Modelling Group
WATER NEW ZEALAND

Modelling Symposium

Calibration using SCADA
(Making the most of what you've got)

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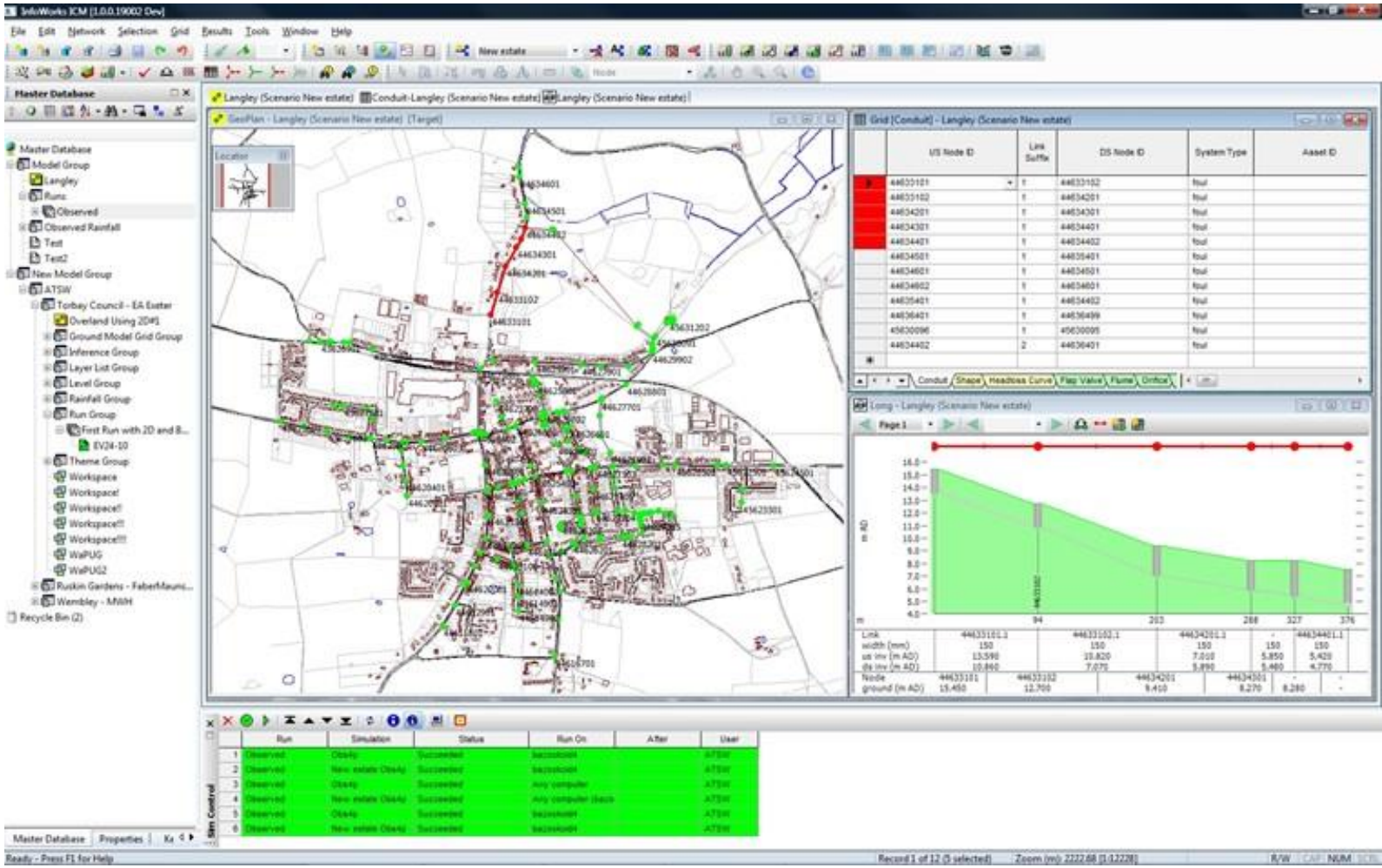
water NEW ZEALAND
The New Zealand Water & Wastes Association Waiora Aotearoa

What are wastewater models?

- Design and planning tools
- 3 Waters:
  - Planning
  - Renewals
  - Resiliency
  - Growth
  - Master Planning
  - Optioneering



Why do we calibrate models?

- Theoretical Tools
- Adding Confidence
- Poor Data + Low Budget = Model Confidence Issues
- ROI: But how much?

Analytics Delivers $9.01 for Every Dollar Spent, Nucleus Research Finds

Analytics becoming central technology for digital transformation as companies depend more on data to drive operations, guide business decisions

March 28, 2019 01:46 PM Eastern Daylight Time

BOSTON--(BUSINESS WIRE)--Analytics is emerging as a business game changer with the ability to increase productivity, cut costs and enable better business decisions, a new report from Nucleus Research finds. Based on ROI case studies since 2017, analytics delivers on average benefit of $9.01 per every dollar spent.

#RESEARCH: #Analytics Delivers $9.01 for Every Dollar Spent. Analytics becoming central technology for digital transformation as companies depend more on data to drive operations, guide business decisions https://bit.ly/2OtAJgF

Tweet this

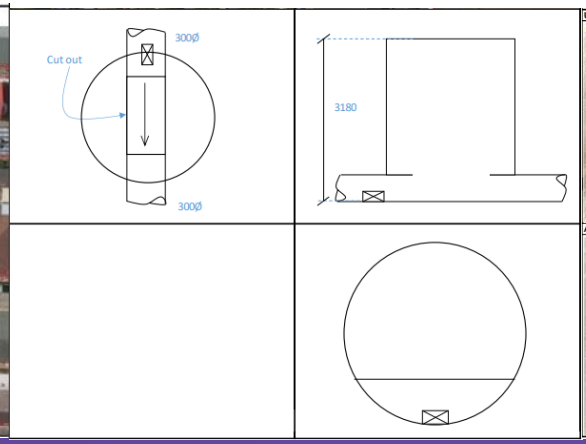
"Analytics has been a top performer in enterprise software for the past decade, only growing in the value it adds. AI and the move from stand-alone apps to highly integrated embedded solutions further boosts that value, making analytics a strategic priority for most companies," said Ian Campbell, CEO of Nucleus Research.

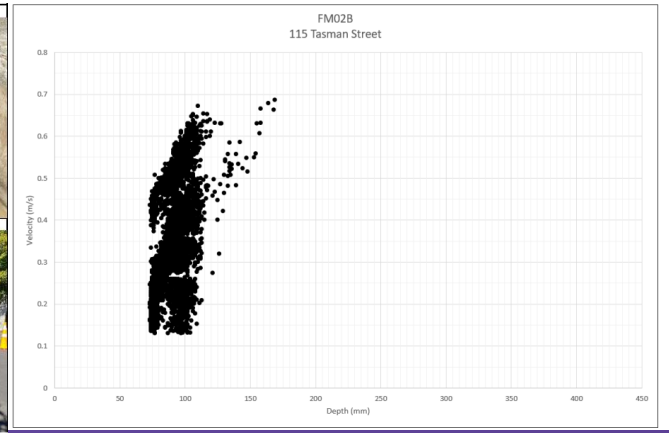
Findings from the research suggest customers are investing in analytics to integrate data sources, streamline data ingestion and leverage predictive analytics and AI as a means toward building a more data-driven organization.

"Prior to 2017, most analytics deployments were a first-generation technology replacing ineffective, homegrown solutions -- often based on

How do we calibrate models?

- Plan Survey
- Collect Data
- Review
- Run Model
- Change Model Parameters





What issues come with calibration?

- Data:
  - Accuracy of Monitors
  - Operational Issues
  - The Weather
- Dollars:
  - Supply vs Demand
  - Health & Safety
  - Time
  - Budgets

Water NZ: Infiltration & Inflow Control Manual, Vol. 2, 2nd Ed., March 2015

Costs

The following table shows indicative costs for undertaking both in-sewer and pump station flow monitoring and rain gauging.

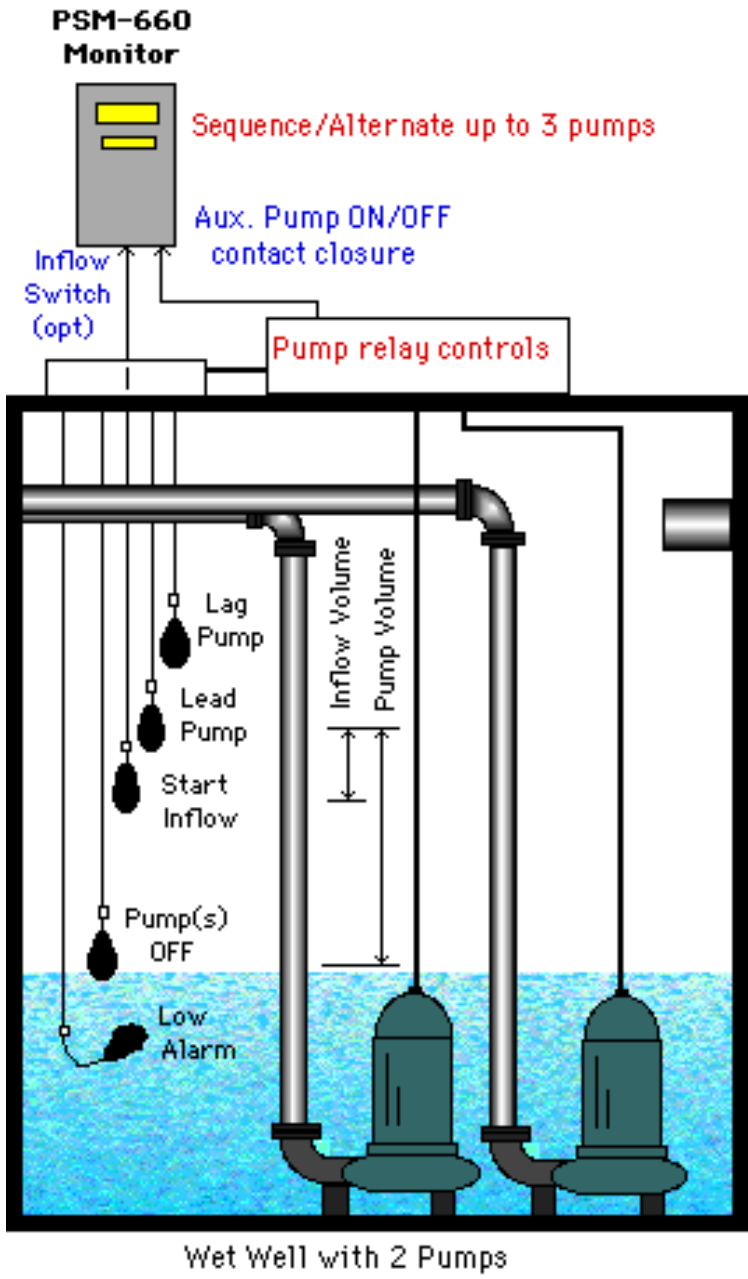
Table 13-1 Budget Investigation Costs

Item	Price Range	Median
In-sewer flow monitoring (incl. investigation installation and data processing)	$600-$700 / site per week	$ 650 / site per week
Pump station flow monitoring	$160-$300/ site per week	$200 /site per week
Rain Gauges	$140 - $500 / week	$250 / week

Solution?

Make the most of what you've got!

A	B	C	D	E	F
WEK-PS-FIT-LOG	FLOW TOTAL		DateTime	WEK-PS-FIT-LOG	WEK-PS-LIT-LOG
WEK-PS-LIT-LOG	LEVEL SIGNAL		17/03/21 12:00:00 AM	2433857	27
			17/03/21 12:02:36 AM	2433857	29
			17/03/21 12:06:29 AM	2433857	31
			17/03/21 12:08:45 AM	2433864	31
			17/03/21 12:11:02 AM	2433864	33
			17/03/21 12:16:30 AM	2433864	35
			17/03/21 12:22:25 AM	2433864	37
			17/03/21 12:28:54 AM	2433864	39
			17/03/21 12:35:59 AM	2433864	41
			17/03/21 12:44:21 AM	2433864	43
			17/03/21 12:51:49 AM	2433864	45
			17/03/21 1:00:24 AM	2433864	47
			17/03/21 1:08:02 AM	2433864	49
			17/03/21 1:16:11 AM	2433864	51
			17/03/21 1:20:55 AM	2433864	49
			17/03/21 1:21:00 AM	2433864	47
			17/03/21 1:21:07 AM	2433864	45
			17/03/21 1:21:16 AM	2433864	43
			17/03/21 1:21:23 AM	2433867	43
			17/03/21 1:21:28 AM	2433867	41
			17/03/21 1:21:45 AM	2433867	39
			17/03/21 1:23:04 AM	2433867	37
			17/03/21 1:23:50 AM	2433877	37
			17/03/21 1:24:52 AM	2433877	35
			17/03/21 1:26:19 AM	2433887	35
			17/03/21 1:26:23 AM	2433887	33
			17/03/21 1:27:22 AM	2433887	31
			17/03/21 1:28:34 AM	2433887	29
			17/03/21 1:28:48 AM	2433897	29
			17/03/21 1:29:49 AM	2433897	27
			17/03/21 1:31:02 AM	2433897	25
			17/03/21 1:31:17 AM	2433907	25
			17/03/21 1:31:54 AM	2433907	23
			17/03/21 1:32:38 AM	2433907	21
			17/03/21 1:33:14 AM	2433907	19



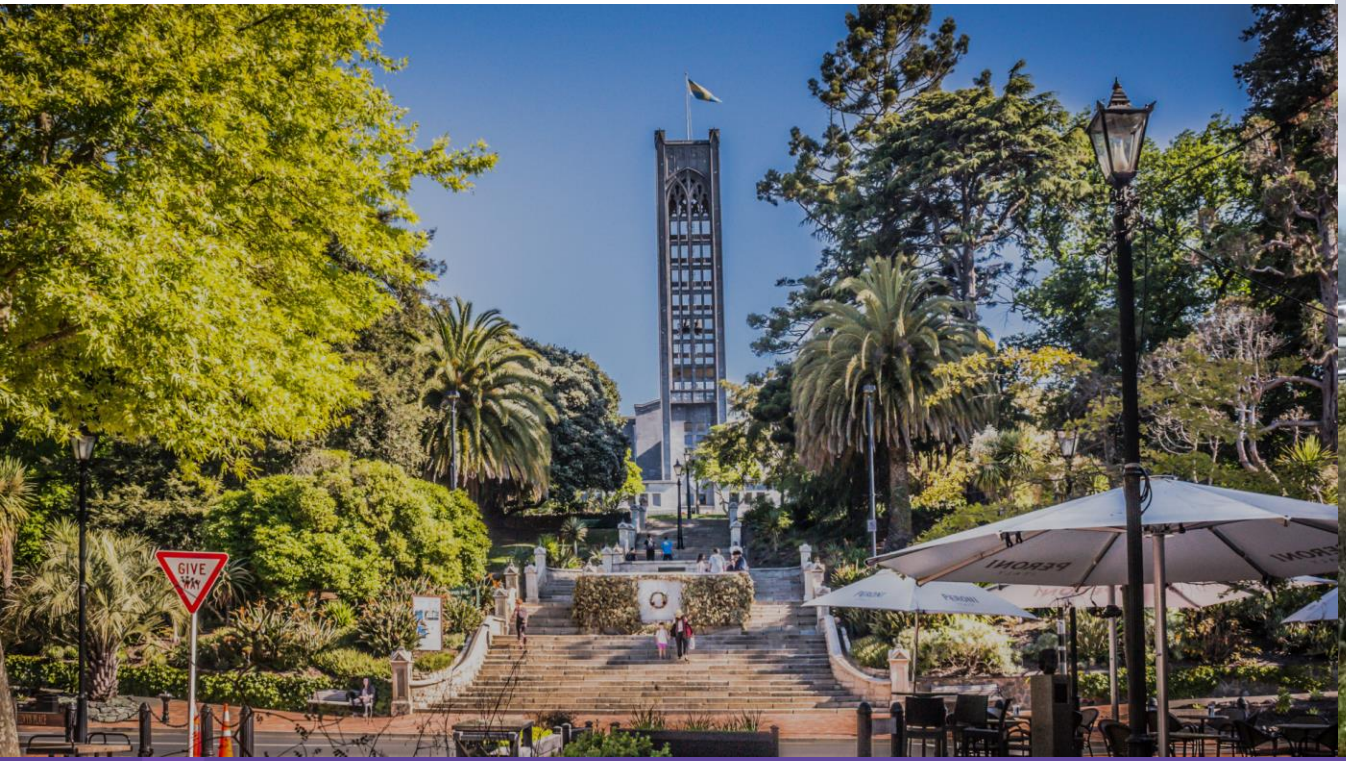
Wet Well with 2 Pumps

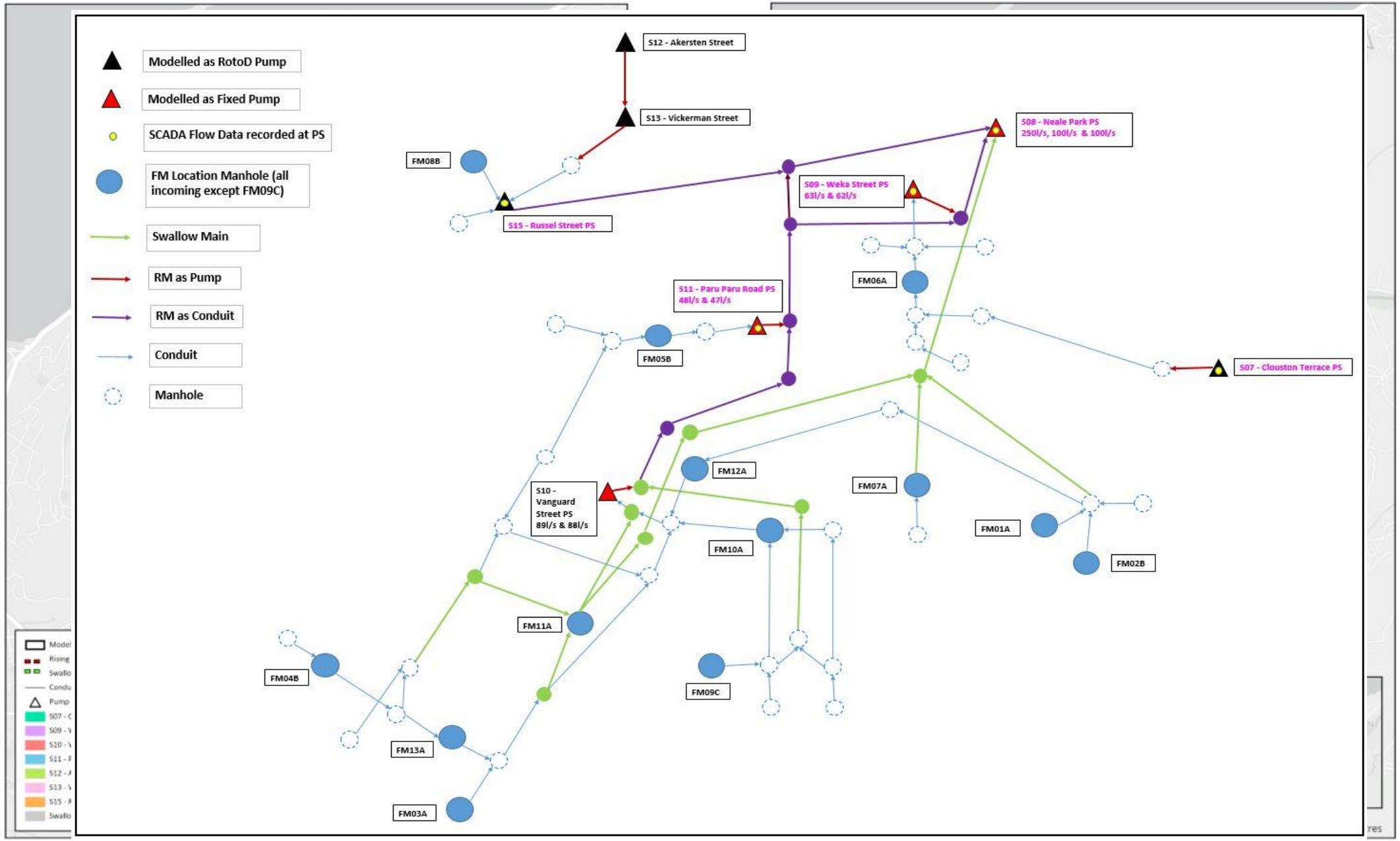
What is SCADA?

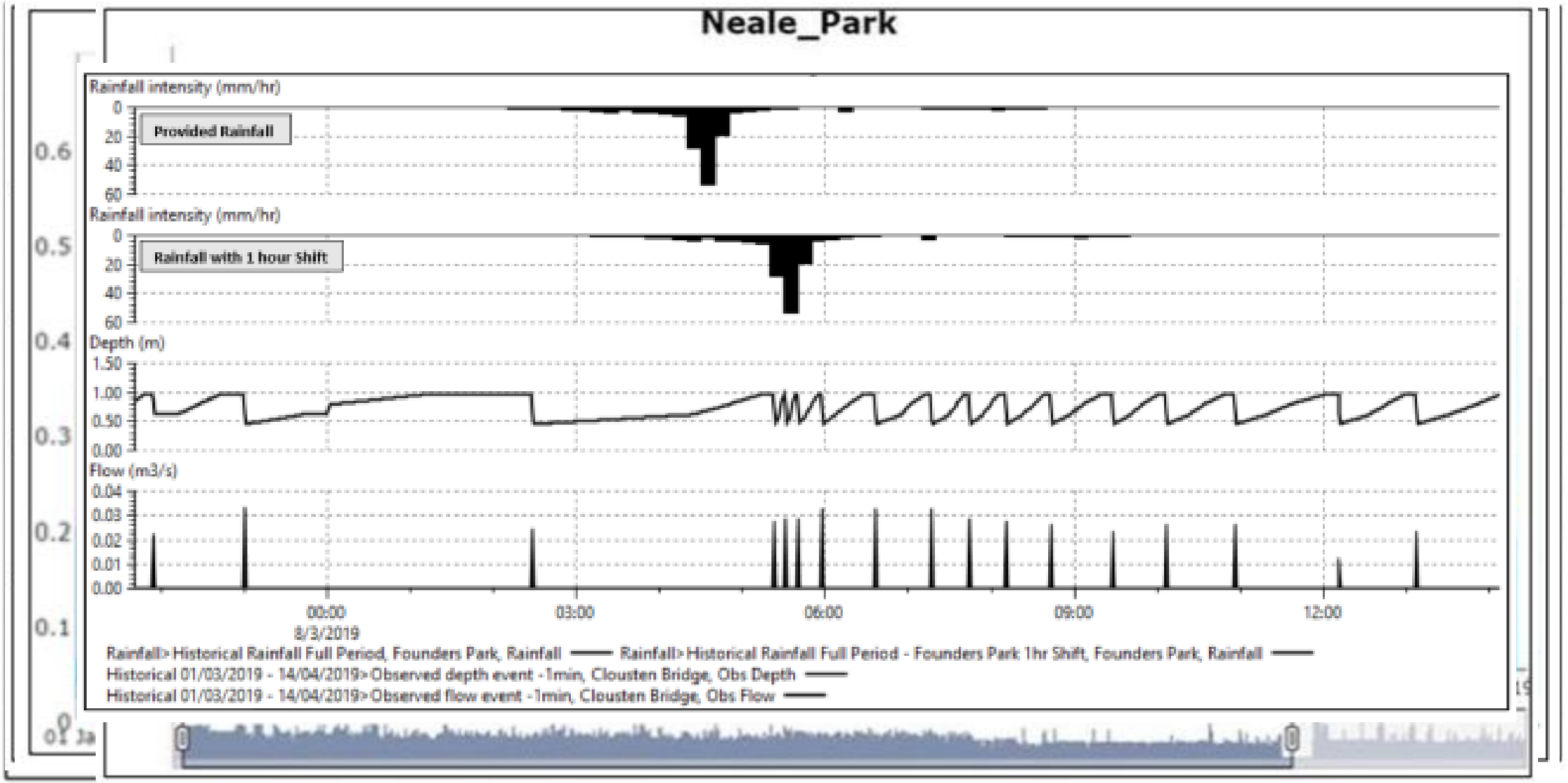
A SCADA system is **a combination of hardware and software enabling the capture of data within, and automation of, processes**. SCADA connects sensors that monitor equipment like motors, pumps, and valves to an onsite or remote server.

Case Study: Nelson Central

Here's Nelson. It's lovely. Seriously, you should go some time.

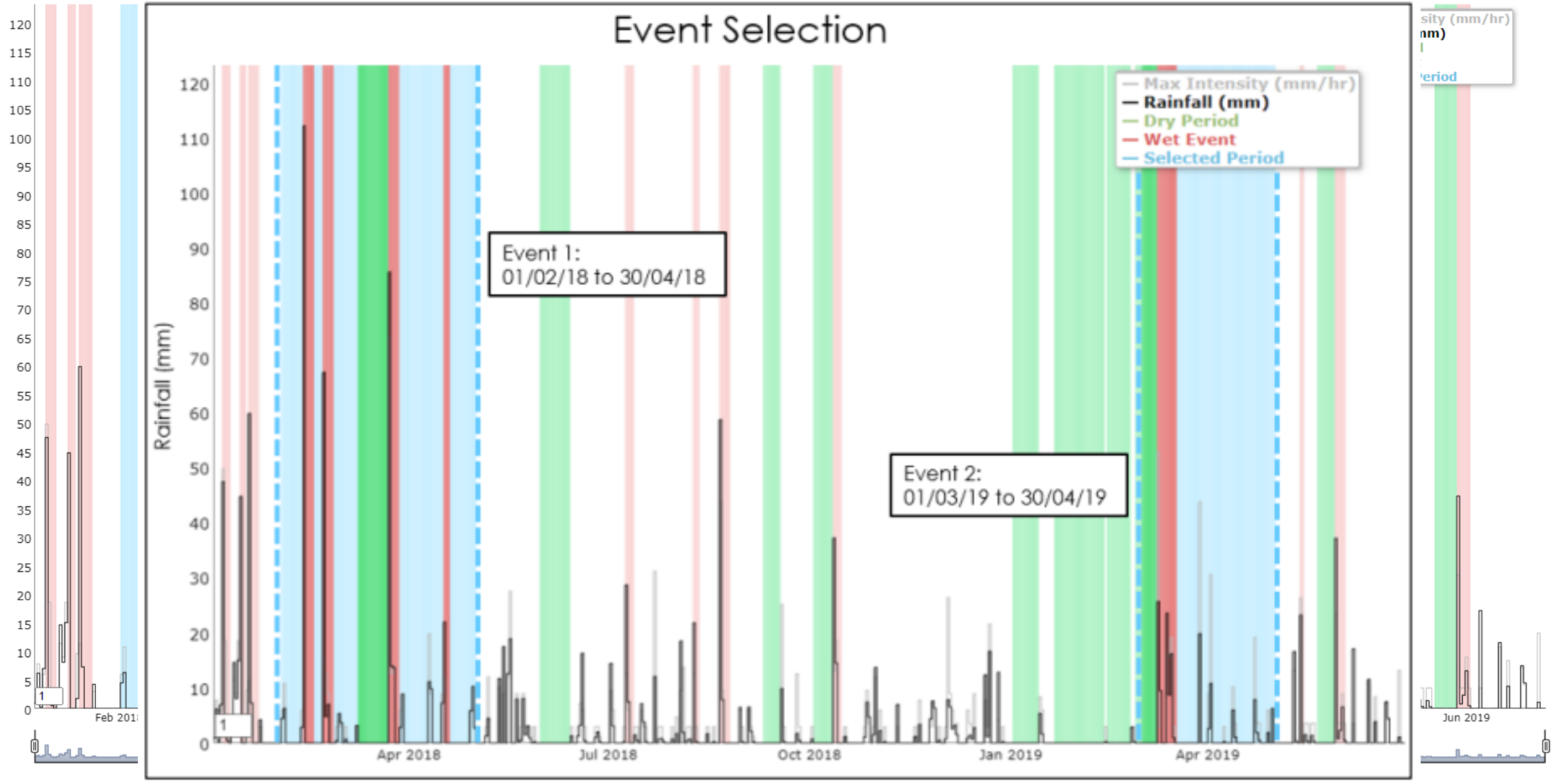



Modelled as RotoD Pump
Modelled as Fixed Pump
SCADA Flow Data recorded at PS
FM Location Manhole (all incoming except FM09C)
Swallow Main
RM as Pump
RM as Conduit
Conduit
Manhole
S12 - Akersten Street
S13 - Vickerman Street
S15 - Russel Street PS
S08 - Neale Park PS 250l/s, 100l/s & 100l/s
S09 - Weka Street PS 63l/s & 62l/s
S11 - Paru Paru Road PS 48l/s & 47l/s
S10 - Vanguard Street PS 89l/s & 88l/s
S07 - Clouston Terrace PS
FM08B
FM05B
FM06A
FM12A
FM07A
FM10A
FM01A
FM02B
FM11A
FM04B
FM09C
FM13A
FM03A


Neale_Park
Rainfall intensity (mm/hr)
Provided Rainfall
Rainfall intensity (mm/hr)
Rainfall with 1 hour Shift
Depth (m)
Flow (m3/s)
00:00
8/3/2019
03:00
06:00
09:00
12:00
Rainfall>Historical Rainfall Full Period, Founders Park, Rainfall
Rainfall>Historical Rainfall Full Period - Founders Park 1hr Shift, Founders Park, Rainfall
Historical 01/03/2019 - 14/04/2019>Observed depth event -1min, Clousten Bridge, Obs Depth
Historical 01/03/2019 - 14/04/2019>Observed flow event -1min, Clousten Bridge, Obs Flow

PS Name	Data Provided	Duration	Level Signal	Flow Total	Flow Instantaneous	P1# Starts	P2# Starts	Depth Calibration Against	Flow Calibration Against	Data Review Remarks
Akersten St PS	Nelmac	Full Period	P	-	-	-	-	NCC	-	1. Nelmac and NCC wet well level (depth) data are same. 2. No Nelmac or NCC flow data provided.
	NCC	Event 2	P	-	-	-	-			
Clouston Terrace PS	Nelmac	Full Period	P	-	P	-	-	NCC	Nelmac	1. NCC wet well level (depth) data looks appropriate for calibration. 2. There is low confidence in NCC's provided Flow Total data. Hence, old flow data will be used for calibration. 3. NCC wet well level (depth) pattern matches well with the Nelmac flow data as well.
	NCC	Event 2	P	P	-	P	P			
Neale Park PS	Nelmac	Full Period	P	-	P	-	-	Nelmac	Nelmac	1. No NCC wet well level (depth) and flow data provided. 2. The Nelmac % depth data will be used for calibration. 3. The Nelmac flow data is recorded at 30min time interval and is not appropriate for the calibration. 4. This pump was upgraded in Aug 2019 and the SCADA data shows the change in operational regime before and after the upgrades.
	NCC	Event 2	-	-	-	-	-			
Paru Paru Rd PS	Nelmac	Full Period								
	NCC	Event 2								
Russell St PS	Nelmac	Full Period								
	NCC	Event 2								
Vickerman St PS	Nelmac	Full Period								
	NCC	Event 2								
Vanguard St PS	Nelmac	Full Period								
	NCC	Event 2								
Weka St PS	Nelmac	Full Period								
	NCC	Event 2								

Subevent Name	Dates	Time	Duration	Tide Cycle
DWF 1	04 March 2019 to 05 March 2019	00:00 – 00:00	24 hrs	Low
DWF 2	27 February 2019 to 06 March 2019	00:00 – 00:00	192 hrs	Low
DWF 3	18 March 2019 to 25 March 2019	00:00 – 00:00	192 hrs	High
WWF 1	14 March 2019 to 15 March 2019	13:00 – 00:00	11 hrs	Low
WWF 2	28 May 2019 to 29 May 2019	06:00 – 00:00	18 hrs	Low
WWF 3	31 March 2019 to 01 April 2019	15:00 – 12:00	21 hrs	High
Event Period 2	01 Feb 2019 to 31 May 2019	00:00 – 00:00	2,880 hrs	Variable


Event Selection
Max Intensity (mm/hr)
Rainfall (mm)
Dry Period
Wet Event
Selected Period
Rainfall (mm)
Event 1:
01/02/18 to 30/04/18
Event 2:
01/03/19 to 30/04/19
Apr 2018
Jul 2018
Oct 2018
Jan 2019
Apr 2019
Jun 2019

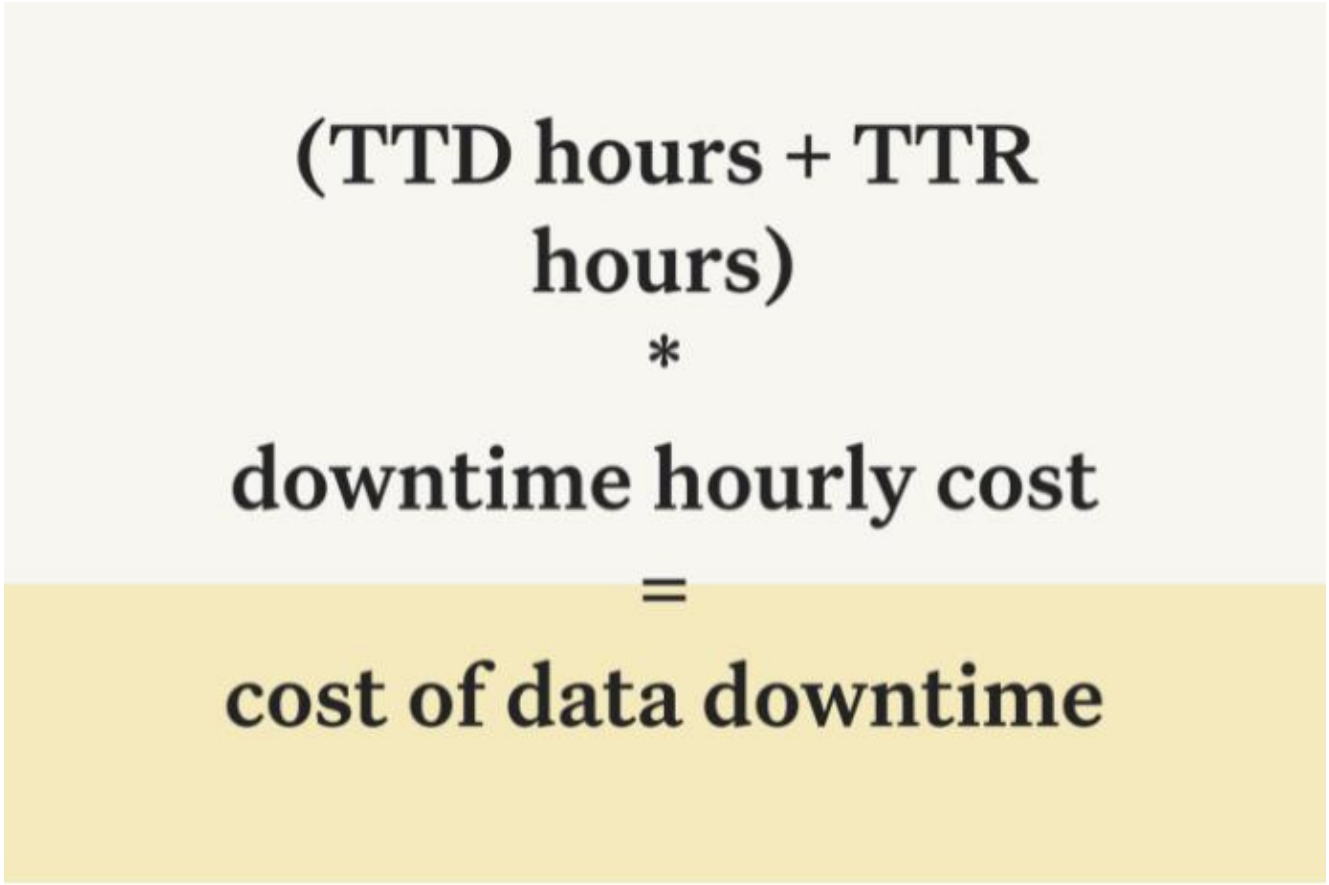
Rainfall event: >Model By NCC>Nelson Central Historical Verification>Rainfall>Historical Rainfall Event/Period - Founders Park 1hr Shift (27/10/21 4:24:01 pm)
Level: >Model By NCC>Nelson Central Historical Verification>Level Group>Tide Level - Historical Verification (LINZ NZVD 2016) (3/09/21 3:55:17 pm)
Observed depth event: >Model By NCC>Nelson Central Historical Verification>Historical Flow Survey>Historical Event/Period 2>Observed depth event -1min (11/10/21 3:24:32 pm)
Sim: >Model By NCC>Nelson Central Historical Verification>Sim Group - Event 2>Full Event 2>Model v40 - Full Event>Historical Rainfall Event/Period - Founders Park 1hr Shift (3/11/21 8:32:15 pm)

WWF 1: Historical Calibration for 14 March 2019 13:00 to 15 March 2019 00:00

Location	Observed			Baseline Model			Calibrated Model			Difference between Observed and Calibrated Results (%)			Time to Peak Difference (min)
	Peak Depth (m)	*Peak Flow (m^3/s)*	*Volume (m^3)*	*Peak Depth (m)*	*Peak Flow (m^3/s)*	*Volume (m^3)*	*Peak Depth (m)*	*Peak Flow (m^3/s)*	*Volume (m^3)*	*Peak Depth + 0.5m to 0.1m*	*Peak Flow +25%/-15%*	*Volume +20%/-10%*	*+0.5hr/-0.5hr*
Clouston Terrace PS	0.957	0.026	16	N/A	N/A	N/A	1.121	0.030	37	0.164	15%	125%	18 mins
Clouston Terrace PS Rev 1	0.957	0.026	31	1.263	0.060	60	1.121	0.030	37	0.164	15%	19%	18 mins
Weka Street PS	1.565	0.078	701	1.953	0.063	1136	1.569	0.071	641	0.004	-9%	-9%	25 mins
Akersten Street PS	1.261	N/A	N/A	N/A	N/A	N/A	1.413	N/A	N/A	0.152	N/A	N/A	35 mins
Akersten Street PS Rev1	1.261	N/A	51	1.369	N/A	N/A	1.413	0.010	55	0.152	N/A	8%	35 mins
Vickerman Street PS	0.953	0.040	146	1.058	0.038	63	1.003	0.038	117	0.050	-5%	-20%	9 mins
Russell Street PS	1.330	0.093	695	1.387	0.086	378	1.414	0.090	664	0.084	-3%	-4%	13 mins
Paru Paru Road PS	1.856	0.083	401	1.914	0.047	636	1.824	0.060	360	-0.032	-28%	-10%	14 mins
Vanguard Street PS	1.974	N/A	N/A	2.694	N/A	N/A	3.027	N/A	N/A	1.053	N/A	N/A	80 mins
Neale Park PS	N/A	N/A	5662	N/A	N/A	6050	N/A	N/A	5615	N/A	N/A	-1%	N/A

... 1hr Shift, S406703.1 -0.001 0.085 4615.215

Case Study: Lessons Learned



"Building your data stack without factoring in data quality is like buying a Ferrari but keeping it in the garage."

"We all know that reliable data is important … But we don't have a great way to measure its ROI, and from there, justify investment".

Conclusions

- Overall Good Calibration
- Different insights
- Ranging benefits e.g., H&S
- Cheaper than traditional approach
- Be aware of data downtime and be proactive to address it

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Thank you!
Questions? Patai?

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