This presentation premiered at WaterSmart Innovations

watersmartinnovations.com
Out of Sight, But Not Out of Mind: Using Satellites to Find Leaks
Irving Water Utilities

- Irving lies between Dallas and Fort Worth; east side of DFW Airport
- 68 square miles
- Population: 256,684
- Three Systems
  - Water Supply
  - Water Distribution
  - Wastewater Collection
- Functions
  - Pumping
  - Maintenance/Repairs
  - Regulatory Compliance
  - Engineering/Project Management
  - Water Conservation
  - Customer service, billing, metering
  - GIS Mapping
Water Supply

Average use – 37 MGD:
- Jim Chapman Lake: 85%
- Dallas Purchase: 15%

Distribution System:
- 731 miles of pipe
- 6 Pump Stations
- 9 elevated storage tanks
- 10 ground storage tanks
- Flow ranges:
  - Summer: up to 70 MGD
  - Winter: drops to 25 MGD
- Water Loss ranges between 8% and 10%
Proactive Leak Detection

- Test 546,103 LF/year
- Logger and Manual Patrols
- Goal: 100% every 7 years
  - 2014: 52 leaks
  - 2015: 90 leaks
  - 2016: 64 leaks
  - 2017: 40 leaks
  - 2018: 41 leaks
  - 2019: 82 leaks; +38 Sat.
  - 2020: 64 leaks; +133 Sat.
  - 2021: 61 leaks; +61 Sat. so far
Reactive Leak Detection

- Pinpoint leaks to support water repair crews
- Minimizes disruption/digging
- May use correlation
- Crews learn LD basics
- 2018: 87
- 2019: 101
- 2020: 105
- 2021: 71 so far
FY2018-19 Pilot Project: Detecting Non-Revenue Water from Space

- **Pilot Project** - evaluated 500 (69%) miles of contiguous water lines with 1 satellite pass on 12/25/18

- Technology Uses ground-penetrating L-band microwave signals and proprietary algorithms to track the spectral signature of drinking water

- Potential leaks captured and analyzed (accounting for recent repair work)

- Follow up field investigations within a 100 meter radius: Pilot completed February 2019
Leak Detection Process

• Image is analyzed to track the spectral signature of drinking water subsurface in relation to the utility’s water infrastructure

• Follow-up with field operations requires acoustic leak equipment with experienced operators
  – Locate
  – Pinpoint
Main Leak: Cast Iron

- 8” Line
- Location required multiple repairs

Area Photo:

<table>
<thead>
<tr>
<th>Leak ID:</th>
<th>00005</th>
<th>Date:</th>
<th>2/1/2019</th>
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</thead>
<tbody>
<tr>
<td>Leak Status:</td>
<td>Leak</td>
<td>Type of Leak:</td>
<td>Main</td>
</tr>
<tr>
<td>Pipe Size (in):</td>
<td>8</td>
<td>Pipe Material:</td>
<td>Cast Iron</td>
</tr>
<tr>
<td>Leak Subtype:</td>
<td></td>
<td>Address:</td>
<td>5002 Riverside Dr</td>
</tr>
<tr>
<td>Cross Street:</td>
<td></td>
<td>Location Description:</td>
<td></td>
</tr>
<tr>
<td>Surface Material:</td>
<td></td>
<td>Sound Strength:</td>
<td></td>
</tr>
<tr>
<td>Surfacing:</td>
<td></td>
<td>Comments:</td>
<td>Appears to have been recently repaired</td>
</tr>
</tbody>
</table>
Main Leak: Ductile Iron

- 6” Line
- Work order submitted to Fire Hydrant Crew

Leak ID: 00006
Leak Status: Leak
Type of Leak: Main
Pipe Size (in): 6
Pipe Material: Ductile Iron
Leak Subtype: Hydrant
Address: 3349 University Park Ln
Cross Street:
Location Description:
Surface Material: Dirt/Grass
Sound Strength: 426
Surfacing: No - Unable to Visually Confirm
Comments: Possibly leaking from weep hole.
Residential Leak: Copper

- ¾ inch line
- Repairs made by resident; follow-up by utilities staff

Area Photo:

<table>
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<tr>
<th>Leak ID:</th>
<th>00031</th>
<th>Date:</th>
<th>1/28/2019</th>
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<tbody>
<tr>
<td>Leak Status:</td>
<td>Leak</td>
<td>Type of Leak:</td>
<td>Residential</td>
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<tr>
<td>Pipe Size (in):</td>
<td>3/4</td>
<td>Pipe Material:</td>
<td>Copper</td>
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<tr>
<td>Leak Subtype:</td>
<td>Outside Meter Pit (Unknown)</td>
<td>Address:</td>
<td>3609 W Rochelle Rd</td>
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<tr>
<td>Cross Street:</td>
<td></td>
<td>Location Description:</td>
<td></td>
</tr>
<tr>
<td>Surface Material:</td>
<td>Dirt/Grass</td>
<td>Sound Strength:</td>
<td>222</td>
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<tr>
<td>Surfacing:</td>
<td>Yes - Surfacing</td>
<td>Comments:</td>
<td></td>
</tr>
</tbody>
</table>
Residential Service Leak: Copper

- Meter Connection
- Improper Installation repaired by contractor
Summary of Pilot Satellite Project

- 96 potential leak findings
  - vs. random approach
- 30.41 miles audited in the field
  - 1 leak found for every 0.8 miles audited
- 38 leaks found in 7 days of field work (extended days)
  - vs. 95 days to find 38 leaks using standard methods at rate of .4/day (Irving avg.)
# Standard Acoustic Survey vs. Satellite-guided Acoustic Survey

<table>
<thead>
<tr>
<th></th>
<th>Standard Acoustic Survey</th>
<th>Satellite-guided Acoustic Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leaks found per day:</strong></td>
<td>1.16 is daily national avg.</td>
<td>Up to 8 per day</td>
</tr>
<tr>
<td><strong>Leak Density per mile:</strong></td>
<td>1 leak finding per 2.5 – 3.7 miles</td>
<td>1 leak every .8 miles</td>
</tr>
<tr>
<td><strong>Survey Cycle:</strong></td>
<td>1-5 years</td>
<td>Quarterly, Bi-annual or Annual</td>
</tr>
<tr>
<td><strong>30.41 miles in Irving</strong></td>
<td>8-12 leaks</td>
<td>38 leaks</td>
</tr>
</tbody>
</table>
From Image to Repair in 4 Easy Steps

1) Image Acquisition and Analysis
2) POI Delivery
3) Pinpoint Leaks
4) Mark/Repair

Satellite imagery enables noninvasive, indirect condition assessment of water lines.
2020 Satellite Leak Detection Results

- Pass #1: 289 POIs (March)
  - 72 leaks found
  - Main/Valve/Hydrant – 10
  - Angle stop/service – 23
    - 11 not surfacing
  - Private – 39

- 40 Day Evaluation of:
  - 326,704 lf
  - 6,513 Meters
  - 783 Hydrants
  - 1,073 Valves
2020 Satellite Leak Detection Results, Cont.

• Pass #2: 257 POIs (June)
  ▪ 61 leaks found
  ▪ Main/Valve/Hydrant – 6
  ▪ Angle stop/service – 33
    ▪ 4 not surfacing
  ▪ Private – 22

• 36 Day Evaluation:
  ▪ 266,327 lf
  ▪ 4,758 Meters
  ▪ 611 Hydrants
  ▪ 836 Valves
Value Metrics

- POI/LLLs: 546
- Leaks: 133; 76 NR
- Crew Days: 77
- Leaks per day: 1.7
- Miles: 120.7
- Leaks per mile: 1.1
- Estimated savings - $112,420/year
- Investment of $164,400 – payback of 17 months
2021 Satellite Leak Detection Results

- Pass #1: 311 POIs (May)
  - 61 leaks found
  - Main/Valve/Hydrant – 4
  - Angle stop/service – 20
    - 15 not surfacing
  - Private – 37

- 43 Day Evaluation:
  - 284,679 lf
  - 5,446 Meters
  - 676 Hydrants
  - 763 Valves
Planning Considerations

- Internal vs. contracted leak detection crews
- Number of appurtenances listened to
- Number of satellite passes to use
- Completion of repairs by Field Operations
The Unfindable: A Game-changer

- 50-year old 16” main
  - Inaccessible by vehicle
  - Under Loop 12
  - In Wooded area
  - Between creek and railroad tracks
  - No listening points
  - No visible leak
  - Audible water flowing into the creek
A Hidden Leak is Discovered by leak detection staff:

“I would have never found the leak without the POI being there.”
Benefits

• Find leaks before catastrophic pipeline failures - significant potential savings

• Regular use allows for consistent, virtually continual oversight of entire system
  – ID problem areas for constant oversight

• Identifies focus areas for field crews
  – Improved utilization/efficiency of personnel and resources

• Time required without satellite technology is significantly longer
  – Prior Annual Average (6 years): 62
  – Satellite Pilot study: 38 (7 days)
  – 2020 Satellite work: 133 (77 days)
  – 2021 Satellite work: 61 (43 days)
What Satellite Leak Detection Ensures

- What is out of sight in Irving is never out of mind
Texas Cities Using Satellite Leak Detection

- Galveston
- Garland
- Georgetown
- Irving
- League City
- New Braunfels
- North Texas Municipal Water District
- Plano
- SAWS - San Antonio
Contact Information

Donna Starling
Water Programs Manager
City of Irving
dstarling@cityofirving.org
972) 721-2431

Technical Information:
inquiry@utiliscorp.com
www.utiliscorp.com