



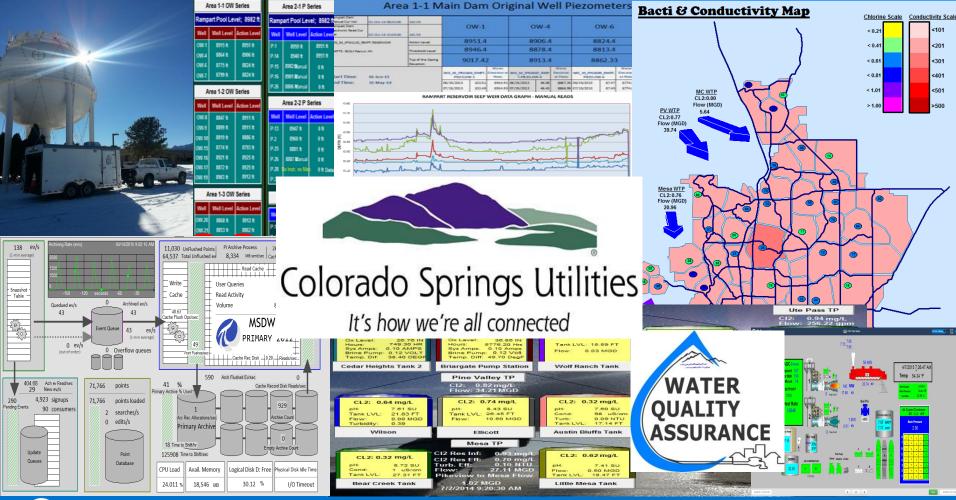


Improving Business Processes through Operational Intelligence in the Water Quality Industry

Presented by David Mora ~ Water Quality Assurance Lead

Jeannette Ortiz ~ Systems and Database Lead





Water Quality Assurance

- Responsibilities include
 - Compliance and process control sampling
 - Customer Service Support (Internal and External)
 - Providing technical guidance for all water quality related disciplines
 - Source water, treatment, distribution system wastewater treatment, and dewatering activities
 - Water Quality Subject Matter Experts
 - PI Super-users

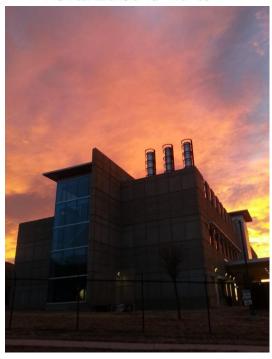
We reside within the Laboratory Services Section, which provides support for all four utility services

- Colorado certified laboratory
- Process 14,000 samples annually
- over 80,000 analytes
- WQA are involved with 85% of the Laboratory Samples



Colorado Springs Utilities

It's how we're all connected



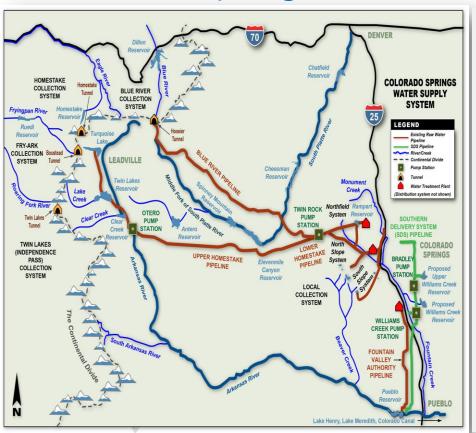


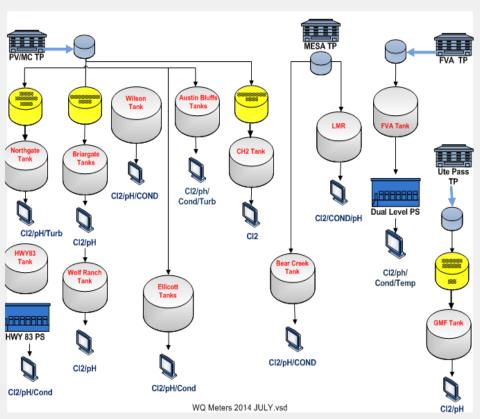
Scope of Responsibility

- Expand across
 - 8 Watersheds
 - 7 Finished Water Treatment Facilities
 - 286 MGD peak and 215 MGD sustained
 - 38 Finished Water Reservoirs
 - 4 Post-Chlorination Stations
 - 2700 miles of potable water main
 - Serving 449,260 Customers
 - 137,619 water meters
 - 2 Wastewater Treatment facilities
 - Treat 38 MGD permit for 85 MGD
 - Solids handling facility
 - 19 lift stations



Colorado Springs Critical Water Infrastructure





Business Challenges

- Multiple Enterprise Interfaces and Dissimilar Systems
 - Users required to learn many systems
 - Enterprise integration issues
 - Data redundancy
 - Disconnected technologies
- Dependent upon other departments for information
 - SCADA Operators tasked to monitor Water Quality Assets
 - Communication standard via cell phone and radio
- Business Drivers
 - Expanding Infrastructure with limited resources
 - Environmental and Compliance Regulatory Drivers
- Obsolete Systems
 - Hard Coded Static Reports (SQR)
 - 3 week turnaround time





Sustainable WQ Management Program

We needed to identify who we are

- Why are we here?
- What value can we bring?
- How can we leverage the data and show it's value?

We needed to focus on Business Process Improvements

- Leveraging technologies
- Create a environment of data sharing
 - Create a just-in-time informed process
- Create a Dynamic Reporting System
 - Improve compliance and process control data timeliness
- Capture institutional knowledge
 - Optimize on training and development opportunities
- Transforming users with actionable information

LASTLY... BUILDING VALUE NOW & BUILDING VALUE OVER TIME



What is this PI Thang?



Can the PI System been utilized?

- To what extent?
- How can we leverage this technology?
- Can we improve efficiency using real-time data?
- Can we visualize the value of data?

Determine where to start the PI System implementation for WQA

We started with Key business processes

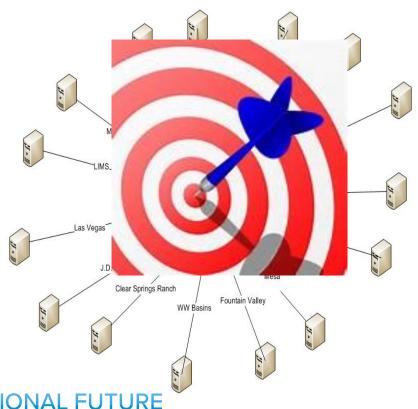
- Total Coliform Rule Monitoring Program
 - 56 monitoring location collected weekly with over 10 analytes per site.
- Post-Chlorination and Water Quality Monitoring Stations
- Compliance and Process Control Sampling Program
 - Water and Wastewater Treatment Plants
 - ➤ Watersheds and Source Water Management



Hone in on the Data Target

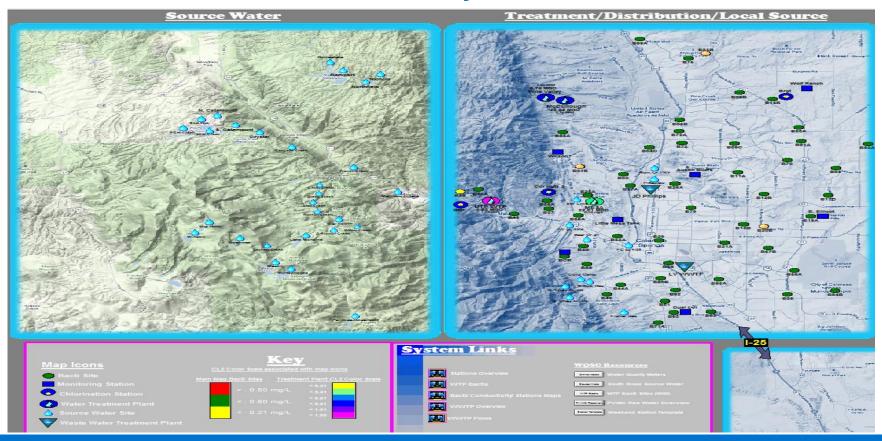
We created a Centralized Data Platform

- Which enables us the ability to
 - Interface with multiple enterprise data sources
 - Leverage all related enterprise systems
 - Access Real-Time data
 - Capture sensor-based data
 - Operate independently
- Which Leads to
 - Maximize Real-time Data Intelligence
 - Improved decision quality
 - End-User Ownership and Empowerment
 - Data Sharing across the organization

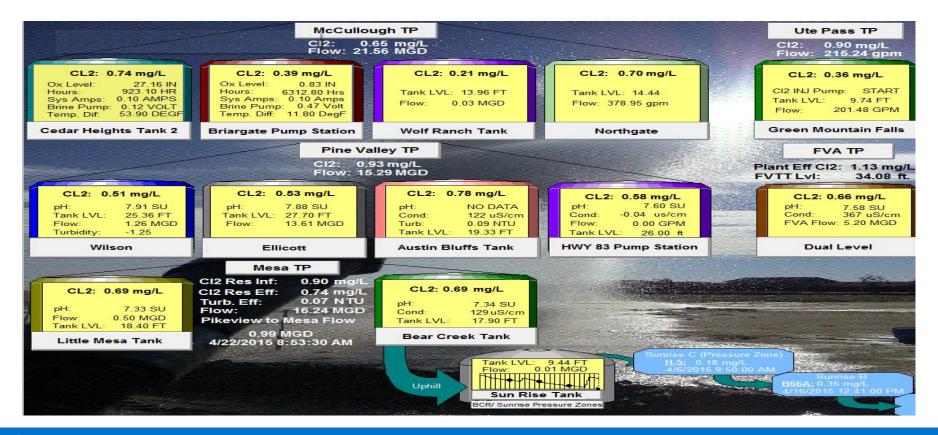


SUSTAINABLE OPERATIONAL FUTURE

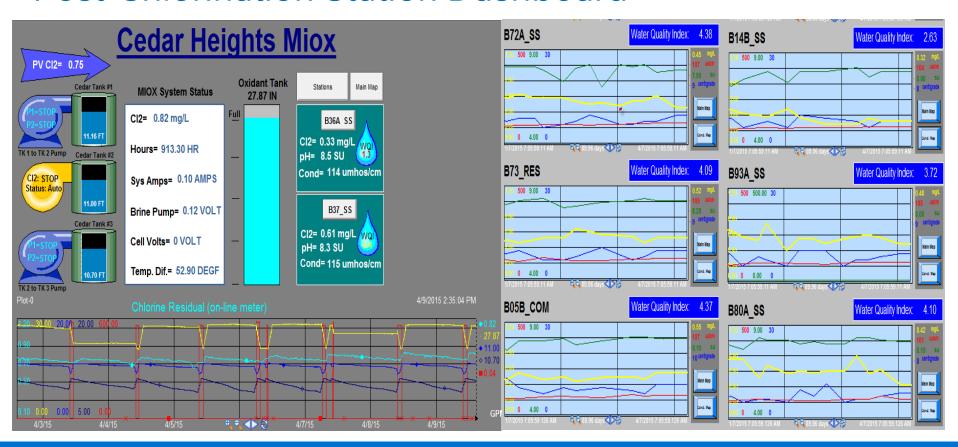
Holistic View of Water Quality Assets



Water Quality Monitoring Dashboard



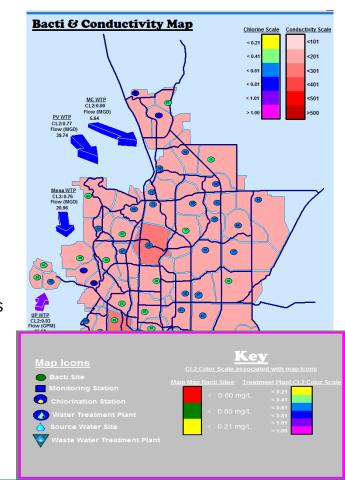
Post-Chlorination Station Dashboard



Then the analytics began...

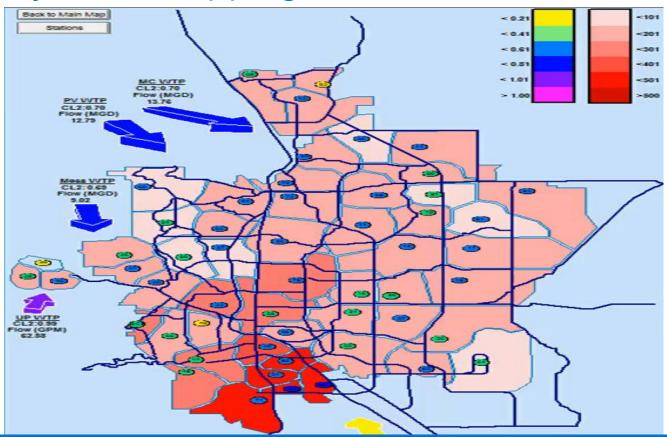
Getting deep into the data now that it's accessible and dynamic

- Accessibility to the real-time data
 - Created a environment of data accessibility
 - Empowered team members and customers
- Utilizing PI DataLink and PI ProcessBook
 - Centralized data source
 - Visualization and Leverage Data Sources
 - The ability to perform event analysis by rewinding the data
 - Tell the data story
- Gives us the ability to Perform Advanced Water Quality Analytics
 - Development a Algorithm for Water Quality Index
 - Leveraging PI Server Asset Framework (AF)
 - Enhance Water Quality Station Performance KPI's
 - Visualization of Chlorine Residual in the Water Distribution System
 - Treatment Plant Zone of Influence with Conductivity Source Trace
 - Water Distribution System Optimization



Source Trace Dynamic Mapping

- Understand
- Predict
- Mitigate





Leveraging PI System Tools

Bear Creek & Sunrise Pressure Zone Water Quality issues

- •Real-time PI System data makes a big difference
- •A powerful tool that not only provides data that helps us identify problems but provides the ability to perform data analytics that enables us the insight into solving them





CHALLENGES

Persistent low chlorine water in large area of town

Potential safety concerns with low chlorine residual

Low water turnover lead to higher water age and lower Chlorine residual

SOLUTION

Reactive approach
Poor allocation of resources
Spill reservoir as needed
Not sustainable
Manually add Chlorine to Reservoir
Temporary solution
Capital investment of post
chlorination system
Costly

RESULTS

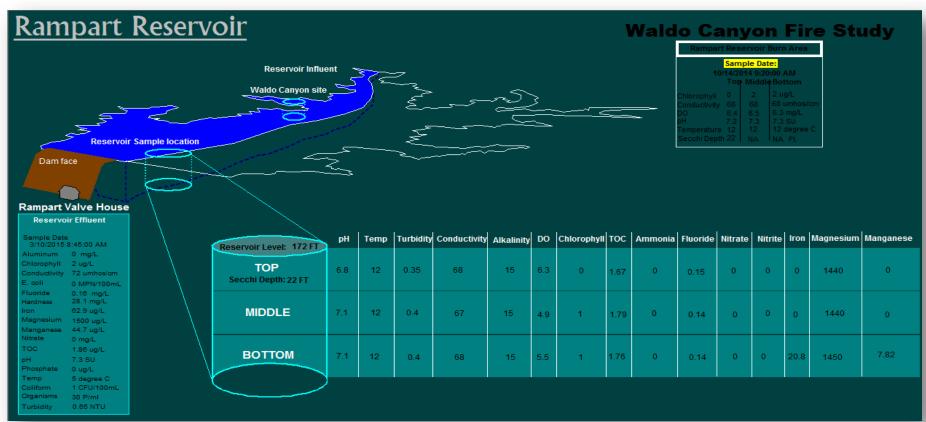
Problem mitigated through optimum conveyance of water using real-time data

Mechanical solution has led to chlorine residual managed

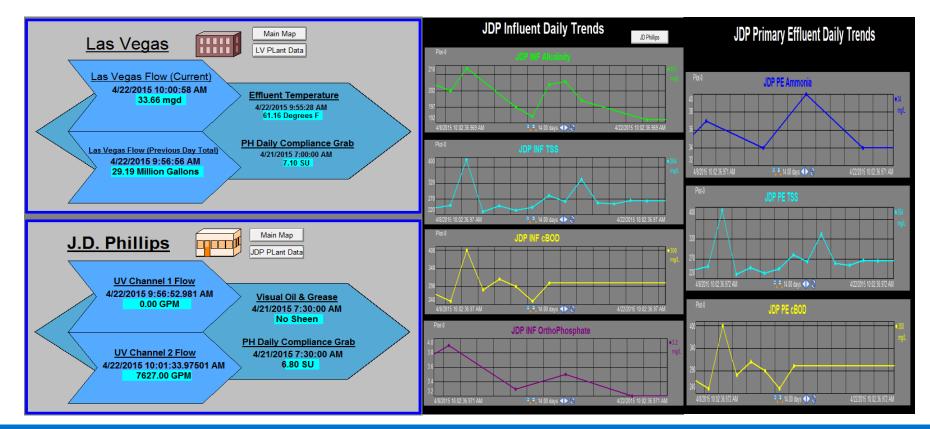
Water System Awareness-Informed and educated team



Reservoir Water Quality Display



Operational Intelligence for Wastewater Treatment





Ad-Hoc Trending using PI Coresight

- Empowering end-users
 - Increased ownership of the data and autonomy
 - It is an intuitive and interactive tool
- Creates a platform for users to have the ability to access real-time data
 - Custom views that can be designed to meet specific business needs
- Web-based client allows users to analyze enterprise data
 - Mobile accessibility and device agnostic
- Data analytical in the field improves decision quality
 - Reduces operational costs



Utilization of the PI System Real-Time Data

- Leads to new discoveries
 - Proactively identify treatment plant zone of influence and system disruptions
 - Optimize system control by decreasing water age at the fringe of the distribution system
 - Reduce treatment plant effluent chlorination set points
 - Anticipate customer service impact
- Lead to Improved operational efficiencies
 - Improved internal and external customers service
 - Meet our ability to sustain operational needs

MAINTAINING OPERATIONAL EFFICIENCY AS WE EXPERIENCE GROWING INFRASTRUCTURE WITHOUT INCREASING STAFFING LEVELS



Operational Gains Realized with PI System Utilization

- Significant O&M Reduction Realized
 - 29% Reduction in resource allocation for online Instrumentation Inspections
 - 30% Reduction in Vehicle Usage Annually
 - 58% Reduction in Overtime
- Saving has helped with reallocation of O&M dollars
 - To expand our Water Quality Instrumentation Program
 - Pre PI System utilization we had only 6 operating WQ systems
 - Compared to 18 operational by end of year 2015



Realized Benefits and the Power of Data

- Transformed from a static and reactionary team to a SOLUTIONS based team
- Eliminate the need for assistance from other operating areas
- Identify System disruptions
 - Flexibility in resource allocation
 - Improved decision process
- Disaster Recovery and Event Analysis
 - Replay events and perform analysis
 - Troubleshooting and training
- Centralized data accessibility
- Increased ownership of the data, its values and the processes around WQ
- Allowing internal customers access and visualize data in real-time
- Quick accessibility to the data within 15 minutes of LIMS authorization

LEVERAGING DATA HAS TRULY REVOLUTIONIZE OUR TEAM DYNAMICS AND OUR IMPACT TO THE ORGANIZATION



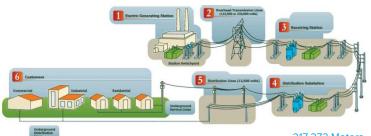
What does it take to Empower the Water Quality Assurance Group?





COLLABORATION, TEAMWORK AND INFRASTRUCTURE

Colorado Springs Utilities – 4 Service Utility



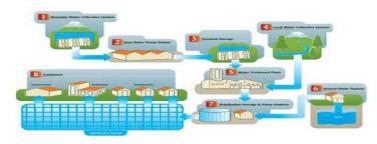
ELECTRIC

217,273 Meters

- 4 Hydro Electric Plants
- 2 Gas Plants
- 2 Coal Plants

Contracted Solar

Generating Capacity 1164MW's





137,619 Meters 7 Water Plants Treatment Capacity 286 MGD's

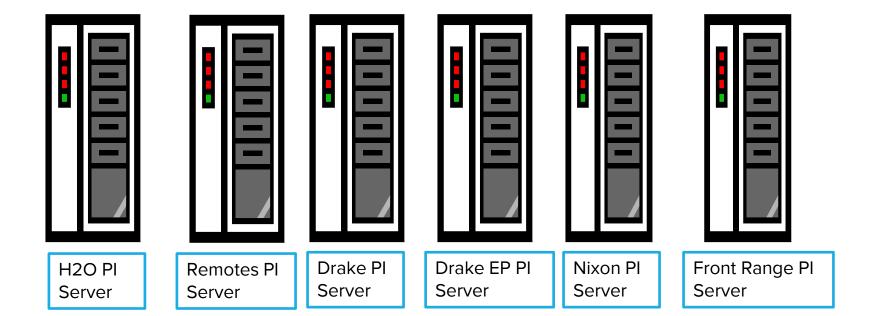


192,872 Meters 7 Gate Stations Net Volume Throughput 269.8 MCF's



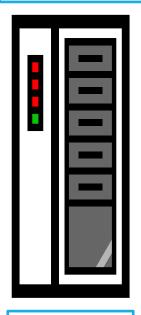
1 Solids Handling Facility 19 Lift Stations Treatment Capacity 38 MGD's

Source PI Servers

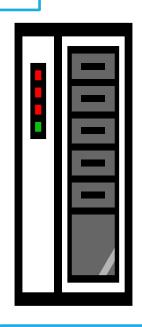


Enterprise PI System Infrastructure

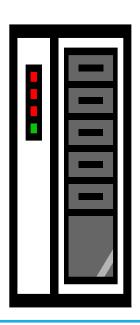
CSU PI Collective



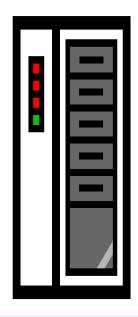




Secondary PI Server

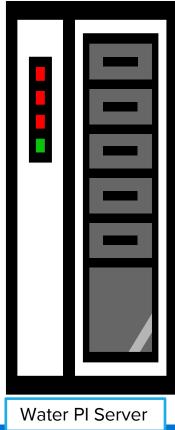


Asset Framework Notifications PI Analyses

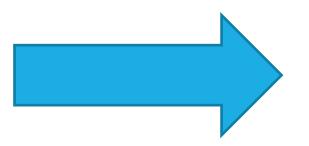


PI WebServer
PI Coresight
PI Manual Logger

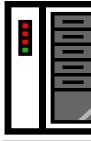
PI to PI



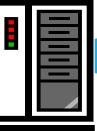
PI Collective



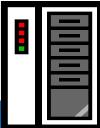
Primary Pl Server



Secondary Pl Server



AF & Notifications



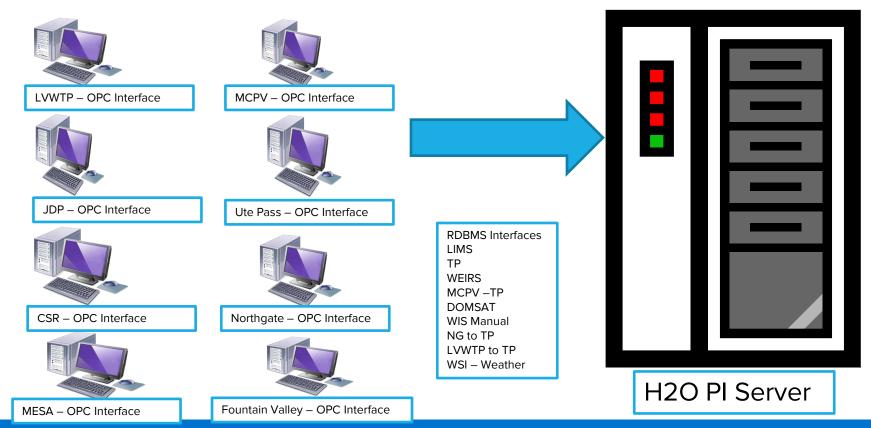
PI Web Server – PI Coresight



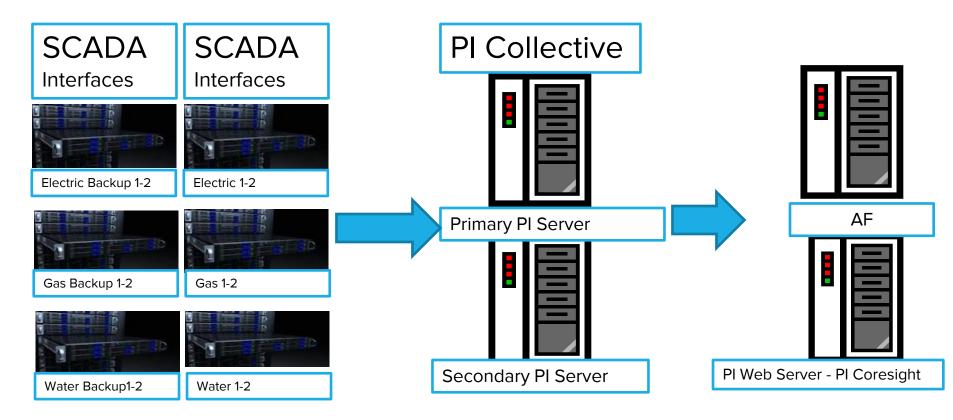
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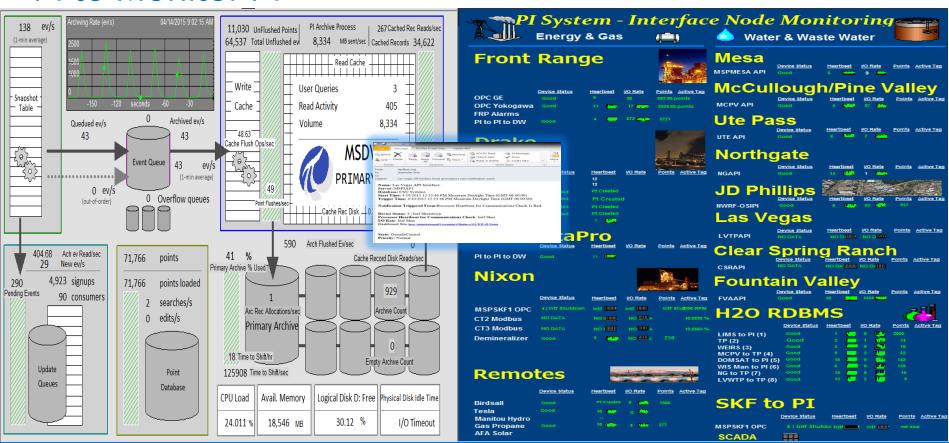
H2O PI Server & 17 Interfaces



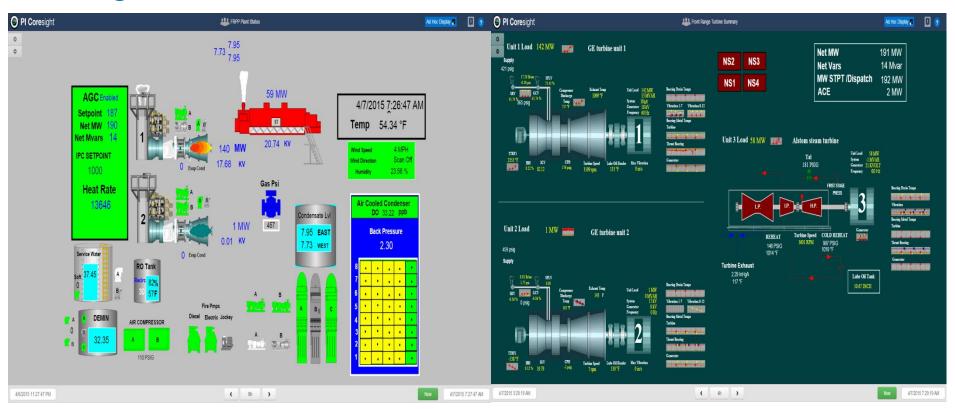
Data Flow from SCADA to the Collective



PI to Monitor PI



Improving Business Processes through Operational Intelligence for Electric Generation

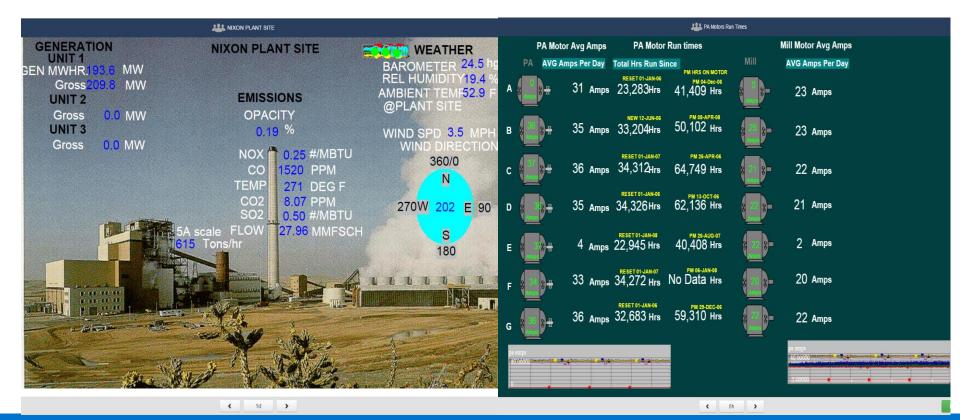


Improving Business Processes through Operational Intelligence for Electric Generation

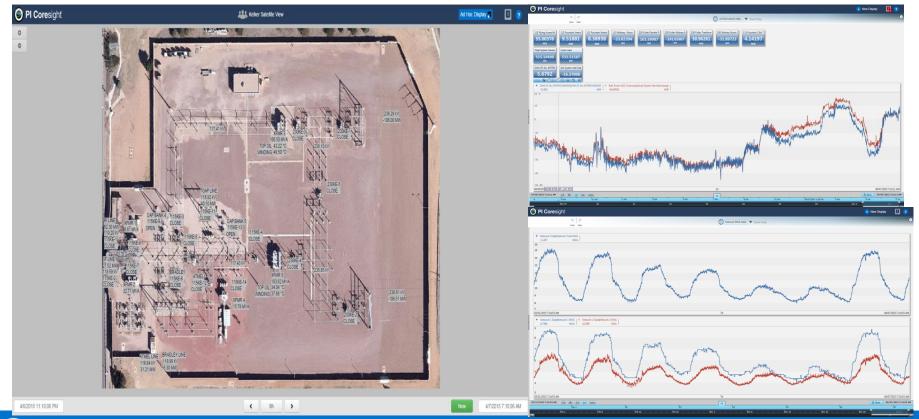




Improving Business Processes through Operational Intelligence for Electric Generation



Improving Business Processes through Operational Intelligence for Electric T&D



Improving Business Processes through Operational Intelligence for Natural Gas

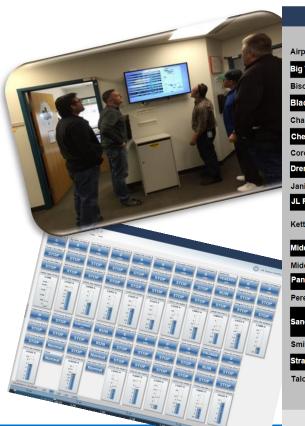




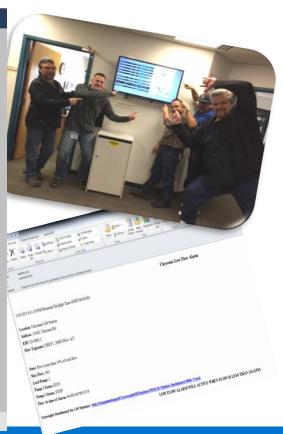
Dam Monitoring and FERC Reporting



Improving Business Processes through Operational Intelligence for Wastewater Lift Stations



Lift Station			Lead Pump	Pump Start		Wet well Level		
Airport Business Park L.S.	0 GPM	0)	0	1 STOP 2 STOP	-9-9-9-	4.95536 ft	Start Stop	6 ft 4 ft
Big Valley L.S.	0 GPM	0	1	1 STOP 2 STOP		2.57975 ft	Start Stop	2.8 ft 2 ft
Bison Ridge L.S	0 GPM	0	1	1 STOP 2 STOP		3.66911 ft	Start Stop	4 ft 2.8 ft
Black Squirrel L.S	0 GPM	0)	2	1STOP 2STOP		4.78442 ft	Start Stop	5.5 ft 3.5 ft
Chapel Hills L.S.	0 GPM	0	1	1 STOP 2 STOP	The same	3.73207 ft	Start Stop	4.5 ft 2.6 ft
Cheyenne L.S.	0 GPM	0	1	1 STOP 2 STOP		2.7735 ft	Start Stop	4.5 ft 2.5 ft
Coronado L.S	0 GPM	0	2	1STOP 2STOP		3.58364 ft	Start Stop	4.1 ft 2.2 ft
Drennan L.S	0 GPM	0	1	1 STOP 2 STOP		3.33333 ft	Start	3.5 ft 2.5 ft
Janitell L.S.	0 GPM	0)	1	1STOP 2STOP		2.69231 ft	Start Stop	3 ft 2 ft
JL Ranch L.S.	0 GPM	0	1	1 STOP 2 STOP		2.98474 ft	Start Stop	3 ft 2 ft
Kettle Creek L.S.	1180.39 GPM	#	2 Lag	1 STOP 2 RUN 3 STOP 4 STOP		5.31364 ft	Start Stop	5.2 ft 4.2 ft
Middle Tributary L.S.	0 GPM	©	2	1 STOP 2 STOP		4.78251 ft	Start Stop	5.5 ft 3 ft
Middle Monument L.S.	0 GPM	0	2	1 STOP 2 STOP		5.08013 ft	Start Stop	5.5 ft 3.5 ft
Pando Lift Station L.S.	273.29 GPM	₹	2	1 STOP 2 RUN		4.00053 ft	Start Stop	4.5 ft 2.5 ft
Peregrine L.S.	245.301 GPM	•	2	1STOP 2 RUN		4.24603 ft	Start Stop	4.5 ft 3 ft
P1 0.00 P2 0.00 P3 0.11 P4 0.23	20 5 08 8352.58 GPM	Æ	Lead 3 Lag 4	1 STOP 2 STOP 3 RUN 4 RUN		A 13.9658 ft B 14.0585 ft	Start Stop Start Stop	14 ft 8.2 ft 15 ft 13 ft
Smith Creek L.S.	0 GPM	0	2	2STOP 1STOP		3.52885 ft	Start Stop	3.6 ft 2.2 ft
Stratton Meadows L.S.	534.824 GPM	<u>T</u>	2	1STOP 2 RUN	THE STATE OF	3.98016 ft	Start Stop	5.75 ft 3.25 ft
Talon Hill L.S.	0 GPM	0	2	1 STOP 2 STOP		9.98924 ft	Start Stop	10 ft 6 ft



Operational Gains Realized throughout CSU with the Utilization of the PI System

- Reduction in O&M costs
- Continued growth experienced for management and monitoring of critical systems
- Leverage Integration Opportunities
- Single platform for data access PI Client tools





Colorado Springs Utilities

It's how we're all connected

COLLABORATION, TEAMWORK AND INFRASTRUCTURE



Lessons Learned

- Demonstrating the value and potential of the PI System was a challenge at first; However, once the benefits were realized support has been plentiful
 - It was discovered that the more assets we monitored using PI System the more we felt empowered
 - We realized improved efficiencies which has led to operational cost saving
 - PI System can be used as a training tool
 - Evaluation of real-time data rather than traditional hypothetical approach
 - Leverage of data and the transferring of institutional knowledge
- Develop a Road Map
 - Start with process that can easily be converted and move to more complex and labor intensive
- Maintain Momentum and continue to build upon successes
- Lastly, it is essential to foster team collaboration between the End-Users and IT professionals
 - End-users should be involved and encouraged throughout the entire process of development
 - Leverage SME's and their institutional knowledge provides a vision backed by facts and expertise

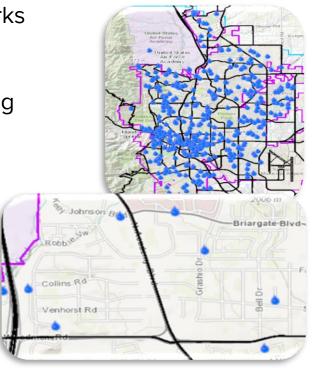
Future Plans

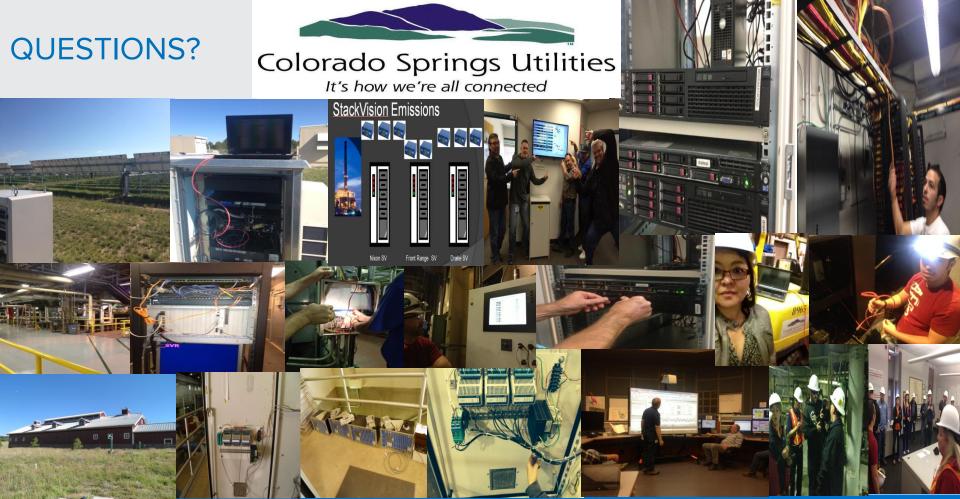
Leveraging our KPI's and improving our operational efficiencies

Continuous Calibration of Baselines and Benchmarks

Continue to capture institutional knowledge

- Discontinued Antiquated Reporting Systems
 - Improve Compliance and Process Control Reporting
 - Continued to expand data sharing opportunities
- Integrate with Esri ArcGIS
 - Visualization and spatial analytics
 - Customer service inquires
 - System disruptions
- Integration with Maximo
 - Asset management
 - Expanding Notifications







Contact Information

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Colorado Springs Utilities

It's how we're all connected



COLLABORATION, TEAMWORK AND INFRASTRUCTURE



HANK IT IS A NOT ONLY A PI THANG BUT ALSO A TEAM THANG!

