned for meter replacement labor costs based on a 30-month completion timeline for meter replacements that would begin in October 2016. At that time, we estimate that about 229,963

assumption that there would be the equivalent of 23.8 employees installing meters in the field each workday, on average, meant that each employee would need to install an average of 15.4 meters per workday.

However, as explained in more detail in Finding 2, the actual number of employees in the field was far less during the most recent period of the implementation. Furthermore, while the amount of time crews spent in the field appears reasonable, we estimated that each crew member was only able to install an average of 10.4 meters per day.[10] As a result, PUD installed an average of about 3,000 meters per month between October 2016 and March 2018—less than half of what was required to meet PUD's original project timeline. **Exhibit 11** compares the number of meter installations required by PUD's original project timeline to the actual number of installations recorded in SAP.

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meters were pending replacement. Therefore, about 7,665 meters would need to be replaced each month to meet the 30-month timeline.

[10] Our review of meter replacement crew productivity covers the period during fiscal year 2018 between July 1, 2017 and March 11, 2018. On March 12, 2018, PUD transitioned to the City's new Enterprise Asset Management system (EAM). This transition likely affected overall crew productivity as employees had to adapt to the new technology and workflows. Therefore, our review focused on the period immediately before EAM was deployed, with the intention of capturing the most accurate representation of typical work crew productivity. We found that, during our review period, crews replaced about 10.4 meters per day (95% confidence ± 0.4 meters), taking about 26 minutes to replace each one (95% confidence ± 1 minute) and spending a reasonable amount of their time in the field completing work.

PUD Replaced far Fewer Meters Than Planned During Implementation
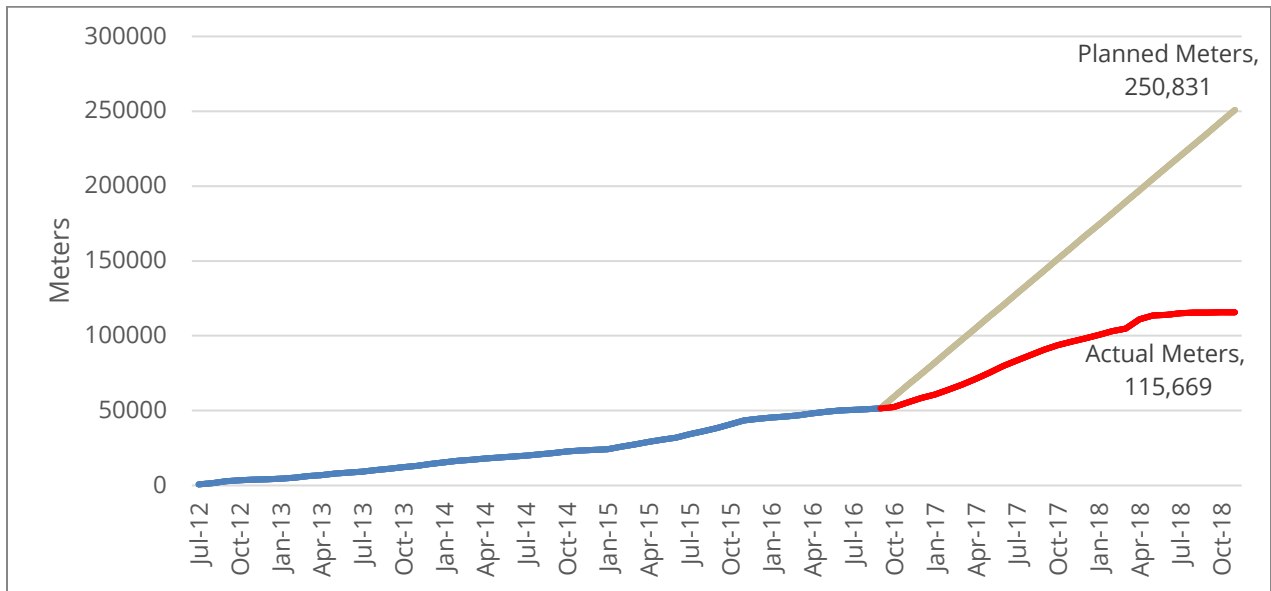
Note: The blue and red lines on the graph reflect actual meter installations through November 1, 2018. Therefore, the planned number of meters (250,831) is less than the total number of meters Citywide (281,493) because PUD did not anticipate completing all meter replacements until March 2019.

Source: Auditor generated from PUD data. Planned installations calculated from 30-month estimate used in September 2016 to create budget for labor funds request.

PUD Appears to Have Tried Backing into an Unrealistic Project Timeline

Moreover, it appears PUD did not base the initial project timeline on actual employee productivity. In September 2016, when developing the FY 2018 budget, PUD estimated a need for about $5.3 million in additional project funding to account for meter installation labor. However, based on documents we reviewed, it appears that:

- Within the span of two days, the department shortened the estimated project timeline from 42 to 30 months, despite—or, perhaps, because of—recognizing at that time that the project was already a year behind schedule.

- In both the 42-month and the 30-month scenarios, the department assumed 30 employees would be installing meters.[11] Using the same number of employees in a shortened period had the effect of increasing the expected output by about 40 percent without any regard to the actual capacity of the meter installation group.

- Beginning in October 2016, 30 months for completion would mean the meter installations would be complete by March 2019. However, this was not the case. We estimate that about 166,000 meters were still pending replacement as of November 1, 2018, a few months after PUD put the Citywide AMI implementation on hold.

- On an average workday in the most recent period of the implementation, the meter replacement crew consisted of about 14.9 employees, each replacing about 10.4 meters per day.[12] At that rate, replacing the estimated number of meters remaining as of November 1, 2018 would take closer to 51 additional months—meaning that, at those productivity levels, PUD would not have completed meter replacements until January 2023, almost four years behind schedule.

- Additionally, since the project budget for meter replacement labor was intended to last only through June 2019, PUD may need additional funding to cover meter replacement labor beyond that time.

By raising productivity expectations during the initial attempt at deploying AMI across the City, it appears PUD was trying to back into a pre-determined project schedule that was unrealistic; the schedule did not align with actual staffing levels or employee productivity. These were critical

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[11] PUD estimated the rate of non-productive time to be 20.67 percent. At this rate, the 30 employees in the field would be reduced to the equivalent of 23.8 employees when factoring in non-productive time.

[12] 95% confidence ± 1.9 employees per day.

discrepancies that hampered PUD's ability to meet the project's completion timeline.[13]

PUD Appears to Lack a Policy on How Major Projects It Completes Internally Should be Managed

In addition, we did not find any evidence that PUD has or follows a general policy related to project management for major projects undertaken exclusively by the department. We requested to review such a policy, but staff explained that most of its projects are managed by the Public Works Department (Public Works) and that major projects undertaken by PUD would normally be managed similarly to how Public Works manages Capital Improvement Program (CIP) projects.

PUD management provided several documents that collectively serve as department guidance for CIP projects, including a planning flowchart, an internal policy for business case evaluation, a Council Policy for the prioritization of CIP projects, and a service level agreement between PUD and Public Works that defines roles and responsibilities between the two departments for the planning, design, and construction of CIP projects.

While the department policy for business case evaluation applies to all projects with estimated expenditures over $50,000, we were not provided with the business case evaluation done for the Citywide portion of the AMI implementation. Moreover, the AMI project is not covered by the service level agreement, because PUD decided to complete the AMI project on its own, without any services provided by Public Works.

PUD staff explained the reason for this was that the AMI project is unique and unlike typical CIP projects, involving aspects of both construction and information technology. PUD management reiterated the complex and unique nature

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[13] This timeline does not include endpoint installations, which are also a necessary component of AMI implementation. We have no basis of estimating staffing and productivity levels for endpoint installation, because PUD has not made significant progress on endpoint installation.

of the project, which ultimately led to the decision to manage the AMI project in-house.

For these reasons, PUD did not provide any specific project management policies for our review that would apply to the AMI project or other projects that are similar in nature. Therefore, PUD appears to lack project management guidance for complex, large-scale projects that affect several business areas and are completed in-house, without the assistance of Public Works.

The Citywide AMI Implementation Has Experienced Major Delays

As a result of these issues, the Citywide AMI implementation has experienced major delays. Since work began on the Citywide AMI implementation, the project's estimated completion date changed several times before PUD put the project on hold altogether in 2018. **Exhibit 12** shows notable events within the Citywide implementation portion of PUD's AMI project history.

Exhibit 12:

PUD's Citywide AMI Implementation Has Been Delayed Several Times

Date	Event	Estimated Completion
June 2015	PUD begins installing AMI-ready meters as part of the Citywide implementation.	N/A
January 2016	IROC states that the Citywide implementation had begun, with an estimated cost of $60 million and a target completion date of December 31, 2017.	2017
June 2016	City Council approves $60 million project budget.	2017
December 2016	IROC notes that the AMI project had been delayed by procurement of hardware and installation issues but that the project is on track with a completion date of 2018.	2018
June 2017	PUD updates the Environment Committee on the AMI project, anticipating completion by March 2020.	2020
June 2017	$7.5 million adjustment is approved, bringing the total project budget to $67.6 million.	2020
July 2018	PUD temporarily suspends the AMI project while several reviews of the department are completed.	TBD

Date	Event	Estimated Completion
December 2018	The City Council approves an agreement with Itron for Citywide AMI implementation, which includes AMI equipment and project management services at a cost of $25.2 million. PUD management states they are still re-evaluating how to move forward with the AMI project.	TBD
December 2018	The Office of the City Auditor sends a memo to PUD management notifying them of significant project management deficiencies so that they may take immediate corrective action to address them.	TBD
April 2019	PUD informs the Office of the City Auditor that it has restructured management of the AMI project, assigned a project manager, and intends to start a new pilot phase. PUD anticipates hiring a contractor to perform work alongside City forces for approximately nine months in order to evaluate how to proceed.	TBD

Source: Auditor generated from City Council, Council Committees, IROC, and PUD materials.

Despite at Least Three Years to Complete Work, Only 41 Percent of Meters were Installed by November 1, 2018

Moreover, these project delays have coincided with only limited progress toward Citywide AMI. For example, only about 115,669 meters (41 percent) have been installed; this means about 165,824 (59 percent) are still pending completion as of November 1, 2018—over three years after having started installing AMI-ready meters for the Citywide AMI implementation in June 2015. **Exhibit 13** provides a breakdown of meter installation progress as of November 1, 2018.

Exhibit 13:

PUD Installed 41% of Needed Meters as of November 1, 2018

Source: Auditor generated from information provided by PUD. Each meter represents 10,000 meters. Filled meters are completed, transparent meters are pending.

Only 6 Percent of Meters Were Utilizing AMI Technology as of November 1, 2018

More importantly, only a relatively small number of customer accounts are utilizing AMI technology. PUD anticipated that approximately 75,000 meters (27 percent) would be read remotely via the AMI system by June 30, 2018, but, only about 16,000 meters—about 6 percent of all customers—were being read remotely by the system as of November 1, 2018. **Exhibit 14** summarizes endpoint installation progress as of June 30, 2018; because meters cannot be read remotely over the network until endpoints are installed and programmed, **Exhibit 14** also depicts the overall progress of the Citywide AMI implementation as of November 1, 2018.

Exhibit 14:

Because AMI Requires Both a New Meter and an Endpoint, Only 6% of All Customers Have Their Meter Read Over the AMI Network as of November 1, 2018

Only 6% of Customers have AMI

Source: Auditor generated from information provided by PUD.

Major Delays Make Cost Overruns More Likely

Furthermore, given that staffing and productivity was lower than PUD anticipated, and based on major delays to date, it is possible—perhaps likely—that the project will experience cost overruns in the future. This is also a risk because PUD had not considered how other variables would affect cost when setting the project budget. For example, the addition of labor

for meter box clean-outs and the impact of a new maintenance management system on employee productivity were issues that arose after the project budget was in place.

As previously stated, significant effort should be put into planning upfront because the cost to change course becomes higher as the project progresses. This is illustrated again in **Exhibit 15**. The intersection of the two curves in the diagram represents the point at which changes to the project become a form of destructive intervention, where the costs to make project changes exceed the added value. Since PUD did not make adequate and measured planning efforts, PUD is now closer to—or may even be past—this point; because so much time has passed, substantial changes now are more likely to incur significant costs than if they had been made previously. As explained later in this section, since around July 2018, PUD has been investing substantial resources to make significant changes to the project.

Exhibit 15:

The Need for Late Project Changes Results in Destructive Intervention
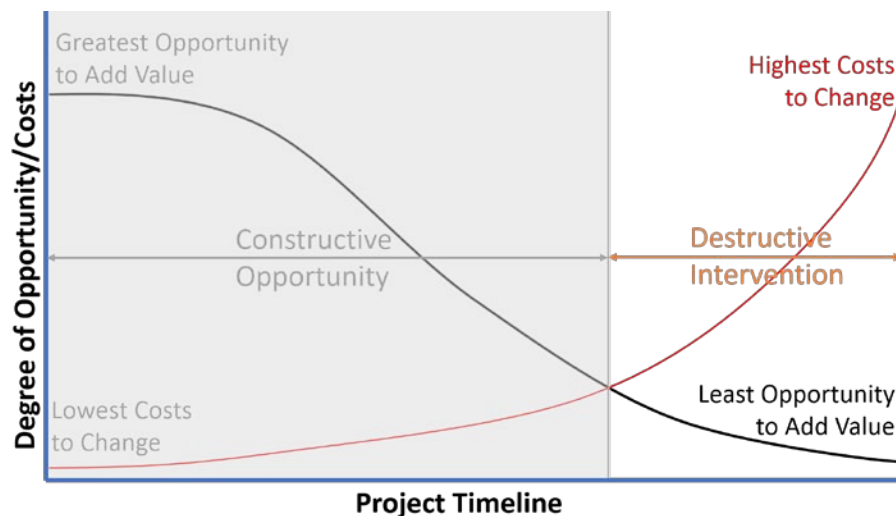
Source: Auditor generated based on *A Guide to the Project Management Body of Knowledge, 4th Edition, and A Framework for Project and Program Management Integration*.

PUD Management Put the Citywide AMI Implementation on Hold in July 2018

Ongoing internal reviews and other operational challenges prompted PUD to put the Citywide AMI project on hold in July 2018. Many of the deficiencies in project planning, budgeting, and management described above became apparent to us early in the audit process. Therefore, and pursuant to Government Auditing Standards, we notified PUD management in December 2018 of these deficiencies to encourage immediate corrective action.

We made the following recommendations to PUD at that time.

Recommendation #1:

The Public Utilities Department should designate a project manager to be responsible for all aspects of the project; the project manager should be empowered with an appropriate level of authority and resource availability. (Priority 1)

Recommendation #2:

The Public Utilities Department should create a formal Executive Steering Committee for the AMI implementation project, including, at a minimum, management representatives from the Water Construction and Maintenance Division, the Customer Support Division, the Communications Department, and the Department of Information Technology, as well as the project manager and the Public Utilities Director. (Priority 1)

Recommendation #3:

The Executive Steering Committee, in conjunction with the project manager, should develop a deployment plan for the Citywide AMI implementation project, which includes specific and detailed tasks, responsibilities, budgets, and a timeline for completion. Budgets and timelines for completion should be supported by detailed analysis based on realistic assumptions. (Priority 1)

Recommendation #4:

The Executive Steering Committee should meet regularly to review performance against project goals and timelines and adjust the deployment plan as needed. (Priority 1)

PUD Has Taken Some Remedial Actions and is Currently Planning Other Areas of the Project

Since our December 2018 memo, PUD has taken significant steps toward correcting the issues we identified. In June 2019, PUD provided documentation indicating that they had assigned a project manager with appropriate authority and established an executive steering committee. Based on our review of this documentation and our conversations with PUD management, we consider Recommendations 1 and 2 to be implemented.

In addition, PUD reported being in the process of developing several areas of the project, including:

- Holding regular meetings of the established executive steering committee;

- Identifying personnel resources;

- Mapping out processes and system interfaces;

- Consulting with the Communications Department to plan customer outreach efforts;

- Consulting with the Performance and Analytics Department to create performance metrics for the project; and

- Evaluating new methods for completing the remaining installation work, including a pilot project to evaluate whether and how to divide project tasks between City forces and a contractor.

We will continue to evaluate PUD's progress towards implementing these recommendations.

In addition to the recommendations we made to PUD in our December 2018 memorandum, and to ensure that the lessons learned during the Citywide AMI implementation to date are incorporated into the development and planning of major projects at PUD in the future, we also recommend the following.

Recommendation #5:   The Public Utilities Department (PUD) should issue a directive, through a departmental policy or memorandum, that would be in effect and applicable to major projects where the Chief Operating Officer has decided for PUD to manage the project in-house instead of through the Public Works Department. The directive should require PUD management to document the reason(s) for this decision.

Additionally, the directive should require that staff complete the project according to the Project Management Body of Knowledge or other generally accepted project management standards, which includes developing and putting into practice certain project management documents, such as a project charter and a project management plan.

The directive should also establish an appropriate executive authority for approving the decision to manage the project in-house as well as key project management documents, such as the project charter and the project management plan. (Priority 2)

In June 2019, PUD issued a directive that meets the intention of this recommendation, and we consider Recommendation 5 to be implemented as well.

Finding 2: The Public Utilities Department Needs to Address Several Staffing Issues to Improve the Performance of the Citywide AMI Implementation

As mentioned in Finding 1, staffing issues were an unforeseen risk that have significantly slowed the Citywide AMI implementation. PUD management decided that the Citywide portion of the AMI implementation, including meter replacement and endpoint installations, would be completed by in-house crews. The meter replacement group as a whole and individual meter installers had lower productivity than management assumed in planning the implementation. We found that, due to several reasons, including management decisions about how to staff these functions, a hiring freeze, and possibly uncompetitive pay, PUD has experienced high vacancy and turnover levels in key groups responsible for the AMI implementation. Although these individuals are not always leaving the City, they are leaving the meter replacement group at a high rate.

PUD relies on employees in the meter replacement group to conduct meter replacements for the AMI implementation. Unlike PUD's ordinary operations in which meters are replaced as they age, the AMI implementation requires replacing all non-AMI meters with AMI-ready meters before endpoints can be installed and the customer can be connected to the AMI network.

PUD has stated that the meter reading group will be responsible for part of the AMI implementation. Although not as severe as the meter replacement group, the Meter Reading group has also experienced high vacancy and turnover. Additionally, the meter reading group remains responsible for conducting in-person reads for non-AMI meters.[14]

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[14] The Meter Reading group is also responsible for reading AMI meters that did not report a read within 72 hours prior to its billing read date.

The high vacancy rate and annual turnover in groups responsible for the Citywide AMI implementation have resulted in severe delays, as PUD lacks a sufficient number of staff to complete the implementation on schedule. While we found that staff spend a reasonable amount of time in the field, they complete significantly fewer meter replacements per crewmember per day than PUD management anticipated. Without a reliable workforce of sufficient size to complete meter and endpoint installation and programming, the AMI implementation will continue to fall behind schedule.

In order to prevent the Citywide AMI implementation from falling further behind schedule, we recommend that PUD develop staffing management plans for its meter replacement and endpoint installation work. Additionally, we recommend that PUD determine the causes and impacts of high vacancies and turnover in the meter replacement group and work with the Personnel Department (Personnel) to address any identified causes, as needed.

Planning an AMI Implementation Should Include Determining a Timeframe and Estimating Labor Costs

The *Guide to the Project Management Body of Knowledge* (PMBOK Guide) provides guidance on project human resource management. This includes developing a staffing management plan to describe when and how human resource requirements will be met, including considerations of staff acquisition from within the organization or from external, contracted sources. When the organization lacks the in-house staff needed to complete a project, the required services may be acquired from outside sources. Failure to acquire the necessary human resources for the project may negatively affect project schedules, budgets, customer satisfaction, and quality; it could increase the risk of failure and ultimately result in project cancellation. Additionally, cost estimates should include the identification and consideration of alternatives to initiate and complete the project, including outsourcing.

In addition, *West Monroe's Guide to Water Utility AMI Deployment* advises that, as part of planning and strategizing

for AMI implementation, utilities should calculate AMI costs and savings. As part of this effort, utilities should:

- Determine a deployment timeframe and whether new AMI meters and endpoints can be installed with in-house labor or whether this work should be contracted out to a third party;

- Estimate labor costs based on the anticipated volume of meter replacements, including any needed infrastructure repairs, such as meter boxes and lids; and

- Validate key business case costs, savings, and assumptions with business, field, and technology stakeholders.

By making these efforts, the water utility can have a better understanding of the labor resources necessary to complete the implementation within the selected timeframe.

During our interviews with other water agencies who have or are implementing AMI, we asked about outsourcing considerations. The agencies we spoke with that had completed AMI projects stated that they outsourced both meter and endpoint installation labor. One agency with an in-progress AMI implementation stated that it did not outsource installation labor for its agency-wide implementation, but that it plans for a project timeline of about 11 years. This highlights that it is possible to conduct an AMI implementation in-house, but it may require a long timeline.

To Achieve its 30-month Meter Replacement Timeline, PUD Anticipated Using 30 Employees Dedicated to That Work

Based on documentation we reviewed, we found that PUD did at one point adopt a project timeframe and consider the labor cost for meter replacements. PUD staff developed a budget for meter replacement labor in September 2016. At that time, PUD anticipated the Citywide AMI meter replacements would be completed in a period of 30 months

with 30 employees installing meters.[15] Additionally, PUD accounted for a non-productive rate for these employees of about 21 percent due to "vacations, holidays, training, etc." This implies that the equivalent of approximately 23.8 employees would actually be replacing meters on a typical workday. Moreover, based on meter data from SAP and PUD's claim that they began exclusively installing AMI-ready meters in July 2012, we estimate that PUD had installed approximately 51,530 AMI-ready meters by the end of September 2016. This means approximately 229,963 meters were pending replacement at that time. While not explicity stated in their analysis, PUD's labor assumptions in September 2016 imply that each employee would need to replace about 15 meters per day to complete the meter portion of the Citywide AMI implementation in a 30-month timeframe.[16]

In Reality, PUD Used Far Fewer Employees for Meter Replacement, and Those Employees Were Less Productive Than Necessary to Meet the Timeline

However, we found that in the most recent period of the implementation, and due to a variety of issues outlined in the next section, PUD's meter replacement group was staffed at a level far below the expected 30 employees, and that average productivity—for both the group and individual meter installers—was significantly less than anticipated.

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[15] Based on supporting documentation, meter installations would begin the first week of October 2016. Using a start date of October 1, 2016 and a 30-month timeline, the meter replacement portion of the Citywide deployment would have already been completed by March 31, 2019. Additionally, meter installations actually began in late June 2015; a 30-month timeline from July 1, 2015 would have been completed by December 31, 2017.

[16] PUD provided additional documentation that shows that, beginning in October 2016, PUD's production goal was to replace 6,240 meters per month. We learned from PUD that this monthly goal assumed 26 employees would be replacing meters, working 20 days per month, and that PUD's goal for each employee was to replace 12 meters per day. We emphasize that the requirement of 15 meters per employee per day is a figure we calculated based on PUD's staffing and timeframe assumptions in September 2016 and on our estimate of the number of meters pending replacement at that time. Nevertheless, as explained further in Finding 2, the meter replacement group did not meet either of these targets between July 1, 2017 and March 11, 2018, with each employee replacing an average of 10.4 meters per workday and an average monthly productivity for the meter replacement group of 2,958 between October 2016 and March 2018.

For example, in the most recent period of the implementation, an average of about 21 positions in the meter replacement group (out of a total of 32) were filled, and we estimate that only about 15 employees were actually replacing meters on a typical workday.[17] This actual staffing level is about 38 percent less than PUD had anticipated—far less than required to meet the 30-month timeframe PUD adopted in September 2016.

Moreover, as stated in Finding 1, we estimated that each crew member installed an average of 10.4 meters per day—5 (32 percent) fewer than PUD's expectation. As illustrated in **Exhibit 16**, these two factors combined resulted in a significant disparity between the requirements of the original timeline adopted in September 2016 and the reality of the meter replacement group's actual capacity later in the implementation.

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[17] This is based on a random sample of workdays between July 1, 2017 and March 11, 2018. We selected this period because it represents the most recent portion of PUD's Citywide AMI implementation prior to the City's deployment of the Enterprise Asset Management system (EAM). On March 12, 2018, PUD transitioned to EAM; this transition likely affected overall crew productivity as employees had to adapt to the new technology and workflows. Therefore, our review focused on the period immediately before EAM was deployed, with the intention of capturing the most accurate representation of typical work crew productivity.

Exhibit 16:

The Meter Replacement Group's Actual Staffing and Productivity Levels Were Far Lower than PUD Anticipated
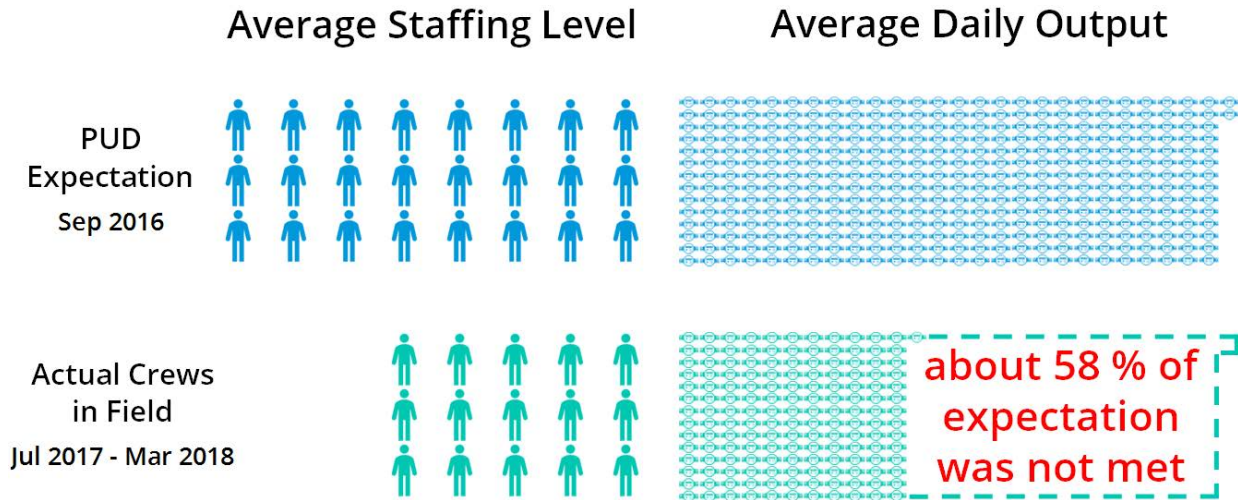
Note: Each person represents one meter installer, and each meter represents one expected installation per day. The staffing level reflects the number of employees in the field replacing meters on an average workday. Since PUD anticipated that the equivalent of about six employees would be absent due to vacations, holidays, training, etc., those employees are not shown under PUD's expectation in the graphic.

Source: Auditor generated based on internal communications from PUD, meter data from SAP, and work order data from SWIM.

Staffing and Productivity Issues in the Meter Replacement Group Were Caused by Several Factors

Several factors caused PUD to fall far short of the level of staffing or productivity it anticipated in September 2016, including:

- PUD management did not adequately consider staffing prior to the Citywide AMI implementation;

- The meter replacement group had a significant number of vacant positions;

- PUD staffed the meter replacement group with a significant number of limited positions, which may be less desirable for employees and may have made these positions more difficult to fill or retain;

- The meter replacement group suffered from high employee turnover;

- Management took actions that contributed to having fewer employees dedicated to meter replacement, such as regularly reassigning staff based on competing priorities and instituting a hiring freeze;

- Management did not adequately plan for meter site conditions prior to the implementation;

- Pay for San Diego Water Systems Technicians (WST's), who along with Laborers make up the meter replacement group, is 30 percent below the median of 15 benchmark cities; and

- Laborers may wish to transfer out of the meter replacement group to less demanding positions.

PUD Management Did Not Adequately Consider Staffing Prior to Citywide AMI Implementation

First, there is the issue of inadequate project planning. As discussed in more detail in Finding 1, PUD management did not sufficiently plan the Citywide AMI implementation, which would have included staffing and productivity analysis to ensure that project budgets and timelines could be met. This is evident by the fact that cost considerations for meter replacement labor were not included in the original project budget that was adopted as part of the FY 2017 Capital Improvements Program. Instead, those costs were contemplated in September 2016—over a year after the first meter replacements for the Citywide AMI implementation began in June 2015.

The Meter Replacement Group Had a Significant Number of Vacant Positions

Moreover, PUD did not complete a staffing analysis ahead of time to ensure the meter replacement group was capable of meeting management expectations. We conducted a staffing analysis for the period since PUD began the Citywide installation of AMI-ready meters in June 2015 and found that the meter replacement group experienced a high rate of vacant positions. Between July 1, 2015 and March 31, 2019, the meter replacement group consisted of an average of about 35 positions. However, on average, only about 27 of

those positions were filled.[18] Therefore, the average monthly vacancy rate was about 22 percent during PUD's initial attempt at implementing AMI across the City.

PUD Staffed the Meter Replacement Group with a Significant Number of Limited Positions, Which May be Less Desirable for Employees

Additionally, of the average number of filled positions, almost a third (31 percent) of them were limited positions. Limited positions may be considered by some employees as less desirable for several reasons. For example, employees in limited positions may be terminated at any time, and such action is not subject to review by the Civil Service Commission. Therefore, limited employees do not enjoy the same employment rights and protections as permanent employees.

Moreover, many of these positions are Laborer positions. Laborer positions are unskilled and do not require any specific education or experience; Laborers perform routine, unskilled construction and maintenance tasks that involve heavy physical labor. Finally, Laborer positions are among the lowest paid entry-level positions, making them less attractive in terms of salary potential. As a result, individuals in limited and Laborer positions may be less productive than permanent and skilled WST positions.

While limited positions are meant to be used only in support of urgent operational needs, as can be seen in **Exhibit 17**, the meter replacement group relied heavily on limited positions during its initial attempt at Citywide AMI implementation.

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[18] The figures here differ from the figures on page 30 because they reflect different periods (July 2015 through March 2019 vs. July 2017 through March 2018).
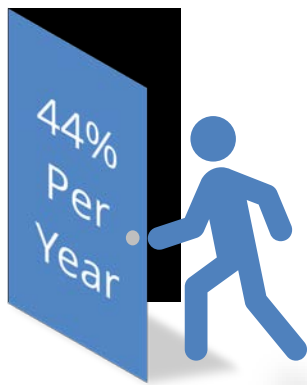
Exhibit 17:

From July 2015 – March 2019, The Meter Replacement Group had an Average Vacancy Rate of 22%, and 31% of Filled Positions were Limited

Filled, permanent position

Filled, limited position
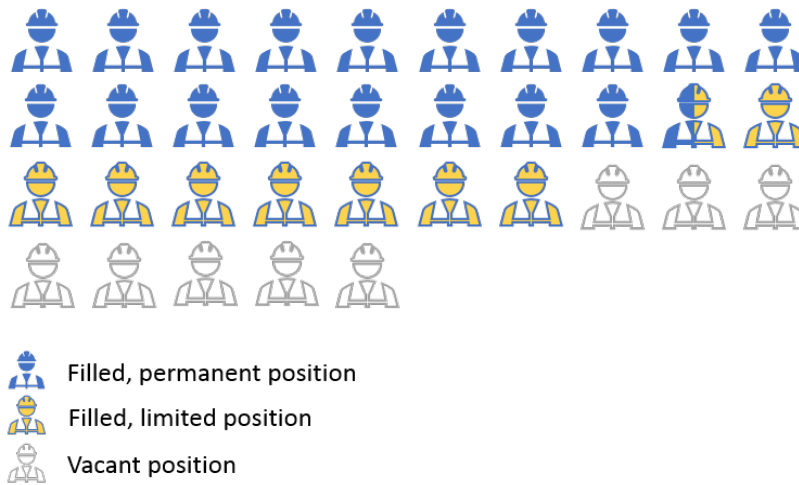
Vacant position

Source: Auditor generated from SAP data.

The Meter Replacement Group Suffered from High Employee Turnover

Aside from the vacancies and limited positions, we observed that the meter replacement group also suffered from a high rate of employee turnover, which may have contributed to a lower staffing level than anticipated. We estimate that the average employee turnover rate within the meter replacement group between July 1, 2015 and March 31, 2019 was approximately 44 percent per year, and that the average length of service in that period was about 1.4 years.[19] While most of these employees remained within the City, turnover likely had a significant impact on meter replacement group operations.

We reviewed the movement of individuals through the meter replacement group during the initial attempt at Citywide AMI implementation and found that about 41 percent of individuals came in as new hires. Of those individuals who worked in the meter replacement group, about 53 percent

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[19] The meter replacement group was made up of an average of about 35 positions, and a total of about 85 employees worked in this group at some point between July 1, 2015 and March 31, 2019. Service is specific to the Citywide AMI implementation and does not include service time prior to fiscal year 2016.

left to work in other PUD groups, 4 percent left to work in other City departments, 7 percent left the City altogether, and about 36 percent remained in the meter replacement group.

Using Limited Positions May Have Contributed to Turnover

We learned from interviews with PUD management that the department decided to use limited positions based on the intention that the Citywide AMI implementation would be temporary in nature. According to PUD, these positions would no longer be necessary once the implementation was complete. Therefore, and rather than risk dealing with reductions in the workforce and the larger disruptions those might cause, PUD decided to use limited positions to meet the staffing needs of the meter replacement group. However, because a significant portion of the positions were limited, employees in these positions may have been inclined to find permanent, benefitted positions when those became available.

Using the Meter Replacement Group as a Career Entry Point May Have Contributed to Turnover

In addition, PUD reported that new hires into the Water Construction and Maintenance Division (WCM) typically begin as Laborers in work groups within the Meter Shop, including the meter replacement group. We learned through interviews with management that PUD sometimes underfilled permanent WST positions with Laborers in limited positions. This may have created a situation where employees were predisposed to remain in their positions for a relatively short term. For example, management reported that new Laborers typically use this opportunity to gain experience and attain the necessary certification for the WST classification; these employees then may move to a permanent position in a different work group—or altogether out of the City—when an opportunity arises.

However, we did not find evidence supporting the claim that individuals gain experience and leave for a higher-level position, as only about 13 percent of individuals in the meter replacement group left or remained employed in the meter replacement group at a higher classification than they

entered. Only about 4 percent of those who left the meter replacement group left for a higher classification. Instead, other issues may explain turnover within the meter replacement group, at least to some extent.

Staffing the meter replacement group with limited positions and using the meter replacement group as an entry point for new hires may have inadvertently had the effect of generating employee turnover. It is possible that many employees started in limited Laborer positions with minimal experience and then moved on to different work groups within the department when permanent positions became available.

Management Took Actions That Contributed to Lower Staffing and Productivity

In addition to employee turnover, PUD management took several actions that limited their ability to maintain an appropriate staffing level for meter replacements. The issue of reassignments and a temporary hiring freeze within the Meter Shop both contributed to having fewer employees dedicated to meter replacement. In addition, management had not factored in meter site conditions prior to the Citywide AMI implementation, contributing to lower-than-anticipated productivity. These issues are discussed in more detail below.

Management Regularly Reassigned Employees Based on Competing Priorities

One of these actions was regularly shifting employees from one work group to another based on competing operational priorities. According to PUD, employees who work on meter replacement—including Laborers and WSTs—are capable of working in other areas that fall within WCM, including on maintenance crews for meter cover replacement, emergency services, hydrants, valves, and backflow devices. Depending on service demands and how management prioritized the work done by each crew, meter replacement employees would sometimes be assigned to work in different work crews, resulting in fewer employees available for meter replacement.[20]

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[20] It is important to note that this would be indicative of greater staffing issues within WCM. Regularly moving employees from one work group to another based on shifting operational work priorities would only be possible if there were fewer employees than necessary throughout all of the

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Management Temporarily Instituted a Hiring Freeze in the Water Construction and Maintenance Division

In addition, according to PUD management, WCM was not able to fill vacancies for a period of about 16 months while hiring practices within the department were improved. This temporary hiring freeze came after our August 2016 fraud hotline report, which found PUD staff did not use approved screening criteria when hiring Laborers into WCM and made eight recommendations to improve the internal controls involved in PUD's hiring process.[21] While we did not specifically recommend a hiring freeze, according to PUD management, the department held back on hiring for some time to ensure all rules were being followed before hiring an employee into the department. As important as it was to address these issues, PUD's hiring freeze also coincided with its initial attempt at Citywide AMI implementation and complicated PUD's ability to staff the meter replacement group appropriately.

Management Did Not Plan for Meter Site Conditions Prior to Citywide AMI Implementation

As Finding 1 discusses in more detail, PUD management did not adequately plan the Citywide AMI implementation. An adequate plan would have included a comprehensive assessment of potential risks to the success of the project. Such risks would include anything that prevents PUD from replacing water meters in a manner that is efficient and effective. We learned from other agencies and from professional guidance that a typical concern when deploying AMI is the condition of the meter sites, including the box or vault that houses the meter and the lid covering it. We observed that meter replacement crews encounter meter sites in many different conditions, making some meter

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groups where these employees work. Therefore, we reviewed staffing levels within WCM specifically for the Water System Technician and Laborer classifications and found an average vacancy rate of about 14 percent between July 1, 2015 and March 31, 2019. While lower than the vacancy rate of the meter replacement group experienced, this vacancy level may have conrtibuted to management's reassignment of employees to and from the meter replacement group during the initial attempt at the Citywide AMI implementation.

[21] The Office of the City Auditor's Fraud Hotline Investigation of Abuse in the Public Utilities Department's Selection Phase of the Hiring Process is available online at: https://www.sandiego.gov/sites/default/files/pud_selection_phase_of_the_hiring_process.pdf.

Example Site Conditions

replacements easier than others. Some of the variables that make the job more difficult (and time-consuming) include:

- Whether the meter can be located and whether it is accessible;

- The placement and size of the meter box/lid; and

- The age and condition of other hardware inside the meter box.

At least one of the other agencies we spoke to noted that their meter reading staff took an inventory of meter site conditions, which included making note of the condition, type, and size of the meter, box, and lid and other useful information. According to the agency, this was helpful ahead of their AMI implementation because it allowed their maintenance team to take care of issues before deploying the installation team, which helped cut down on installation time. Because site conditions directly impact the amount of effort and time spent on a meter installation, it is best to have the sites ready to go ahead of time.

However, we found that a similar process was not in place at PUD prior to the Citywide AMI implementation. Instead, we learned that, in April 2018—almost three years after meter replacements began for the Citywide AMI implementation—PUD began piloting a "one-and-done" approach to improve efficiency of the AMI installation process. This pilot included the use of a vacuum truck and crew to clean out meter boxes ahead of meter installation crews. While it seems likely that the addition of this step may help improve overall meter replacement productivity, PUD has not yet determined if this meter box clean-out process is feasible for the remainder of the Citywide AMI implementation.

San Diego Water Systems Technicians' Pay is 30 Percent Below Median

In addition, there are several factors that potentially impact staffing levels that are outside of PUD's direct control. One major consideration is employee pay. In 2015, a study by Koff & Associates found total compensation for the Water Systems Technician III classification to be about 30 percent below the

median—and second to last—among 15 benchmark cities, many of which have lower costs of living than San Diego. Low pay potentially makes it harder for PUD to hire journey-level Water System Technicians from other organizations, causing PUD to instead rely on unskilled Laborers that require training.

In 2018, Local 127 requested a special salary increase for Laborers and WSTs due to a reported difficulty in recruiting and retaining employees for these positions. The labor union described problems with the availability of qualified candidates and employee turnover, among other reasons. The Personnel Department, however, recommended that the Civil Service Commission deny the salary increase based on their review of the reported issues, which found that the City was not experiencing turnover or recruitment problems for these classifications.[22]

Meter Installation May Be More Demanding Than Other Laborer Tasks in the City

According to PUD, the department has used the Laborer classification to underfill the WST positions in the meter installation group. Laborers who underfill the WST position are required to perform difficult tasks and must pass a certification examination within three years. Across the City, the Laborer classification is used to perform a wide variety of tasks. According to PUD, in other groups within PUD and at other departments around the City, Laborers perform less demanding tasks and are not required to achieve any special certification. As a result, individuals in these positions may wish to transfer out of the meter installation group to less physically demanding positions or positions without a certification requirement.

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[22] We are currently conducting an audit of the City's strategic human capital management in regards to compensation competitiveness and employee discipline and rewards. We plan to investigate this issue further as part of that audit.

Without Reliable Staffing, the Project Will Not be Completed in a Reasonable Amount of Time

The combination of vacancies, turnover, and reassignments resulted in more employees assigned to replace meters on some days than others. Since PUD did not maintain a sufficient base of employees dedicated solely to meter replacement, and because employees were less productive than anticipated, the volume of meter installations required by the Citywide AMI implementation was not feasible to complete within the 30-month timeline anticipated in September 2016.

If Staffing and Productivity Levels Remain the Same, PUD Would Need Over Four Additional Years to Complete the Meter Portion of the Citywide AMI Implementation

Given the significant disparity between what PUD anticipated and what we observed, we developed our own estimate of the amount of time that would be needed to complete pending meter replacements. We based this on the actual meter replacement staffing and productivity levels we observed in the most recent period of the implementation. However, we note that these likely do not reflect actual productivity levels now that EAM is in place. Therefore, this example is meant only for illustrative purposes—to show what might be expected if staffing and productivity remains the same—and should not be used to plan future meter replacements for the Citywide AMI implementation.

We used the following variables to develop our estimate:

- The estimated number of meters pending replacement as of November 1, 2018;

- Average daily meter replacement productivity, based on SWIM data between July 1, 2017 and March 11, 2018;

- An estimate for meter replacement crews' non-productive time, based on SAP data between July 1, 2017 and March 11, 2018; and

- A year consisting of 251 workdays.[23]'

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[23] After factoring in weekends and City holidays.

Based on these variables, we estimate that PUD would need about 51 months (4.3 years) to complete the remaining meter replacements for the Citywide AMI implementation. This Is significantly more time than the 30 months PUD had estimated it would need beginning in October 2016.

The Work Group Responsible for Endpoint Activation May Face Similar Staffing Challenges

As discussed in the Background, endpoints must be installed and programmed in order for meters to be read remotely over the AMI network. Therefore, the completion of the Citywide AMI implementation also depends on endpoint installation and programming. Based on our review, it appears similar staffing issues may be affecting the work group responsible for those tasks.

PUD management has stated that they intend to use the meter replacement crews to install endpoints in the future, but that they intend to have meter readers activate and program the endpoints. We note that the meter reading group has also experienced an average vacancy rate of about 13 percent and a turnover rate of 33 percent since July 2015. Additionally, it has also relied heavily on limited positions, with those positions accounting for an average of about 39 percent of filled positions.

Given the importance of the meter reading group to the completion of Citywide AMI implementation, PUD should develop a staffing management plan for this group as well to determine how best to proceed with the project.

PUD has taken some steps to address staffing issues, such as by adding 25 full time equivalent positions in FY 2020. However, without analyzing and addressing the underlying causes of employee vacancies and turnover, this may not be sufficient to adequately staff the implementation. Therefore, in order to address issues related to adequate staffing for the AMI implementation and prevent project delays due to inadequate staffing and lower than anticipated productivity, we made the following recommendations.

Recommendation #6:   The Public Utilities Department (PUD) should develop a staffing management plan for meter replacements to enable the department to complete the Citywide AMI implementation on a schedule, as determined by PUD. As part of this plan, PUD should consider:

- A dedicated work group with experienced and stable staff to complete meter replacements; and

- Augmenting City forces with a third-party meter installation provider. (Priority 1)

Recommendation #7:   The Public Utilities Department (PUD) should evaluate the impacts and causes of turnover and vacancies in the meter replacement group, working with the Personnel Department (Personnel) to address any identified causes, as needed. This should include, but not be limited to, evaluating the impact of job classification requirements and pay competitiveness on employee recruitment and retention.

If PUD determines pay competitiveness is a significant driver of turnover and vacancies, PUD management should submit a Special Salary Adjustment to Personnel for Water Systems Technician, Laborer, and any other affected classifications.

Similarly, if PUD determines current job classifications are preventing PUD from hiring and retaining employees, PUD should work with Personnel to modify or create new classifications that are better suited to the tasks associated with the AMI implementation and other PUD business needs. (Priority 2)

Recommendation #8: The Public Utilities Department (PUD) should develop a staffing management plan for endpoint installation and programming to enable the department to complete the Citywide AMI implementation on a schedule, as determined by PUD. As part of this plan, PUD should consider:

- A dedicated work group with experienced and stable staff to complete endpoint installation and programming; and

- Augmenting City forces with a third-party endpoint installation and programming provider. (Priority 1)

Finding 3: The Public Utilities Department Should Accurately Track Meter Replacement Labor Costs to Improve Project Oversight

In addition to accurate budgeting, it is important for the Public Utilities Department (PUD) management to accurately track actual implementation costs to improve financial accountability, enhance operational effectiveness, and promote citizens' confidence in their government.

We found that PUD is not accurately tracking labor costs for the Citywide AMI implementation. Specifically, between July 2017 and mid-March 2018, we estimated that meter replacement crews undercharged their time to the AMI project by about 27 percent. During this time period, we estimated the amount undercharged was approximately $361,000. While this is a small portion of the project budget, it is important to note that we only reviewed labor charges for an 8.5 month period. Because the project began in 2015, the actual amount undercharged is likely higher.

Without capturing accurate labor charges, PUD management cannot monitor actual projects costs and identify whether they are aligned with the budget. Tracking labor costs accurately is important for transparency and oversight purposes, and accurate information would help better inform stakeholders involved in making critical decisions about the project.

We recommend that PUD provide timekeeping instructions to all employees working on the Citywide AMI implementation, including establishing supervisory review responsibilities. In addition, the AMI project manager or an appropriate designee should monitor labor charges to the project for reasonableness.

Project Management Guidance Suggests Labor Costs Should be Tracked and Regularly Monitored

According to Government Finance Officers Association (GFOA) best practices, governmental entities should have policies and procedures that support effective capital project monitoring and reporting because such efforts can improve financial accountability, enhance operational effectiveness, and promote citizens' confidence in their government. Specifically, GFOA advises officials to regularly monitor capital projects' financial and project activity information. This monitoring should include:

- A review of project-related financial transactions to support budget review, auditing, and asset management;

- A review of expenditures, both in relation to the current budget and over the entire project life; and

- A comparison of results to established measures of performance, including, at a minimum, cost and schedule performance indices.[24]

PUD is Not Accurately Tracking Meter Replacement Labor Costs

We found that PUD is not accurately tracking labor costs for the Citywide AMI implementation. Specifically, we estimate that, between July 1, 2017 and March 11, 2018, meter replacement crews undercharged time to the project by about 27 percent.[25]

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[24] The Government Finance Officers Association's best practices for capital project monitoring and reporting are available at https://www.gfoa.org/capital-project-monitoring-and-reporting.

[25] We arrived at this estimate by totaling hours charged on sampled days by individuals who worked in the meter replacement group at some point from 2015 to 2019, in order to exclude personnel working on the project but not installing meters. However, PUD noted that individuals from other groups may have been assigned to meter replacements as operational needs demanded. Making no assumptions about who may have worked on the meter installations, the total time charged by all PUD employees is approximately 18 percent less than expected from the SWIM data analysis during this time. We believe this inappropriately overestimates the time recorded for meter replacements, as it would include time spent by other work units on other parts of the project. Despite uncertainty on the magnitude of the undercharging, PUD agreed that time had been undercharged but should be charged accurately.

To test whether labor hours were accurately charged to the project, we compared service request and timecard data for 30 randomly-selected work days between July 1, 2017 and March 11, 2018. The service request data from PUD's legacy maintenance management system, SWIM, provided the number of employees that conducted meter replacements and the amount of time they spent conducting that work. The timecard data from the City's financial system, SAP, provided the employees who charged time to the project and the amount of time they charged.

We estimated the amount of time that should have been charged to the project based on the number of meter replacement employees in SWIM and time entry patterns in SAP. This analysis showed that meter replacement crews may be undercharging the AMI project by 32.3 hours per workday, which amounts to approximately 27 percent of the estimated meter replacement labor hours that should have been charged to the AMI project in SAP.[26] Using average crew costs over this time period, we estimated that approximately $361,000 was undercharged during the period we reviewed.[27] While this is a small portion of the overall project budget, it is important to note this is only for a period of 8.5 months, and that the project began in 2015. Therefore, total undercharging is likely higher than this amount. **Exhibit 18** summarizes our results.

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[26] 95% confidence ±12.4 hours per workday.

[27] 95% confidence ± $138,112

Exhibit 18:

Labor Costs for Meter Replacement Were Underreported for the Project by About 27% between July 1, 2017 and March 11, 2018
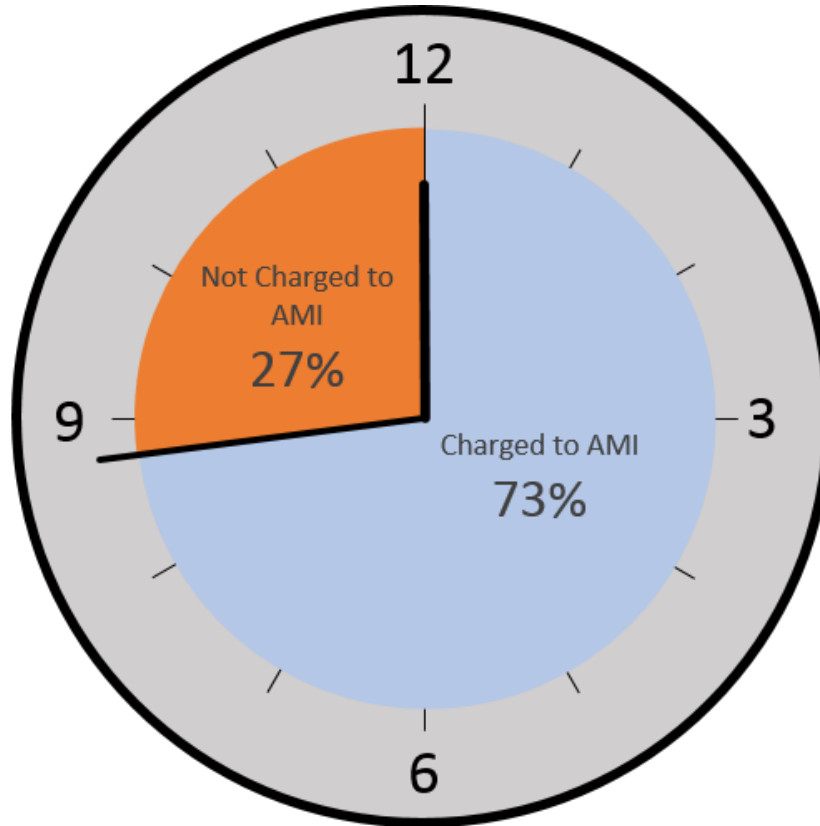
Source: Auditor generated based on data from PUD's legacy maintenance management system, SWIM, and the City's financial system, SAP.

Inaccurate Cost Tracking Increases the Likelihood of Running Over Budget and Diminishes Project Oversight

The importance of tracking project costs accurately—including labor costs—is several fold. First, labor costs directly affect the project budget. Therefore, charging less time to the project than accurate makes labor costs appear artificially low and overestimates the efficiency of the project. Further, and depending on how much has been budgeted for the project, there is a risk that the project budget for labor is not enough to cover actual costs. If this is the case, PUD is likely to require additional funding to cover actual labor costs.

Along the same lines, if labor costs are not charged accurately to the project, the portion of those costs charged inaccurately could be borne by water customers above the agreed distribution between the Water Fund and the Sewer Fund.

Finally, tracking project costs accurately is important for transparency and oversight purposes. This is especially relevant given that PUD is convening an oversight committee to keep the project on track and is working to make project-related information more readily available to customers and the public. Moreover, accurate information would help better inform stakeholders involved in making critical decisions about the project. This is especially relevant given that PUD is planning to run another pilot on the Citywide AMI implementation for the express purpose of comparing the efficiency and effectiveness of the work done by its own workforces to that of an outside contractor. Tracking its labor costs accurately could help PUD management make a more informed decision about whether or not to outsource meter installation labor.

PUD Does Not Have Formal Policies or Directives Related to AMI Project Timekeeping and Its Monitoring and Review Activities for Labor Costs are Insufficient

PUD acknowledged a lack of formalized timekeeping policies and procedures for the use of internal orders (IOs) or work breakdown structure (WBS) elements.[28] Instead, PUD explained that they advised employees via e-mail to use IOs and WBS elements appropriately when working on projects.

Moreover, there were insufficient monitoring activities to ensure the accuracy of labor charges for the project. For example, as previously explained, the project suffered management deficiencies, including the lack of a project manager who could oversee all aspects of the project, including labor costs. We did not find evidence that PUD was monitoring or reviewing labor costs to ensure their

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[28] An internal order is an element within SAP that is used to monitor the costs—and in some instances, the revenues—of an organization. A WBS element is a single element within a project structure; WBS elements are grouped together in a hierarchical structure under a project definition.

reasonableness. Further, inaccurate labor charges also likely resulted from a breakdown in supervisory controls at the point of timecard approval. Supervisors have the ability to request that an employee make changes to their timecard before approving it. Since supervisors have direct knowledge of employees' daily work activities, they are able to prevent inaccurate time entries from being recorded in the system. However, it appears likely that supervisors in some instances approved inaccurate time entries.

In order to ensure accurate tracking of project labor expenses, we made the following recommendations.

Recommendation #9:   To capture labor costs more accurately, Public Utilities Department management should provide timekeeping instructions to all employees working on the AMI project that specify how and when to charge their working time to the project. These instructions should be provided to employees in all business units working on the project, including (but not limited to) field crews that complete meter and endpoint installation, programming, and troubleshooting and office staff performing related administrative duties. These timekeeping instructions should also include guidance on supervisory responsibilities for those employees who approve others' time entries and guidance on which WBS sub-element(s) is (are) appropriate to use. (Priority 2)

Recommendation #10:   The AMI project manager or an appropriate designee should continuously monitor time entries and/or labor charges to the project for reasonableness. If issues are identified as part of this review, the project manager should coordinate appropriate corrective actions across the organization as necessary. (Priority 2)

Finding 4: EAM Work Manager Data Controls Do Not Effectively Prevent Data Entry Errors, Leading to Inefficiencies and Billing Delays

Successfully replacing an existing meter with an AMI-ready meter involves more than just removing and installing the physical meters. Meter replacement crews must completely and accurately enter a variety of information in a mobile tracking system, the EAM Work Manager, to prevent future troubleshooting, billing delays, and possible billing errors.

Professional guidance recommends that a system of preventive and detective controls operate together to prevent incorrect data from affecting business processes. It also recommends that systems validate data as close to the point of entry as possible, and that it utilize automated controls.

We found that the EAM Work Manager used by meter replacement crews did not effectively prevent data entry errors, leading to office staff reviewing and resolving errors later. Sometimes, this resolution requires additional field visits to correct missing or incorrect data. PUD has system and process controls to detect most data errors related to the meter replacement process. However, the detective controls in place are not as efficient as preventive system controls and have led to at least some customers receiving late bills, including multiple bills at the same time. Unfortunately, due to the nature of available data and a lack of exceptions tracking by PUD, we were unable to determine the number of affected customers.

It is important to note that PUD and the Department of Information Technology (DoIT) are working together to develop an improvement to the field device Work Manager application. DoIT reported this improvement will place controls

at the device level to prevent data errors at the point of data entry. DoIT stated that they are working on improvements to the user experience, including ease of use, a simplified process, validation controls on the device, reduced fields for the end-user, and utilization of cell phone technology to allow scanning of bar codes, taking pictures of the work, and automatic entering of GPS data. These new developments will change the control environment. Therefore, management will need to continue evaluating the control environment with the new developments. According to PUD, this new development was implemented on May 30, 2019.

Additionally, we were only able to review data entry controls related to meter installations. PUD reports that it will use EAM in the future to manage work orders for endpoint installations as well. If data on endpoint installation is inaccurate, it may result in a failure to connect to the AMI network or an endpoint being incorrectly assigned to the wrong meter.

We recommend that PUD and DoIT work together on developing, testing, and deploying improvements to EAM in order to evaluate the control environment to ensure accurate and complete data is entered into the EAM system. Additionally, we recommend that PUD track and evaluate exceptions created by SAP Customer Care Solutions (CCS) system to determine if the control environment is effective and efficient.

Professional Guidance Recommends a System of Both Preventive and Detective Controls

In order to ensure that business operations are efficient and effective, professional guidance recommends utilizing both preventive and detective controls.

A preventive control is designed to avoid an unintended event or result at the time of occurence. For example, effective training in a business process attempts to ensure that an employee performs the task correctly the first time, preventing errors. Similarly, preventive data entry controls—

such as required fields or invalid entry errors—prevent a system from accepting incorrect data when a user makes a mistake.

A detective control is designed to discover an unintended event or result after the initial processing has occurred, but before the ultimate objective has concluded. For example, when a supervisor reviews an employee's work, they should detect mistakes that were not prevented by other means. Likewise, detective data validation controls perform a check of data against expectations and needs. If the data in the system does not meet the expectations and needs—such as a valid meter providing an expected reading for a customer account—the system creates exceptions that a person must investigate and correct.

An effective and efficient system of controls should have both preventive and detective controls in place. If an organization relies entirely on preventive controls, unexpected events that do not meet the prevention criteria may create errors that are undetected and affect operations. If an organization relies entirely on detective controls, then it will be necessary to spend staff time investigating and resolving errors.

Data Controls Should Be in Place as Close to the Point of Data Entry as Possible

For data entry and validation controls, COBIT advises that IT systems should contain controls that protect operational objectives, correct data entry errors early, and allow performance analysis.[29]

As part of this system of controls, COBIT specifically recommends identifying and documenting the necessary control activities for operational objectives. It also recommends implementing automated controls. COBIT recommends validating input data and editing or, where applicable, sending data back for correction as close to the point of origin as possible.
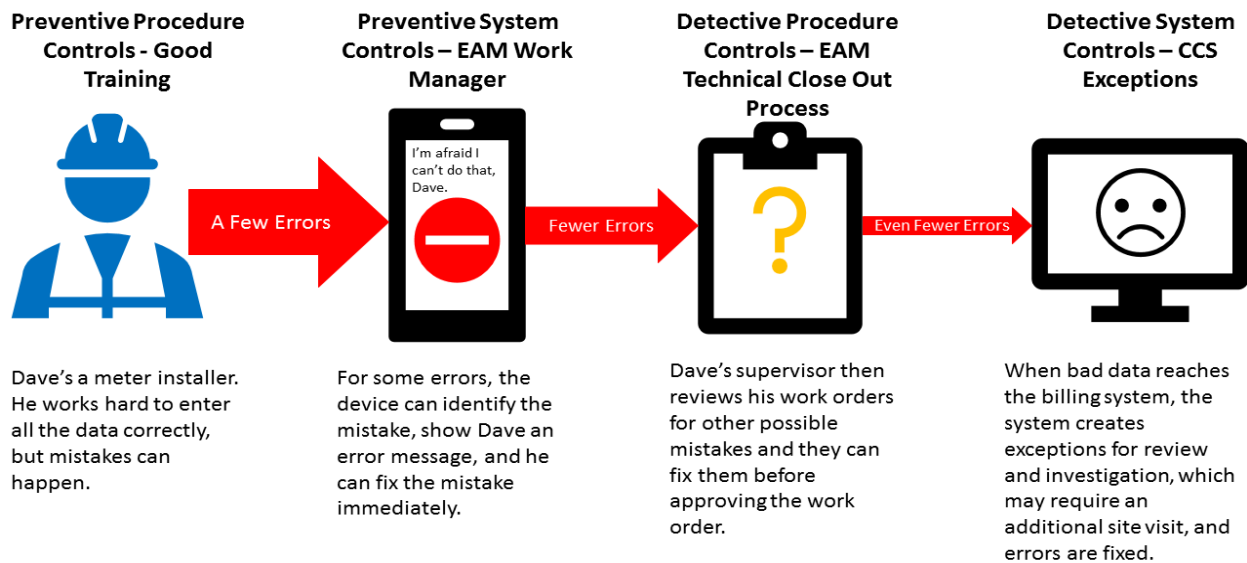
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[29] COBIT is a framework for the governance and management of enterprise information and technology, aimed at the whole enterprise.

When errors make it through the other controls, COBIT recommends that the organization manage business process exceptions and errors, facilitate remediation, execute defined corrective actions, and escalate as necessary. Furthermore, it recommends that organizations maintain evidence of remedial actions and report relevant business information process errors in a timely manner to perform root cause and trending analysis.

Exhibit 19 shows how PUD's training, systems, supervisor review, and exceptions reviews should work together to prevent human error from affecting business data.

Exhibit 19:

Multiple Lines of Defense Ensure an Effective and Efficient Data Control Environment

Preventive Procedure Controls - Good Training	Preventive System Controls – EAM Work Manager	Detective Procedure Controls – EAM Technical Close Out Process	Detective System Controls – CCS Exceptions
Dave's a meter installer. He works hard to enter all the data correctly, but mistakes can happen.	For some errors, the device can identify the mistake, show Dave an error message, and he can fix the mistake immediately.	Dave's supervisor then reviews his work orders for other possible mistakes and they can fix them before approving the work order.	When bad data reaches the billing system, the system creates exceptions for review and investigation, which may require an additional site visit, and errors are fixed.

Source: Auditor generated from information provided by PUD and DoIT.

The Department of IT Believed EAM Work Manager had a Sufficient System of Preventive Controls in Place

PUD's meter replacement process involves multiple lines of defense against entering incorrect data. The first line of defense is the EAM Work Manager that meter replacement crews use to record their work order information. DoIT reported that the EAM Work Manager includes several "hard errors" that would prevent crews from syncing data that does not meet validation criteria, which could cause operational and billing problems if not corrected. These criteria include:

- Attempting to enter information on meters that are locked by another user;

- Attempting to enter meter serial numbers that do not exist;

- Attempting to enter components that are not compatible with the meter;

- Attempting to enter meter serial numbers that are assigned to another job, truck, or already installed at another location;

- Attempting to enter meter reads that are smaller than the previous read; or

- Attempting to enter meter read dates that are prior to the previous read.

We asked to view error logs for Work Manager errors, but DoIT reported that the system does not keep a log of these errors.

**EAM Work Manager Controls Did Not Effectively Prevent Data Entry Errors**

Although DoIT reported that these controls would prevent syncing if data did not meet the validation criteria, we found that, while some preventive controls existed and were effective, several controls did not prevent syncing bad data to EAM. In order to assess the EAM Work Manager data controls, we asked PUD staff to deliberately enter incorrect data in order to demonstrate the errors described by DoIT. We observed that the following scenarios were not prevented from syncing:

- A service notification with incompatible meter components;

- A service notification with a meter serial number assigned to another job, on another truck, and already installed; and

- A service notification with a meter read date prior to the last recorded meter reading.

In all of these scenarios, the field crew's Work Manager device successfully synced with the EAM system during the equipment assignment step of the meter installation.Therefore, we concluded that the EAM Work Manager was not effectively preventing data entry errors.[30] As discussed below, these errors required additional staff time from the Meter Shop, Customer Support Division (CSD), or both to investigate and resolve these errors at a later time.

Working Data Controls Prevent Crews from Using EAM Work Manager Until the Service Notification is Resent by the Office

In addition, field crews reported that when a data error occurs, the EAM Work Manager will prevent them from proceeding with other service notifications until they call the office to send the service notification back. Field crews also reported that they have continued to fill out paper work orders alongside the EAM Work Manager. In the event that they encounter problems with EAM Work Manager, they will resort to only filling out paper work orders. They report that they will then return to the yard and enter the information into the EAM Work Manager after the service notifications are resent.
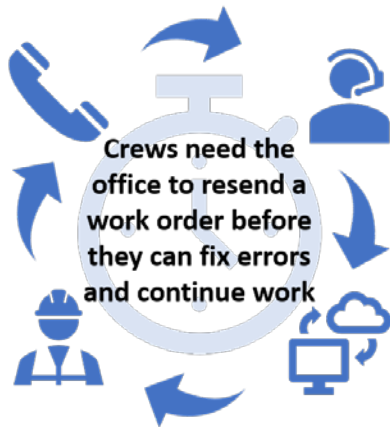
We also note that DoIT and PUD report that they are working together to develop an update to EAM Work Manager. DoIT reports that this updated version of Work Manager will be easier to use and include a simplified process, validation controls on the device, reduced fields for the field crews, and utilization of cell phone technology to allow scanning of bar codes, taking pictures of the work, and automatic entering of GPS data. According to PUD, this new development was implemented on May 30, 2019.

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[30] After observing these control failures, we stopped testing. As these critical data fields were entered incorrectly, we found this to be sufficient to determine that the control environment was not effective. Additionally, PUD staff only had three work orders to fill out to test the controls. As each error required the crews to call their supervisor to send the service notification back, we determined that further testing would only require additional staff time without significant benefit.

PUD's Supervisor Review is a Procedural Detective Control in Place

Although we found that the first line of defense—the EAM Work Manager—was not effectively preventing data entry errors, the remaining detective lines of defense are identifying and correcting most data errors that could produce an inaccurate bill. However, the process for detecting, investigating, and correcting the data entry errors is time-consuming and has resulted in at least some delayed bills.

One detective control is supervisor review when closing out work orders. Before closing out a work order—referred to as "TECO"—supervisors perform a quality check of information, including activity, measurement documents, time entry, and parts usage. Supervisors accomplish this by selecting individual service notifications and reviewing sub-tabs. During the TECO process, the supervisor is to check that: time entered is valid and accurate, all parts are used and accounted for, and all documentation is completed.

Auditors observed the TECO process during observation of the AMI meter replacement process. Several workstations and staff were assigned to a "war room" to review the notifications according to this process. When operational, the process prevents incomplete or inaccurate data from affecting meter replacements and customer accounts. However, the process is inefficient, requiring significant staff resources to review work orders.

PUD provided evidence that the department now has a "Meter QC Report." The report provides supervisors with the ability to review work orders for data validation. The report indicates "red" if there are data conflicts, "yellow" if there are missing data entries, and "green" if all data is properly entered. This report allows PUD to more easily identify incomplete work orders.

PUD's Billing System Has Automated Detective Controls in Place

In the event that bad data is transmitted to the billing system, CCS performs validation of billing events. A water bill consists of multiple billing items: water, sewer, and wastewater. If the system cannot generate a bill for one of these items, CCS will generate an exception and send it to the "EMMA queue" for review by PUD staff. Such a case could be generated when a field crew accidentally records a meter removal without a subsequent meter installation on a work order, and the supervisor approves and closes the work order.

We observed review of the EMMA queue and concluded that there is sufficient evidence to support that this control is in place and functioning. However, during our observation, PUD staff stated that there were over 1,000 cases in the EMMA queue for review, and that there were still unresolved cases in January 2019 related to data entry errors that occurred during the deployment of EAM in March 2018. It was not possible to quantify the number of cases related to the AMI implementation or the EAM deployment, as PUD reported that it does not keep data on EMMA cases.

According to PUD staff, another automated detective control is the SAP Exchange Workflow Inbox, which creates exceptions for some meter replacement problems. They stated that this inbox would collect cases where a meter serial number did not match, the most recent meter read was implausible, the meter serial number is installed elsewhere, or the outgoing read for a removed meter is not in line with its previous read.[31] PUD staff stated that they were not aware of any tracking of the SAP Exchange Workflow Inbox, but that there was no backlog as of May 14, 2019.

Exhibit 20 shows how the meter replacement data controls are made less efficient by a breakdown in automated preventive controls at the device level, leading to inefficiencies and billing delays.

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[31] Implausible meter reads are a system control to prevent inaccurate billings.

Exhibit 20:
Missing Data Controls Cause Inefficiencies and Billing Delays
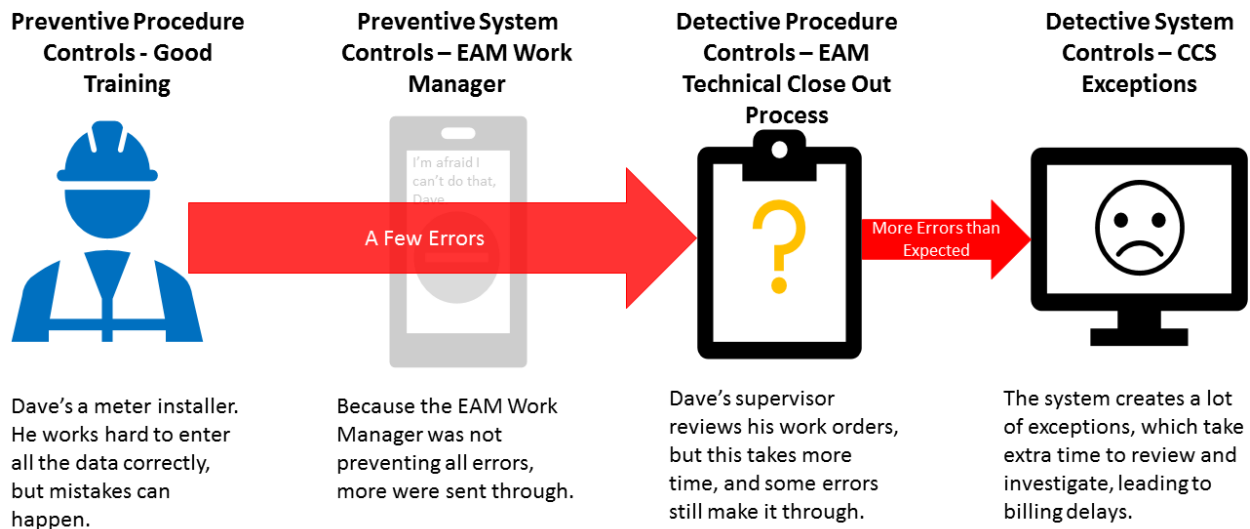
Source: Auditor generated from information provided by PUD and DoIT and auditor observations.

Although PUD staff report that they have made significant progress processing exceptions in the EMMA queue and SAP Exchange Workflow Inbox, and that the "Meter QC Report" should improve the efficiency of the TECO process, it is important to note that PUD has not been aggressively replacing meters since July 2018. Therefore, if the inefficiencies remain when the Citywide AMI implementation resumes, it may lead to more items for exception review and possible billing delays.

EAM Work Manager May Not Have Been Adequately Tested for the Meter Replacement Process

We found that the preventive control deficiencies we identified were because, according to PUD, EAM was not originally intended for meter replacements. PUD stated that Itron's Field Deployment Manager (FDM) was initially planned as the primary tool for recording meter replacements, as well as endpoint installations. They stated that EAM was expected to allow other crews to record one-off meter installations as needed, but that it was not expected to handle crews replacing 15 to 20 meter replacements a day.

PUD staff involved in the development and user acceptance testing of EAM reported that the timeline for EAM deployment made it difficult to fully evaluate the system, especially for meter replacements. PUD staff stated that some field crews were involved in the testing, but not many. They stated this happened in the final testing phase only. PUD staff stated that they did test the system in the field, but they noted that they only tested with information entered correctly so they could not speak to the functioning of controls in the field.

PUD staff stated that different people tested different pieces of the system, and this occurred primarily around the last few weeks before production. They noted that they tested scenarios across system roles, such as crew, supervisor, etc. They noted that synchronizing testing was difficult due to the moving nature of the project, because new features were developed or changed during the testing phase and could not always be tested together. They also noted that warehousing of inventory was a particular challenge, especially goods movement from the truck to the ground. PUD staff stated that there were other issues associated with the mobile device itself. They stated that there were issues with incomplete syncing of data and difficulties understanding error messages.

PUD staff also noted that some of the crews did not use computers in their regular course of work prior to EAM, and training them on the new devices proved demanding. PUD staff noted that the Water Construction and Maintenance Division (WCM) was previously fully paper-based. They also stated that although there were trainings, they did not believe there was enough time due to a management decision to continue aggressively replacing meters at the same time, thereby sacrificing training time.

PUD Must Devote Staff Time to Investigations

When data problems are entered and transmitted to the billing system, they cause billing exceptions that must be reviewed by PUD staff. This requires coordination with multiple work units, resulting in delays.

We observed a case review that involved a meter that appears to have been replaced but the replacement meter was not entered into the system (the meter readings steadily rose until a sudden drop from over 6,000 to below 100). PUD staff noted that this resulted in an EMMA case description that indicated the system could not issue a bill because "more than two bills cannot be invoiced." Staff stated that having identified the apparent meter exchange, they sent an email to the Meter Shop and is awaiting completion of the work order to update the system. They stated that when the installation is updated, they will remove the readings from the old meter and create new readings with those numbers for the new meter.

We asked how long fixing such a case would take, and staff stated that the duration depends primarily on the Meter Shop. They stated that fixing the data on the CSD side does not take a significant amount of time.

At Least Some Customers Have Received Late Bills, Resulting in Multiple Bills at Once

PUD staff stated that there were over 1,000 cases in the EMMA queue for review. They stated that during the initial deployment of EAM, this rose to over 10,000 cases. We asked if CSD had any tracking of the cases in the queue such as distribution of cases by type, resolution, or duration; PUD staff stated that they do not, and that each case is unique.

PUD staff stated that there is no method of prioritization aside from addressing the oldest cases first, or if a customer complaint draw attention to existing cases in the EMMA queue.

Due to the nature of data in SAP and the lack of tracking by PUD, we were unable to determine the number of customers experiencing billing delays due to meter replacements.

However, we did identify several cases of customers receivinglate bills, including at least one that we identified as receiving up to four bills within two days.

PUD staff stated that they send cases of late and multiple billings to collections to call the customer ahead of time and offer an installment plan. They stated that collections would call the customer the day before a bill is created.

Information and Technology Strategies should be Aligned with Business Objectives to be a Value Add Partner

COBIT provides guidance on the role of information and technology systems in an organization. Enterprise information and technology means all the technology and information processing the enterprise puts in place to achieve its goals, regardless of where this happens in the enterprise. In other words, enterprise information and technology is not limited to the IT department of an organization, but certainly includes it. When developing new systems, COBIT recommends that developers understand current business issues, objectives and expectations for information and technology systems; ensure that requirements are understood, managed, and communicated; and their status agreed and approved. This includes maintaining an awareness of business processes and associated activities.

COBIT also recommends aligning information and technology strategies with current business objectives and expectations to enable IT to be a value-add partner for the business and a governance component for enhanced enterprise performance.

In order to prevent business inefficiencies and billing delays due to data entry errors during the AMI implementation process, and to ensure information and technology systems are a value-add partner in PUD's performance, we made the following recommendations.

Recommendation #11:   The Public Utilities Department (PUD) and the Department of Information Technology (DoIT) should work together to evaluate the EAM Work Manager control environment and ensure the new Work Manager development meets PUD's needs for complete, accurate, and timely data entry for meter replacements. Specifically, these should include controls at the device level that prevent incomplete and inaccurate data from entering the meter replacement workflow.

Additionally, this evaluation should include maintaining an awareness of business processes and associated activities, and comprehensive testing of EAM Work Manager for the meter replacement process. (Priority 2)

Recommendation #12:   The Public Utilities Department (PUD) and the Department of Information Technology (DoIT) should work together to evaluate the control environment of any application to be used for endpoint installations—such as EAM—and ensure that it meets PUD's needs for complete, accurate, and timely data entry for endpoint installations. Specifically, these should include controls at the device level that prevent incomplete and inaccurate data from entering the meter replacement workflow.

Additionally, this evaluation should include maintaining an awareness of business processes and associated activities, and comprehensive testing of any application to be used for endpoint installation—such as EAM—for the endpoint installation process. (Priority 3)

Recommendation #13:   The Public Utilities Department should track the causes, resolution, and duration of all exceptions cases resulting from AMI meter replacements, including but not limited to EMMA and the SAP Workflow Inbox, and review the data to perform trending and root cause analyses. (Priority 3)

Conclusion

Advanced Metering Infrastructure (AMI) has the potential to improve the Public Utilities Department's (PUD) water billing and customer service operations. It can reduce human error in the meter reading process, improve customer service by providing detailed water usage data and leak detection, and allow customers to view their hourly consumption data to encourage conservation. However, the Citywide AMI implementation is a major project that touches all aspects of PUD's water billing operations, which requires extensive planning and project management.

We found that the Citywide AMI implementation lacked adequate planning and project management, resulting in major delays and increased risk of cost overruns. Four years after the Citywide AMI implementation was initiated, only 6 percent of meters are on AMI, and the majority of these were activated during the Pilot phase, which preceded the Citywide portion of the project.

Additionally, we found that staffing issues in the meter replacement group, and potentially in the Meter Reading and Field Investigations group, have negatively impacted PUD's ability to complete the Citywide AMI implementation in a timely manner.

We also found that PUD did not have policies in place to ensure that employees charged their time accurately to the project. As a result, the project has been undercharged for meter replacement labor.

We found that the EAM Work Manager may not have been adequately tested for the operational needs of the meter replacement crews. As a result, device-level data entry controls were not in place, resulting in additional staff time to review and fix data entry errors. In some cases, this resulted in delayed bills to customers, including some customers that received multiple bills at once.

To address the issues we found during this audit, we made a total of 13 recommendations, including establishing planning and oversight components for the AMI project, evaluating causes of high turnover and vacancies in AMI-relevant work groups and taking actions to address any identified causes, and ensuring labor costs are tracked comprehensively. We also recommend that PUD work with the Department of Information Technology (DoIT) to ensure that the control environment for any system used for work management in the meter replacement and endpoint installation provides PUD with complete and accurate data in a timely manner. PUD agreed to implement all of the recommendations.

Implementing these recommendations will help improve PUD operations in several ways, including providing proper planning and oversight to guide the remainder of the Citywide AMI implementation; ensure that future major projects conducted in-house by PUD are properly planned and managed; ensure adequate staff resources are available to complete needed implementation tasks; allow PUD to accurately track and report on project costs; and reduce inefficient troubleshooting and delayed customer bills by preventing inaccurate meter and endpoint install data from being entered into EAM.

Pursuant to generally accepted government auditing standards, four of these recommendations—related specifically to planning and oversight—were made through a memo to management in December 2018 to provide early notice of deficiencies. Since that time, PUD has implemented two of these recommendations to improve planning and oversight of the AMI project. In this report, we also recommended that PUD issue a department directive to establish such planning and oversight for any future major projects conducted in house. PUD has also implemented this recommendation.

Recommendations

Recommendation #1:   The Public Utilities Department should designate a project manager to be responsible for all aspects of the project; the project manager should be empowered with an appropriate level of authority and resource availability. (Priority 1)

Recommendation #2:   The Public Utilities Department should create a formal Executive Steering Committee for the AMI implementation project, including, at a minimum, management representatives from the Water Construction and Maintenance Division, the Customer Support Division, the Communications Department, and the Department of Information Technology, as well as the project manager and the Public Utilities Director. (Priority 1)

Recommendation #3:   The Executive Steering Committee, in conjunction with the project manager, should develop a deployment plan for the Citywide AMI implementation project, which includes specific and detailed tasks, responsibilities, budgets, and a timeline for completion. Budgets and timelines for completion should be supported by detailed analysis based on realistic assumptions. (Priority 1)

Recommendation #4:   The Executive Steering Committee should meet regularly to review performance against project goals and timelines and adjust the deployment plan as needed. (Priority 1)

Recommendation #5:   The Public Utilities Department (PUD) should issue a directive, through a departmental policy or memorandum, that would be in effect and applicable to major projects where the Chief Operating Officer has decided for PUD to manage the project in-house instead of through the Public Works Department. The directive should require PUD management to document the reason(s) for this decision.

Additionally, the directive should require that staff complete the project according to the Project Management Body of Knowledge or other generally accepted project management standards, which includes developing and putting into practice certain project management documents, such as a project charter and a project management plan.

The directive should also establish an appropriate executive authority for approving the decision to manage the project in-house as well as key project management documents, such as the project charter and the project management plan. (Priority 2)

Recommendation #6:   The Public Utilities Department (PUD) should develop a staffing management plan for meter replacements to enable the department to complete the Citywide AMI implementation on a schedule, as determined by PUD. As part of this plan, PUD should consider:

- A dedicated work group with experienced and stable staff to complete meter replacements; and

- Augmenting City forces with a third-party meter installation provider. (Priority 1)

Recommendation #7:   The Public Utilities Department (PUD) should evaluate the impacts and causes of turnover and vacancies in the meter replacement group, working with the Personnel Department (Personnel) to address any identified causes, as needed. This should include, but not be limited to, evaluating the impact of job classification requirements and pay competitiveness on employee recruitment and retention.

If PUD determines pay competitiveness is a significant driver of turnover and vacancies, PUD management should submit a Special Salary Adjustment to Personnel for Water Systems Technician, Laborer, and any other affected classifications. Similarly, if PUD determines current job classifications are preventing PUD from hiring and retaining employees, PUD

should work with Personnel to modify or create new classifications that are better suited to the tasks associated with the AMI implementation and other PUD business needs. (Priority 2)

Recommendation #8:   The Public Utilities Department (PUD) should develop a staffing management plan for endpoint installation and programming to enable the department to complete the Citywide AMI implementation on a schedule, as determined by PUD. As part of this plan, PUD should consider:

- A dedicated work group with experienced and stable staff to complete endpoint installation and programming; and

- Augmenting City forces with a third-party endpoint installation and programming provider. (Priority 1)

Recommendation #9:   To capture labor costs more accurately, Public Utilities management should provide timekeeping instructions to all employees working on the AMI project that specify how and when to charge their working time to the project. These instructions should be provided to employees in all business units working on the project, including (but not limited to) field crews that complete meter and endpoint installation, programming, and troubleshooting and office staff performing related administrative duties. These timekeeping instructions should also include guidance on supervisory responsibilities for those employees who approve others' time entries and guidance on which WBS sub-element(s) is (are) appropriate to use. (Priority 2)

Recommendation #10:   The AMI project manager or an appropriate designee should be assigned to continuously monitor time entries and/or labor charges to the project for reasonableness; if issues are identified as part of this review, the project manager should coordinate appropriate corrective actions across the organization as necessary. (Priority 2)

Recommendation #11: The Public Utilities Department (PUD) and the Department of Information Technology (DoIT) should work together to evaluate the EAM Work Manager control environment and ensure the new Work Manager development meets PUD's needs for complete, accurate, and timely data entry for meter replacements. Specifically, these should include controls at the device level that prevent incomplete and inaccurate data from entering the meter replacement workflow.

Additionally, this evaluation should include maintaining an awareness of business processes and associated activities, and comprehensive testing of EAM Work Manager for the meter replacement process. (Priority 2)

Recommendation #12: The Public Utilities Department (PUD) and Department of Information Technology (DoIT) should work together to evaluate the control environment of any application to be used for endpoint installations—such as EAM—and ensure that it meets PUD's needs for complete, accurate, and timely data entry for endpoint installations. Specifically, these should include controls at the device level that prevent incomplete and inaccurate data from entering the meter replacement workflow.

Additionally, this evaluation should include maintaining an awareness of business processes and associated activities, and comprehensive testing of any application to be used for endpoint installation—such as EAM—for the endpoint installation process. (Priority 2)

Recommendation #13: The Public Utilities Department should track the causes, resolution, and duration of all exceptions cases resulting from AMI meter replacements, including but not limited to EMMA and the SAP Workflow Inbox, and review the data to perform trending and root cause analyses. (Priority 3)

Appendix A: Definition of Audit Recommendation Priorities

DEFINITIONS OF PRIORITY 1, 2, AND 3

AUDIT RECOMMENDATIONS

The Office of the City Auditor maintains a priority classification scheme for audit recommendations based on the importance of each recommendation to the City, as described in the table below. While the City Auditor is responsible for providing a priority classification for recommendations, it is the City Administration's responsibility to establish a target date to implement each recommendation taking into consideration its priority. The City Auditor requests that target dates be included in the Administration's official response to the audit findings and recommendations.

Priority Class [32]	Description
1	Fraud or serious violations are being committed. Significant fiscal and/or equivalent non-fiscal losses are occurring. Costly and/or detrimental operational inefficiencies are taking place. A significant internal control weakness has been identified.
2	The potential for incurring significant fiscal and/or equivalent non-fiscal losses exists. The potential for costly and/or detrimental operational inefficiencies exists. The potential for strengthening or improving internal controls exists.
3	Operation or administrative process will be improved.

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[32] The City Auditor is responsible for assigning audit recommendation priority class numbers. A recommendation which clearly fits the description for more than one priority class shall be assigned the higher priority.

Appendix B: Objectives, Scope, and Methodology

Audit Objectives

During our previous Performance Audit of the Public Utilities Department's Water Meter Cover Replacement Program and the Performance Audit of the Public Utilities Department's Customer Billing Operations, we identified risks related to the Citywide AMI implementation. As a result, and in accordance with the City Auditor's Fiscal Year (FY) 2019 Audit Work Plan, we conducted a performance audit of the Public Utilities Department's (PUD's) Advanced Metering Infrastructure (AMI) implementation. Our audit focused on the Citywide AMI implementation, covering FY 2016 to FY 2019. The overall objectives of this audit were to:

1. Evaluate PUD's management of the Citywide AMI implementation to-date and identify lessons learned to inform the remainder of the AMI implementation and any future major projects at PUD; and

2. Determine if the efficiency and effectiveness of the AMI implementation can be improved to reduce costs, improve the speed of the implementation, and ensure accurate and timely billing.

Scope and Methodology

Project Planning and Management

To assess PUD's planning and project management of the Citywide AMI implementation, we reviewed PUD's documentation on project management, budgeting, and deployment timelines as well as City Council and IROC meeting materials and minutes related to the AMI implementation. We also interviewed PUD management and staff involved in planning, project management, and operations for the AMI implementation. Finally, we reviewed industry guidance and professional standards and conducted interviews with other water agencies with AMI in

order to understand elements of project management that are relevant to the AMI implementation.[33]

Productivity Analysis   To assess employee productivity for meter installation, we reviewed work order data from PUD's legacy maintenance management system, SWIM, for a random sample of 30 workdays between July 1, 2017 and March 11, 2018.[34] We reviewed SWIM records for work crews conducting meter replacements as part of the AMI implementation to determine the following average daily productivity figures:

- The number of employees conducting meter replacements;

- The number of meters each crew replaced;

- The amount of time crews spent replacing a meter; and

- The amount of time crews spent in the field.

Staffing Analysis   To assess PUD's staffing of the AMI implementation, we interviewed PUD staff and management to understand their general approach and the staffing practices in place. We also interviewed staff in the Human Resources and Personnel Departments to understand how underlying labor rules and other issues may be affecting PUD's ability to staff the AMI implementation using City workforces. To determine vacancy levels and turnover rates in the meter replacement and meter reading work groups, we reviewed staffing reports

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[33] These agencies were: Alameda County Water District, Albuquerque Bernalillo County Water Authority, the City of Azusa, the City of Bismarck, the City of Cleveland, Contra Costa Water District, East Bay Municipal Utility District, the City of Mountain View, and San Francisco Public Utilities Commission.

[34] Our review of meter replacement crew productivity covers the period during fiscal year 2018 between July 1, 2017 and March 11, 2018. On March 12, 2018, PUD transitioned to the City's new Enterprise Asset Management system (EAM). This transition likely affected overall crew productivity as employees had to adapt to the new technology and workflows. Therefore, our review focused on the period immediately before EAM was deployed, with the intention of capturing the most accurate representation of typical work crew productivity.

from SAP for dates between July 2015 and March 2019. To analyze employee promotion and turnover in the meter replacement group, we reviewed organizational records from SAP for those same dates. Finally, we reviewed pertinent documentation, including project management standards related to project staffing; civil service rules and class specifications; recent salary adjustment requests; and a Citywide salary study done in 2015.

Labor Cost Tracking Analysis

To evaluate whether PUD was accurately tracking project labor expenses for the AMI implementation, we reviewed SAP time card entries for the same 30 random workdays we used to determine crew productivity. We developed an estimate of the time spent by PUD's meter replacement crews that should be charged to the AMI implementation project based on SWIM work order data. We then compared this to actual time entries in SAP by employees from the meter replacement crew to assess whether time spent on the AMI implementation was being accurately tracked in SAP for those crews.

IT Controls Analysis

Finally, to assess PUD's internal controls for meter replacement data, we reviewed PUD's documentation on data controls in AMI-related systems, including SAP's Customer Care Solutions (CCS), Itron's Multi-Vendor Reading System (MV-RS), Itron's ChoiceConnect Network, and SAP's Enterprise Asset Management (EAM). For system controls, we reviewed system error logs and reports to determine if the controls were in place and functioning. For system controls without error logs, we tested the controls with PUD staff in a controlled environment. For procedural controls, we reviewed process narratives and observed PUD staff performing the controls.

Data Reliability Testing

As part of our previous Performance Audit of the Public Utilities Department's Water Meter Cover Replacement Program, we conducted data reliability testing on SWIM data. The testing performed matching of a random sample of 20

meter box locations and their associated service requests, comparing data in SWIM to the paper service requests. We determined that the data in SWIM was sufficiently complete, accurate, and reliable for the analyses performed in this audit.

We did not evaluate the internal controls over SAP as part of the scope of this audit. The City prepares an Annual Report on Internal Financial Control, which includes topics such as control over payroll and transactions in SAP, and describes the controls environment over these functions.

Internal Controls Testing   Our internal controls testing was limited to specific controls relevant to our audit objectives, including controls to ensure that major projects at PUD are adequately planned and managed; controls for monitoring staff productivity; controls to ensure that staffing levels are commensurate with productivity expectations; controls to ensure that project labor costs are tracked accurately; and controls related to data entry for meter replacement work orders.

Compliance Statement   We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on the audit objectives.

THE CITY OF SAN DIEGO

M E M O R A N D U M

DATE: July 10, 2019

TO: Kyle Elser, Interim City Auditor, Office of the City Auditor

FROM: Matthew Vespi, Interim Director, Public Utilities Department
             via Johnnie Perkins, Deputy Chief Operating Officer, Infrastructure/Public
             Works

SUBJECT: Management's Response to the Public Utilities Department's Advanced Metering
             Infrastructure Implementation Audit

The purpose of this memorandum is to provide Management's response to the recommendations in the Office of the City Auditor's Performance Audit of the Public Utilities Department's (PUD) Advanced Metering Infrastructure (AMI) Implementation Project, and to provide an update on related actions already taken by PUD. We appreciate the recommendations provided by the Office of the City Auditor.

Concurrent with the City Auditor's work on this topic, PUD completed an internal assessment of the AMI project. PUD would like to take this opportunity to provide findings and outcomes of that internal assessment, some of which overlap with the City Auditor's recommendations and have already been implemented.

The intent of the internal analysis was to examine the experiences of other utilities implementing AMI to gain lessons learned on technology installations and implementation strategies. The results of our analysis and the progress made to date on significantly modifying our approach for AMI closely align with the City Auditor's efforts.

In the internal analysis, benchmarked projects of other utilities confirmed that AMI implementations can achieve substantial cost reductions for metering and billing operations, such as fewer truck rolls, labor savings, more accurate and timely billing, and improvements in operational efficiencies. This in addition to more customer control over water consumption, costs, and bills.

The implementation of San Diego's citywide AMI project is complex due to the impacts to nearly all PUD metering and billing functions, such as meter installations, issuing customer bills, and ultimately delivering improved utility services to our customers. The AMI project requires coordination between multiple vendors and internal teams, new business processes, and a robust, long-term customer outreach and education plan.

Beginning in January of this year, PUD started the development of a comprehensive field AMI deployment plan that is achievable, customer-centric, and operationally efficient accounting for anticipated technology and field deployment risks; the addition of an executive level PUD Project Sponsor and assignment of a dedicated full-time Project

Page 2
Kyle Elser, Interim City Auditor, Office of the City Auditor
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Manager; and the establishment of an interdisciplinary Citywide executive level AMI Project Oversight Committee.

As we learned from our assessment and as the City Auditor concluded, a successful AMI project implementation is typically guided by an AMI Oversight Committee, with executive level representation and oversight provided from water construction/field services, financial services, information technology, billing, customer service, and public affairs. Also, for a large utility agency like the City of San Diego, it is important to identify an installation provider to enable a steady deployment plan without impacting normal operational activities performed by City staff. The established AMI Oversight Committee consists of City department directors representing the Department of Information Technology, Debt Management, Communications, and Performance and Analytics, as well as team members from multiple department divisions.

One of the AMI Oversight Committee's first tasks is to complete a comprehensive Project Charter which will formalize the AMI project's scope, commitment of City staff and the installation provider, budget, milestones, risk assessment, and project timeline. The Project Charter will include the AMI Project Organization Chart which will identify resources and descriptions of each functional team member's role. PUD will continue to work with stakeholder departments to confirm resource commitments necessary to successfully implement the AMI project.

A final AMI Phase II – Project Governance Structure guiding document was also completed and disseminated to assist with defining the functional teams' composition and dedication of City resources, in conjunction with a third-party installation provider per the AMI Project Organization & Deployment Model. PUD management is committed to implement a successful AMI project citywide that will result in a direct benefit to our customers and rate-payers.

RECOMMENDATION 1
The Public Utilities Department should designate a project manager to be responsible for all aspects of the project; the project manager should be empowered with an appropriate level of authority and resource availability. (Priority 1)

MANAGEMENT RESPONSE: Management agrees with the recommendation; this item has been completed.

This recommendation has been implemented. A designated Project Manager is assigned, as identified in the Citywide AMI Project Organization and Project Governance Structure documentation. Supporting documentation has been provided to the Office of the City Auditor to satisfy fulfillment of this recommendation.

Target Implementation Date: Completed.

RECOMMENDATION 2
The Public Utilities Department should create a formal Executive Steering Committee for the AMI Implementation Project, including, at a minimum, management representatives from the Water Construction and Maintenance Division, the Customer Support Division, the Communications Department, and the Department of Information Technology, as well as the project manager and Public Utilities Director.

MANAGEMENT RESPONSE: Management agrees with the recommendation; this item has been completed.

- PUD has established an interdisciplinary AMI Oversight Committee, consisting of City leadership.
- The AMI Oversight Committee Kick-Off Meeting was conducted May 31, 2019; next meeting scheduled August 30, 2019.
- Supporting documentation has been provided to the Office of the City Auditor in order to satisfy fulfillment of this recommendation.

Target Implementation Date: Completed.

RECOMMENDATION 3
The Executive Steering Committee, in conjunction with the project manager, should develop a deployment plan for the Citywide AMI implementation project, which includes specific and detailed tasks, responsibilities, budgets, and a timeline for completion. Budgets and timelines for completion should be supported by detailed analysis based on realistic assumptions. (Priority 1)

MANAGEMENT RESPONSE: Management agrees with the recommendation.

PUD is in the process of developing a robust Citywide deployment project plan that includes all mentioned elements in the recommendation. The plan will reflect the use of an installation provider to complete the work. Completion of the Citywide AMI Deployment Project Plan will be presented to the AMI Oversight Committee for approval in November 2019 and subsequently brought forward to City Council. In parallel, the Itron, Inc., contract amendment is anticipated to be adopted by City Council in January 2020.

Target Implementation: January 2020

RECOMMENDATION 4
The Executive Steering Committee should meet regularly to review performance against project goals and timelines and adjust the deployment plan as needed. (Priority 1)

MANAGEMENT RESPONSE: Management agrees with the recommendation.

- The AMI Oversight Committee Kick-Off Meeting was conducted May 31, 2019.
- Supporting documentation has been provided to the Office of the City Auditor to demonstrate the AMI Oversight Committee meetings are calendared on a quarterly basis to review performance against project goals, timelines, and to adjust deployment plan as needed.
- In addition, ad-hoc meetings will be scheduled as necessary to consider specific and critical project decisions.

Target Implementation: January 2020

RECOMMENDATION 5
The Public Utilities Department (PUD) should issue a directive, through a departmental policy or memorandum, that would be in effect and applicable to major projects where the Chief Operating Officer has decided for PUD to manage the project in-house instead of through the Public Works Department. The directive should require PUD management to document the reason(s) for this decision.

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Additionally, the directive should require that staff complete the project according to the Project Management Body of Knowledge or other generally accepted project management standards, which includes developing and putting into practice certain project management documents, such as a project charter and a project management plan.

The directive should also establish an appropriate executive authority for approving the decision to manage the project in-house as wells as key project management documents, such as the project charter and the project management plan. (Priority 2)

MANAGEMENT RESPONSE: Management agrees with the recommendation; this item has been completed.

A directive memorandum from the PUD Department Director has been issued which includes the requirements outlined by the Office of the City Auditor.

Target Implementation Date: Completed.

Recommendation 6
The Public Utilities Department (PUD) should develop a staffing management plan for meter replacements to enable the department to complete the Citywide AMI implementation on a schedule, as determined by PUD. As part of this plan, PUD should consider:

- A dedicated work group with experienced and stable staff to complete meter replacements; and
- Augmenting City forces with a third-party meter installation provider. (Priority 1)

Management Response: Management agrees with the recommendation.

- As a part of the AMI Project Charter, PUD will formalize the Citywide AMI Deployment staffing plan which will identify dedicated work groups with designated staff to support the deployment plan.
- Per the staffing analysis, PUD will process a Request for Proposal (RFP) for a third-party installation provider to achieve the AMI implementation goals including the project budget and schedule as defined in the Project Charter.

Target Implementation: January 2020

Recommendation 7
The Public Utilities Department (PUD) should evaluate the impacts and causes of turnover and vacancies in the meter replacement group, working with the Personnel Department (Personnel) to address any identified causes, as needed. This should include, but not be limited to, evaluating the impact of job classification requirements and pay competitiveness on employee recruitment and retention.

If PUD determines pay competitiveness is a significant driver of turnover and vacancies, PUD management should submit a Special Salary Adjustment to Personnel for Water Systems Technician, laborer, and any other affected classifications. Similarly, if PUD determines current job classifications are preventing PUD from hiring and retaining employees, PUD should work with Personnel to modify or create new classifications that are better suited to the tasks associated with the AMI implementation and other PUD business needs. (Priority 2)

Management Response: Management agrees with the recommendation.

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- PUD will continue to analyze the issue of vacancies and turnover within the meter replacement group. The analysis will include how job classifications and pay are affecting PUD's ability to hire and retain adequate number of employees to complete daily meter replacement operations and maintenance, as well as assist the Citywide AMI implementation, as needed.
- The analysis will also determine the right number of employees and level of staffing necessary to maintain and operate AMI smart meters, post AMI project deployment.

Target Implementation: July 2020

Recommendation 8
The Public Utilities Department (PUD) should develop a staffing management plan for endpoint installation and programming to enable the department to complete the Citywide AMI implementation on a schedule, as determined by PUD. As part of this plan, PUD should consider:
- A dedicated work group with experienced and stable staff to complete endpoint installation and programming; and
- Augmenting City forces with a third-party endpoint installation and programming provider. (Priority 1)

Management Response: Management agrees with the recommendation.

- PUD will dedicate a work group with experienced and consistent staff to complete endpoint installation and programming.
- PUD will continue to analyze the issue of vacancies and turnover within the endpoint (Encoder Receiver Transmitter (ERT)) installation group. The analysis will include how job classifications and pay are affecting PUD's ability to hire and retain employees to complete daily endpoint operations and maintenance, as well as assist the Citywide AMI implementation, as needed.
- The analysis will also determine the right number of employees and level of staffing necessary to maintain and operate AMI endpoints (ERTs), post AMI project deployment.

Target Implementation: July 2020

Recommendation 9
To capture labor costs more accurately, Public Utilities management should provide timekeeping instructions to all employees working on the AMI project that specify how and when to charge their working time to the project. These instructions should be provided to employees in all business units working on the project, including (but not limited to) field crews that complete meter and endpoint installation, programming, and troubleshooting and office staff performing related administrative duties. These timekeeping instructions should also include guidance on supervisory responsibilities for those employees who approve others' time entries and guidance on which Work Breakdown Structure (WBS) sub-element(s) is (are) appropriate to use. (Priority 2)

MANAGEMENT RESPONSE: Management agrees with the recommendation.

- PUD will conduct onboarding training for all staff assigned to the AMI project which will include documented instructions for proper timekeeping.
- EAM functionality in SAP will be used to track all AMI-related work using the Mobile Work Manager and appropriately categorized work orders and link to the AMI Project WBS number(s).

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- These timekeeping instructions will also include guidance on supervisory responsibilities for those employees who approve others' time entries and guidance on which WBS sub-element(s) is (are) appropriate to use. (Priority 2)

Target Implementation: January 2020

Recommendation 10
The AMI project manager or an appropriate designee should be assigned to continuously monitor time entries and/or labor charges to the project for reasonableness; if issues are identified as part of this review, the project manager should coordinate appropriate corrective actions across the organization as necessary. (Priority 2)

Management Response: Management agrees with the recommendation.

- The AMI Project Management Office, at the direction of the Project Manager, will appoint designees from each business unit to continuously monitor time entries and/or labor charges for their reasonableness. The oversight of this function is typically performed by a Project Controller assigned to the Project Management Office, as the Project Manager is ultimately responsible for taking appropriate corrective actions when issues arise.
- Monitoring reports will be developed in EAM.

Target Implementation: January 2020

Recommendation 11
The Public Utilities Department (PUD) and the Department of Information Technology (DoIT) should work together to evaluate the EAM Work Manager control environment and ensure new Work Manager development meets PUD's needs for complete, accurate, and timely data entry for meter replacements. Specifically, these should include controls at the device level that prevent incomplete and inaccurate data from entering the meter replacement workflow.

Additionally, this evaluation this should include maintaining an awareness of business processes and associated activities, and comprehensive testing of EAM Work Manager for the meter replacement process. (Priority 2)

Management Response: Management agrees with the recommendation.

- New EAM Work Manager enhancements were rolled out in May 2019.
- Super Users and internal help desk support have been established.
- Business and flow processes have been created and training materials will follow.
- Ongoing testing and technical support by End Users and supervisors are taking place.
- PUD, in partnership with DoIT-ERP, will identify requirements for a third-party installer to integrate with the existing billing and asset management systems, and all other City standard applications as required.

Target Implementation: February 2020

Recommendation 12
The Public Utilities Department (PUD) and Department of Information Technology (DoIT) should work together to evaluate the control environment of any application to be used for endpoint installations—such as EAM—and ensure that it meets PUD's needs for complete, accurate, and timely data entry for endpoint installations. Specifically, these should include

controls at the device level that prevent incomplete and inaccurate data from entering the meter replacement workflow.

Additionally, this evaluation should include maintaining an awareness of business processes and associated activities, and comprehensive testing of any application to be used for endpoint installation—such as EAM—for the endpoint installation process. (Priority 2)

Management Response: Management agrees with the recommendation.

- DoIT – ERP, in partnership with PUD, will be working next on developing a Work Manager Form for endpoint installation and performing all the necessary testing and training.
- PUD, in partnership with DoIT-ERP, will identify requirements for a third-party installer to integrate with the existing billing and asset management systems, and all other City standard applications as required.

Target Implementation: July 2020

Recommendation 13
The Public Utilities Department (PUD) should track the causes, resolution, and duration of all exceptions cases resulting from AMI meter replacements, including but not limited to EMMA and the SAP Workflow Inbox, and review the data to perform trending and root cause analyses. (Priority 3)

Management Response: Management agrees with the recommendation.

- A Supervising Management Analyst currently performs these types of monitoring and analysis.
- Moving forward, EAM dashboard reports will be created to monitor the performance of AMI and address issues when they arise.

Target Implementation: July 2020

The implementation of AMI will provide long-term benefits to the City's customers. Continuing with these significant modifications to our deployment plan, will facilitate those benefits. We appreciate the City Auditor's guidance on this critical project.

Sincerely,

Matthew Vespi
Interim Director, Public Utilities Department

RA:jma

cc: Kris Michell, Chief Operating Officer
        Stacey LoMedico, Assistant Chief Operating Officer
        Ronald H. Villa, Assistant Chief Operating Officer
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