Advanced Metering Infrastructure (AMI)
Pilot Studies Update
Presentation Overview

- Water Conservation Master Plan (AMI) Strategies
- Review of EBMUD AMR/AMI pilot studies
  - AMI Trends and Components
  - Study Objectives and Background
  - Customer Engagement & Conservation Findings
- Supply-side Conservation Findings
- AMI Implementation Study Objectives
- Recommended Approach
- Next Steps
Water Conservation Master Plan

39 MGD by 2040:
- >100 measures evaluated, selected 53
- AMI Fixed Network Infrastructure
- Up to 135,000 customer end points

AMI Applications:
- Demand mgmt.
- Supply-side eval.
- Conservation svgs. verification
- Customer service
Evolution of Meter Reading

- Straight read
- Touch read
- Telephone based systems
- Walk by or handheld technology
- Mobile bubble up one way
- Mobile bubble up with datalogging
- Two way mobile system
- One way fixed network
- Mesh network two way
- Two way fixed network
Components of AMI

Transmission Units
- Meters
- Radio Transmitter
- Leak Detector

Collectors
- Collector

Main Computers
- Network Server

End Uses
- Utility Workstations
- CIS, WMS, OP Data
- Customer Interface
AMI and Water Loss Control
Pilot Study Objectives

• Test technology and application areas
• Improve customer and staff understanding of water consumption patterns, peak use
• Facilitate water conservation by identifying leaks, excess irrigation, high water consumption devices, etc.
• Provide timely and cost-effective customer notifications
• Help resolve customer high bill inquires
• Help identify real and apparent (supply-side) water losses, revenue recovery within distribution system
• Synchronize water, energy and GHG management efforts
Pilot Study Areas (2002-14)

- San Pablo
- Kensington
- Reliez PZ
- Round Hill PZ
- Holly PZ
- Blackhawk
- Downtown
- DERWA
- Mobile
- Fixed
- New
Reliez AMI Project Area

1 Collector

78 Residential Meters
Blackhawk AMI Pilot Project

- Difficult topography
- ~4,000 meters
- 9 collectors
- 10 square miles
- Web interface
  - Consumption
  - Weather
  - Leak notification
  - Water Budgets
Customer WaterSmart Toolbox

Hourly Water Usage

4.5 Gallons

Climate

Temperature vs. Precipitation

Download Report

Enter timeframe

Choose...
Customer Engagement Pilot Study Findings

• A surprising number of leaks detected
• Over irrigation
• Flow rates exceeding meter warranty
• Meter inaccuracy and revenue loss
• Online tool beneficial for customer engagement
• 5-50% (15% average) conservation savings
• Technology still being improved
“I have access to 3 accounts for the Homeowners Assoc. and 1 personal account. I track daily usage, this year versus last year, for all the accounts I have access to. Having the ability to track water usage has been very useful in controlling our water usage.”

“I really like the site. Excellent tool. Thanks also for your insight and feedback. Super valuable. We are going to walk the property this weekend to try to find a leak as well as change our irrigation schedules. Thanks for your expertise and for all the team for this wonderful website!”
Supply-Side Conservation

• Identify apparent and real system losses
  - “Apparent” loss = meter accuracy, revenue losses
  - “Real” loss = pipeline leakage

• Deploy remote sensing field instrumentation
  - Real time pipeline and facility leak detection
  - Real time pressure zone/district metered area balancing
  - Ancillary equipment:
    • pressure, water quality sensors
Supply-Side Pilot Study Findings

- Historical 4-25% production and demand discrepancy
- Tested distribution system and found no leakage
- Found both oversized and undersized meters
- Customer leaks below meter accuracy
- Demand driven by irrigation
Unmeasured Flow Study

• Objective to determine portion of unmeasured (non-revenue) water use

• District has approx. 350k 5/8-inch meters

• Meters designed for ¼ gpm minimum flow rate

• 430 Sensus meters installed
  • 1 min. intervals over 12 months
  • 55 Million meter reads

• Tested old meters @ 1/32 - 15 gpm
# Meter Accuracy Testing

(≈200 Residential Meters)

## Flow (gpm)

<table>
<thead>
<tr>
<th>Flow (gpm)</th>
<th>15</th>
<th>5</th>
<th>2</th>
<th>1</th>
<th>½</th>
<th>¼</th>
<th>1/8</th>
<th>1/16</th>
<th>1/32</th>
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<tbody>
<tr>
<td>% accy</td>
<td>98</td>
<td>99</td>
<td>99</td>
<td>98</td>
<td>94</td>
<td>87</td>
<td>69</td>
<td>50</td>
<td>19</td>
</tr>
</tbody>
</table>

## Log of Flow rate vs. tested Accuracy

![Graph showing accuracy vs. flow rate with typical leakage highlighted.](Typical Leakage.png)
AMI Implementation Study Goals

- Review of existing assets and operations
- Identify potential areas for improvement
- Evaluate possible AMI applications
- Develop implementation plan based on findings and AMI capabilities
<table>
<thead>
<tr>
<th>Operations and Maintenance</th>
<th>Customer and Community Services</th>
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<tbody>
<tr>
<td>• Meter Division</td>
<td>• Water Conservation</td>
</tr>
<tr>
<td>• Construction</td>
<td>• Contact Center</td>
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<tr>
<td>• Facilities</td>
<td>• Field Services</td>
</tr>
<tr>
<td>• Distribution</td>
<td>• New Business</td>
</tr>
<tr>
<td>• Water Quality</td>
<td>• CIS Control</td>
</tr>
<tr>
<td>• Regulatory and Security</td>
<td></td>
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<tr>
<td>• Supply</td>
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<table>
<thead>
<tr>
<th>Engineering</th>
<th>Finance</th>
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<tbody>
<tr>
<td>• Water Distribution Planning</td>
<td>• Purchasing</td>
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<tr>
<td>• Mapping</td>
<td>• Risk Management</td>
</tr>
<tr>
<td></td>
<td>• Auditing</td>
</tr>
<tr>
<td></td>
<td>• ISD</td>
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<table>
<thead>
<tr>
<th>Water and Natural Resources</th>
<th>Wastewater</th>
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<tbody>
<tr>
<td>• Planning</td>
<td>• Engineering</td>
</tr>
<tr>
<td>• Water Supply Improvements</td>
<td>• Planning</td>
</tr>
<tr>
<td>• Recycled Water</td>
<td>• Waste Water control</td>
</tr>
<tr>
<td>• Environmental Affairs</td>
<td>• Environmental Services</td>
</tr>
</tbody>
</table>
Evaluating the AMI Business Case

- Customer demand reduction
- Demand forecasting
- Water loss control
- Facility sizing
- Climate change considerations
- System water quality improvements
- Integration of SCADA systems
- Energy management
- Customer service improvements
- Revenue loss recovery
- Asset management and predictive maintenance
- System reliability
- Meter management and replacement
- Security
## Notable Other Agency Installations

<table>
<thead>
<tr>
<th>City</th>
<th>Total</th>
<th>Status</th>
<th>Vendor</th>
<th>Web Interface</th>
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<tbody>
<tr>
<td>San Francisco</td>
<td>172k</td>
<td>90%</td>
<td>Aclara</td>
<td>Yes</td>
</tr>
<tr>
<td>DSRSD</td>
<td>18k</td>
<td>100%</td>
<td>Sensus</td>
<td>Yes</td>
</tr>
<tr>
<td>Eastern MWD</td>
<td>145k</td>
<td>40%</td>
<td>Sensus</td>
<td>Planned</td>
</tr>
<tr>
<td>Fresno</td>
<td>130k</td>
<td>20%</td>
<td>Badger</td>
<td>Planned</td>
</tr>
<tr>
<td>Sacramento</td>
<td>140k</td>
<td>25%</td>
<td>Badger</td>
<td>Planned</td>
</tr>
<tr>
<td>New York</td>
<td>830k</td>
<td>95%</td>
<td>Aclara</td>
<td>Yes</td>
</tr>
<tr>
<td>Ottawa</td>
<td>200k</td>
<td>92%</td>
<td>Itron</td>
<td>Planned</td>
</tr>
<tr>
<td>Houston</td>
<td>1,007k</td>
<td>95%</td>
<td>Aclara/Badger/Itron</td>
<td>Planned</td>
</tr>
<tr>
<td>Washington DC</td>
<td>145k</td>
<td>100%</td>
<td>Aclara</td>
<td>Yes</td>
</tr>
<tr>
<td>Boston</td>
<td>95k</td>
<td>100%</td>
<td>Aclara</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Recommended Approach

• Continue AMI evaluations and strategic planning toward phased, selective implementation
• Pursue additional AMI grant opportunities
• Install AMI-related equipment based on largest benefit (e.g. conservation, water loss)
• Target meter replacements/upgrades for revenue recovery
• Encourage AMI industry standards for system integration and compatibility
Next Steps

- Nov-Dec. 2014  Fixed Network Leak Detection installation and testing
- Feb. 2015  Complete Unmeasured Flow Study
- March 2015  Submit AMI Implementation Study to USBR
- FY15-16  Pursue phased AMI deployments, (incl. 4,000 haz. meter reading mitigation)
Overview

• Background
• Addressing Water Losses
• Pilot Project
• Next Steps and Schedule
Goal
- Better understand water loss
- Improve leak detection (District and customer)
- Better quantify unmetered water
- Reduce overall water loss

Leader in water loss control
Water Loss Defined

Water Loss = Non Revenue Water = Apparent + Real Losses

- Meter inaccuracy
- Unauthorized consumption
- Data handling errors
- Reducing apparent losses increases revenue

- Leaks
- Reducing real losses recovers water
Unaccounted For Water

Unaccounted for Water (UAW) = \frac{\text{Leakage}}{\text{Production}}

- Leakage typically is relatively constant
- As Production increases, UAW decreases
- As Production decreases, UAW increases
Water Production and Consumption

Water Treatment Plants

Reservoirs

EBMUD Service Area

Customer Water Meters

= Gross Water Production

= Gross Water Consumption

Water Loss = Gross Water Production – Gross Water Consumption
Water Consumption and Production

Production Decreases

UAW Flat

Fiscal Year
Challenge: Determine Water Loss

- 5 WTPs
- 4,200 miles distribution pipe
- 380,000+ services read bi-monthly and monthly
- Unable to accurately determine real and apparent losses
Guidance for Water Loss Control

AWWA M36 Manual

- Volume of Apparent Losses
- Volume of Real Losses
- Performance Indicators

WRF Component Analysis Tool

- Understand Real Loss Breakdown
  - Where are losses occurring?
  - What types of leakage?
Addressing Apparent and Real Losses

- Meter accuracy
- Unauthorized consumption
- Data transfer errors
- Data analysis errors

- Active Leakage control
- Pressure management
- Speed and quality of repairs
- Infrastructure management
Addressing Real Losses

Background Leakage
Unreported and undetectable using traditional acoustic equipment

Tools
- DMA, AMI
- Pressure reduction
- Infrastructure replacement

Unreported Leakage
Does not surface but is detectable using traditional acoustic equipment

Tools
- DMA, AMI
- Pressure reduction
- Infrastructure replacement
- Active leak control

Reported Leakage
Surfaces and is reported by the utility or the public

Tools
- DMA, AMI
- Pressure reduction
- Infrastructure replacement
- Improved repair time and quality
Real Losses
District Metered Area (DMA)

- **What is a DMA?**
  - Divide distribution system into smaller areas with a defined and permanent boundary
  - Install flow meters to measure flows into and out of the area
  - Addresses Real Losses

- **Benefit of a DMA**
  - Find leaks
  - Reduce leaks through pressure management
## Real Losses
### DMA Pilot

<table>
<thead>
<tr>
<th>Area</th>
<th>Blackhawk</th>
<th>Kensington</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miles of pipe</td>
<td>6 miles</td>
<td>5.6 miles</td>
</tr>
<tr>
<td># Customers</td>
<td>320</td>
<td>490</td>
</tr>
<tr>
<td>Pipe</td>
<td>Newer pipe</td>
<td>Older pipe (history of leaks)</td>
</tr>
<tr>
<td>Area demand</td>
<td>0.4 MGD</td>
<td>0.3 MGD</td>
</tr>
<tr>
<td>AMI/AMR</td>
<td>Within existing AMI project</td>
<td>Within Sensus propagation study area</td>
</tr>
</tbody>
</table>
# Real Losses
## Active Leak Control Technology

<table>
<thead>
<tr>
<th>Technology</th>
<th>Metallic Pipe</th>
<th>Non-Metallic Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustic Leak Detection</td>
<td>✓</td>
<td>Limited</td>
</tr>
<tr>
<td>Echologics</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Smart Ball</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Tracer Gas</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Real Losses

Active Leak Control Plan

- Acoustic Leak Detection
  - 20 used for leak repairs
  - 480 deployed in known areas of leakage (read monthly)
  - 50 deployed Blackhawk DMA (read monthly)
  - 50 planned in Kensington on an AMI fixed network
  - 80 planned in downtown Oakland on an AMI fixed network

- Non-coated copper service connections on non-metallic mains
  - 32,000 connections
  - Surveyed 6,000 and plan to survey 4,000 per year
  - Up to 12% leak rate
  - Pilot to determine water loss from service connections
Apparent Losses
Meter Replacement Plan

- Purchase and install 500 automated meters for Kensington DMA Pilot
- Other potential areas for AMI include Alamo Creek and Bishop Ranch
- Meter replacement program
- Information guides meter replacement program
# Water Meter Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Traditional Meter</th>
<th>AMI Meter</th>
<th>Incremental Cost Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meter</td>
<td>$35</td>
<td>$80</td>
<td>$45</td>
</tr>
<tr>
<td>Transmitter</td>
<td>$0</td>
<td>$75 - $100</td>
<td>$75 - $100</td>
</tr>
<tr>
<td>Meter Box Lid and Connector</td>
<td>$0</td>
<td>$20</td>
<td>$20</td>
</tr>
<tr>
<td>Installation Cost</td>
<td>$55</td>
<td>$70</td>
<td>$15</td>
</tr>
<tr>
<td>Collection Network</td>
<td>$0</td>
<td>$15</td>
<td>$15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$90</strong></td>
<td><strong>$260 - $285</strong></td>
<td><strong>$170 - $195</strong></td>
</tr>
</tbody>
</table>
Water Loss Control Initiative

Cost

• DMA Pilot
  – DMA Installation: $200K
  – 500 AMI meters (Kensington): $130K

• Additional Acoustic Leak Detection Equipment: $70K

• Tracer Gas Leak Detection: $25K
# Next Steps

<table>
<thead>
<tr>
<th>Task</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setup DMAs</td>
<td></td>
</tr>
<tr>
<td>• Install valves and flow meters in DMA</td>
<td>• 3&lt;sup&gt;rd&lt;/sup&gt; Quarter FY15</td>
</tr>
<tr>
<td>• Install AMI/AMR and data collection units</td>
<td></td>
</tr>
<tr>
<td>Board approval for automated meters</td>
<td>• December 9</td>
</tr>
<tr>
<td>Active leak detection</td>
<td></td>
</tr>
<tr>
<td>• Transient monitoring</td>
<td>• 2&lt;sup&gt;nd&lt;/sup&gt; Quarter FY15</td>
</tr>
<tr>
<td>• Purchase leak detection equipment</td>
<td>• 3&lt;sup&gt;rd&lt;/sup&gt; Quarter FY15</td>
</tr>
<tr>
<td>• Pilot tracer gas leak detection</td>
<td></td>
</tr>
<tr>
<td>• Copper service connection</td>
<td></td>
</tr>
<tr>
<td>• Use new technologies (Echologics, Smartball)</td>
<td></td>
</tr>
</tbody>
</table>
Questions