CwMAG WORKSHOP 2022

Best Practice Guide

Workshop Programme – Wednesday 19th October

09:15 - 09:20 **Welcome & Introduction -** Jon Cockram (United Utilities)

Session 1 – Model Build Guidelines

09:20 – 09:30 **Introduction to the Guidelines -** Duncan Allen (Scottish Water)
09:30 – 09:50 **Model Build -** Fiona Page (Yorkshire Water)
09:50 – 10:10 **Field Testing -** Hossein Rezaei (RPS)
10:10 – 10:30 **Demand Analysis -** Tim Balding (Atkins)
10:30 – 10:50 **Calibration -** Simon Croft (Anglian Water)

10:50 - 11:20 Coffee Break

Session 2 – Demand Profiles Project

11:20 – 11:25 **Introduction to the project -** Jon Cockram (United Utilities)
11:25 – 13:00 Dilraj Dillon & Stephen Burgess (Crowders)

13:00 - 14:00 Lunch

CwMAG Best Practice Guide - History

- One of the original purposes of CwMAG was to set up a UK methodology
- A number of attempts and discussions have been held over the years to advance this including:
  - Company specification reviews
  - Discussions with WRC
  - Sponsored a University Literary review
  - Lots of internal chat ….

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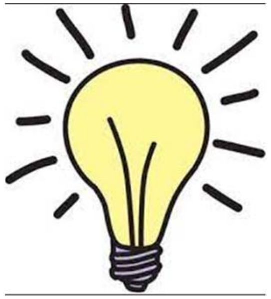

- A new approach was taken / attempted …
- Questionnaires were compiled and sent around all the water companies
- Focus was on a Yes / No basis
- General approach has been if over 75% of company answers same then deemed best practice
- Where under 75% further work required ….

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- Questionnaire focused on 4 main categories plus some general questions:
  - Model Build
  - Demands
  - Field Test
  - Calibration

- Total of 115 questions – 80 Y/N with 35 additional info text answers. E.g. Do you have a model build specification <5yrs old (y/n) – when was it last reviewed (text)
- Questionnaire was sent to 25 UK Water Companies with responses received from 17
- Each of the following chapters are based on these categories

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- General area of questionnaire

ID	Y/N or Text	Area	Query	Count Yes	Count No	% Yes
1	Y/N	General	Do you have a current model build & calibration specification (<5 years old)?	13	4	76%
2	Text	General	What year was it last reviewed / updated?	Date of specification ranged from 2005-2019		
3	Y/N	General	Do you have different levels of model build?	11	6	65%
4	Text	General	Levels of model build	Largely all mains with some strategic etc.		
5	Y/N	General	Do you carry out a detailed pre model build assessment of network assets?	10	7	59%
6	Y/N	General	Do you have a standardised report template for calibration report?	11	6	65%
7	Y/N	General	Do you have a model audit procedure?	13	4	76%
8	Y/N	General	Do you get a network performance report as part of the model build?	13	4	76%
9	Y/N	General	Do you specify additional models to be provided above the calibration day?	11	6	65%
10	Y/N	General	If calibration day specific controls used do you specify a working model to be provided?	11	6	65%

MODEL BUILDING

Fiona Page
Yorkshire Water

Aims of Model Building

- The aim is to create a replica/digital twin of the distribution or supply system in the software that mimics reality as practicably as possible.
- May be simplified in some ways for a strategic model, or a specific purpose or area.
- But in general we need to include all relevant hydraulic devices and allow for flow/pressure monitoring points
- Most companies will specify a specific model starting point

Data Sources

- GIS – a variety of different GIS systems across the companies
- Topographical information – node and property
- Address/Billing data - properties
- Asset Information – Pumps and Reservoirs
- Telemetry & field data
- Demand profiles – actual and derived

Query	Count Yes	Count No	% Yes	Count Yes	Count No	% Yes
Do you specify co-ordinate system to be used?	13	3	81%	13	4	76%
If yes - which?				National Grid		
Do you have a minimum Digital Terrain Mapping grid requirement for nod	12	4	75%	12	5	71%
What is used?				Majority 10m grid or better		
Do you include pologons in your model?	15	2	88%	16	2	89%
If yes - which?				typically DMA plus some others		

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To start with

- Define model purpose (type) and area
- Data extract
- Data cleansing – best practice to feed back errors found
- Demand allocation
- Data (fieldtest) processing/allocation

Each water company will have their own specific methods for each aspect depending on GIS and model software.

Most modelling software has a certain number of model building tools within them (file converters/importers and scripts)

The conversion process will create nodes, pipes and assets

Query	Yes	No	% Yes	Yes	No	% Yes
Do you specify typical model starting points?	12	4	75%	12	5	71%

Nodes

These may exist in GIS, but generally extra ones need to be created.

From the questionnaire:

- A unique but repeatable node numbering methodology is required – usually Grid Reference format
- Elevation is usually derived from 10m or better DTM or LIDAR data
- Each node (and pipe) should be assigned to a specific area code (DMA etc)
- Each node needs a grid reference (12 point)

Query	Count Yes	Count No	% Yes	Count Yes	Count No	% Yes
Do you have a specified node naming format?	16	0	100%	17	0	100%
What?				Generally grid ref based on GIS based		
Do you use area codes for all nodes and links?	16	1	94%	17	1	94%
Do you include all hydrants in the model as a hydrant type?	12	5	71%	13	5	72%

Pipes (upstream:node – downstream:node)

Query	Count Yes	Count No	% Yes	Count Yes	Count No	% Yes	
Do you include all valves in the model build as a valve type?	15	2	88%	16	2	89%	
Do you include all Boundary valves with neighbouring systems (i.e. areas n	15	2	88%	16	2	89%	
Do you specify a default valve curve?	11	5	69%	12	5	71%	
Do you specify any standard head loss through specific valve types?	4	12	25%	4	13	24%	
If yes, details				IW/SynerGi diff. typically k in SynerGi with valve curves in IW			
Do you include all washout pipes in the model build?	10	7	59%	11	7	61%	
Do you have a specified link naming format?	6	9	40%	7	9	44%	
What?							
Are pipe lengths automatically calculated based on geographical length?	14	2	88%	15	2	88%	
Do you specify internal diameters of PE pipes to be used?	17	0	100%	18	0	100%	
Do you specify which friction factors to be used?	17	0	100%	18	0	100%	
Which?				4 CW, 3 DW, 1 HW			
Do you specify what default friction factors should be applied?	15	2	88%	16	2	89%	May be wor
Basis of this application?				Most appear to have look up tables - may be worth gathering to see similarities e			
Do you specify how any unknown diameters should be assumed?	12	5	71%	13	5	72%	
If yes, how?				typically surrounding pipes/local knowledge			
Do you specify internal diameters of PE pipes to be used?	15	0	100%	15	1	94%	May be wor

Pipes (upstream:node – downstream:node)

- Required - Diameter/length/roughness coefficient (ie material)
- Look-up tables for diameters and coefficients – vary considerable across companies, a standard table was not obvious
- Valves should be included, especially boundary valves to other areas
- Control Valves should be modelled dynamically
- Most use an automatic length calculator
- Differing softwares use different valve curves/tau values/headloss coefficients such that standardisation isn't possible, default software curves are used.

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Pipes (upstream:node – downstream:node)

- Unlike nodes, there isn't a tendency to stipulate a pipe naming convention (assume us-ds.node)
- While individual look-up tables are used for friction factors it was interesting that we don't all use the same type. Mix of Hazen-Williams, Dary-Weisbach and Colebrook-White

Question - A standard Look-up Table?

- *Is it something we would find useful?*
- *Pipe diameters, Coefficients or both?*

As can be seen from the table below, a wide variety of values are used across different companies, making developing a standard look up table difficult.

Material		Age	*Company 1*	*Company 2*	*Company 3*	*Company 4*	*Company 5*	*Company 6*					
		0	0.03	0.03	0.03			0.05					
		20	0.06	0.06	0.03		0.3	0.05					
		30	0.08	0.08	0.03		0.3	0.05					
AC	Asbestos Cement	40	0.1	0.1	0.03		0.3	0.05					
		50	0.2	0.2	0.03		0.3	0.05					
		60	0.3	0.3	0.03		0.3	0.05					
		70	0.4	0.4	0.03		0.3	0.05					
		0	0.03	0.03	0.03	0.03	0.03	2					
		15	0.05	0.05	0.05	0.05	0.05	2					
		20	0.88	0.88	0.88	0.88	0.88	2					
		25	1	1	1	1	1	2					
		30	1.5	1.5	1.5	1.5	1.5	2					
		40	2	2	2	2	2	2					
		50	2.5	2.5	2.5	2.5	2.5	3					
CI	Cast Iron	60	3	3	3	3	3	3					
		70	3.5	3.5	3.5	3.5	3.5	4					
		80	4	4	4	4	4	4					
		90	5	5	5	5	5	5					
		100	6	6	6	6	6	5					
		110	7.5	7.5	7.5	7.5	7.5	5					
		120			7.5	7.5	7.5						
		0	0.03	0.03				0.05		1.5		1.5	
		15	0.05	0.05				0.05		1.5		1.5	
		20	0.88	0.88				0.05		1.5		1.5	
		25	1	1				0.05		1.5		1.5	
CIL	Cast Iron Lined	30	1.5	1.5				0.05	Epoxy	1.5	Bitumen	1.5	Cement
		40	2	2				0.05		1.5		1.5	
		50	2.5	2.5				0.05		1.5		1.5	
		60	3	3				0.05		1.5		1.5	
		70	3.5	3.5				0.05		1.5		1.5	

Network Assets

Service Reservoirs/Water Towers/Break Pressure Tanks and Pumping Stations

Query	Count Yes	Count No	% Yes	Count Yes	Count No	% Yes
Do you model a CWT/storage at treatment works as a reservoir node (stor	10	7	59%	10	8	56%
Do you model multiple cell reservoirs as a single reservoir in the model?	10	7	59%	11	7	61%
Do you have guidelines regarding node elevations around reservoirs?	4	13	24%	4	14	22%
If yes , what?				Generally no neg pressures where stated		
As reservoirs are typically point objects do you have any guidelines regard	8	8	50%	8	9	47%
If yes, what?						
For reservoirs, if inlet pipe level is unknown do you have any guidelines fo	7	10	41%	7	11	39%
If yes, what?				Typically high level		
Do you model each individual pump?	17	0	100%	18	0	100%
Do you use manufacturers pump curves?	15	2	88%	16	2	89%
Do you specify that pump tests should be carried out in order to calculate	1	16	6%	1	17	6%
Do you include all meters in the model?	16	1	94%	17	1	94%
Do you specify any standard head loss through specific meter types?	2	15	12%	2	16	11%
If yes, details				based on meter type		

Network Assets

Service Reservoirs/Water Towers/Break Pressure Tanks and Pumping Stations

From the questionnaire:

- These should be modelled as variable head reservoirs, preferably with inlet & outlet flows measured and modelled.
- Reservoirs of more than one cell are usually modelled as a single cell
- Pumps should be modelled individually with manufacturers pump curves where possible.

Network Assets

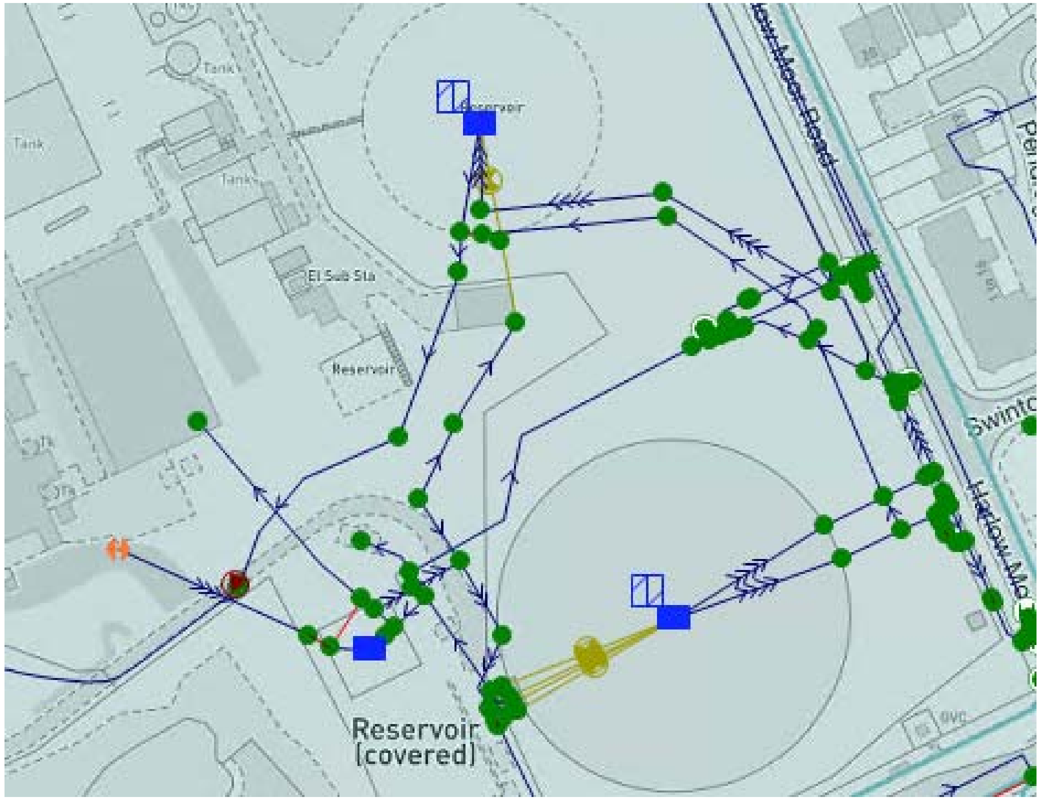
Service Reservoirs/Water Towers/Break Pressure Tanks and Pumping Stations

From the questionnaire:

- Variable as to whether a tank at a Water Treatment Works is modelled or not
- No guidelines for elevations round reservoirs (often lead to negative pressures)
- Rare that there are any specific guidelines for modelling reservoirs/inlets etc
- Pump tests are rarely undertaken
- No standard headloss for meter types

Question

- *Regarding pumps and reservoirs – would examples of how they are modelled be of use?*



Properties and Property Allocation

- Domestic/non-domestic and either metered or unmetered

- Usually present in GIS as geo-referenced ‘points’, and can be allocated within the model or GIS to a specific algorithm, usually
- Pipes >8”/200mm not allocated to
- Distance to pipe limited (eg 200m) to identify private supplies/errors
- Maximum number of properties usually 200 (rare to exceed that in modern models)

Data Flags/Labels

Best Practice to include them, though too many are counter-productive. The following are common

- Calibration Change
- Model Maintenance
- Levelled point
- GIS import
- Assumed data

User Defined Flags

Name	Display Colour	Obsolete	Description
#A		☐	Asset Data
#D		☐	System Default
#G		☐	Data from GeoPlan
#I		☐	Model Import
#N		☐	Data from Node
#V		☐	CSV Import
AS		☐	ASSUMED - Data assumed by Modeller based on Engineering Judgemer
CC		☐	Calibration Change
EX		☐	Length extended for Infoworks
FT		☐	Data from Field Test
IF		☐	INFERRED - Data Inferred by Infoworks automated process
IT		☐	INFERRED - Level data inferred from a Terrain Model > 900mm accurac
KM		☐	KM Check before sending
MA		☐	Maintenance changes
MI		☐	MapInfo
NB		☐	Netbase flow/ pressure data
OP		☒	Data gathered from Operations/ Asset Management
SL		☐	SURVEYED - Data obtained from Level Survey
TA		☒	TEMPORARY - Temporary assumption made pending survey or other da
*		☐	

Query	Yes	No	% Yes	Count Yes	No	% Yes
Do you have a list of data flags for use within the modelling software?	10	7	59%	11	7	61%
If flags being used do you have a clear guide as to typical usage?	9	5	64%	10	5	67%

Thankyou

FIELD TESTING

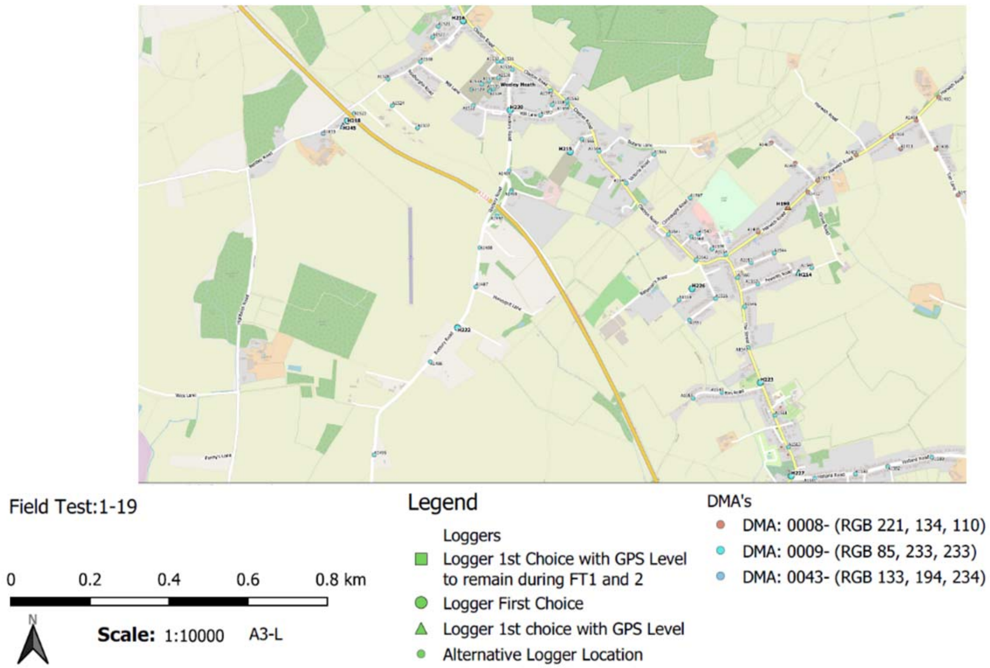
Hossein Rezaei
RPS Group

Content

- Purpose of field testing
- Field test planning
- Flow, pressure, depth
- Telemetry and existing data
- Operational sites
- Duration and timing
- Coverage and logger density
- Accuracy and logger setup
- Practicalities and failures

Field test planning

- System hydraulics
- Data
  - GIS, asset and operational data
  - System and site schematics
  - Billing data
  - Previous models
  - System anomalies
  - Various corporate databases, etc.
- Practicalities
- Communication



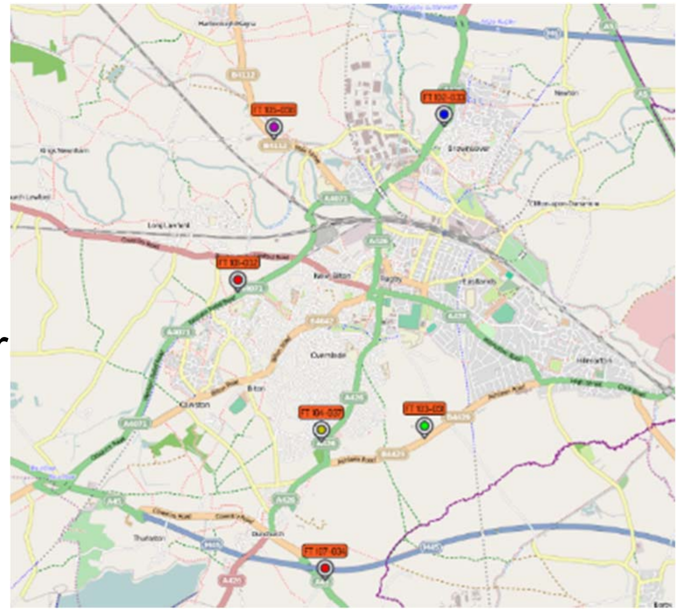
Flow

- Majority are permanently logged
- Flows in and out of the model area (i.e. transfer nodes)
- Flows in and out of reservoirs and towers
- Flows delivered by all pumps
- Flows through hydraulically-defined zones and DMA meters
- Flows to large metered customers

Coverage and logger density

- DMA
  - 1 logger per ~200 properties for urban areas
  - 1 logger per approximately 5km length of pipe for rural areas
  - A minimum of 3 loggers per DMA
  - Single-fed DMA: inlet, CP, end of DMA

- TM
  - Often driven by availability of existing logging points
  - 1 logger for every 3-5km of trunk main length and/or
  - Where there is a significant change in trunk main characteristics (network or hydraulic)



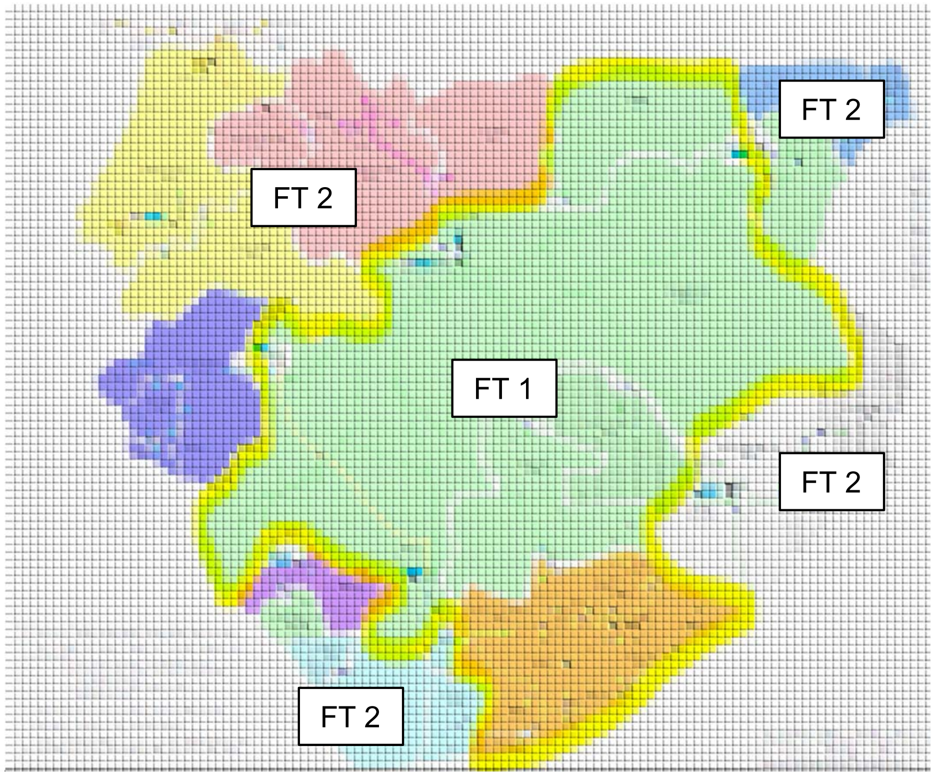
Operational assets

- Often on telemetry/SCADA systems
- **Reservoirs**; depth, multi-cell, and site visit to confirm operation, connectivity
- **Pump stations**; logged individually, enabling works, confirm operation/model/type/curve, clarify standby/duty
- **Regulating valves**; u/s and d/s

- Other data
  - Site visits to collect info about system hydraulics
  - Details of anomalies

Duration and timing

- Consider calibration day
- At least 1 full week
- Aiming for ‘typical’ behaviour (avoid times of other planned activities)
- If more than one FT, plans for suitable hydraulic splits
- If flow is changing, aiming for time of high flow/headloss

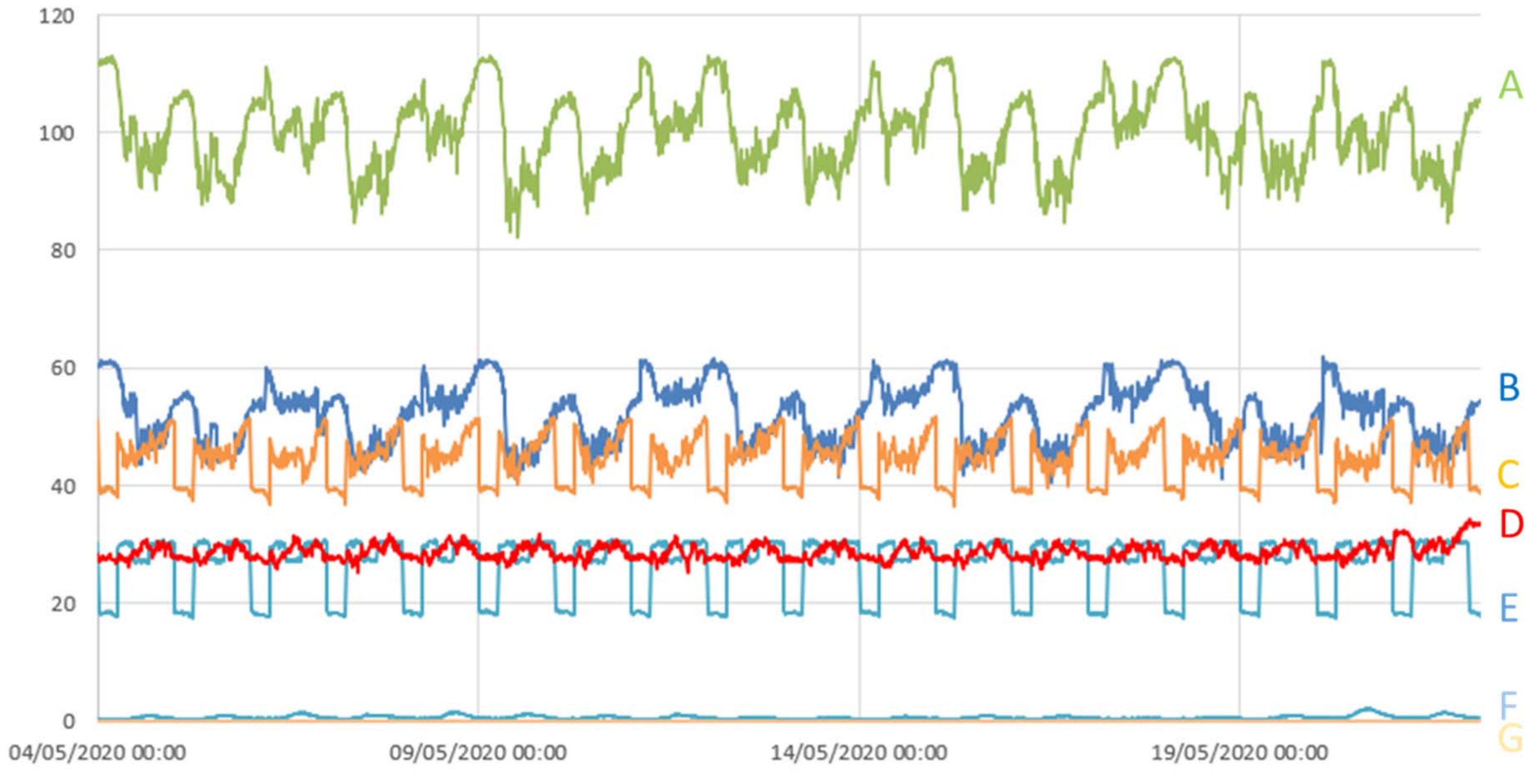


Accuracy and logger setup

- Typically 15-minute time interval data (higher resolution conversions)
- Logging device accuracy typically 0.1%.
- Loggers suitably calibrated
- All pressure and depth locations are levelled, a tolerance within ±25mm to ±50mm
- Mindful of coverage when using GPS levelling

Quality checks

- Spot check/manual readings during installation
- Interim field test checks on key logged locations
- Data check for consistency and reliability, soon after collection



Practicalities

- Working assets
- Alternative locations
- Prior site visits
- e-forms/tools
- H&S,
  - Suitability trained and experienced
  - Safe access to logging locations
  - RAMS, PPE, etc.
- Trainings
  - Water hygiene, calm network, traffic permits, etc.
- Naming convention

- Acceptable rate of **failure** agreed between all stakeholders

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Future developments

- Practices may be adjusted to benefit from new developments
  - High resolution pressure testing
  - Increased density of permanent logging
  - Enhanced pressure monitoring
  - Advances in ‘Internet of Things’ technologies
  - Near real-time modelling
  - Smart metering, etc.

https://www.biz4intellia.com/blog/iot-in-water-water-conservation-for-future-generation/

Thank you.

Tim Balding

Associate – Atkins Ltd

DEMAND ANALYSIS – Introduction

One of the most important elements of simulating a water supply system is representing demands for the system, the three key things to consider are:

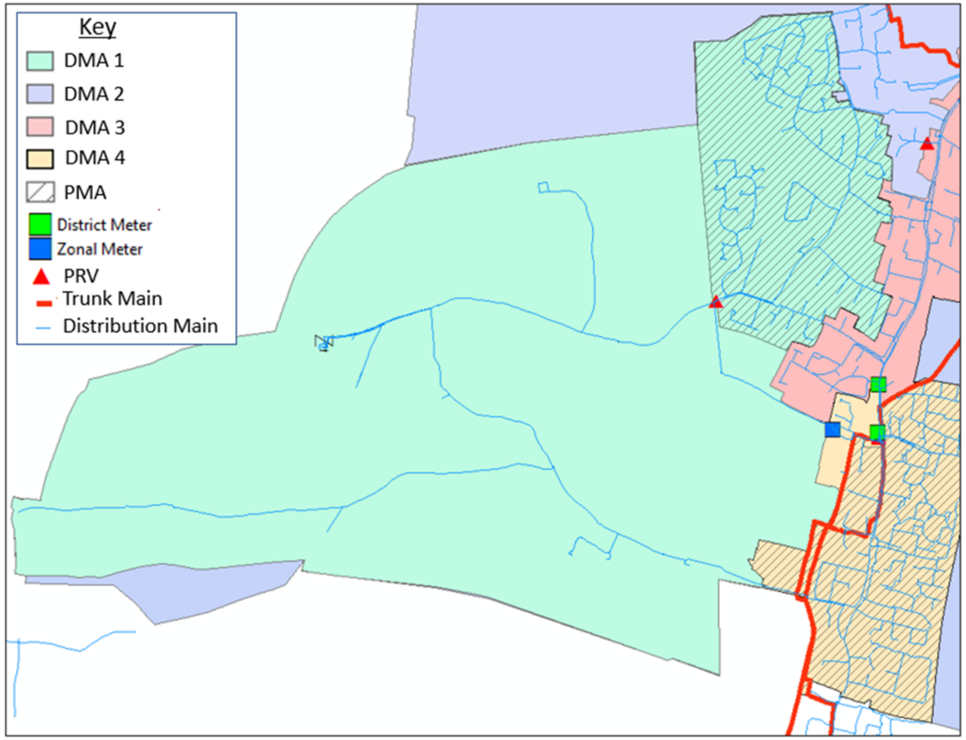
- Distribution of demand
- Known demand
- Unknown demand

Assigning the demand is carried out as part of the model build process the Demand Analysis involves setting up demand scenarios, typically including Calibration day, ADD and ADPW scenarios.

Requirements for Demand Analysis

Collection of data will typically include

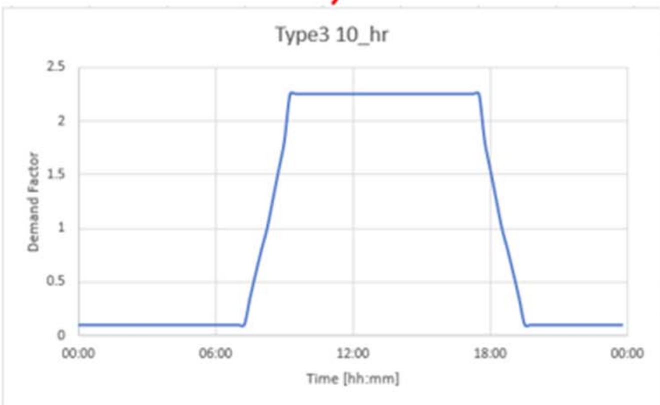
- Details of the defined area to be analysed e.g. District Metered Area (DMA) Pressure Managed Area (PMA)
- Flow data from the relevant inlet and outlet meters
- Details of the population breakdown within the defined areas.

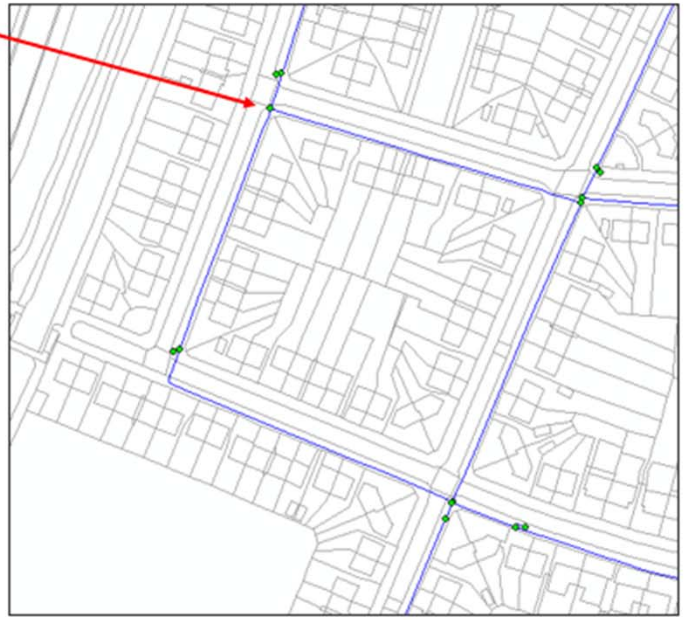


Distribution of Demands

- Following on from the demand allocation during the model build
- Property points will have been classified into demand types
- Property counts and demand types will have been aggregated on to demand nodes

Demand Type	Base Demand	Units
Type 1 (Domestic Equivalent)	20	Property Count
Type 2 (Leakage of UFW)	20	Property Count
Type 3 (Meterd 10 hour)	0.02	Average daily demand [l/s]
Type 4 (Metered 16 hour)	0.12	
Type 5 (Metered 24 hour)	0.017	
Type 6 (Agricltural)	0	
Type 7 (Hotels)	0	
Type 8 (Hospitals)	0.3	
Type 9 (Domestic Equivalent Metered)	0.41	
Type 10 (Specials or LMC'S)	0	



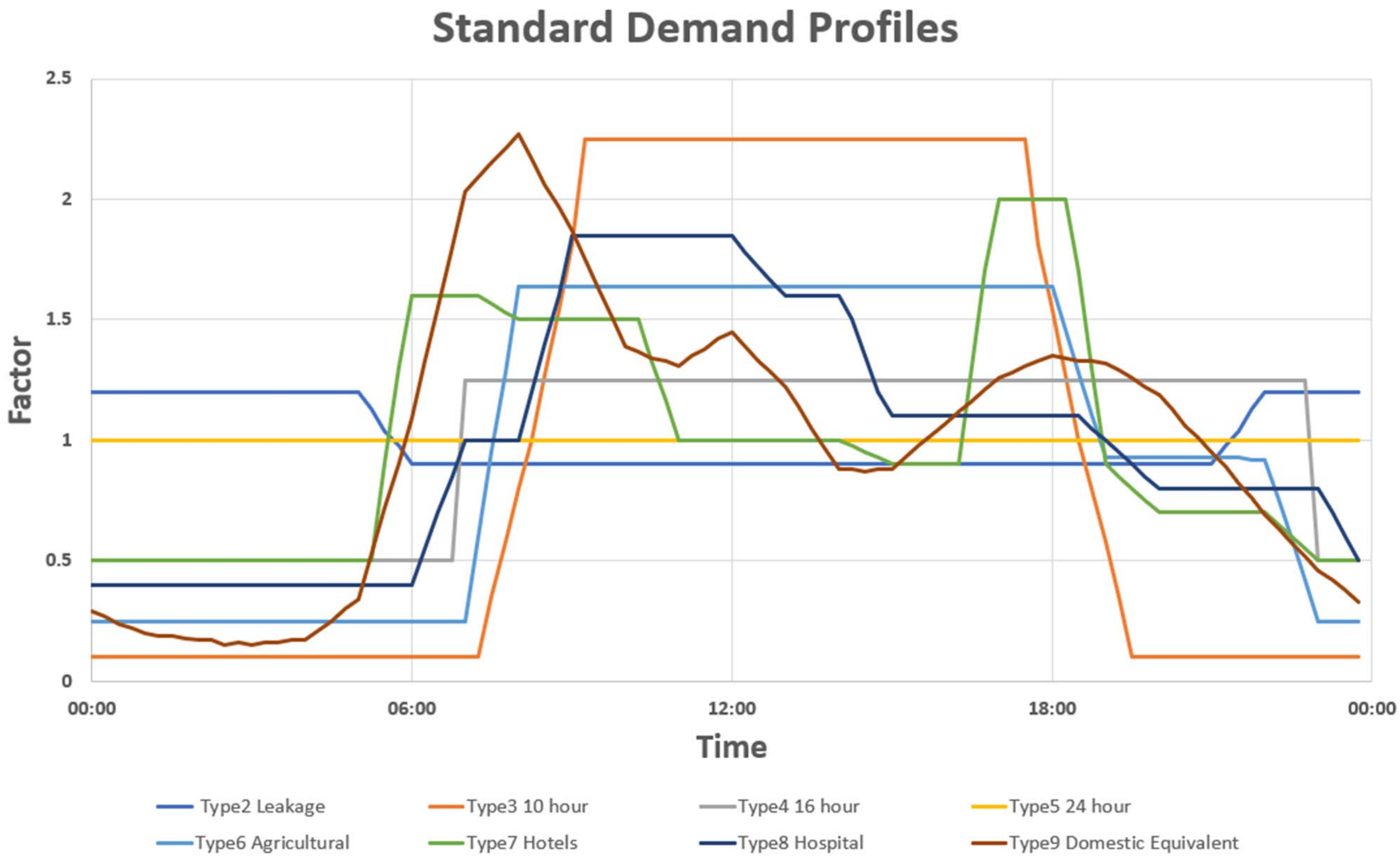


Demand Types

- Unknown Demand
  - UnMetered Domestic
  - UFW
- Metered Non Domestic
  - 10 Hour etc
- Metered Domestic
  - and LMC's

DEMAND CATGORY	Units
Domestic	Property count
Leakage or Unaccounted for Water (UFW)	Property count / Mains length
Metered 10 Hour	Average Daily Demand [/s or l/d etc]
Metered 16 Hour	
Metered 24 Hour	
Agricultural	
Hotels	
Hospitals	
Domestic Equivalent Metered	
Specials or LMCs	Profile representing usage

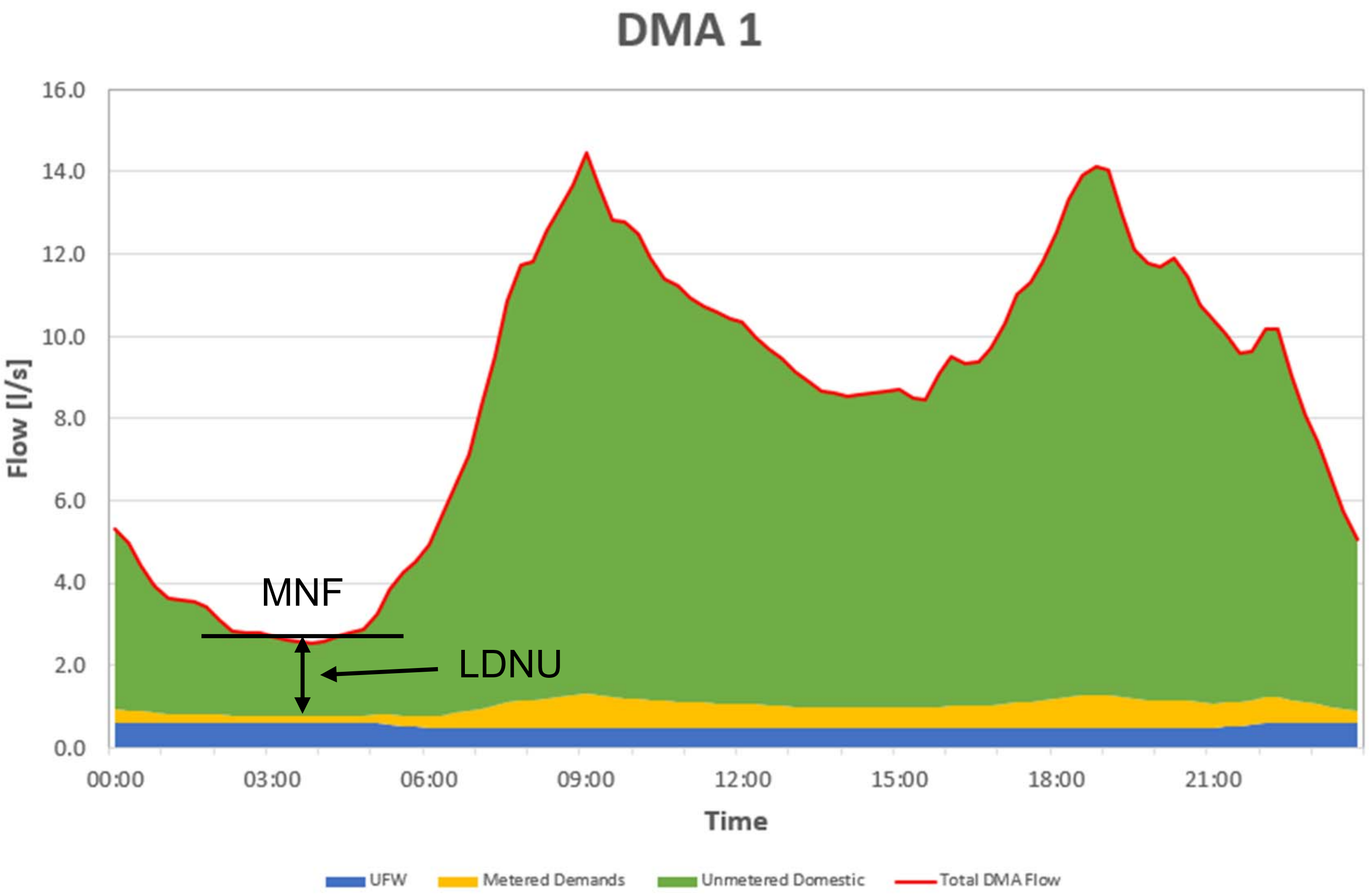
Demand Profiles



Analyse

DMA	DMA 1
Domestic (property count)	2141
Type 2 (property count)	2141
Type3 [l/s]	0
Type4 [l/s]	0.0039
Type5 [l/s]	0
Type6 [l/s]	0
Type7 [l/s]	0
Type8 [l/s]	0.001078
Type9 [l/s]	0.494291
Type10 (Count)	0

Total Daily Demand	736.78 m^3
Domestic Demand	
Domestic Properties	2141
Occupancy Rate	2.15
Population	4612
Domestic night use	1.78 l/s
Domestic Demand	140.80 l/head/day
Domestic Consumption	649.44 m^3
Metered Demand	
Logged Consumers	0.00 m^3
Unlogged Consumers	43.14 m^3
Total Metered Demand	43.14 m^3
Total UFW	44.20 m^3



Trouble Shooting

- Issues you may encounter
  - A broken or faulty inlet / outlet meter
  - A breach between areas
  - High or Low PCC or UFW values
- Potential solutions
  - Combine areas to cover for the lack of monitoring
  - Further field investigations

CwMAG WORKSHOP

Model Calibration

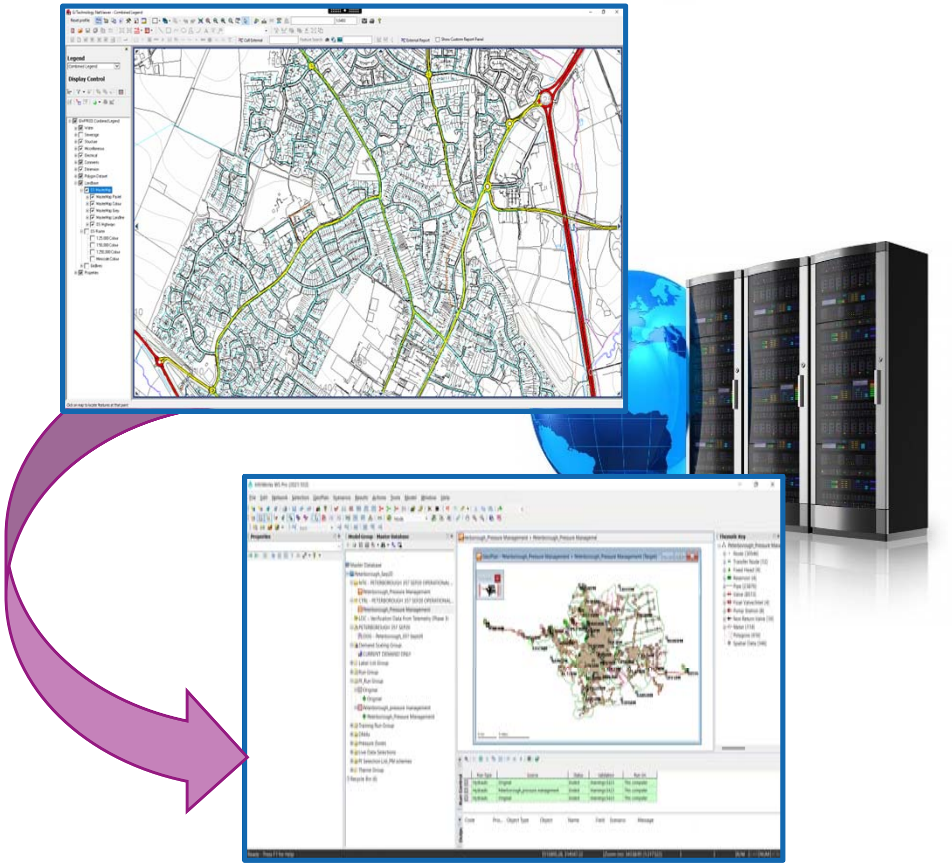
Simon Croft
Anglian Water

Calibration topics

- Introduction
- Flows
- Depth
- Pressure
- Model anomalies
- Model performance

Calibration

Introduction



Typically, models are calibrated over a 24 hour period, based upon the field test day.

The model predictions in the final calibrated model needs to reflect the behaviour of water system over the diurnal variation of both daily peak and minimum night flows.

Model owners will specify their own model settings, but it is recommended that 15 minute time steps over the 24 hour period, with a minim computational accuracy of 0.1l/s.

It’s vital that before significant time is spent calibrating the model, network data from the field tests is validated

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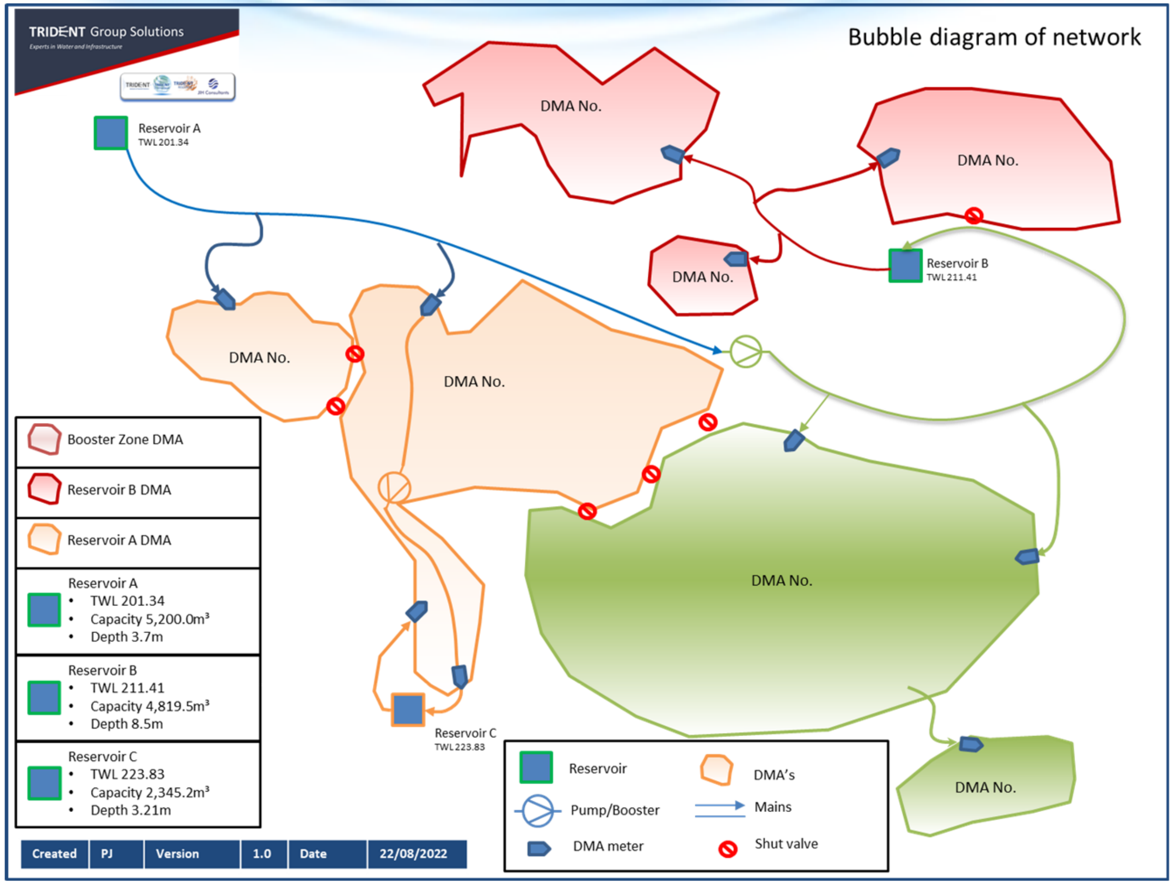
Calibration

Flows



Above, example of a water network from source, showing the input meters, boundaries between areas and the carious number of controls within the network.

The first stage of the calibration process, requires the predicted model flows to compare with the field test data.

For demand areas with a single input e.g. a DMA with one input meter, the flow must match exactly the 24hour period. For areas with multiple inputs e.g. a DMA with more than one input meter, the balance of the predicted flow and the field test data must match.

Flow calibration tolerances are again set my the model owner before calibration work begins, but it is recommended that 85% of all measured values (including all sources) are within ±5%. 95% of all values will be within ±10%.

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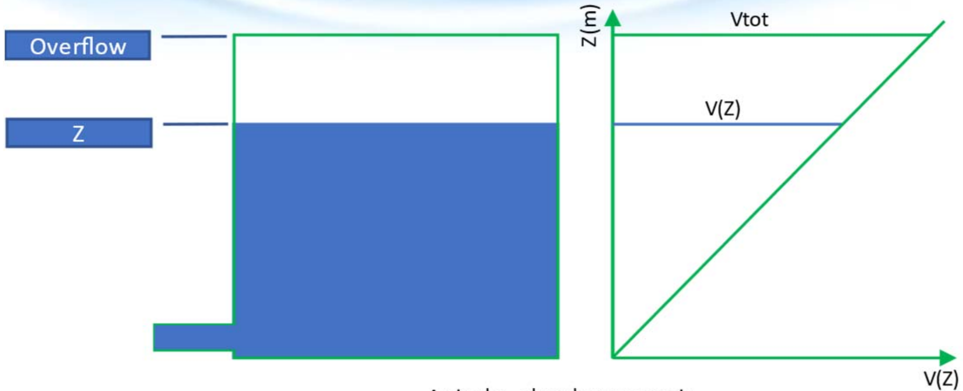
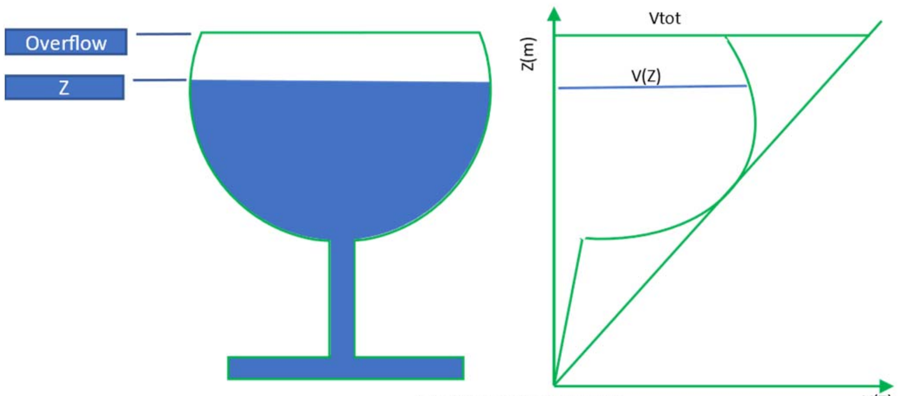
Calibration

Depth



A single– chamber reservoir



A ball shaped water tower

The shape of the storage has to be considered, as this will affect the volume curve.

As always, depth calibration of storage tanks (reservoirs and towers) is specified by the model owner.

The elevation type of a storage tank needs to be considered, the illustrations provide factors that need to be considered.

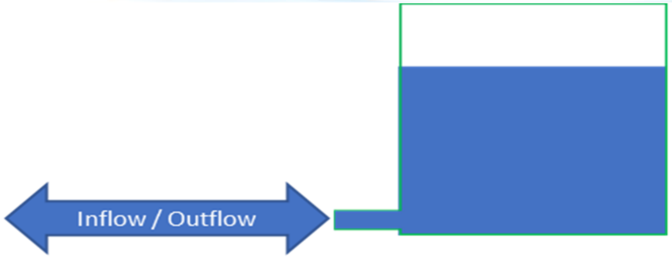
Standard or typical tolerances accepted within the water industry of between ± 0.05 and ± 0.1 for 85 to 95% of values.

When existing telemetry data is to be used, it is important to ensure that the data is validated and confirmed that 100% full does not equate to top water level of the tank. Best practice means that dedicated calibrated depth logging is carried out.

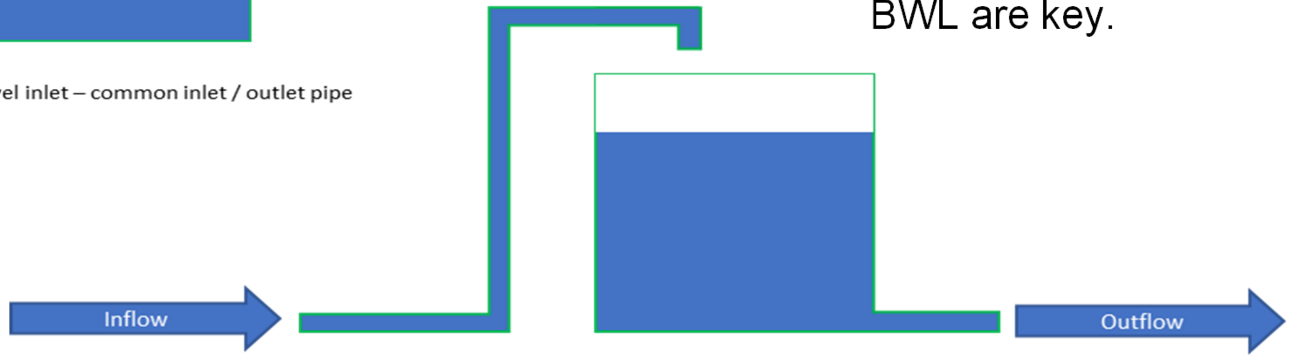
Calibration

Depth

Typical storage tank configurations, inlet and outlets to the storage must always be considered, elevations e.g. TWL, BWL are key.

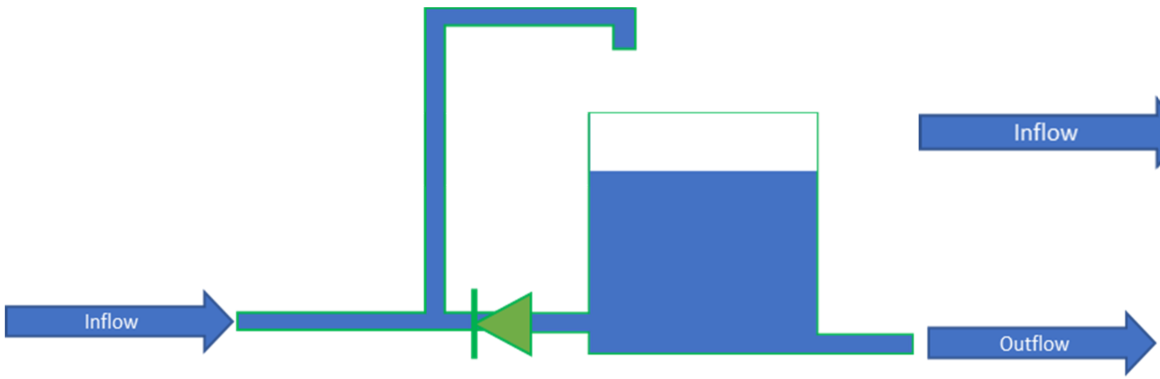


2. Low level inlet – common inlet / outlet pipe



3. High level inlet

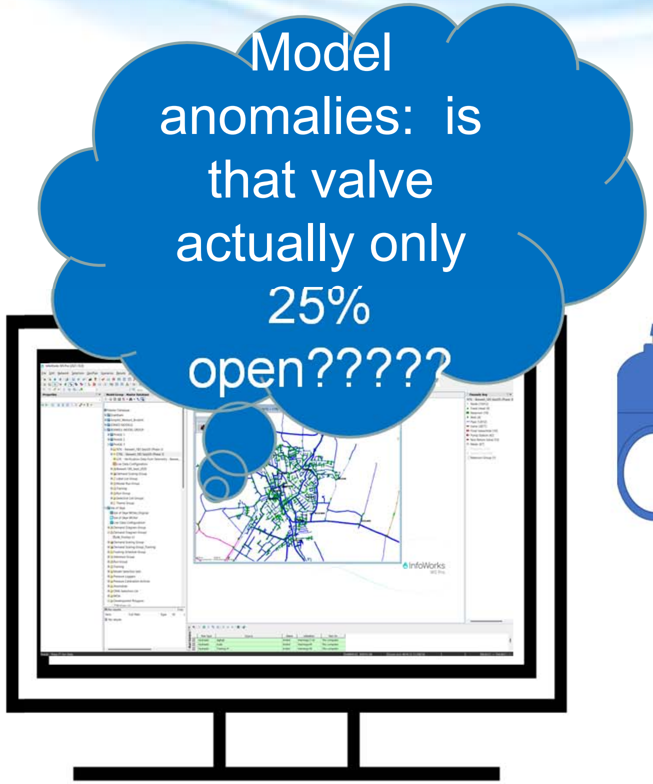
1. Low level inlet – separate inlet / outlet pipes

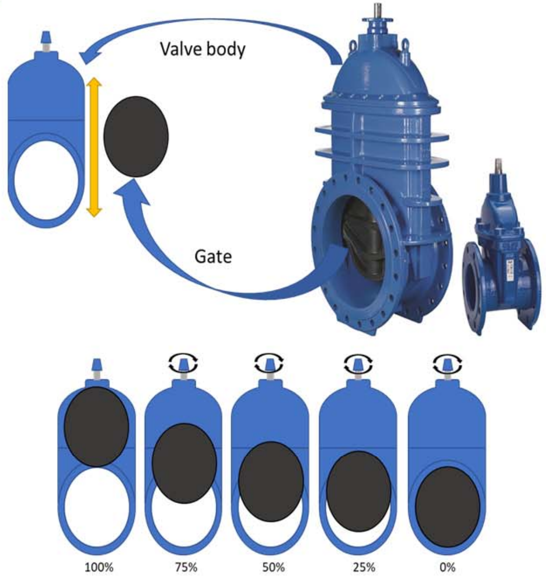


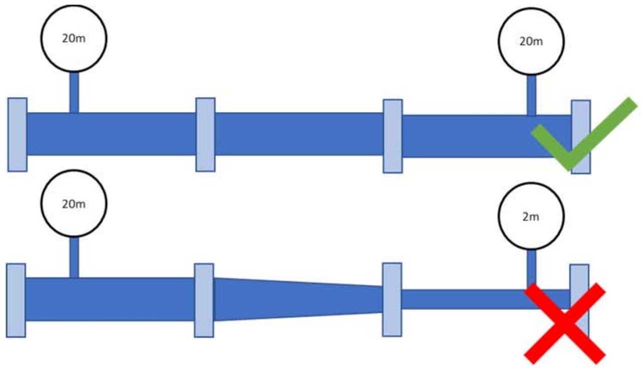
4. High level inlet with backflow pipe

Calibration

Pressure







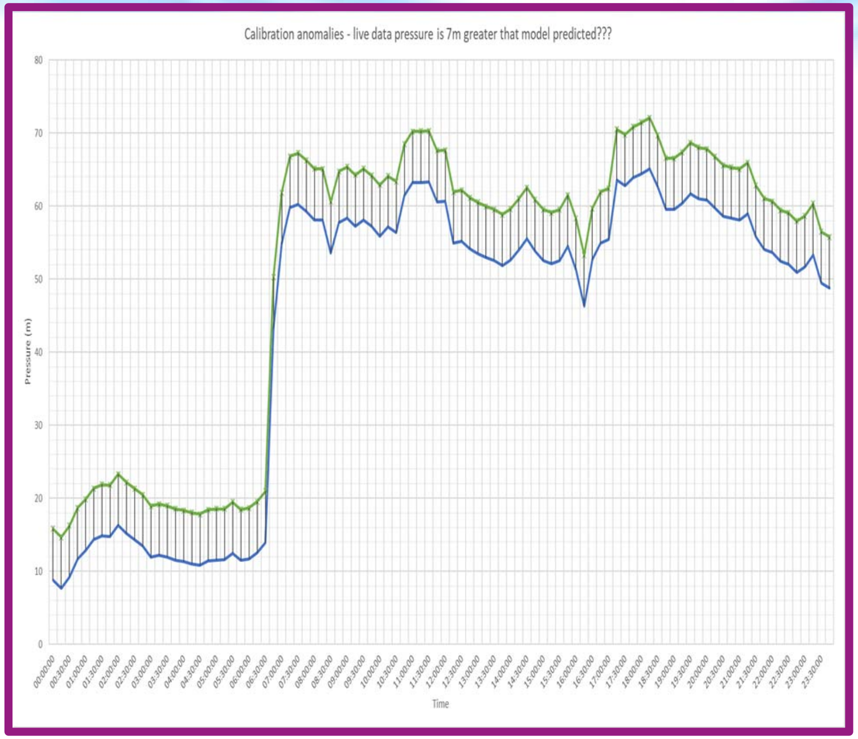
When calibrating the predicted pressure, a modeller must always consider the impact of modelling suspected modelling anomalies, such as throttled or closed valves. Such changes in the model may not represent the actual network operation.

Known pressures at pumps or PRV's should be set when calibrating the model, but then changed to a dynamic setting in the model in its final version.

Pressure calibration tolerances are specified by the model owners, typical accepted ranges in the water industry are 85% to 100% of monitored points shall be within ±1.0m to ±2.0m. Frictional losses may also need to be considered.

Calibration

Model Anomalies



When building a model anomalies could occur, it is down to the model owner prior to calibration on what actions will need to be taken to over come this problems:

Pipe diameter changes are permitted, but justification needed, which may require site investigation.

Re-allocation of demand or leakage, e.g. 10 hour to 24 hour, justification required.

The addition of **local losses** of loss co-efficient on certain assets.

Plastic **pipe roughness co-efficient** should not be increased beyond normal starting values, but is acceptable with iron material pipes. Asbestos Cement, generally has a low co-efficient, increasing should be limited.

Pipe pressure rating and pipe linings need to be considered on the impact of nominal bore roughness coefficient.

Closed and throttled valves should be configured as expected during calibration, further investigation may be required to confirm.

PRVs and pumps in a model need to be considered when calibrating. **A report** at the end of any model calibration should be produced, any anomalies found during calibration must be included within the report, along with detail of investigation and checks carried out.

• Questionnaire

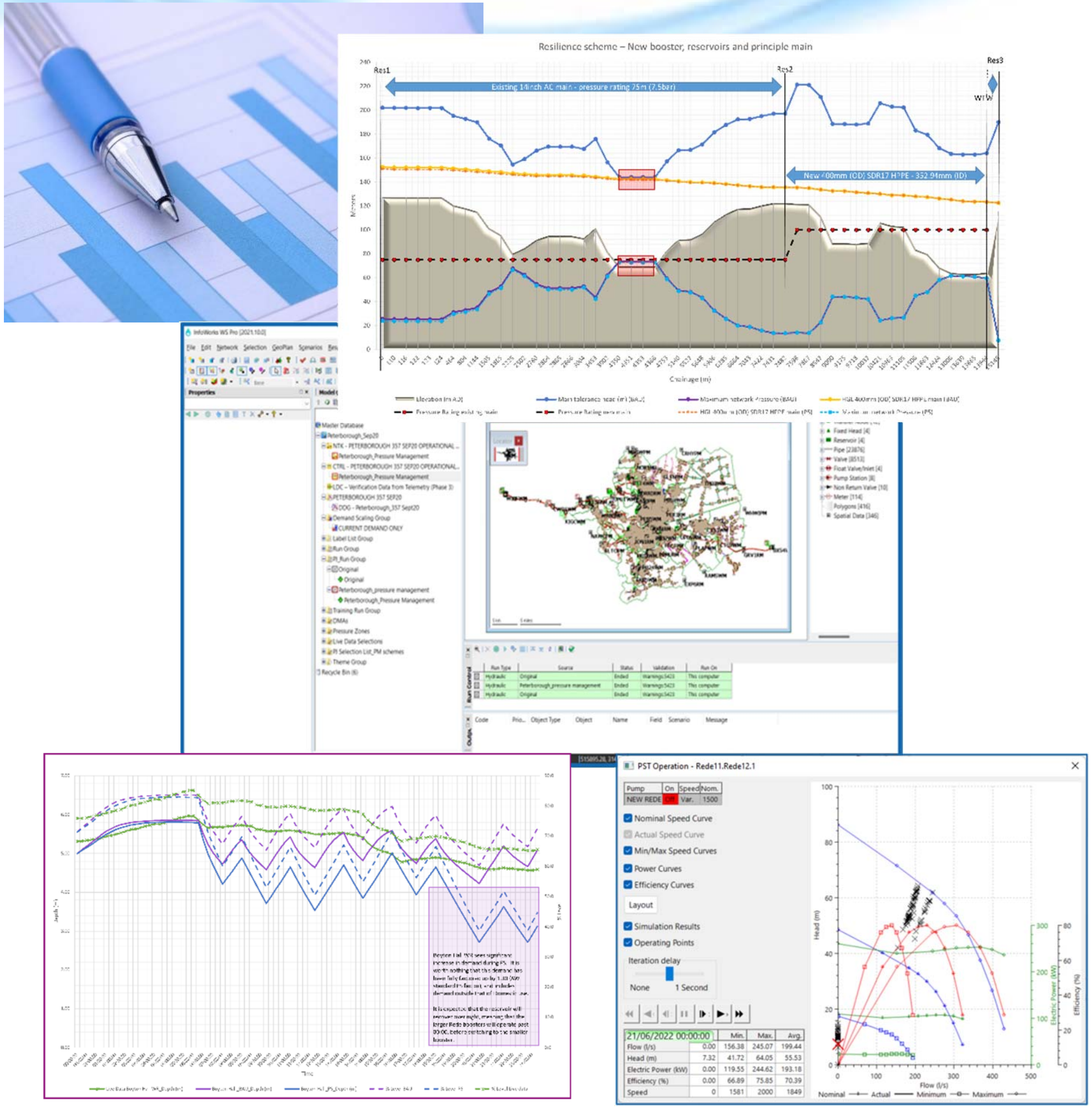
ID	Y/N or Text	Area	Query	Count Yes	Count No	% Yes	Count Yes	Count No	% Yes
100	Y/N	Calibration	Do you have specified model run settings?	15	2	88%	16	2	89%
101	Text	Calibration	What?				predominately similar		
102	Y/N	Calibration	Do you have specified flow calibration tolerances	16	1	94%	17	1	94%
103	Text	Calibration	What?				some differences but largely similar		
104	Y/N	Calibration	Do you have specified depth calibration tolerances?	14	2	88%	15	2	88%
105	Text	Calibration	What?				some differences but largely similar		
106	Y/N	Calibration	Do you have specified pressure calibration tolerances?	16	1	94%	17	1	94%
107	Text	Calibration	What?				some differences but largely similar		
108	Y/N	Calibration	Do you specify preference for calibration actions to be used?	12	4	75%	13	4	76%
109	Y/N	Calibration	Do you specify maximum friction values to be used?	5	11	31%	6	11	35%
110	Y/N	Calibration	Do you allow pipe diameter changes?	16	0	100%	17	0	100%
111	Y/N	Calibration	Do you allow re-allocation of demands?	15	2	88%	16	2	89%
112	Y/N	Calibration	Do you allow re-allocation demand categories (e.g. 10 hour to 24 hour)?	14	3	82%	15	3	83%
113	Y/N	Calibration	Do you allow re-allocation of leakage?	15	2	88%	16	2	89%
114	Y/N	Calibration	Do you allow additional of local losses of loss co-efficients on certain objects?	15	1	94%	16	1	94%
115	Y/N	Calibration	Is there any post calibration anomaly resolution carried out to confirm the calibration actions?	12	3	80%	12	3	80%

Question

Are there any calibration actions that should never be used?

Calibration

Model Performance



At the point a modeller completes a model calibration, then it can be a good idea, within the final report to include graphical plots of predicted model results compared to live data logged in the field tests. This includes, pressure flow, reservoir depth, PRV's, pumps.

Models are typically calibrated for a 24hr period and should be able to run uninterrupted for an extended period of time.

The final model should become the basis for all other model versions, such as average day, peak day models, considering the dynamic controls between versions.

Question

What types of models could be created?

Question

What else would you like to see included the calibration section?

Thankyou for taking part