Mobile GIS Transforms Operations at St. Johns County Utilities

St. Johns County Utilities is using technology that transforms how they manage and provide water, waste water, and reuse water to 100,000 customers in NE Florida. Implementing these tools will help us keep high customer satisfaction, water quality and cost effectiveness, while facing new challenges from high growth, development, aging infrastructure, and new regulations.

This presentation illustrates the implementation, improved management and savings through our Cityworks enterprise asset management system, Mobile Technology, ArcGIS Online, ArcGIS for Water Utilities Emergency Response, Hydraulic Modeling, Data Reviewer and Fleet Management AVL system.

Download at: http://sjcutilities.maps.arcgis.com

St. Johns County Utility Department, Cityworks 2014 Exemplary User
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St. Johns County Utilities

- Water, Wastewater, Reclaim Services
- 42,000 Accounts & 100,000 Customers
- 8 Water Treatment Plants (27 mgd)
- 11 Wastewater Treatment Plants (14 mgd)
- 13 Storage Tanks & 336 Pump Stations
- 1,350 miles of Distribution & Collection Mains
St. Johns County Utilities

- **Agency Values:**
  - Water Quality
  - Cost Effectiveness
  - Customer Satisfaction

- **Operational Impacts:**
  - High Growth Rate
  - Expansion
  - Consolidation
  - New Regulations
  - Aging Infrastructure

**The Challenge:** Aging infrastructure, fast-changing population patterns, changing technologies, plus the increased demand for reliable and efficient systems are driving greater investments in infrastructure.
GIS In Utilities

Vision for GIS Technology Solutions Follows Industry Techniques and Emerging Principals
GIS In Utilities

- Review of St. Johns County Utilities Organization, Applications and Functions
- Develop on Platforms that Support Department Wide Functions
- Adapt Dynamic and Flexible Professional Services
  - Focus on meeting budget plans and completing projects
  - Adaptive Contractor structure through Continuing Service Providers
- Agile Projects with Internal Assessment, Management and Contributions
The Challenge: Aging infrastructure, fast-changing population patterns, changing technologies, plus the increased demand for reliable and efficient systems are driving greater investments in infrastructure.

Mobile GIS & Technology Solutions

- Cityworks Enterprise Asset Management System
- Criticality Assessment and Capital Planning
- ArcGIS Online
- ArcGIS for Water Utilities Emergency Response
- Hydraulic modeling
- GIS Data Quality and Workflow
- Fleet Management and Logistics
Enterprise Asset Management

Objectives:

- Improve preventative maintenance
- Extend life of assets
- Reduce asset downtime
- Lower total cost of ownership
- Improve service
- Better accounting
- Better budgeting
Cityworks Asset Management System

Implementation:

Service Request - Call Center
- Recording problems, logging customer calls
- Manage, dispatch investigations, record findings
- Create work orders as needed

Work Order Management
- Job codes with work flow
- Preventive and Reactive maintenance
- Cost summaries and history

Inspections – Condition Assessments
- Maintenance Scoring & Condition Scoring
- Asset Analysis

Resource and Equipment Management
- Labor, Material, Equipment
- Storeroom and Inventory management

Reporting and Management
- Reporting, Dashboards, KPI’s
Asset Management - Service Requests
Asset Management - Inspections
Work Orders - Details
Asset Management - Warehouse & Inventory

- Storeroom Solution
- GL Budget Codes
- Monthly Balance Reports
- Storeroom Inventories
- Match to 10%
Cityworks AMS - Mobile

- Field Crews use Toughbooks & WiFi
- Plants use dedicated PCs
- Pretreatment Uses Win Tablet
Asset Management – Operational Awareness

- Organizational Awareness
- Comprehensive View
- Operational & Financial
- Monthly Activity Reports
  - Work Order, Asset, Cityworks
- Management, Data QC, etc.
- Over 60 Report Templates
Asset Management - Benefits & Impact

- Improved Awareness of Assets, Operations and Functions
- Real-Time Access Throughout the Organization
- Employees are empowered and motivated
- Improved Efficiency and Productivity
- True Cost Tracking for Maintenance, Expenses and Planning
- Better Tracking of Performance Measures
- Improved customer service, with tracking and shorter response times
- Work Orders: 12,362 last twelve months from 588 templates
- Call Center Service Requests: 1,341 last twelve months
INTEGRATED DATAFLOW
Customer Information System

Customer IS Integration
- Update new or retired Accounts in Cityworks
- Update new or retired meters in GIS
- Reconcile w/ Sensus meter locations
- Latest Customer Info

Meter (AMR) Integration
- Consumption Analysis
- Support Conservation
- Trigger WO based on Status
- SJRWMD Cost-Share
Criticality Assessment

Objectives:

- Aging Infrastructure requires capital rehabilitation and reinvestment strategies.
- Establish Data, Criteria, and Decision Matrix
- Identify a Criticality Score = LoF + CoF
  - Likelihood of Failure is impacted by age, material, work order history, impact from force mains, etc
  - Consequence of Failure is impacted by customer density, service network, critical facilities, environmental proximity, etc
- Integrate with Cityworks Tools and Data
The Ponte Vedra Service Area acquired two commercial utilities in 2005-2007 to stabilize the utility services and unified the infrastructure.

Aging infrastructure requires capital rehabilitation to provide safe and reliable service.

143 miles of water transmission and distribution mains, with 2,262 valves.

101 miles of gravity sewer mains and 46 miles of sewer force mains.

2,749 manholes
Criticality Assessment - Data

- Geodatabases and databases for Water Mains and Sewer Mains and Manholes, including diameter, material, age, type...
- Network and Spatial Analysis for flow, downstream relationships, customer density, etc
- GIS Data including identification of critical facilities, pavement, wetlands, Sanitary Sewer Overflows.
Criticality Assessment - Analysis

- Criticality Analysis is performed through GeoProcessing models and scripts.
- Uses custom scoring and weighting.
- Each Asset has a Criticality Score.
  - Likelihood of Failure
  - Consequence of Failure
- Criticality Scores can be reviewed and analyzed geographically, or in tables.
- A summary report, and integrated GIS Data provide format for scalable review and executive summaries.
Criticality Assessment – Impact & Results

- Criticality Assessment Report provided overview for the aging infrastructure within our Ponte Vedra Service Area.
- Criticality Scores identified At-Risk infrastructure in Very High, High, Moderate, and Low classification levels.
- Scoring identified remaining life span of infrastructure and correlation patterns with age, material and usage.
- St. Johns County Utilities is now able to move forward in planning and financing solutions for capital reinvestments to rehabilitate and stabilize the acquired aging infrastructure.
INTEGRATED WORKFLOW
Asset Management & Capital Rehabilitation
Mobility - ArcGIS Online Platform

Objective:

- Increase Response Time
- Enable Collaboration
- Respond to Immediate Needs
- Expand Customer Service
- Improve Field Collection

Implementation:

- ArcGIS Online & ArcGIS Server
ArcGIS Online - Applications

St. Johns County Utilities

Key Improvements
Smoke Testing
Water Quality
Water Line Break Isolation Trace
Boil Water Advisory
Water Line Break Advisory Manager
Sewer Conversion
System Map
Waterwise Landscape
Service Areas
Tower Sites
Caution Water Main Break Ahead
Water Advisory
ArcGIS Online - Applications

Capital Improvement Projects

- Key Improvements Story Map
- CIP Map - App Builder

Purpose:

- Improve customer awareness of capital spending and needs.
- Provide central source for CIP status for internal and partner awareness.
Tower Site Analysis

- Tower Site - App Builder

Purpose:
- Analysis of Tower Locations.
- Compare locations of towers, expected growth, expansion.
- Share easily with Contractor for analysis and to readily collaborate with staff.
ArcGIS Online - Applications

Customer Service

- Water Quality, Service Areas, Advisories, Irrigation Rules...
- Customer Service - App

Purpose:

- Make valuable customer service information readily available for customers.
- Use expanding application and mobile endpoints.
ArcGIS Online - Applications

Project Status

- Smoke Testing
- Sewer Conversion

Purpose:

- Make project status and detail information readily available to customers and partners.
- Improve customer service and experience during public sensitive maintenance and capital improvements.
ArcGIS Online - Applications

Utility System Map

- App Builder
- Explorer for Mobile

Purpose:
- Expand interface to system maps along with Cityworks.
- Provide quick access to maps, in additional environments.
- Expand system maps to business partners and agencies.
INTEGRATED WORKFLOW
I&I Prevention and Smoke Testing

Asset Management
Eliminated age and maintenance issues.

GIS Analysis
Eliminated Likely Sources of Cross-Connection and supported analysis of SCADA values.

Mobile Notice
Adaptive Public Notice Operational Awareness Contract Collaboration SJSO & FD Awareness

Find It & Fix It
Cityworks WO on the Fly County Maintenance Private Repairs Less Reporting & More Repairing
ArcGIS for Water Utilities Emergency Response

Objective:

- Improve Line Break Response
- Improve Customer Advisory
- Reduce Steps
- Improve Capability

Implementation:

- Line Break Identification
- Network Tracing
- Advisory Publishing
AG4H20ER – Line Break Response

- Line Break Response
  - Collector App to Identify Break
  - SJC Utilities – Integration with Cityworks Service Request

- Network & Valve Trace
  - Finds Valves. Options for barriers and valve bypassing

- Isolation/Outage Area
  - Selects and Summarizes Impacted Meters, Hydrants and Valves. Saves to Service for Response and Public Advisories
AG4H20ER – Outages and Advisories

- **Advisory Manager**
  - Uses Outage Area, to create Public Water Advisory zones for low pressure, outage, boil water...
  - SJC Utilities created parcel-based advisory for integration with our CodeRed Reverse 911.
  - Auto-placed into Public Advisory

- **Public Advisory**
  - Displays Advisories, details, instructions and retractions.

- **Outage/Advisory Dashboard**
Scalable
Flexible
COTS & Customizable
Sustainable
Cost-Effective
Integration
Objective:

- Better understanding of hydraulic systems and information readily available for review and analysis.

Implementation:

- Integration with ArcGIS, run in house, using Innovyze InfoWater.
- Engineering Division coordination with a vendor to create models and use parameters to serve growing need. GIS Data provided support and data requirements including direct ArcGIS integration.
- County’s high growth rate requires revision procedures and tools.
Hydraulic Modeling – Data Integration

- Established Protocols
- Import geodatabase with 1:1 FacilityID
- Comparison tool supports updates
- Modeling provides GIS QC and tracks corrections for production GIS Data
  - Identifies incorrect pipe diameters
  - Identifies pipes that are not connected
  - Tracks model revisions that are not classified as corrections.
- 13 Models: Water, Sewer, Reuse Well
Hydraulic Modeling – Case Studies

- “Can we shut down the Innlet Beach Water Treatment Plant for 2 weeks during the low flow months, interconnect the 2 Ponte Vedra water systems, and meet fire flows across both systems”

- “What pressure do we need to set the VFD set point to when we start up the NW WWTP Reuse pumps to allow Turnbull to flow at 300 gpm. How does this change if we open the valve to fill the NW MLS Tank?”

- “What pumps in the Northwest area need to be upgraded when they are redirected to the NW WWTP headworks?”

- “Can we reroute the Innlet Beach WWTP to the Players Club WWTP using and of the existing piping and what pump station upgrades would be necessary”

- “What pipe size do we need to install through the CR207 corridor to improve the high pressures near the CR214 WTP”
GIS Data Quality and Workflow

Objective

- Improve GIS data standards to support ancillary applications
- Improve Editing Workflows, and Data Reviewing timeframes
- Reduce response time by having quality data prior to requests

Implementation

- Professional Services to utilize industry experience and expedite implementation and support staff’s development.
- Utilize Existing Tools and Standards
  - Utilize Data Reviewer, Attribute Assistant & Water Utility Editing Toolbar
  - Evaluate Workflow Manager & Task Manager
GIS Data Quality – Data Reviewer

- Data Reviewer identifies geometry errors and data missing from attribute tables.
- It selects & zooms to each record found by rule.
- Can select from selection, extent, or database.
- Batch jobs can run many rules all at once.

Data Reviewer Check
Configured to layer and the length of unacceptable lines
Attribute Assistant – Series of rules and behavior for editing features.

Top row, without Attribute Assistant, has little information.

The second row, with attribute assistant, has many fields auto-filled.
- The Facility ID is a unique value auto-populated.
- Year field is auto-filled from the Install Date field (set in the template).
- The Diameter fields pull from a separate layer (the pressurized mains).

The third row’s highlighted values self-perpetuate from previous entry.

Connectivity rules require a feature be placed correctly.
- Tap fitting has 1 connection, and cannot be placed with multiple diameters.
GIS Data Quality - Water Utility Editing Toolbar

- Customized using a configuration file
- Provides several tools
- Add Laterals at Connections Example
  - Single Click adds the water meter, service line, sampling station and tap, and joins to the water main
  - Custom settings through configuration files. For example, the distance from the sampling station to the tap can be set as a static distance or as a percentage of the total line length, and also when creating manholes with cleanouts, or join to the Main at a different angle, etc.
Fleet Management and Logistics

Objectives:

- Improve Operational Awareness
- Awareness of Fuel Consumption
- Improve Field Management
- Reduce Maintenance Time
- Integration with WO Fields

Implementation:

- CompassCom product
- Fleet-wide use
St. Johns County Utilities is implementing successful strategies to help solve our challenges.

Focus towards Water Utility Business Patterns has proven very effective and products serve the wider range of needs.

ArcGIS and Cityworks Platforms provide adaptive solutions.

Professional Services supports wider options and expediency.

The needs of the Utility are dynamic and evolving. Solutions that address these needs, through established resources, helps effective responses, reaction times, and predictive solutions.
Animating Utility Asset Management Plans With Real-Time Data

FRWA Annual Conference
August 9, 2016
Key Elements of an AMP*

- Level of service definition
- Selection of performance goals
- Information system
- Asset identification and valuation
- Asset level condition assessment
- Failure impact evaluation and risk management
- Rehabilitation and replacement planning
- Capacity assessment and assurance
- Maintenance analysis and planning
- Financial management
- Continuous improvement

* Source: US EPA Fact Sheet: Asset Management for Sewer Collection Systems
Steps in the Animation Process

Planning & Design → Data Acquisition → Data Analysis → Take Action
Planning and Design

- Which assets/systems to target?
- Why are these assets vulnerable and what risks are of concern?
- How can performance be improved?
- Can real-time data mitigate risks and/or optimize performance?

Examples:
- Chlorinators
- Critical pumps
- Blowers
- Process parameters
- Etc.

Mission Critical
Risk Oppty (Up or Down)
Significant Consequences

Data Platform Design

Informs
Data Acquisition

• Two choices: 24/7 (permanent sensors) or interval (mobile devices)
• Data quantity vs. cost
Data Analysis – Visualizations & KPIs
Data Analysis – Trending
### Data Analysis - Fault Detection/Analytics

![Site Spark Interface](image)

#### Sites

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<th>Sites</th>
<th>Rules</th>
<th>Cost</th>
<th>Dur</th>
<th>Timelines</th>
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CMMS Integration

Permissioned Users

“Intelligent” Work Orders

- Utility’s existing CMMS
- New cloud-based app

Cloud Server

Anomalies

CMMS
Putting It All Together

- Visualizations and trending
- Benchmarking
- Repair vs. replace analytics
- Data to inform CIP

Permissioned Users

“Intelligent” Work Orders

CMMS

Anomalies

Cloud Server
Optimizing System Maintenance Costs

![Graph showing the relationship between Expenditure ($), Degree of Data Integration, and the optimum range for maintenance strategies. The graph illustrates the cost implications for Predictive (PdM), Reactive, Preventive (PM), and Total expenditure across different degrees of data integration, with the optimum range highlighted.]
Summary of Benefits

• Reduces risk of unexpected asset failure and improves component life
• Reduces costs associated with emergency call-outs
• Potential to reduce superfluous preventive maintenance tasks such as routine field inspections
• Creates opportunity for tighter control over processes and systems
• Brings deferred maintenance “out of the shadows”
• Generates data streams that can inform repair vs. replace decisions and the CIP
• In some cases, reduces the need for plant staffing
• Improves operator morale because they are better informed and spend less time responding to emergencies
• Improves regulatory relations
Where Do We Start?

1. Don’t get overwhelmed by the possibilities or the technology.
2. Start small with the most obvious use cases.
   a. Keep the cost down.
   b. Minimize integration issues; develop and validate SOPs.
   c. Build confidence as value is realized.
3. Expand the data platform as new use cases are identified – go deeper and continuously improve!

Ensure operators are “bought in” and have the proper tools, training and incentives to fully integrate asset management planning into day-to-day operations so that the utility system and its ratepayers realize the full benefits of the AMP.
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