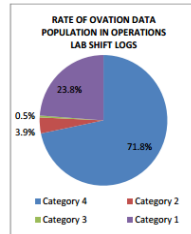
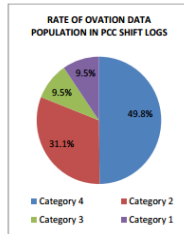
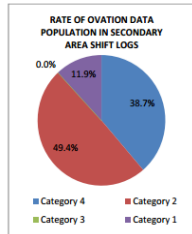




Operational Intelligence Infrastructure for Water Supply Services

Presented by **Ilfat Maatouk**
Betty Thomas

Why we needed the PI System



Business Challenges

- A. Data spread across different platforms – different technologies
- B. Slow and unreliable reporting processes
- C. No tangible way of analyzing equipment efficiencies – present and future

Solution(s)

- A. Implemented a centralized system using different components of the PI system
- B. Rerouted data using the PI system
- C. Use the PI System to monitor and analyze real time data – Predict future data

Results and Benefits

- One unified database with all our data accessible from corporate network
- Less time spent entering data, backfilling, troubleshooting. Less missing data.
- Still in progress

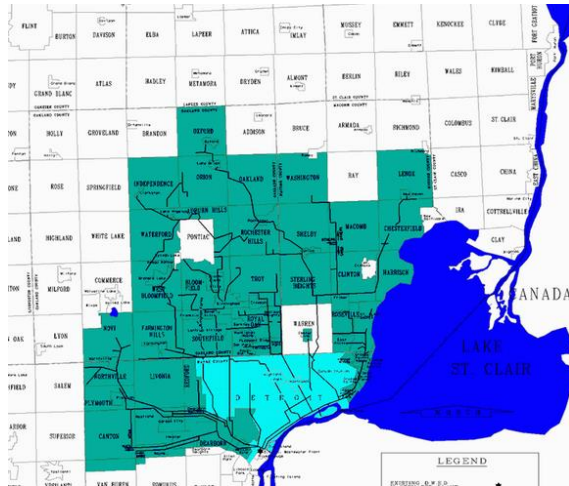
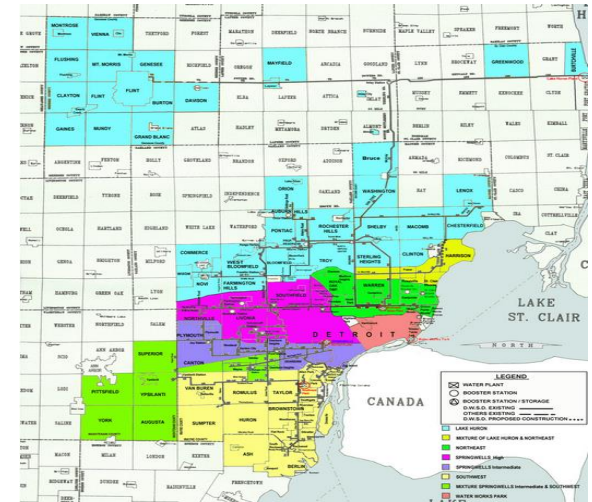
Agenda

- The PI System in the Process and Business Networks
- Reporting with the PI System
- The future of the PI System at DWSD
- Thoughts for improvement
- Financial solutions

About DWSD

Drinking Water

- ✓ 1,079 square miles
- ✓ Detroit and 127 suburban communities
- ✓ 40% of Michigan's population
- ✓ 610 MGD produced

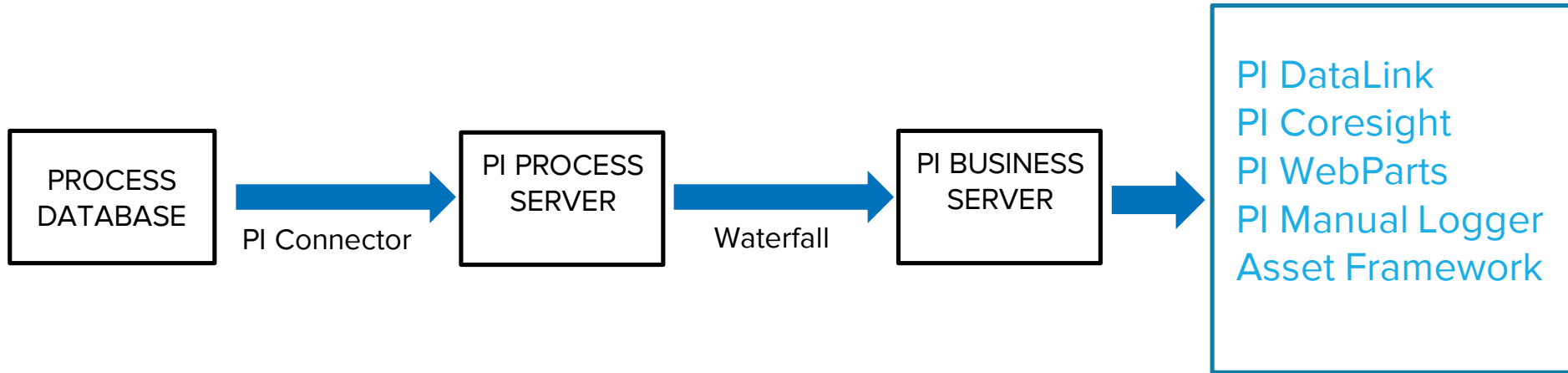


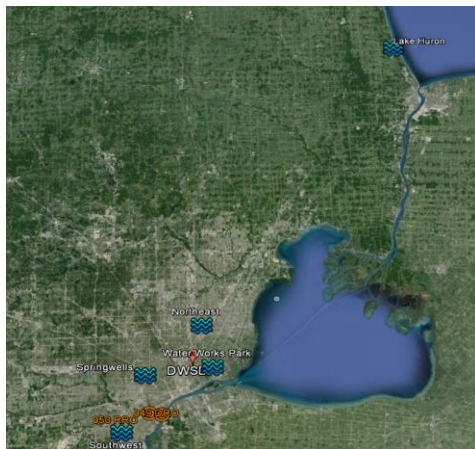
Waste Water

- ✓ 710MGD of water treated
- ✓ 946 square miles
- ✓ +3000 miles of sewer lines

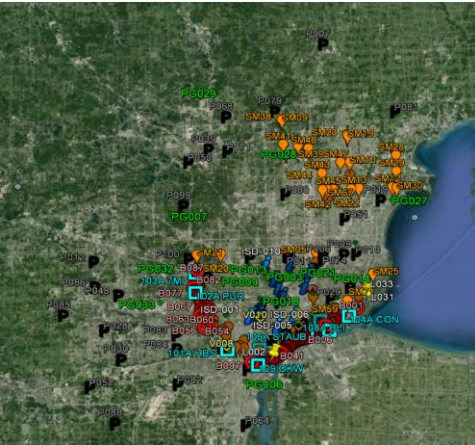
The PI System in the Process and Business networks

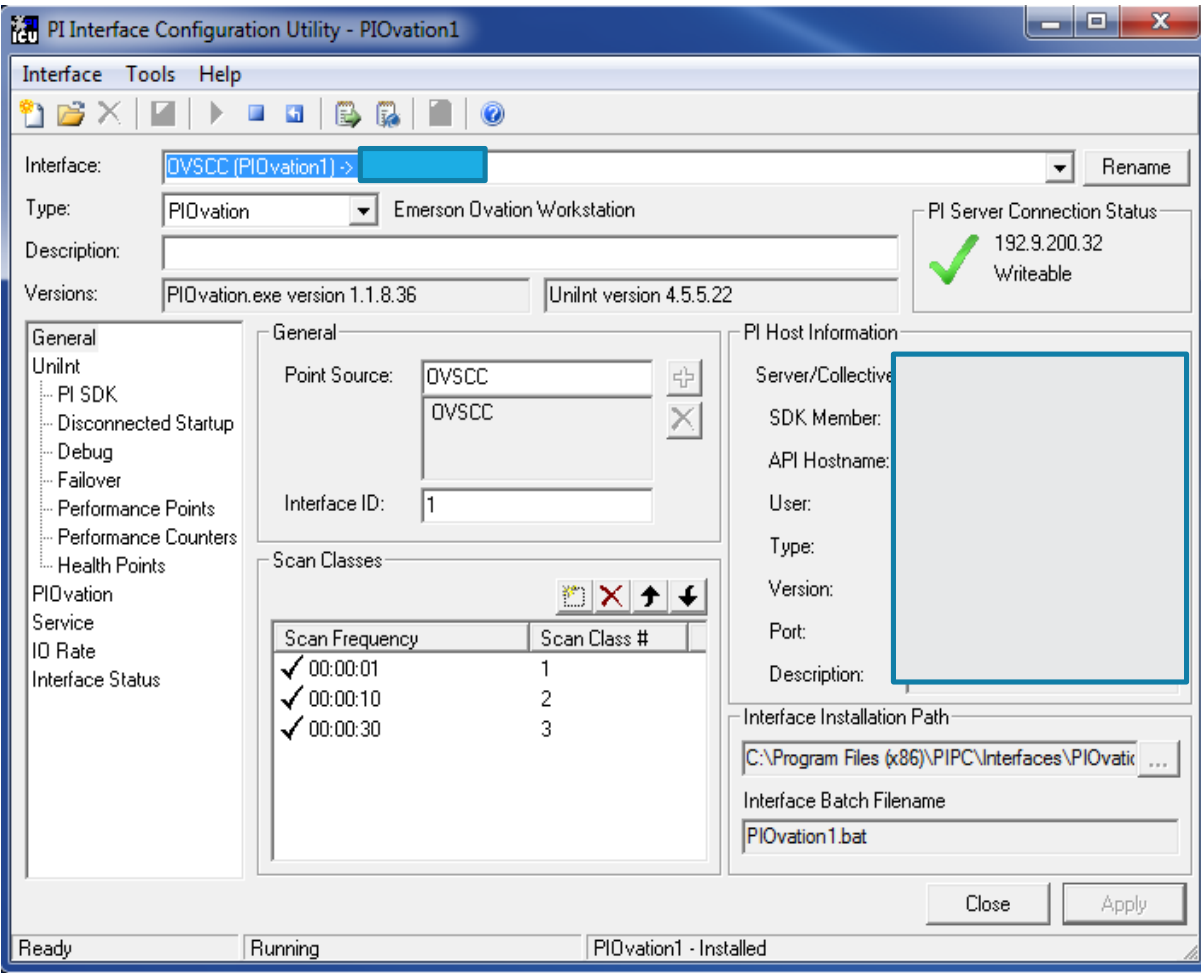
System Architecture





Direct Connection between remote sites and Controls System





PI ICU: Connectivity between PI and other programs

- PI Connectors in all stations
- Control over polling rate, exception, compression, interpolation, range

Data Recovery

Communication Monitor 10:07:51 02/10/15									
	OEM	PNT	RADIO	DROP		OEM	PNT	RADIO	DROP
Electric Ave				250	Adams Road				231
Ford Road				234	Haggerty			N/A	235
Franklin		56K	N/A	210	Newburgh				239
North Service				240	Schoolcraft				246
Ypsilanti				249	West Chicago				215
Belle Isle				216	Conner				222
Freud				219	Fairview				221

3 ways of communication

- PRIMARY
- PNT
- RADIO

PI provides back up:

- Communication loss
- Historian failure

DWSD\CSO Outfall\B054-W.WARREN & ROUGE RIVER Notifications[CSO flag] generated a new notification event.

From:  sharepoint@dwdsd.org

To: Ilfat Maatouk

Name: CSO flag

Server: OS

Database:

Start Time: 5/2/2014 7:50:26 AM Eastern Daylight Time (GMT-04:00:00)

Trigger Time: 5/2/2014 7:50:26 AM Eastern Daylight Time (GMT-04:00:00)

Target: DWSD\CSO Outfall\B054-W.WARREN & ROUGE RIVER

State: OutsideControl

Priority: Normal




Actions:

[Acknowledge](#)

[Acknowledge With Comment](#)

Data was not available for attribute 'LEVEL+ OFFSET'.

Monitoring Flows: Notifications & Event Frames

		DWF SM SE-S-1 20150214 09:13:00			7667.9 Minutes	2/14/2015 9:1...	2/19/2015 5:0...			DWF
		DWF SM SE-S-1 20150219 17:00:57			16714.2 Minutes	2/19/2015 5:0...	3/3/2015 7:35...			DWF
		DWF SM SE-S-1 20150303 20:25:03			1804.9 Minutes	3/3/2015 8:25...	3/5/2015 2:29...			DWF
		DWF SM SE-S-1 20150305 10:05:00			1822.5 Minutes	3/5/2015 10:0...	3/6/2015 4:27...			DWF
		OUTFALLBASIN20150129-001			67842.7 Minutes	1/29/2015 9:5...				OUTFALLBASIN
		SE-S-1 STAGNANT 20150214 17:10:32			1311.8 Minutes	2/14/2015 5:1...	2/15/2015 3:0...			SM STAGNANT
		SE-S-1 STAGNANT 20150215 17:17:36			2666.2 Minutes	2/15/2015 5:1...	2/17/2015 1:4...			SM STAGNANT
		SE-S-1 STAGNANT 20150217 14:26:25			1084.2 Minutes	2/17/2015 2:2...	2/18/2015 8:3...	Event frame w...		SM STAGNANT
		SE-S-1 STAGNANT 20150218 08:30:29			6150.8 Minutes	2/18/2015 8:3...	2/22/2015 3:0...			SM STAGNANT
		SE-S-1 STAGNANT 20150222 17:18:59			2362.1 Minutes	2/22/2015 5:1...	2/24/2015 8:4...	Event frame w...		SM STAGNANT
		SE-S-1 STAGNANT 20150224 08:40:56			30475.8 Minutes	2/24/2015 8:4...				SM STAGNANT
		SE-S-1 STAGNANT 20150224 08:45:06			2881.2 Minutes	2/24/2015 8:4...	2/26/2015 8:4...	Event frame w...		SM STAGNANT
		SE-S-1 STAGNANT 20150226 08:46:06			27590.6 Minutes	2/26/2015 8:4...				SM STAGNANT
		SE-S-1 STAGNANT 20150226 08:54:26			245.7 Minutes	2/26/2015 8:5...	2/26/2015 1:0...			SM STAGNANT
		SE-S-1 STAGNANT 20150226 13:58:48			2922.7 Minutes	2/26/2015 1:5...	2/28/2015 2:4...			SM STAGNANT
		SE-S-1 STAGNANT 20150228 17:02:08			1322.4 Minutes	2/28/2015 5:0...	3/1/2015 3:04...			SM STAGNANT



Event Frames

	A	B	C	D	E	F	G	H
1	Event name	Start time	End time	Duration	FLOWRATE	FLOWRAT	LEVEL +OFF	RIVER LEVEL
2	B054 20140811 12:21:12	11-Aug-14 12:21:12	11-Aug-14 14:07:51	0 1:46:39	7.18	0.34	105.50	103.94
3	B054 20140811 14:34:31	11-Aug-14 14:34:31	11-Aug-14 15:17:52	0 0:43:21	9.91	0.19	105.57	104.75

Explore Events

Search start

8/11/2014

Search end

8/12/2014

☐ Limit to database level

More search options

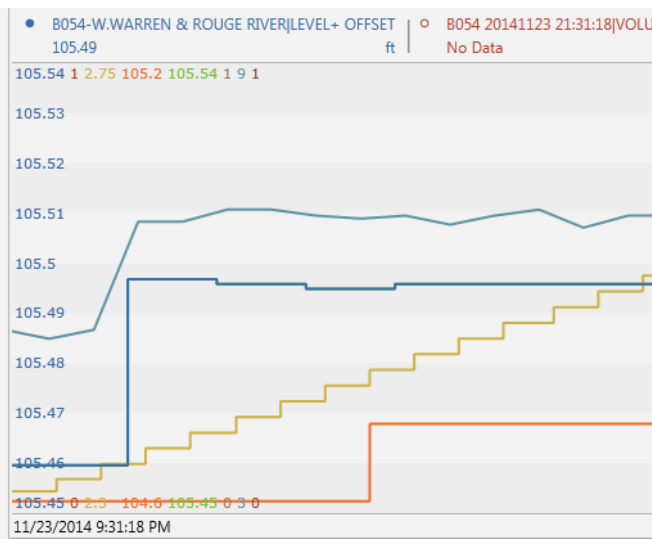
Preview

Events (2 found)
 B054 20140811 12:21:12
 B054 20140811 14:34:31

Events

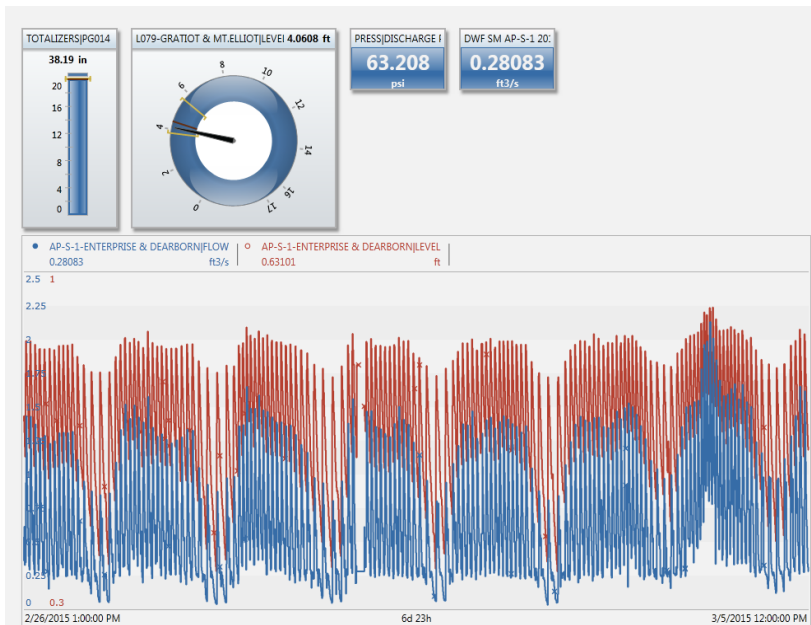
Events from 12/26/2013 6:34 AM - 11/9/2015 7:51 AM

- B054 20141123 21:31:18
11/23/2014 9:31:18 PM - 11/24/2014 12:01:11 PM
- B054 20141014 21:18:57
10/14/2014 9:18:57 PM - 10/14/2014 9:33:38 PM
- B054 20141014 17:58:05
10/14/2014 5:58:05 PM - 10/14/2014 8:08:28 PM
- B054 20141013 05:10:50
10/13/2014 5:10:50 AM - 10/13/2014 6:01:00 PM
- B054 20140930 02:55:01
9/30/2014 2:55:01 AM - 9/30/2014 3:28:08 AM
- B054 20140920 20:28:44
9/20/2014 8:28:44 PM - 9/20/2014 9:34:12 PM
- B054 20140920 20:08:42
9/20/2014 8:08:42 PM - 9/20/2014 8:18:42 PM
- B054 20140910 14:57:05
9/10/2014 2:57:05 PM - 9/10/2014 3:11:55 PM
- B054 20140910 13:11:35
9/10/2014 1:11:35 PM - 9/10/2014 2:47:05 PM



CONDUCTIVITY			
Current Value	17-Mar-15 14:12:00	212.524	µS
Monthly Maximum	17-Feb-15 22:34:49	230.988	µS
Monthly minimum	17-Mar-15 02:06:00	210.3881836	µS
Monthly Average		218.981	µS

DISSOLVED O2			
Current Value	17-Mar-15 14:10:00	9.976	ppm
Monthly Maximum	16-Mar-15 16:07:30	9.982	ppm
Monthly minimum	09-Mar-15 17:31:30	9.002	ppm
Monthly Average		9.857	ppm



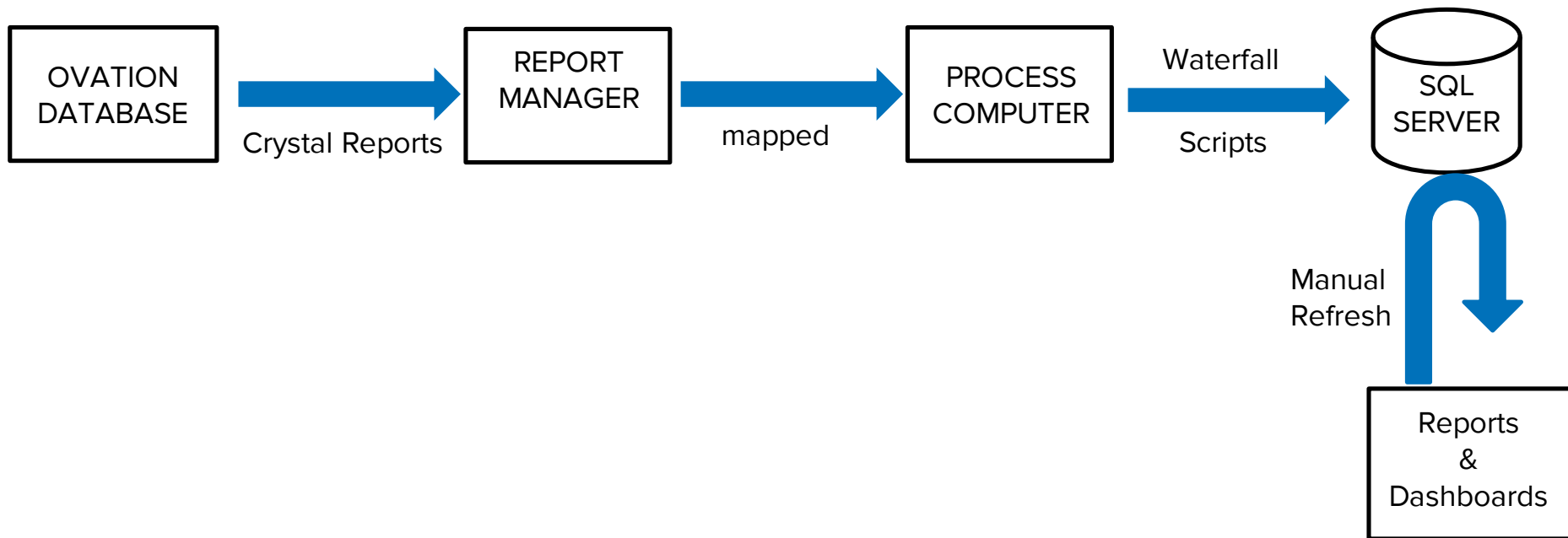
Timestamp	DN-S-2 Flow
18-Mar-15 00:00:00	23.89177704
18-Mar-15 00:05:00	23.85446167
18-Mar-15 00:10:00	19.55451584
18-Mar-15 00:15:00	12.78993702
18-Mar-15 00:20:00	12.82536793
18-Mar-15 00:25:00	12.77845001
18-Mar-15 00:30:00	12.8285017
18-Mar-15 00:35:00	12.85520935
18-Mar-15 00:40:00	12.85520935
18-Mar-15 00:45:00	12.86955929
18-Mar-15 00:50:00	12.87017536
18-Mar-15 00:55:00	12.84119797
18-Mar-15 01:00:00	12.86428356
18-Mar-15 01:05:00	12.85752773
18-Mar-15 01:10:00	12.90472984
18-Mar-15 01:15:00	12.8521595
18-Mar-15 01:20:00	12.8521595
18-Mar-15 01:25:00	14.33553696
18-Mar-15 01:30:00	24.15716743
18-Mar-15 01:35:00	24.07622719

Display & Share Data PI Coresight PI DataLink

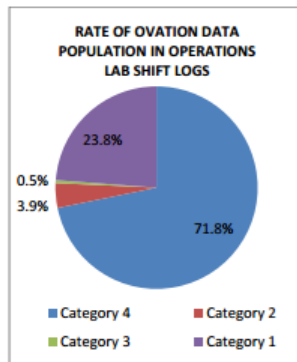
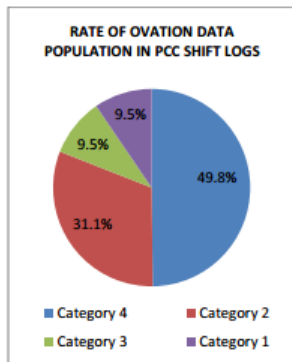
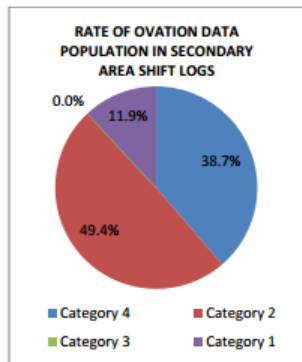
- Data accessible to wide range of people across network
- Efficient visualization
- Clear and reliable
- Monitor data fluctuations over time
- Manipulation of data

Reporting with the PI System

Reporting Prior to the PI System



The challenge: unreliability of process

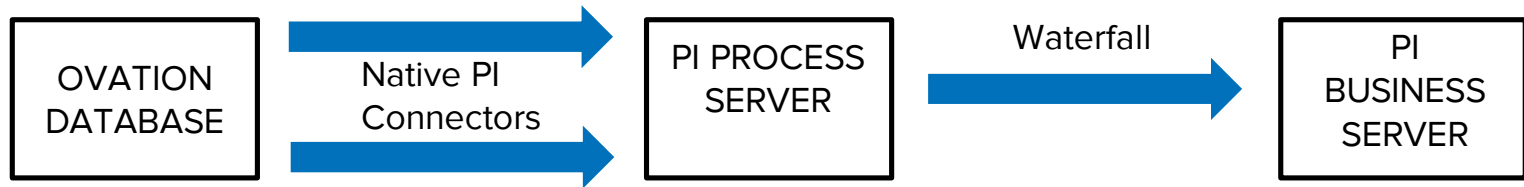


- Category 4: Good Ovation reads
- Category 2: "n/a" Ovation reads
- Category 3: Zero Ovation reads
- Category 1: Non-existing Ovation reads

Courtesy of Saad Ishac

- Regularly missing data
- Reports constantly generating and scripts running
- Too many interfaces used
- Inability to pin down problem

Introducing the PI System



- Redundant Connectors
- Fast and reliable data
- No missing data due to reporting processes
- No need for intermediate interfaces

Asset Framework
PI Manual Logger PI DataLink
PI Coresight
PI ProcessBook Notifications Analyses
Event Frames PI SMT

PI Manual Logger - [Tour Configuration - Primary Pump Stations 1&2 Day]

PIML Tours Mobile Devices Tools MobilePC Window Help

Tour Info

Tour Name
Primary Pump Stations 1&2 Day

Tour Description
Volume, greet box status, and screen box status

Full Access Group
PIMLADMINS

Data Entry Group
PIDataEntry

Tour Comment Tag
Set...

Tour Scheduling
Set...

Notes
EOS-1 hr to allow data entry

Tour Options...

Tag Configuration

Tag Name
PS1 GRIT BOX 1 STS-D
Add...

Barcode
View...

Comment Tag (By default, tour run comments for tags are stored in annotations.)
Set...

Tag Group
Clear Set...

Collection Scheduling
Daily schedules; Starts at 1/29/2015 9:12:14 AM; Every 1 day(s).
Set...

Operator Instructions
Data must be entered 7 hours into the shift
If no data is available, leave blank |

Tag Attributes

Common All

Attribute	Value
Tag Name	PS1 GRIT BOX 1 STS-D
Tag Descriptor	PUMP STATION 1 GRIT BOX
Eng. Unit	%
Point Type	Float32
Zero	0
Span	100
DisplayDigits	-5

Tag List View

Tree View List View

- PS1 GRIT BOX 1 STS-D
- PS1 GRIT BOX 2 STS-D
- PS1 SCREENBOX 1 STS-D
- PS1 SCREENBOX 2 STS-D
- PS1 TOT VOL-D
- PS2 GRIT BOX 1 STS-D
- PS2 GRIT BOX 2 STS-D
- PS2 SCREENBOX 1 STS-D
- PS2 SCREENBOX 2 STS-D
- PS2 TOT VOL-D

Restrict privileges

From SMT

Operator Instructions

PI Manual Logger

Add and configure tours

- Notes
- Time scheduling
- Privileges
- Data Validation
- Tag entry Preformat

[Save](#) | Primary Pump Stations 1&2 Day

Tour Run: Jan 29, 2015, 09:00:00 am



Timestamp Edit

☐ Navigate to remaining items only

1 of 10 (9 remaining)

**PS1 GRIT BOX 1 STS-D**

PUMP STATION 1 GRIT BOX 1 STATUS

Tour Name
Tag Name**Instructions**

Data must be entered 7 hours into the shift. If no data is available, leave blank

Value (%)

172

**Limits violated: HH(100)**

HH:100 LL:0

Previous: 155 - Jan 29, 2015, 09:00:00 am

Limits set by Admin

Timestamp

Jan 29, 2015, 09:00:00 am

Comment[See historical values](#)

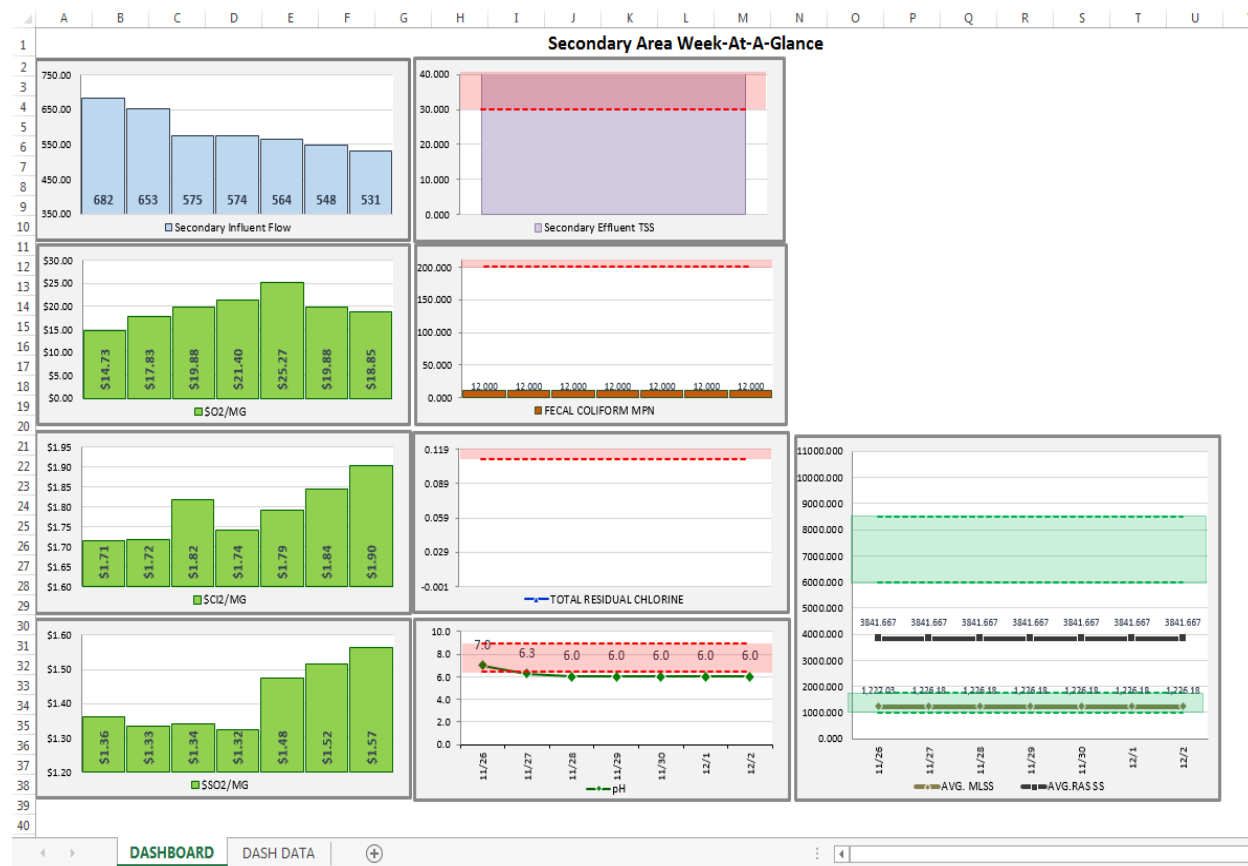
PI Manual Logger Web

- Minimal training required
- Data Entry
- Comments
- Timestamp edit
- No configuration allowed



PI DataLink: Dashboard

- Calculated, compressed, sampled data
- Data from Ovation, PI ML, and analyses



Analyses and Templates

- Averages, counts, logic based commands
- Conversion from bits to words
- Unit Conversions
- Combines Ovation and manual data

The screenshot displays the Allen Park software interface. The top panel shows the 'MLSS MANUAL' analysis template with a table of variables and their expressions. The bottom panel shows the 'Rollup attributes from' dialog, which is used to select criteria for rollup attributes.

MLSS MANUAL Analysis Template

Name	Expression	Value	Output Attribute
Variable1	IF 'MLSS-A-A1'="No Result" THEN 0 ELSE 1		Click to map
Variable2	IF 'MLSS-A-A2'="No Result" THEN 0 ELSE 1		Click to map
Variable3	IF 'MLSS-A-A3'="No Result" THEN 0 ELSE 1		Click to map
Variable4	IF 'MLSS-A-A4'="No Result" THEN 0 ELSE 1		Click to map
Variable5	IF 'MLSS-D-A1'="No Result" THEN 0 ELSE 1		Click to map
Variable6	IF 'MLSS-D-A2'="No Result" THEN 0 ELSE 1		Click to map
Variable7	IF 'MLSS-D-A3'="No Result" THEN 0 ELSE 1		Click to map
Variable8	IF 'MLSS-D-A4'="No Result" THEN 0 ELSE 1		Click to map
Variable9	IF 'MLSS-M-A1'="No Result" THEN 0 ELSE 1		Click to map
Variable10	IF 'MLSS-M-A2'="No Result" THEN 0 ELSE 1		Click to map
Variable11	IF 'MLSS-M-A3'="No Result" THEN 0 ELSE 1		Click to map
Variable12	IF 'MLSS-M-A4'="No Result" THEN 0 ELSE 1		Click to map
Variable13	Total(Variable1,Variable2,Variable3,Variable4,Variable5,Variable6,Variable7,Variable8,Variable9,Variable10,Variable11,Variable12)		Click to map
Variable14	Total('MLSS-A-A1','MLSS-A-A2','MLSS-A-A3','MLSS-A-A4','MLSS-D-A1','MLSS-D-A2','MLSS-D-A3','MLSS-D-A4','MLSS-M-A1','MLSS-M-A2','MLSS-M-A3','MLSS-M-A4')		Click to map
Variable15	Variable14/VARIABLE13		MLSS

Rollup attributes from

Child elements of ALLEN PARK

To select attributes set criteria below

Attribute Name: flow

Attribute Category:

Element Category:

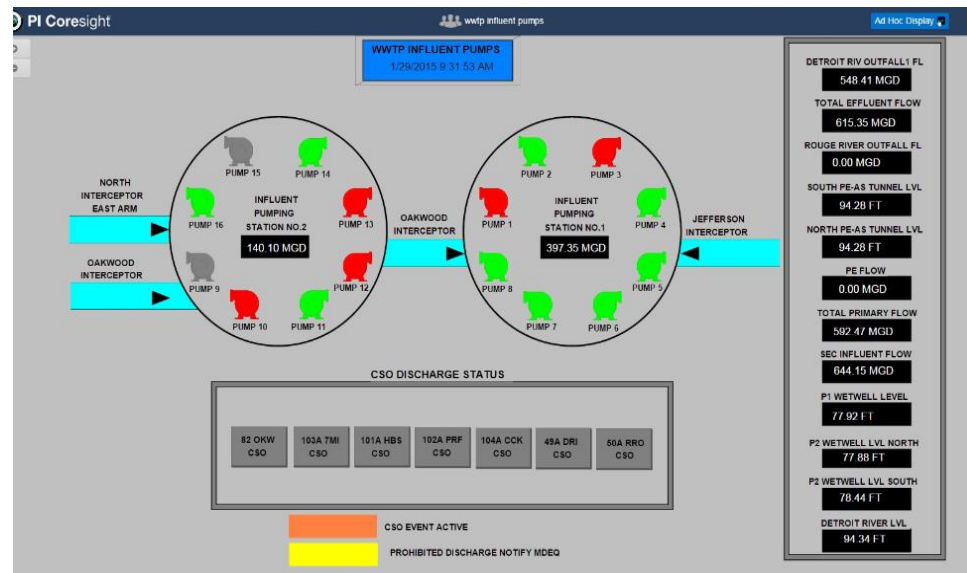
Element Template:

Select the function(s) to write to an attribute

Function	Output(s)	Value
<input checked="" type="checkbox"/> Sum	ALLEN PARK_Flow	
<input type="checkbox"/> Average		
<input type="checkbox"/> Minimum		

Attributes

Name	Parent Element
√ FLOW	AP05
√ FLOW	AP08
√ FLOW	AP11
√ FLOW	AP12
√ FLOW	AP06
√ FLOW	AP07
√ FLOW	AP04
√ FLOW	AP09
HOURLY AVG FLOW	AP04
HOURLY AVG FLOW	AP12
HOURLY AVG FLOW	AP06
HOURLY AVG FLOW	AP07
HOURLY AVG FLOW	AP08
HOURLY AVG FLOW	AP11
HOURLY AVG FLOW	AP09



Visualization

- Share graphics on business network
- Alerts when CSO events are active
- Monitor critical variables
- Accessible through PI Coresight



Thoughts for improvement

- PI WebParts
 - ❖ More plotting options: histograms, fill colors
- PI ML Web
 - ❖ Organize tours into groups, subgroups, tree view
 - ❖ Clock scheduling: set a specific data entry time
 - ❖ Filtering and locking tours according to user privileges
 - ❖ Reject value or display pop up message
 - ❖ Clear cache for display
- PI Coresight
 - ❖ Ability to see values on trend
 - ❖ Import graphs

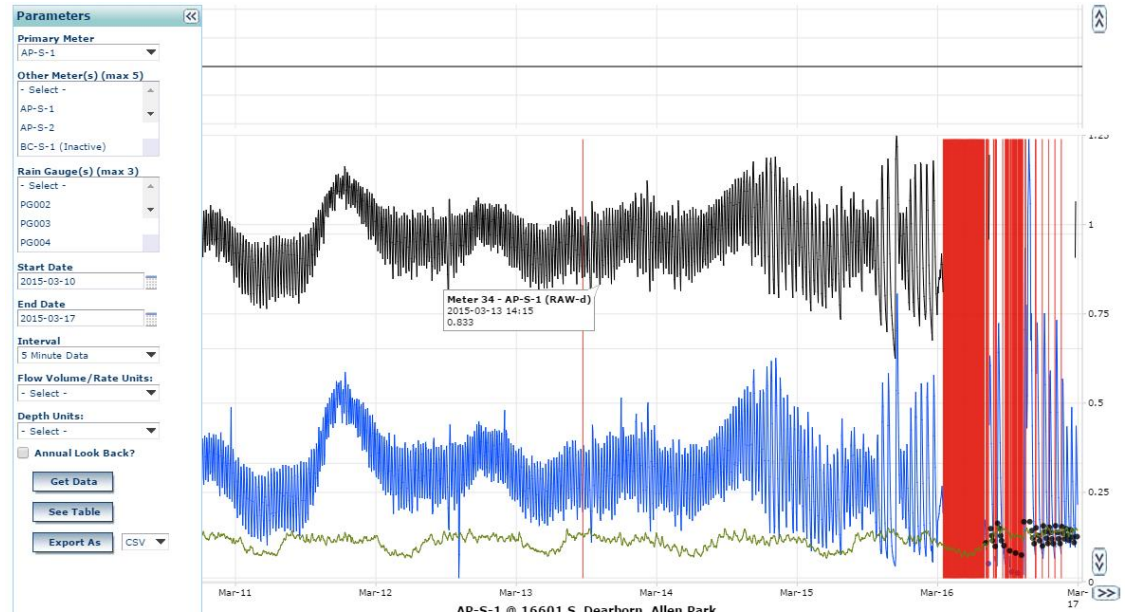
The Future of the PI System at DWSD

- Implement the PI system to remote sites for real time monitoring
- Monitor and maximize pump efficiency
- Energy Management
- Vibration analysis
- Power monitoring
- Sewer Meter Billing

Sewer Meter Billing

Analyses
Event Frames
PI SMT
Notifications
PI Coresight
PI DataLink
Asset Framework

- Linear Interpolation
- Green line
- Correlations
- Flow calculations
- Notifications
- Replace data
- Peaks



Financial Solutions

- 2012-2015: \$500,000
 - ❖ Automating Reports
 - ❖ Notifications and Event Frames
 - ❖ Using the PI System as a back up
 - ❖ Replacing costly software with the PI system
- Savings and Improvements expected in the next 5 years: \$2,000,000
 - ❖ Monitoring Real time data
 - ❖ Energy consumption tracking
 - ❖ Increasing pump efficiency
 - ❖ Predictive data



Conclusion: the benefits of the PI System

- Fast and reliable data
- Reduced uncertainty
- Easy integration and implementation
- Convenient analyses and manipulation of data
- Complete control over data
- Ability to share data throughout the network
- One database tied to all data sources

Ilfat Maatouk

imaatouk@dwsd.org

Engineer

Betty Thomas

bthomas@dwsd.org

Engineer

Anil Gosine

gosine@dwsd.org

System

Administrator

DWSD



Questions

Please wait for the **microphone**
before asking your questions

State your
name & company





THANK
YOU

