



Next Generation Hydraulic Modeling

Forecasting and Real Time Decision Making

Nick Anderson

January 25th 2017

6 pertinent questions

1. What are the challenges we face in the wastewater industry?
2. What is an intelligent sewer system?
3. Why now?
4. Why do it?
5. How do we approach a solution?
6. Can we really predict the future?

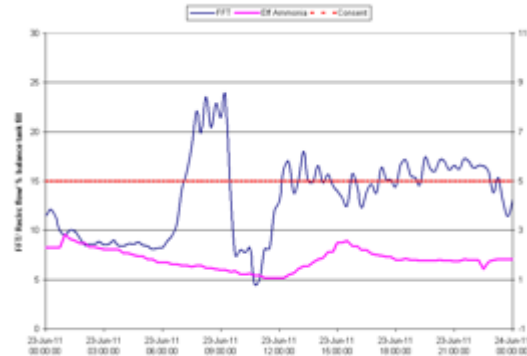
Why do we model sewers?

Identify needs, benefits and value when assessing systems with multiple drivers

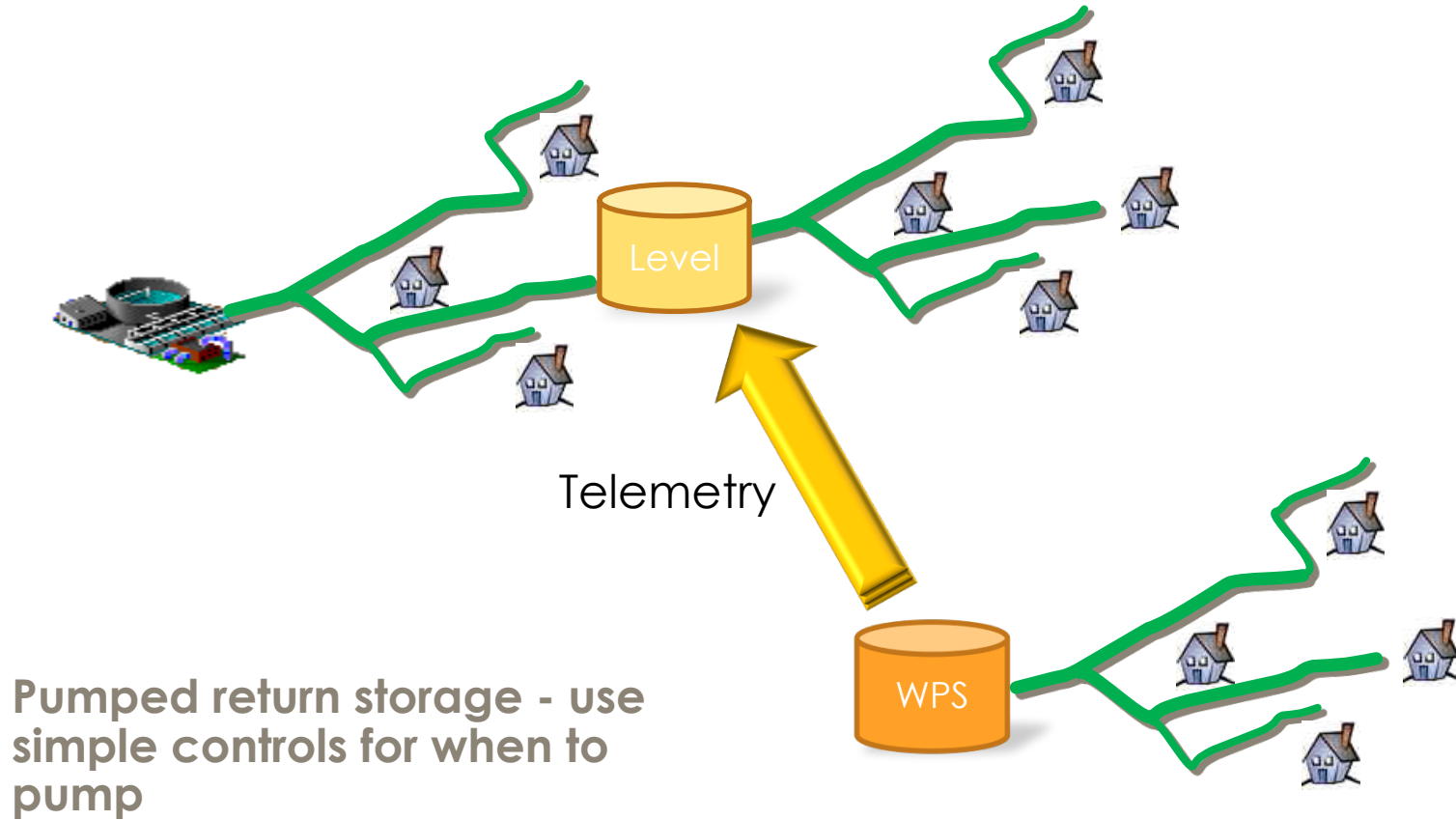


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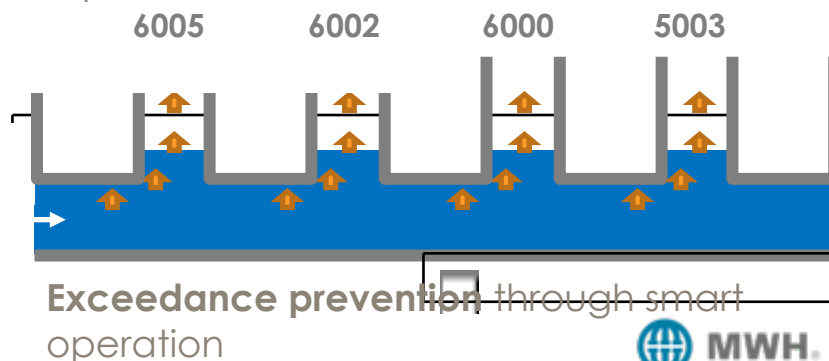
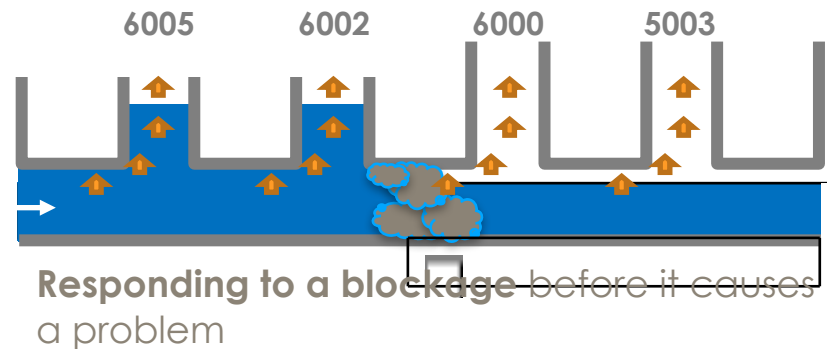
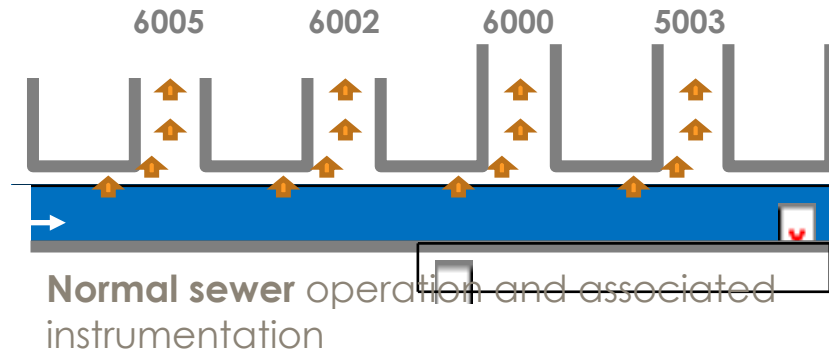
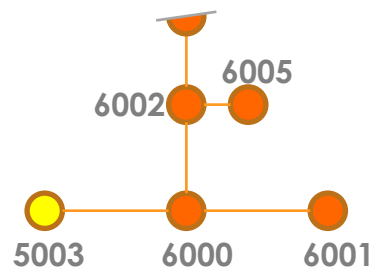
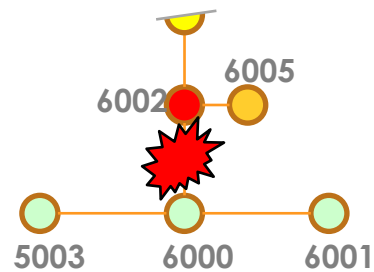
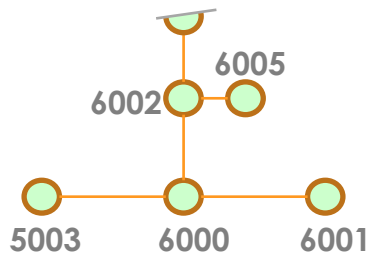
Capital
Costs



Real Time Control



Dry and wet weather analyses



Forecasting

Forecasting systems to improve asset performance in real time

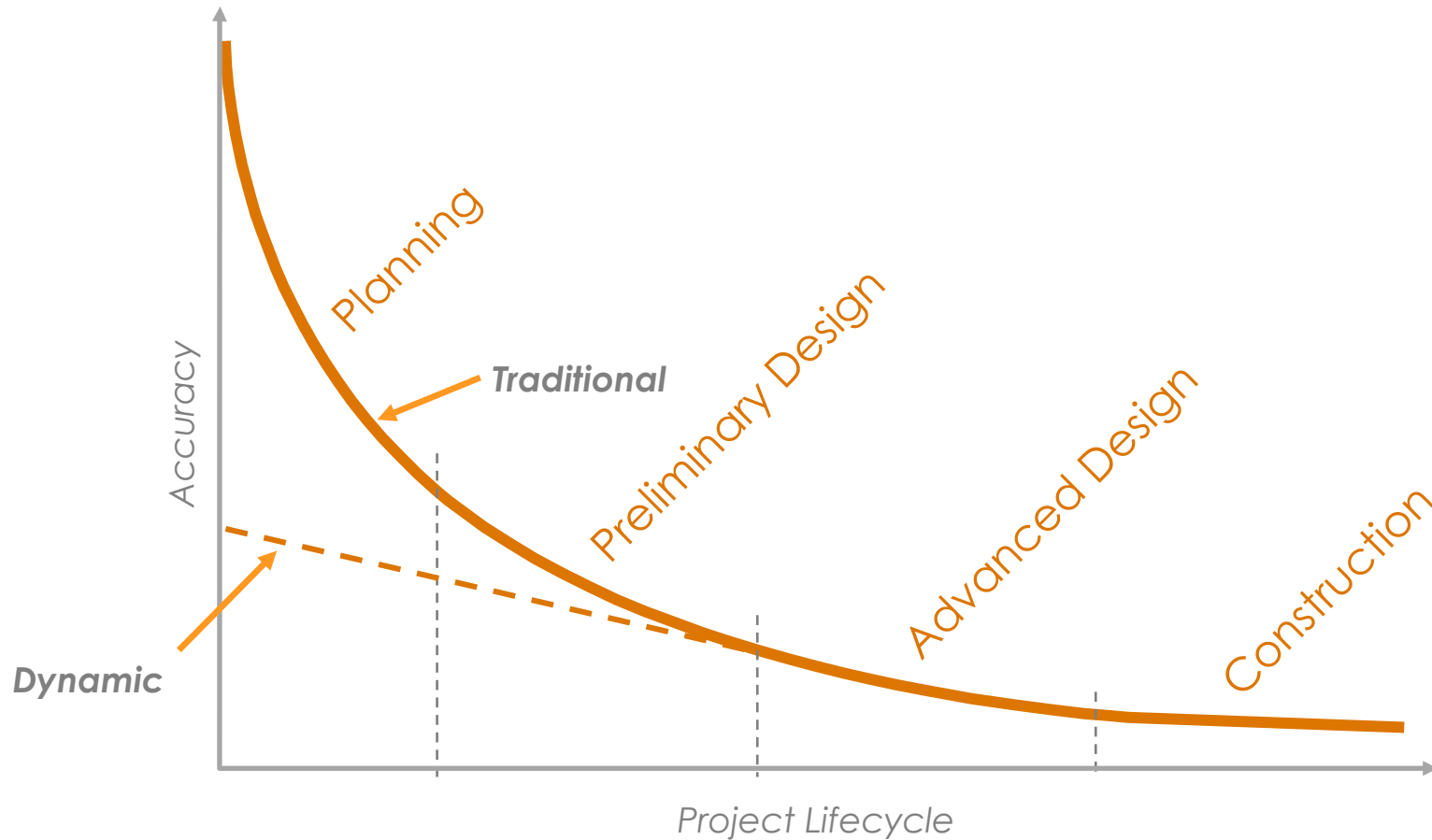


JIT



NQuIT

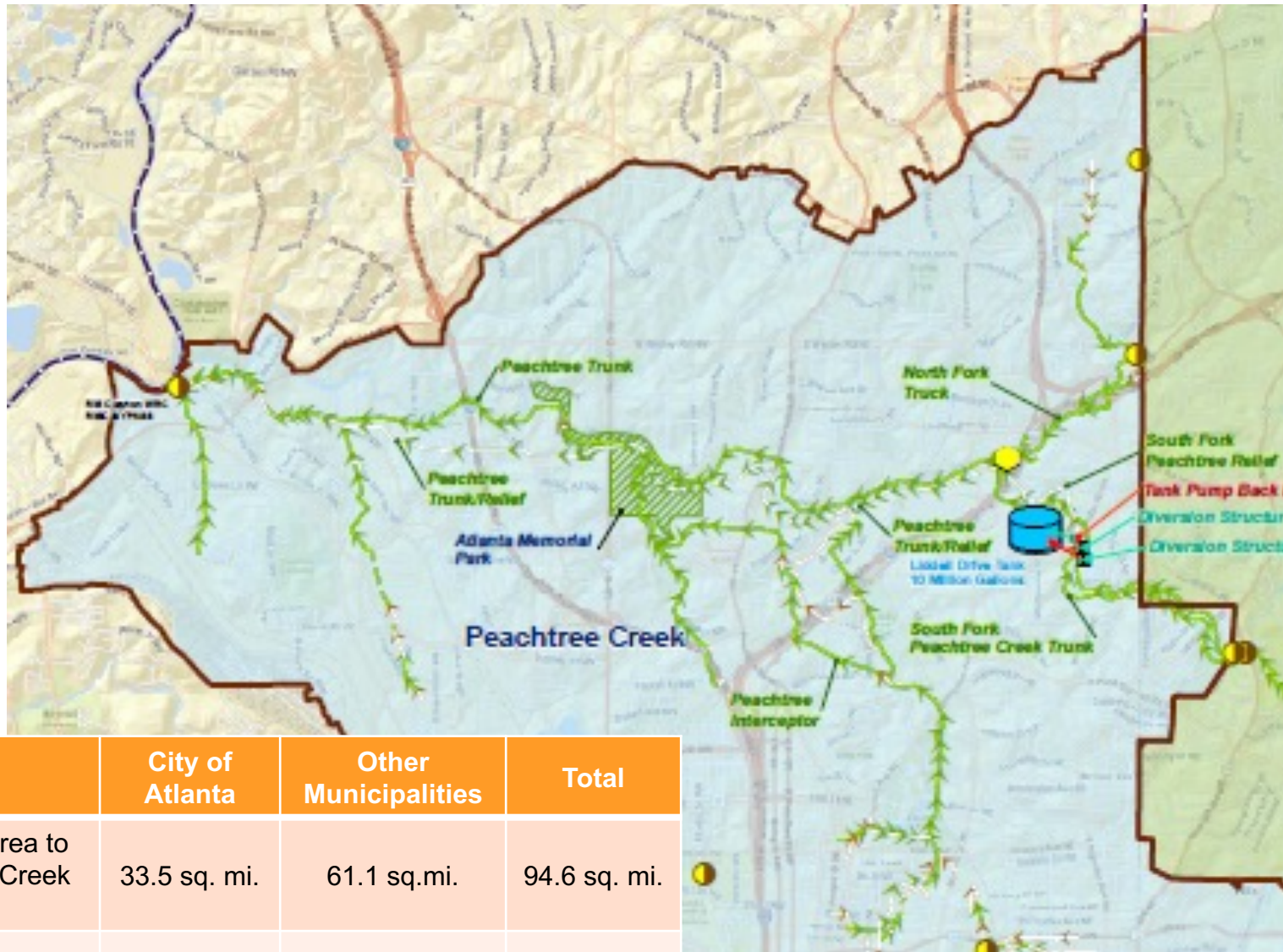
Improving model confidence



Theory into fact

1. Is it possible?
2. Does it add value?
3. Is it practicable?

Introducing the pilot study

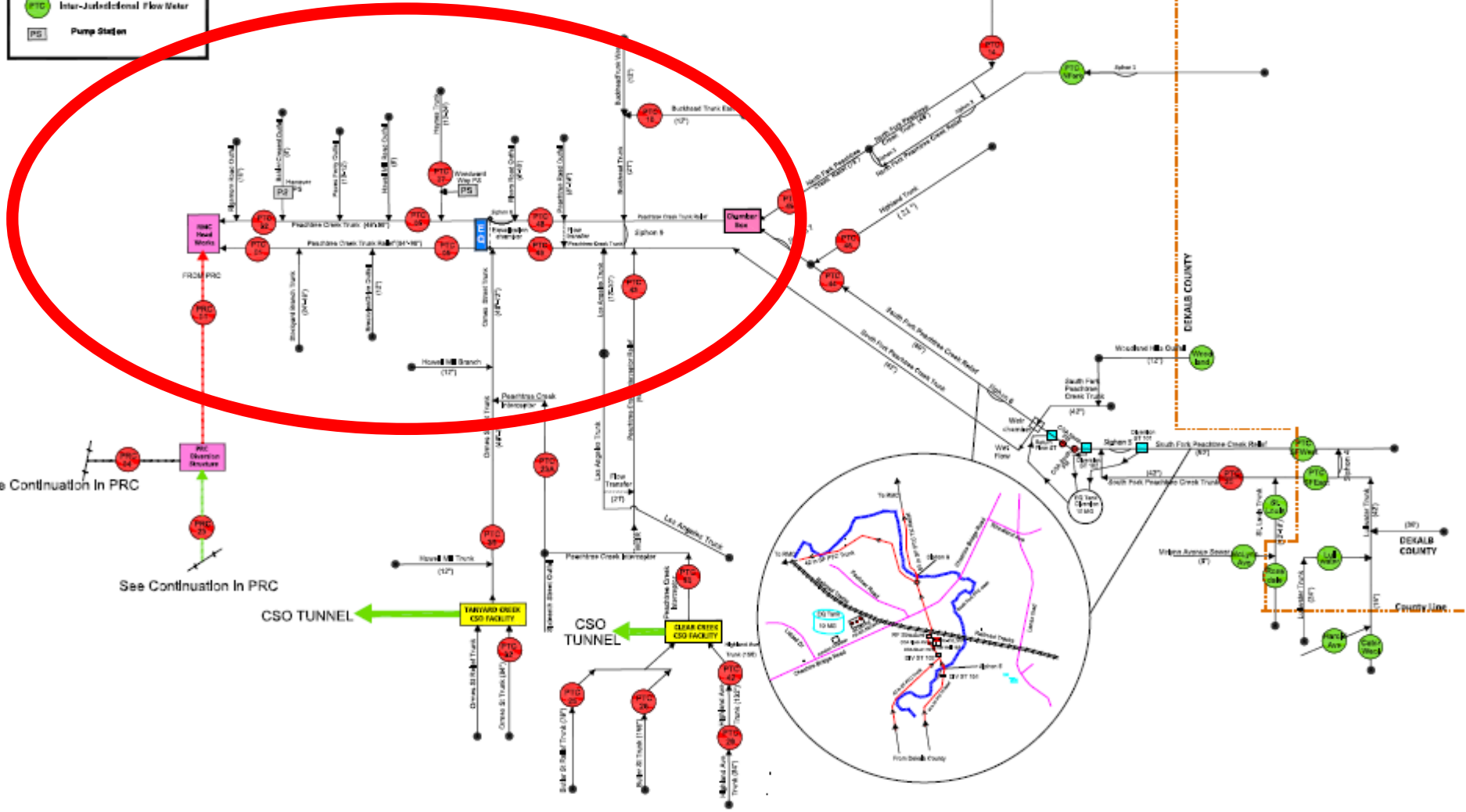


	City of Atlanta	Other Municipalities	Total
Drainage area to Peachtree Creek Basin	33.5 sq. mi.	61.1 sq.mi.	94.6 sq. mi.
Average Dry Weather Flow	20 mgd	23 mgd	43 mgd

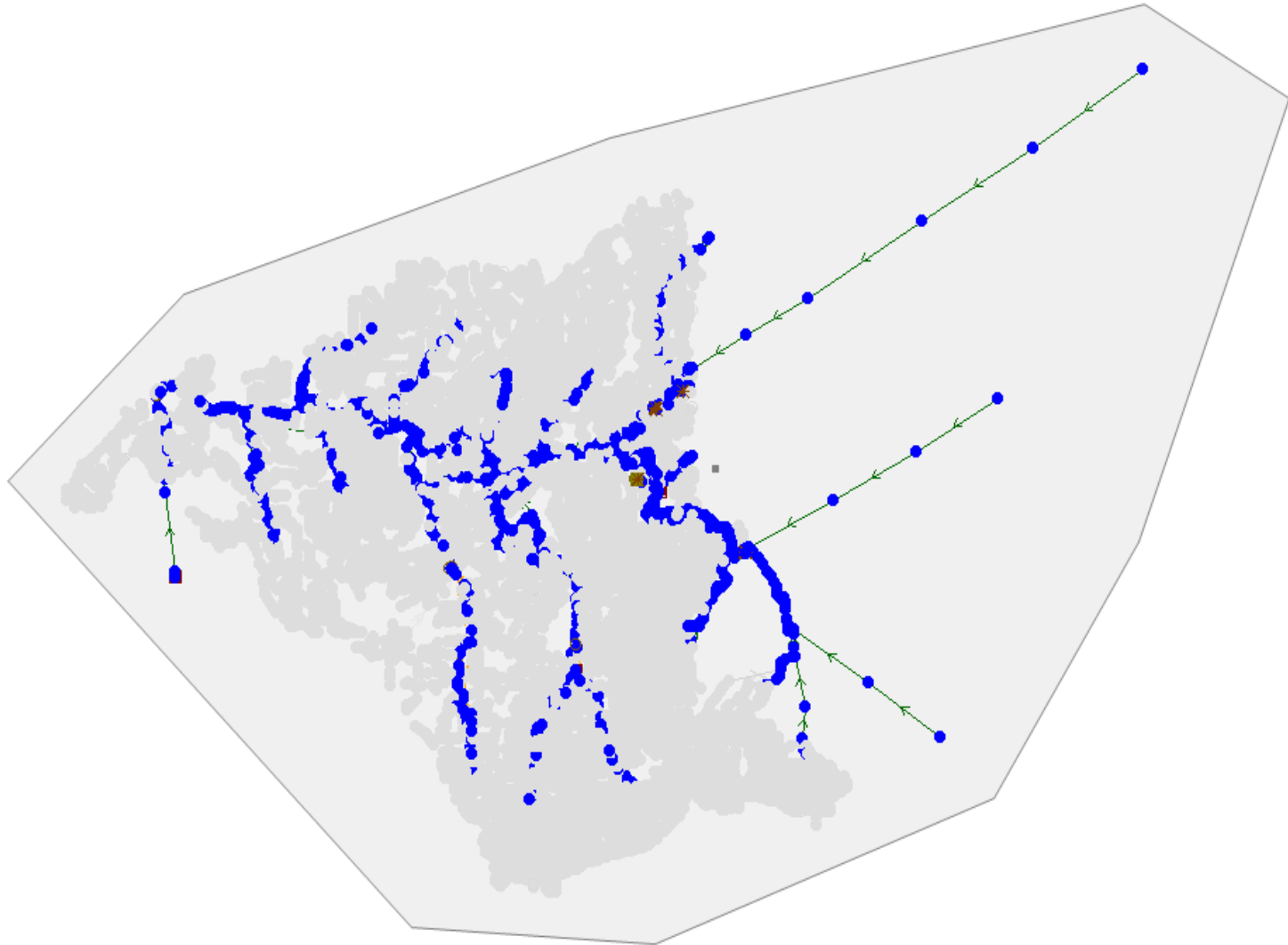
Complex interactions

LEGEND

- Permanent Flow Meter
- Inter-Jurisdictional Flow Meter
- Pump Station



InfoWorks ICM



Time Series Database TSDB

TC_Liddell_04/07/2015 - CAL (Scenario Macro network) CoA Gauges

	Stream Name	Units	Data interval (seconds)	Value interpolation	External data source	External update disabled	Latest update	Latest data	Records	External units
▶	RMC_Admin_Rain	Rainfall intensity	300.000	Extend	CoA	<input type="checkbox"/>	Never	Never	0	in/hr
	PTC-05Level	Depth	900.000	Linear	CoA	<input type="checkbox"/>	Never	Never	0	ft
	PTC-06	Depth	900.000	Linear	CoA	<input type="checkbox"/>	Never	Never	0	ft
	PTC-07	Depth	900.000	Linear	CoA	<input type="checkbox"/>	Never	Never	0	ft
	PTC-01	Depth	900.000	Linear	CoA	<input type="checkbox"/>	Never	Never	0	ft
	PTC-02	Depth	900.000	Linear	CoA	<input type="checkbox"/>	Never	Never	0	ft
*						<input type="checkbox"/>				

TC_Liddell_04/07/2015 - CAL (Scenario Macro network) CoA Gauges

	Data Source Name	Type	Provider	Net Service Name	Server	Database	Logon Type	Username	Password	Command Timeout (s)	Creation User or Schema	Filename / Foldername
▶	CoA	Batch CSV								30		\\423207-amvis1.mwhexternal.local\coatlanta_output*.csv
*												

Time Varying Data Connectors

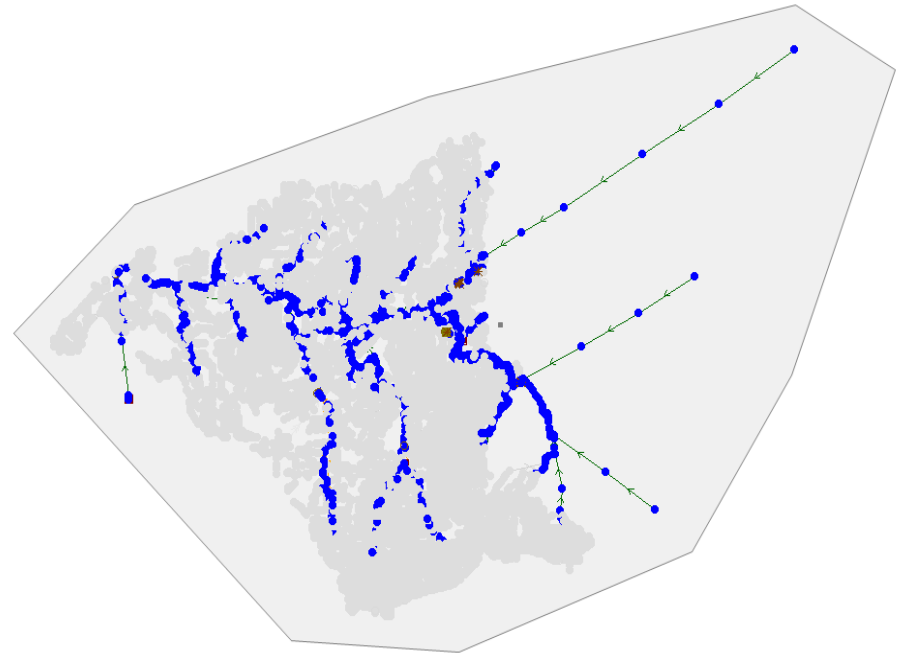
Properties

TVD connector : RMC_Rain : PTC_Liddell_04/07/2015 - CAL (Scenario Mi

TVD connector Object Properties

TVD connector definition

ID	RMC_Rain	
Category	Rain_gauge	
X coord (ft)	2242847.19	#D
Y coord (ft)	1387077.02	#D
Area (acre)	58404.336	#D
Input A units	R	
Input A	#RMC_Admin_Rain	
Input B units	R	#D
Input B		
Input C units	R	#D
Input C		
Output units	R	#D
Output expression	...	
Expression units		
Connected object type		
Connected object id		



PTC_Liddell_04/07/2015 - CAL (Scenario Macro network) TVD connector-PTC_Liddell_04/07/2015 - CAL (Scenario Macro network) Run

ID	Category	Input A units	Input A	Input B units	Input B	Input C units	Input C	Output units	Output expression	Expression units	Connected object type	Connected object id	Connection usage	Input attribute	varianc	Comparison result
RMC_Rain	Rain_gauge	R	#RMC Admin Bldg Weat	R		R		R	...				Input			
PTC-05		Y	#PTC-05Level	Y		Y		Y	...		hw_conduit	23280125101.1	Comparison			DS_DEPTH
PTC-06		Y	#PTC-06Level	Y		Y		Y	...		hw_conduit	EQC2.1	Comparison			DS_DEPTH
*									...							

hyperlinks

User defined properties

Incoming Data

File Explorer window titled "_output" showing a directory of incoming data files. The address bar shows the path: Network > 423207-amviis1.mwhexternal.local > coatlanta > _output. The files are listed in a grid view with columns for name, date/time, description, and size.

Name	Date/Time	Description	Size
1stAVE	6/30/2016 1:10 PM	Microsoft Excel Comma Separated Values File	9 KB
2ALISON	6/30/2016 2:00 PM	Microsoft Excel Comma Separated Values File	9 KB
2LKWDFWY	6/30/2016 2:40 PM	Microsoft Excel Comma Separated Values File	9 KB
2MCCELLAND	6/30/2016 1:40 PM	Microsoft Excel Comma Separated Values File	10 KB
6ELM	6/30/2016 2:00 PM	Microsoft Excel Comma Separated Values File	9 KB
6MERCER	6/30/2016 2:40 PM	Microsoft Excel Comma Separated Values File	9 KB
7Runnemedede	6/30/2016 1:40 PM	Microsoft Excel Comma Separated Values File	10 KB
13BLVDCSO	6/30/2016 2:00 PM	Microsoft Excel Comma Separated Values File	9 KB
13TANYARD	6/30/2016 2:20 PM	Microsoft Excel Comma Separated Values File	9 KB
72 Marietta Weather	6/30/2016 2:40 PM	Microsoft Excel Comma Separated Values File	33 KB
262 Arthur Langford PI	6/30/2016 2:40 PM	Microsoft Excel Comma Separated Values File	12 KB
526 Ross Street	6/30/2016 2:01 PM	Microsoft Excel Comma Separated Values File	11 KB
1150 Collier Road - SSO	6/30/2016 1:10 PM	Microsoft Excel Comma Separated Values File	0 KB
PR-SRV09Bb			
PR-SRV0708B			
PR-SRV0708C1a			
PR-SRV0708C1a			
PR-SRV0708C2			
PR-SRV1112A			
PR-SRV1112Aa			
PR-SRV1112b			
PTC-01			
PTC-02 old			
PTC-02			
PTC-04			
PTC-05			

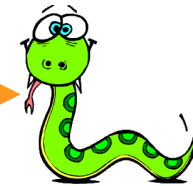
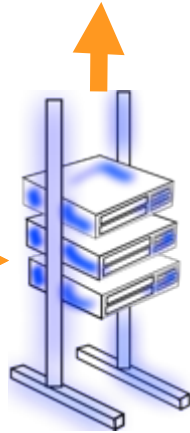
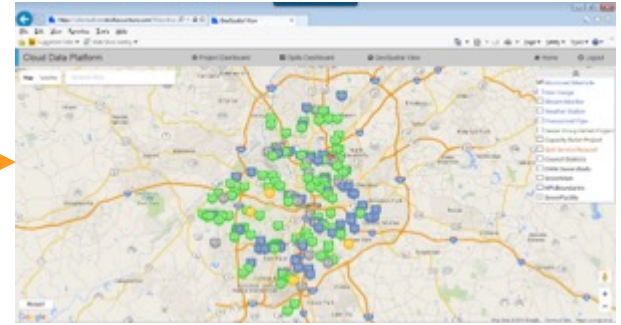
Data format

PTC-02Level 6/28/2016 12:15 3.185714 ft
 PTC-02Level 6/28/2016 12:30 3.158854 ft
 PTC-02Level 6/28/2016 12:45 3.132096 ft
 PTC-02Level 6/28/2016 13:00 3.080881 ft
 PTC-02Level 6/28/2016 13:15 3.059636 ft
 PTC-02Level 6/28/2016 12:15 3.124474 ft
 PTC-02Level 6/28/2016 12:30 3.108398 ft
 PTC-02Level 6/28/2016 12:45 3.085432 ft
 PTC-02Level 6/28/2016 13:00 3.03261 ft
 PTC-02Level 6/28/2016 13:15 3.011285 ft
 PTC-02Level 6/28/2016 13:30 3.020443 ft
 PTC-02Level 6/28/2016 13:45 3.003732 ft
 PTC-02Level 6/28/2016 14:00 2.991308 ft
 PTC-02Level 6/28/2016 14:15 2.99158 ft
 PTC-02Level 6/28/2016 14:30 3.006771 ft
 PTC-02Level 6/28/2016 14:45 3.033464 ft
 PTC-02Level 6/28/2016 15:00 3.094141 ft
 PTC-02Level 6/28/2016 15:15 3.217491 ft
 PTC-02Level 6/28/2016 13:30 2.979789 ft
 PTC-02Level 6/28/2016 13:45 2.952886 ft
 PTC-02Level 6/28/2016 14:00 2.936153 ft
 PTC-02Level 6/28/2016 14:15 2.943371 ft
 PTC-02Level 6/28/2016 14:30 2.96076 ft

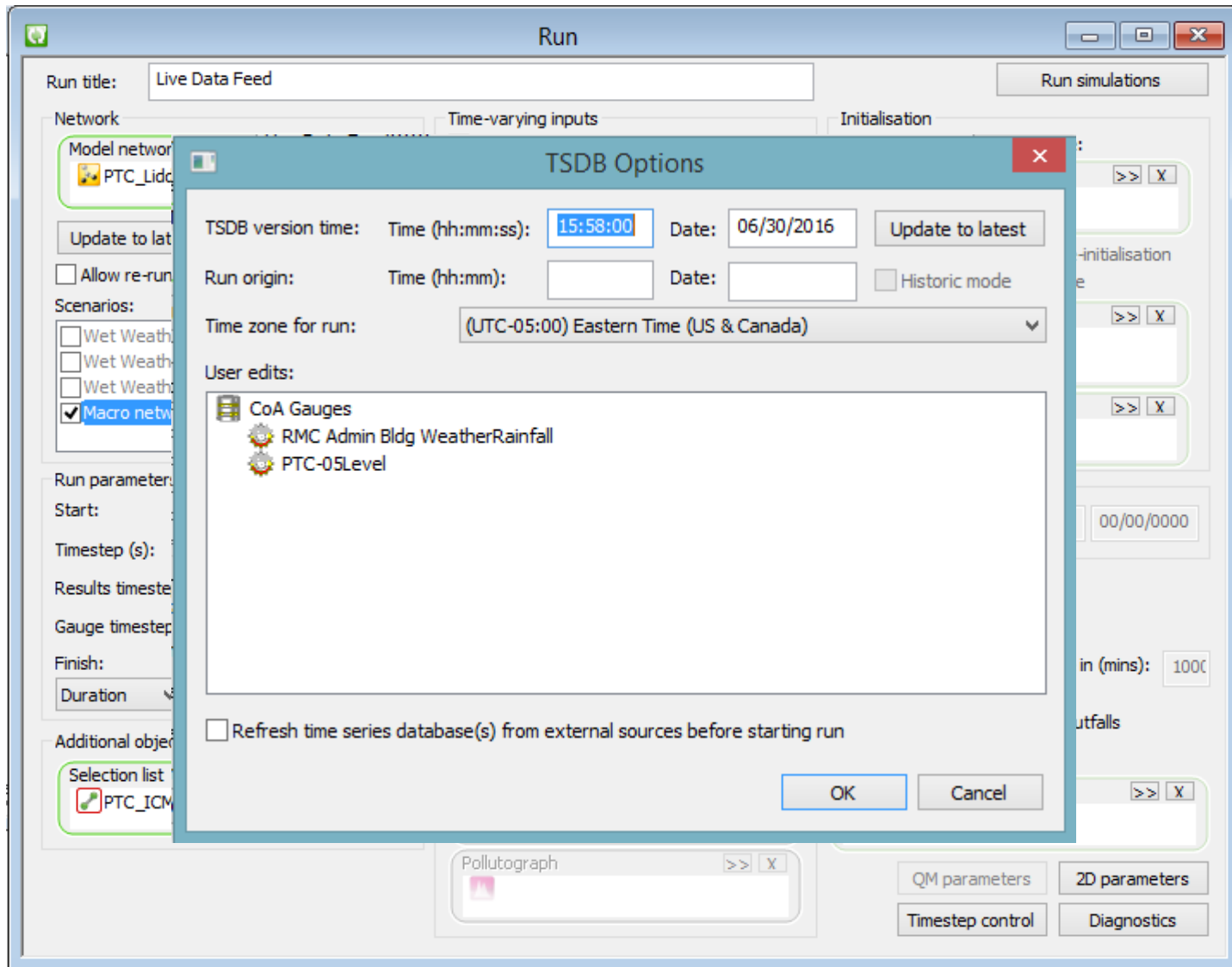
PTC_Liddell_04/07/2015 - CAL (Scenario Macro network)

	Data Source Name	Type
▶	CoA	Batch CSV ▼
*		▼

How the process works.....



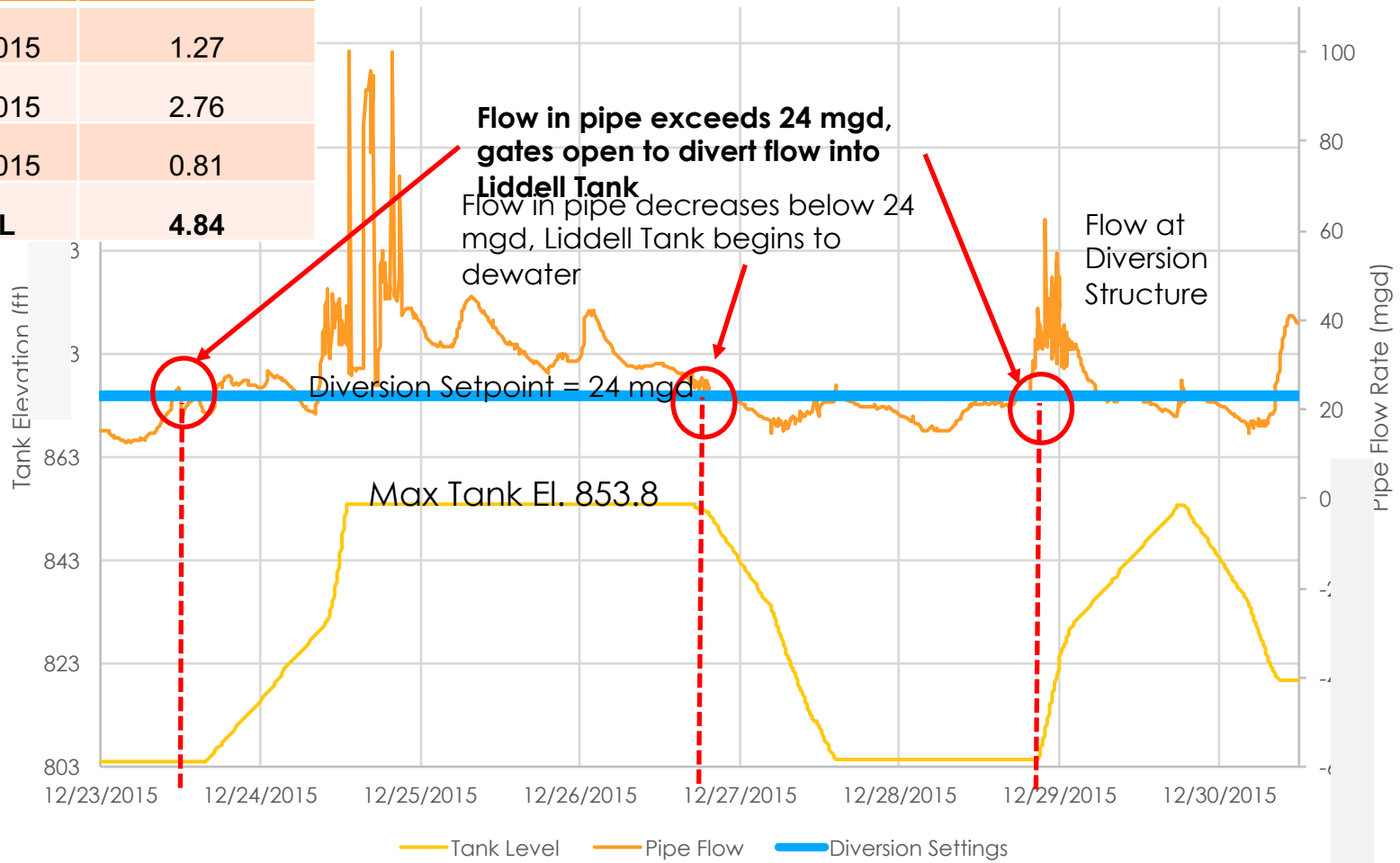
Model Simulations



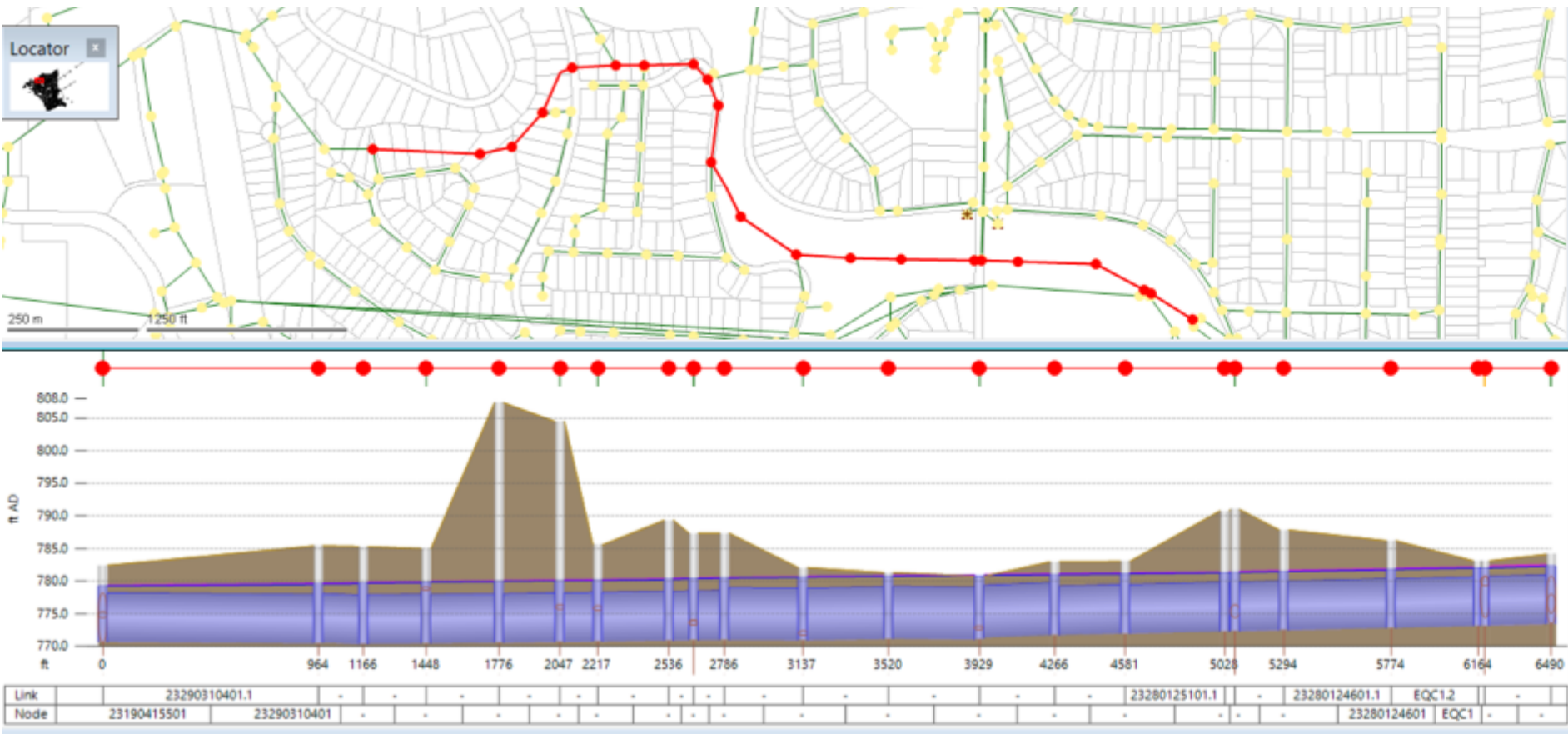
Immediate Results

Liddell Tank - December 24, 2015

Date	Rainfall Total (inches)
12/23/2015	1.27
12/24/2015	2.76
12/25/2015	0.81
TOTAL	4.84



Critical Analysis



Let us revisit the 6 pertinent questions

1. What are the challenges we face in the wastewater industry?
2. What is an intelligent sewer system?
3. Why now?
4. Why do it?
5. How do we approach a solution?
6. Can we really predict the future?

Real time forecasting....

ICMLive Operator Client [2.0.1.9010 Snapshot 20140210_0300] - (Eastney)

File Tools Window Results Help

Normal

Eastney Deployments Eastney

Run

Run operations

- New run
- New run with current parameters
- Simulate run
- Compare with another simulation
- Select another run
- Manage run in library

Run properties

Parameters	Values
Source	Manifest
Run name	28 April 2012
Start time	28/04/2012 00:00
Run origin	28/04/2012 02:00
End time	28/04/2012 08:00
► Hindcast	2 hours 0 mins
Forecast	6 hours 0 mins
State saving run	<input type="checkbox"/>
State saving time	13/02/2014 07:35
Use initial state at	
Observed run	<input type="checkbox"/>
Protected	<input type="checkbox"/>

Graph : LLPSDWF.1

Pump LLPSDWF.1 28 April 2012, Rainfall Profile 0

Rainfall intensity (mm/hr)

Flow (m3/s) [Flow]

0.30
0.20
0.10
0.00
-0.10

00:00 02:00 04:00 06:00
28/4/2012

US Flow (Volume 5367.36 m3)

DS Flow (Volume 5367.36 m3)

Graph : Spill_Chamber.1

Conduit Spill_Chamber.1 28 April 2012, Rainfall Profile 0

Rainfall intensity (mm/hr)

Flow (m3/s) [Flow]

0.0
0.2
0.4
0.6
0.8
1.0
-0.2
-0.4
-0.6
-0.8
-1.0

00:00 02:00 04:00 06:00
28/4/2012

US Flow (Volume 0.00 m3)

DS Flow (Volume 0.00 m3)

Alert definition ID	Target ID	Target type	Priority	Category	Onset time	End time
► Diesels_On_FP	LLPSDWF.1	Pump	1		28/04/2012 02:00	28/04/2012 02:10
Diesels_On_FP	LLPSDWF.1	Pump	1		28/04/2012 02:30	28/04/2012 02:45
Diesels_On_FP	LLPSDWF.1	Pump	1		28/04/2012 03:05	28/04/2012 03:20
Diesels_On_FP	LLPSDWF.1	Pump	1		28/04/2012 03:40	28/04/2012 03:55
Diesels_On_FP	LLPSDWF.1	Pump	1		28/04/2012 04:15	28/04/2012 04:40
Diesels_On_FP	LLPSDWF.1	Pump	1		28/04/2012 04:55	28/04/2012 08:00
Diesels_On_FP	LLPSDWF.2	Pump	1		28/04/2012 05:05	28/04/2012 08:00
Diesels_On_FP	LLPSDWF.3	Pump	1		28/04/2012 06:10	28/04/2012 06:25

Alerts

Run Themes Properties Alerts Live Data Actions

Submitted	Job Type	Source	Target	Status	Run On	After	User
00:30:47 13/02/2014	Alert Generation	Live data	Live data	Ended	This computer		InnovyzeLiveServer
00:30:00 13/02/2014	Simulation	28 April 2012	Live data	Ended	This computer		bodyr
00:30:00 13/02/2014	Alert Generation	Live data	Live data	Ended	This computer		bodyr

Server Sim Schedule | Server Messages | Server Job Control | Job Control | Job Progress | Message Log

Ready - Press F1 for Help

465358, 103885, -, 1.9 | Zoom (m): 5814.14 (1:36994) | READ CAP NUM SC



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Thank you for your time and any questions?

January 25th 2017