



Modelling the “customer experience”

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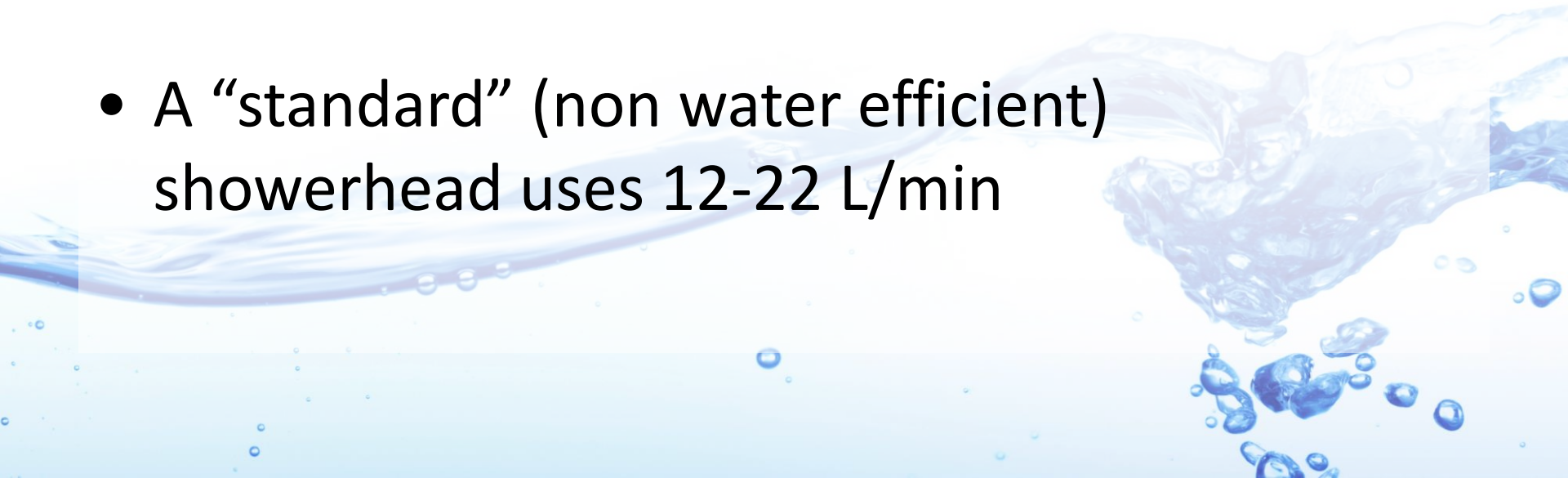
Pacific Water and Waste Association Conference, Vanuatu, 7 August 2019

Summary

- Dissatisfaction with pressure in some regional towns
- Customers are expecting better service
- Study to understand
 - Current Levels of Service
 - Impact of customer plumbing
 - End-user demand choices
 - Develop solution to improve customer experience

Background

- Plumbing Code of Australia
- Cold Water
 - Max flow per fitting (9 L/min)
 - Max pressure at meter (500 kPa)
- A “standard” (non water efficient) showerhead uses 12-22 L/min



Required Levels of Service

- In Victoria = Flow at meter

Water service flow rates (service diameter millimetres)	Minimum flow rate (litres per minute) for each service size
20mm	20
25mm	35
32mm	60
40mm	90
50mm	160

Water service flow rates (Service diameter millimetres)					
20 mm	25 mm	32 mm	40 mm	50 mm	
Minimum flow rate (litres per minute)					
10	25	50	80	130	
See clause 8.2 for exceptions					

Diameter of the property owner's infrastructure	20mm	25mm	32mm	40mm	50mm
Minimum flow rate (litres per minute)	10	14	24	40	60

Required Levels of Service

- In Victoria = Flow at meter
- Outside Victoria – pressure, sometimes pressure and flow (e.g. 15m @ 9L/min)
- Customers expect “good” pressure



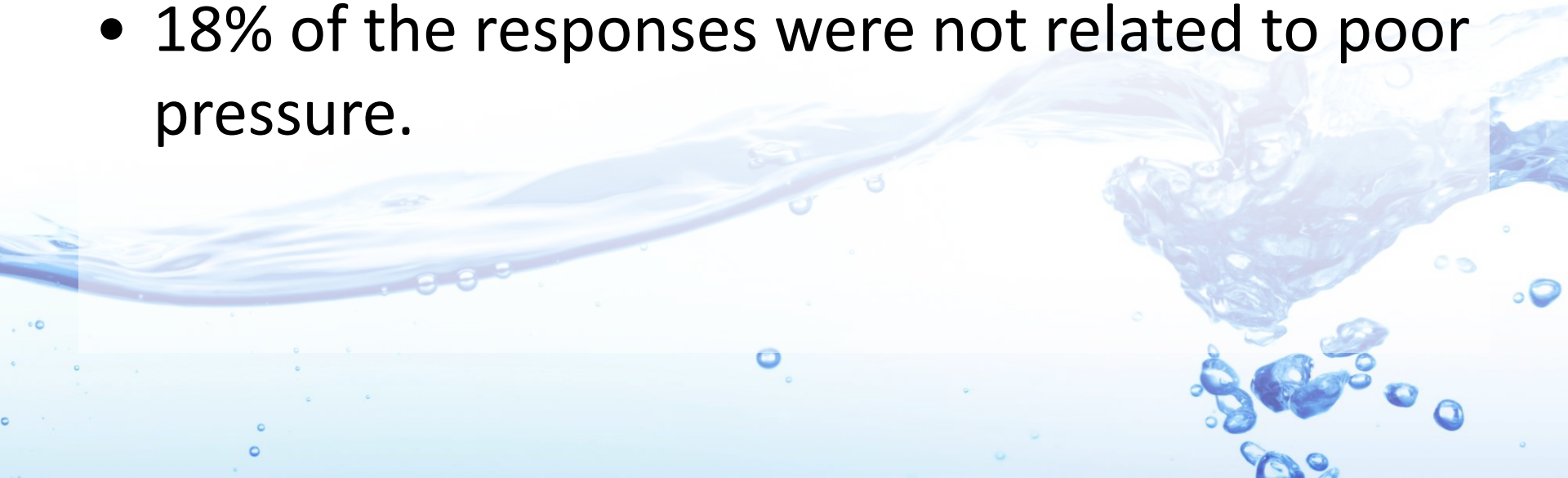
Customer Survey

- Postal Survey
 - Do you have a pressure problem ?
 - What is the nature of the problem ?
 - How many taps do you want to use at a time ?



Customer Survey

- Town P – 100 houses, 10 responses
 - Town S – 230 houses, 73 responses
 - Town T – 1700 houses, 100 responses
-
- 18% of the responses were not related to poor pressure.



Customer Survey - Issues

"We hear from the Fire Brigade that water supply is not adequate for fire-fighting"

"The pressure would also be useless if we had a fire to douse"

"water flow during summer is terrible"

"In Summer when the hoses in the street are all on it's hard to get pressure" –

"Inconsistent water pressure especially over summer"

"living in a new estate, I expect good services – water pressure and quality is a major problem"

By comparison to ... it is pathetic"

"I find the pressure is good"

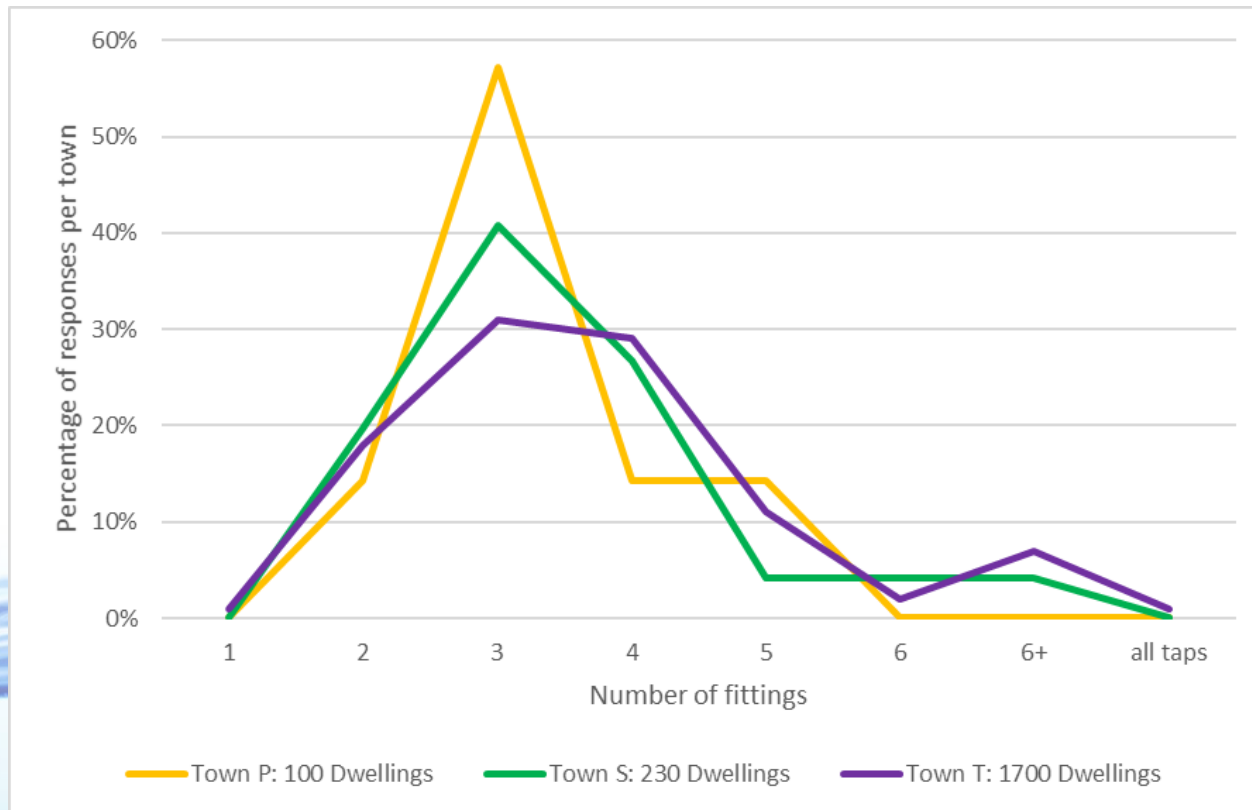
"difficult to have two showers going and turning on another tap reduces flow to showers"

"We pay the same water rates as bigger towns and citys (sic) so why don't we get the same service?"

"Getting to (sic) dear"

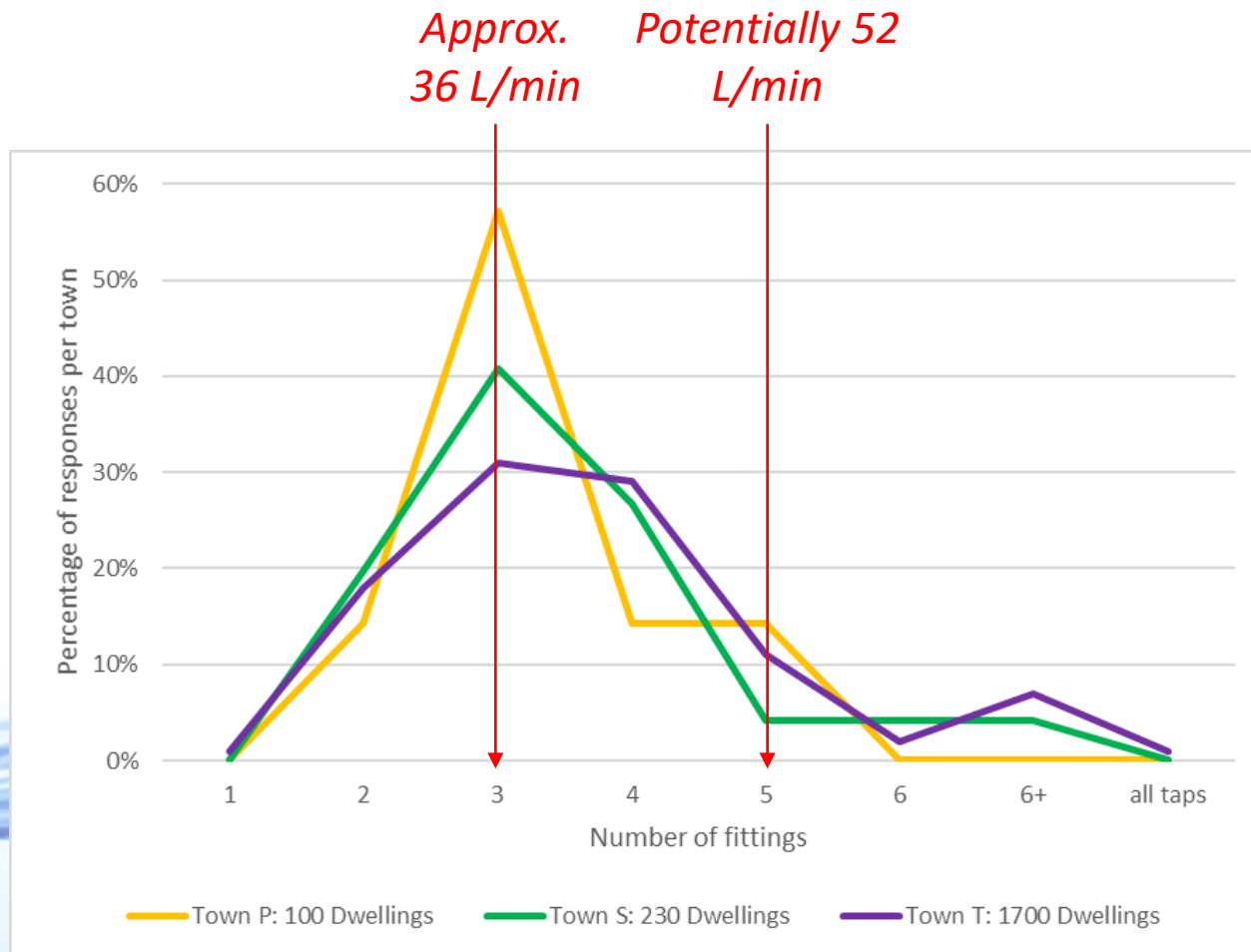
Surveyed Customer Expectation

(191 responses)



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(191 responses)

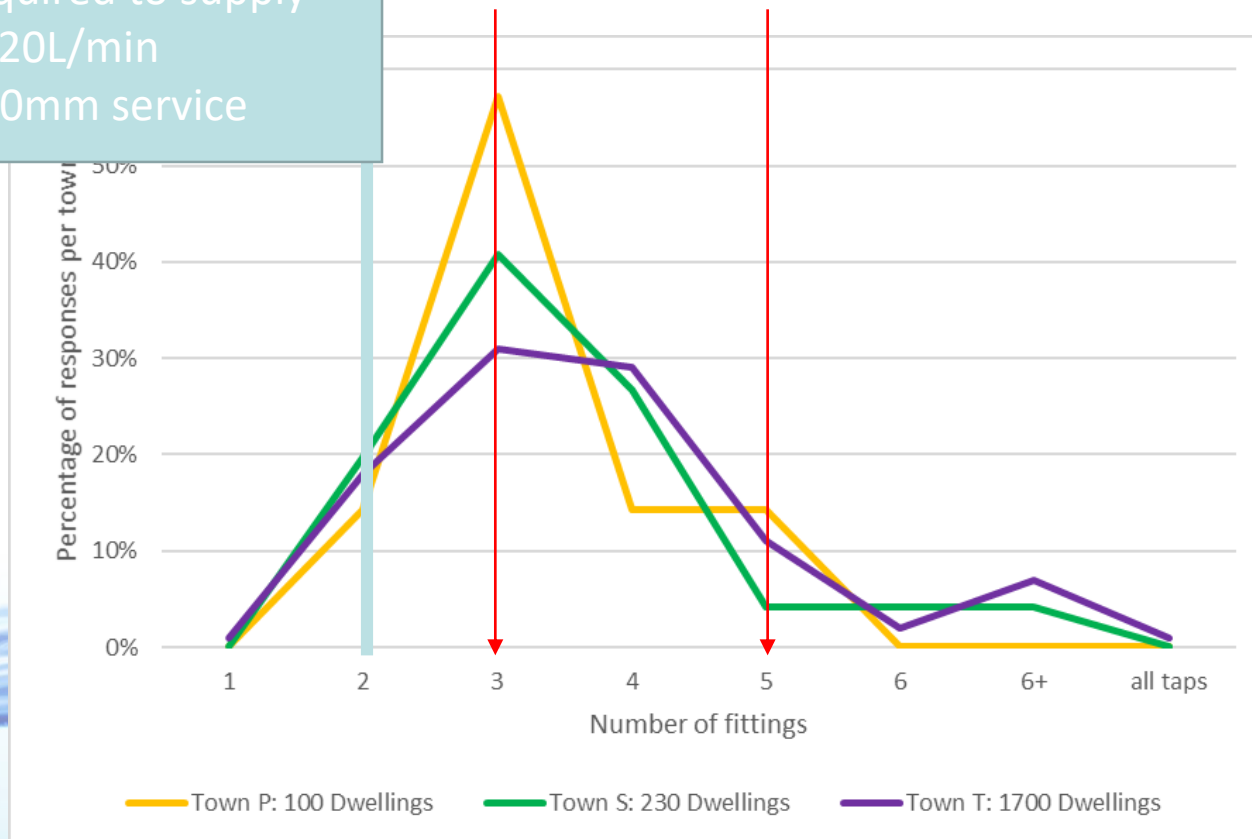


Surveyed Customer Expectation

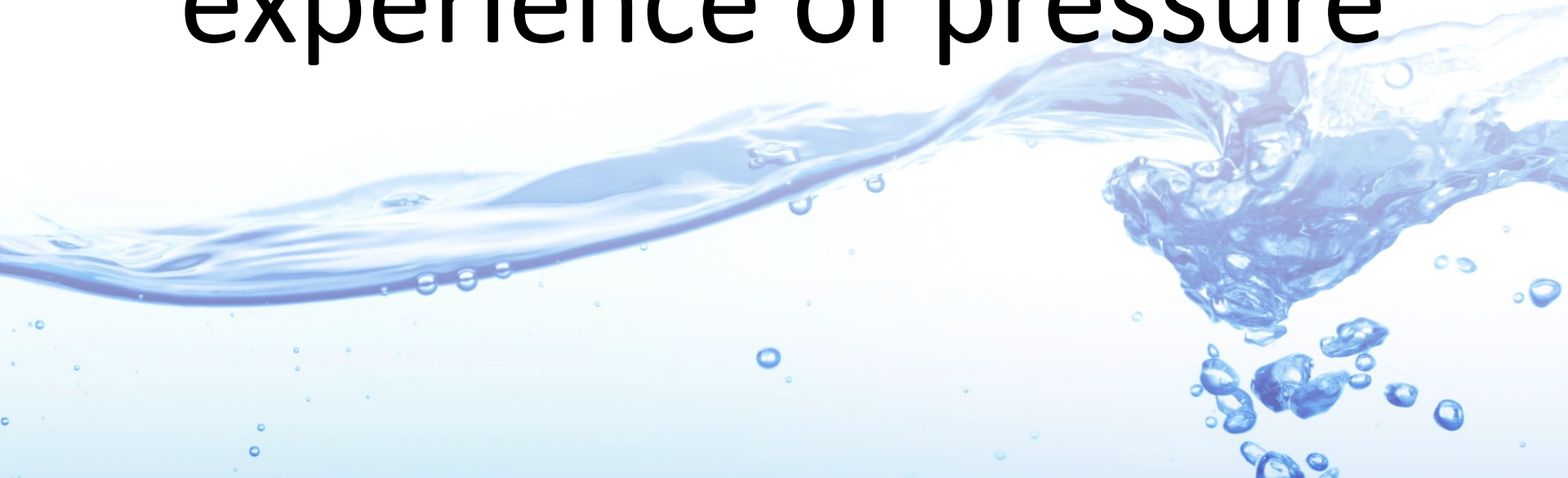
(191 responses)

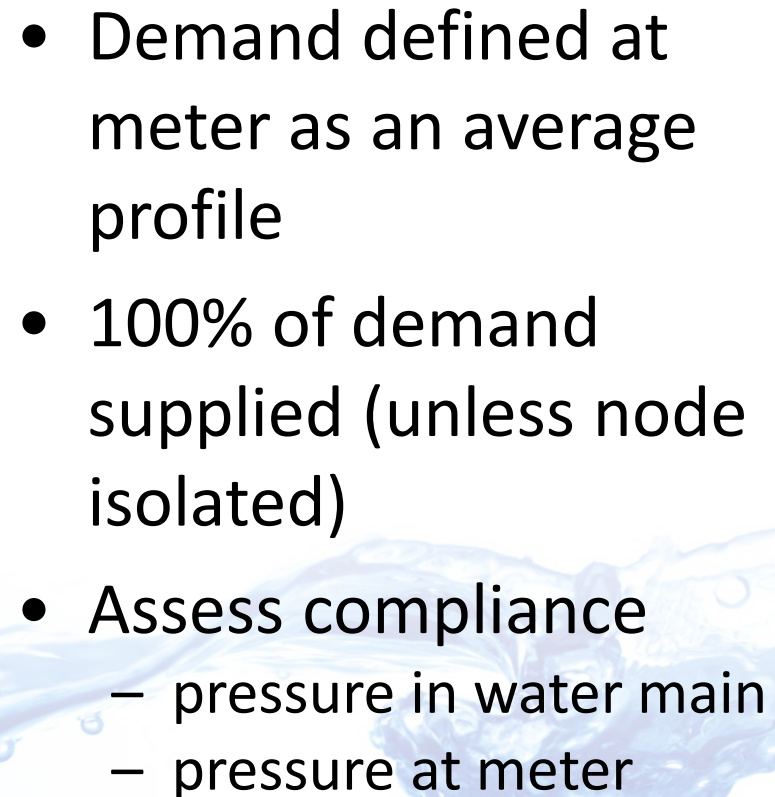
Only required to supply
20L/min
for 20mm service

*Approx.
36 L/min* *Potentially 52
L/min*



Modelling the customer experience of pressure





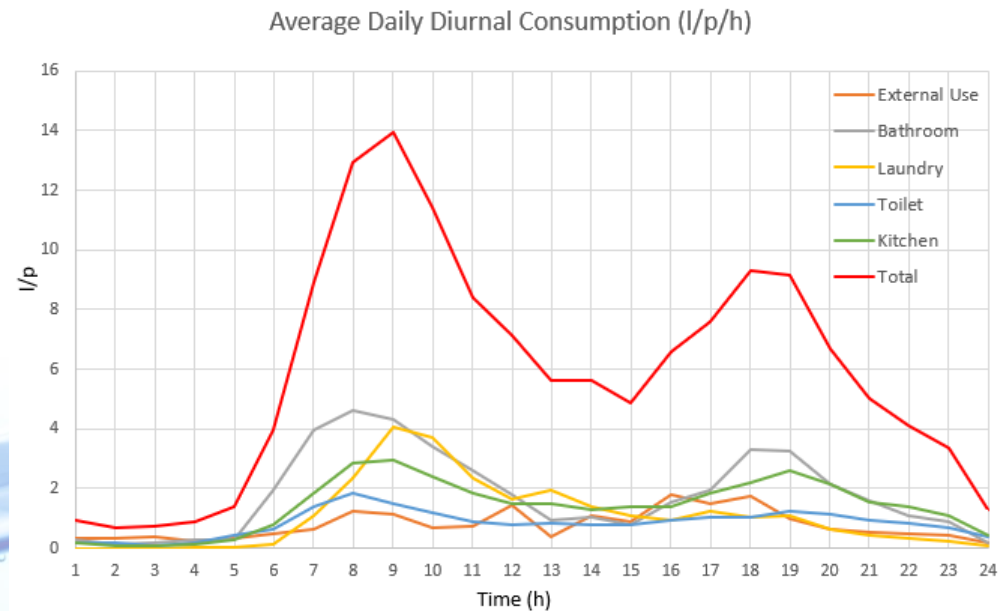
Network Modelling

Average Daily Diurnal Consumption (l/p/h)

- Example of demand developed from end use analysis
 - External Use: Irrigation + Leak
 - Bathroom: Shower + Bathtub
 - Laundry
 - Toilet
 - Kitchen: Tap + Dishwasher

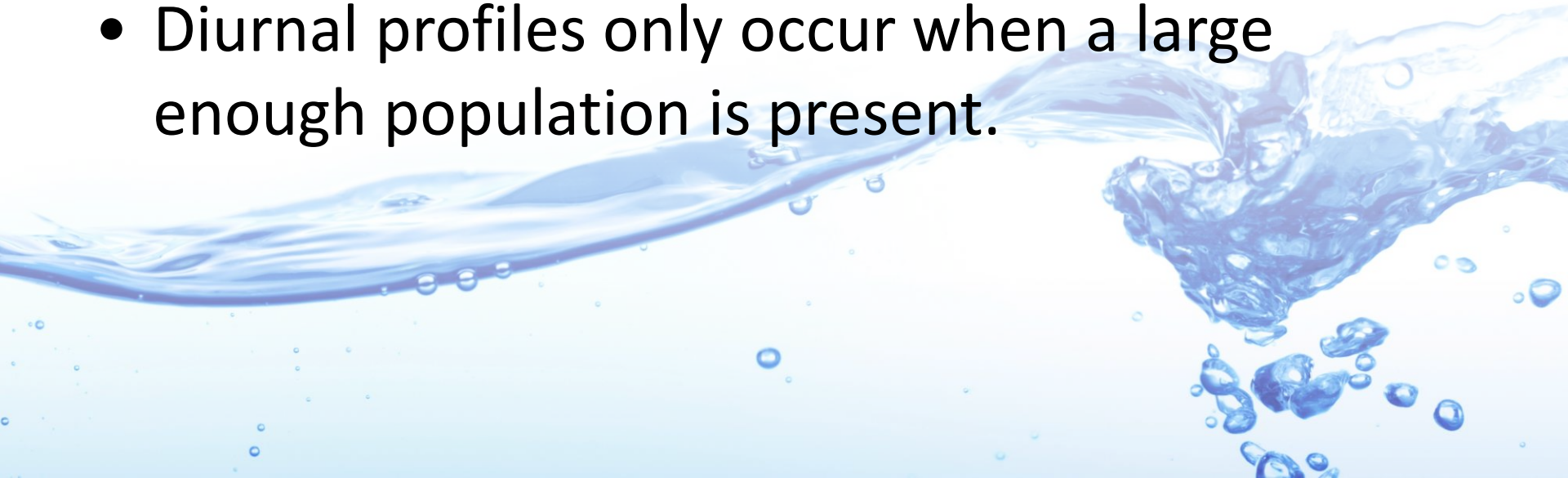
	External Use	Bathroom	Laundry	Toilet	Kitchen	Total
l/p/d	18.57	42.50	25.81	19.91	33.74	140.53
l/h/s	0.0005	0.0012	0.0007	0.0006	0.0010	0.0041

Calculated assuming 2.5 people/household

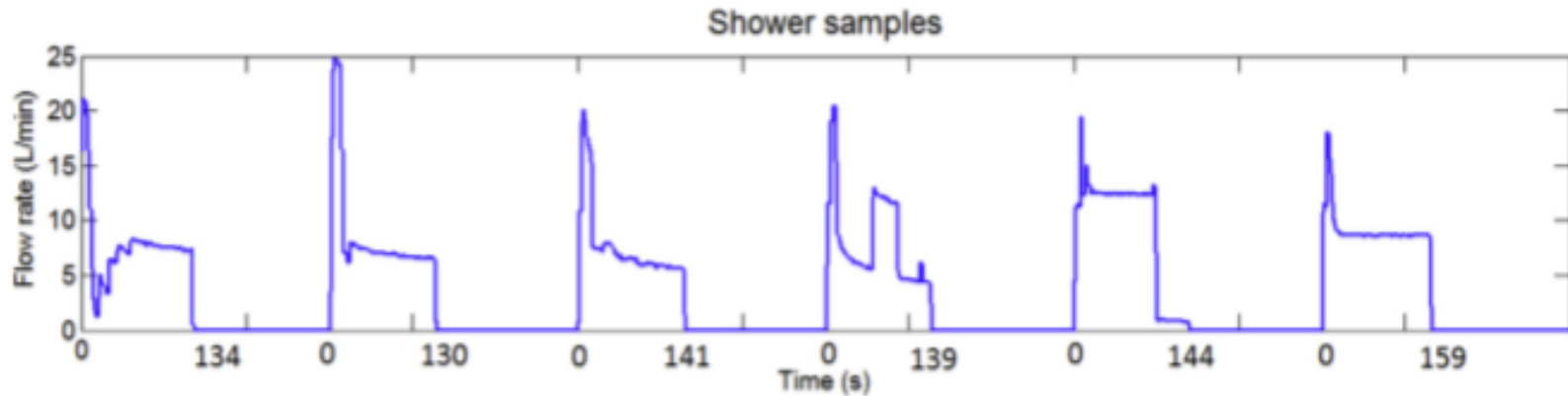


In reality

- Demand within a house is highly variable.
- Simultaneous Instantaneous Demand
- Customer Expectation >3 fittings at a time
- Diurnal profiles only occur when a large enough population is present.

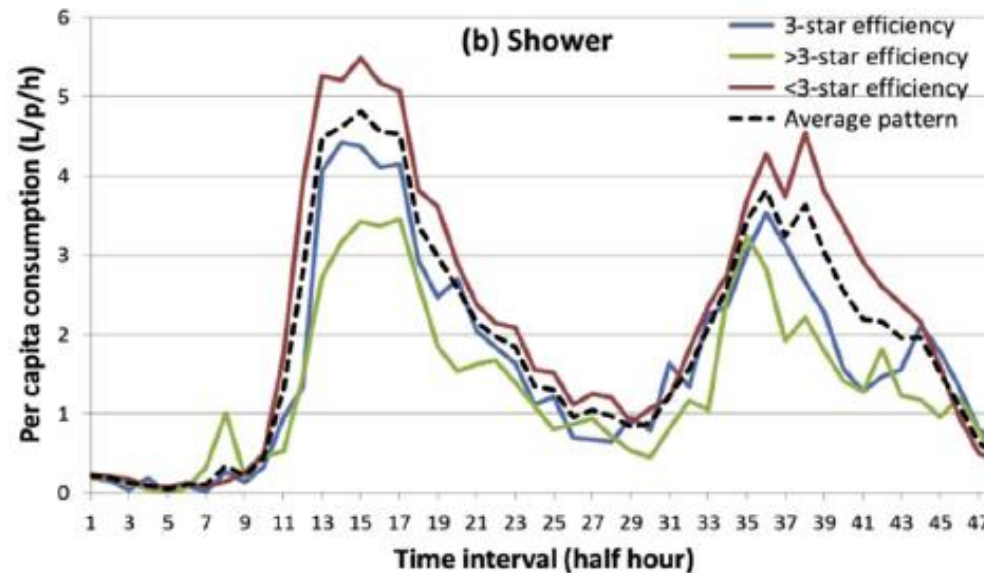


Shower events



- Nguyen, K. A., Stewart, R. A., Zhang, H., & Sahin, O. (2018, January). Re-engineering traditional urban water management practices with smart metering and informatics. *Environmental Modelling & Software*, pp. 256-267.
- Approximately 40L for 2.5 mins
- Peak flow rate of 25L/min
- Average flow rate of 16L/min

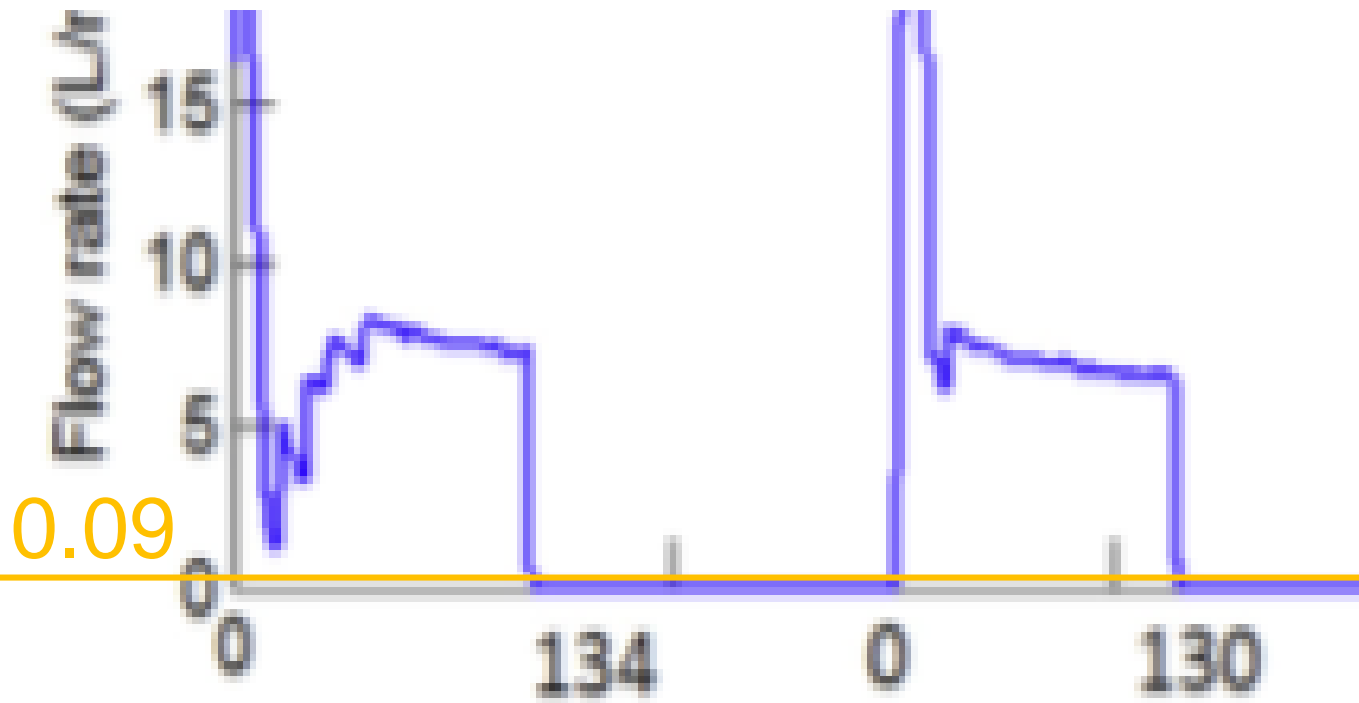
Diurnal Pattern for Shower



- Gurung, T. R., Stewart, R. A., Beal, C. D., & Sharma, A. K. (2014b). Smart meter enabled water end-use demand data: platform for the enhanced infrastructure planning of contemporary urban water supply networks. *Journal of Cleaner Production*, 642-654.
- Daily shower use 45L
- Peak flow 5.5 L/hour (0.09 L/min)

The customer experience

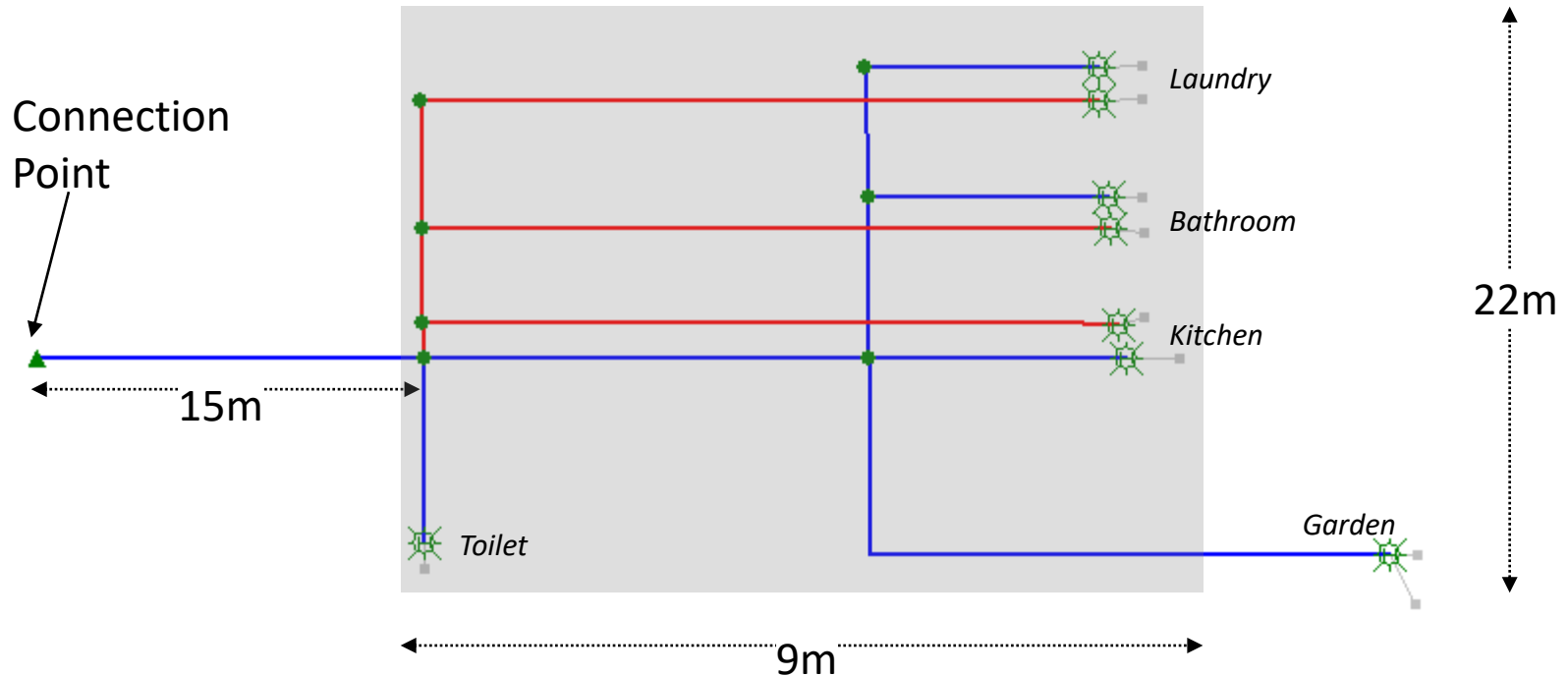
- 25 L/min max flow for Shower event
- Profile = 5.5 L/person/hour or 0.09 L/min max (hourly) flow



The theoretical models



Single Storey House



Shower: 2m high
Laundry, kitchen, toilet: 1m high

20mm pipes in good condition
(CW = 0.06mm)

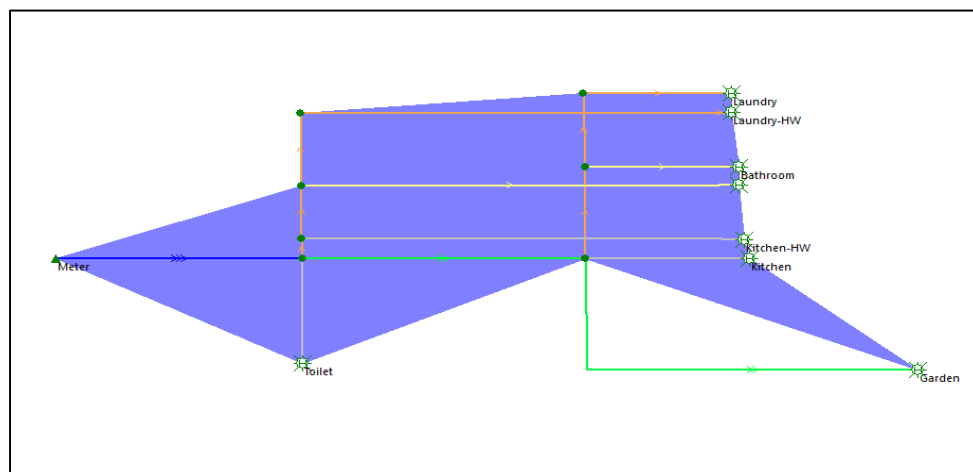
Demands

- Different combinations of water use rather than diurnal profile or “events”

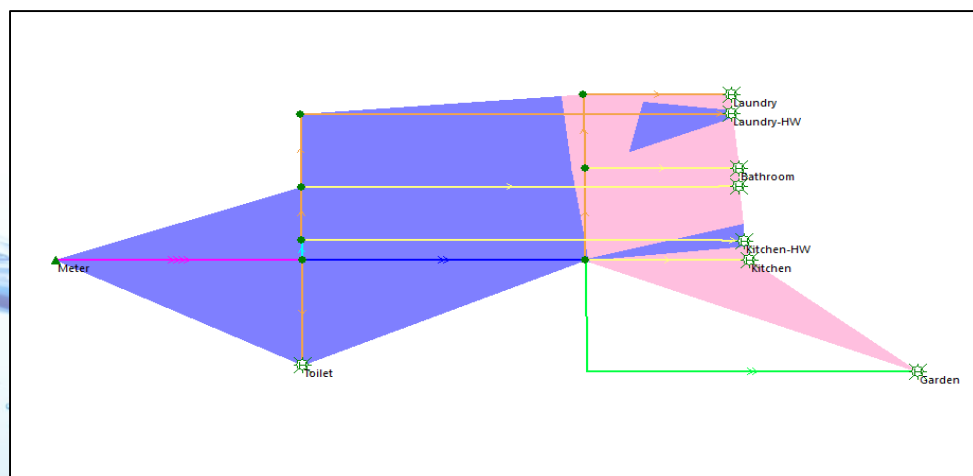
Flow Rate (L/min)	Flow Rate (L/sec)
18 1-2 Fittings	0.3
30 2-3 Fittings	0.5
36 3-4 Fittings	0.6
43 4-5 Fittings	0.72
53 5-6 Fittings	0.88

Results

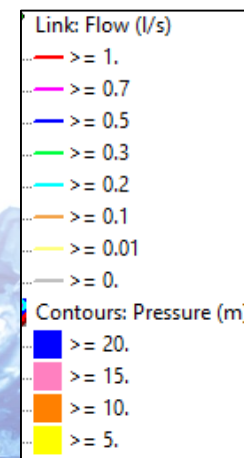
20mm service, 30m pressure, 0.06mm roughness



Garden, Laundry and Bathroom

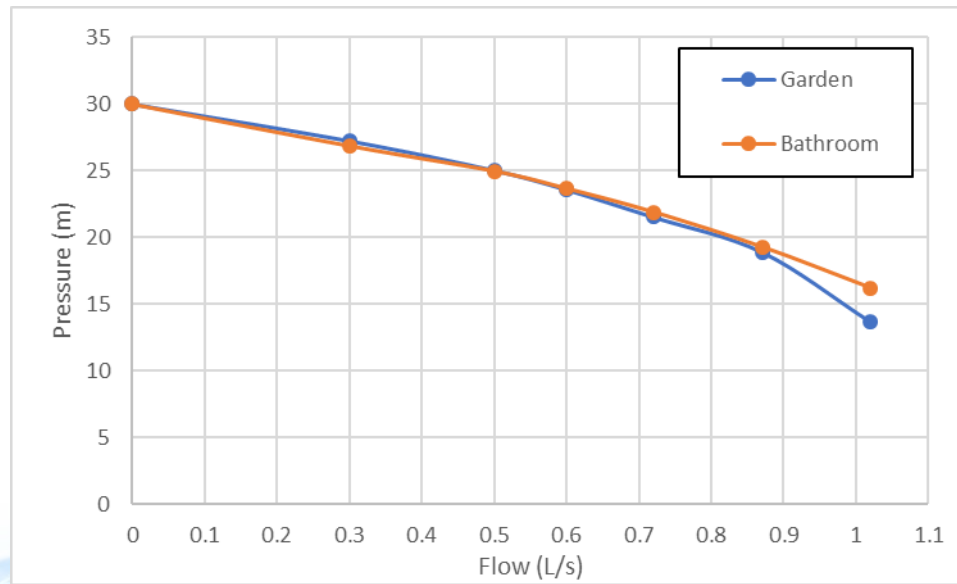


Garden, Laundry
(Cold Only),
Bathroom, Kitchen
(Cold Only) and
Toilet



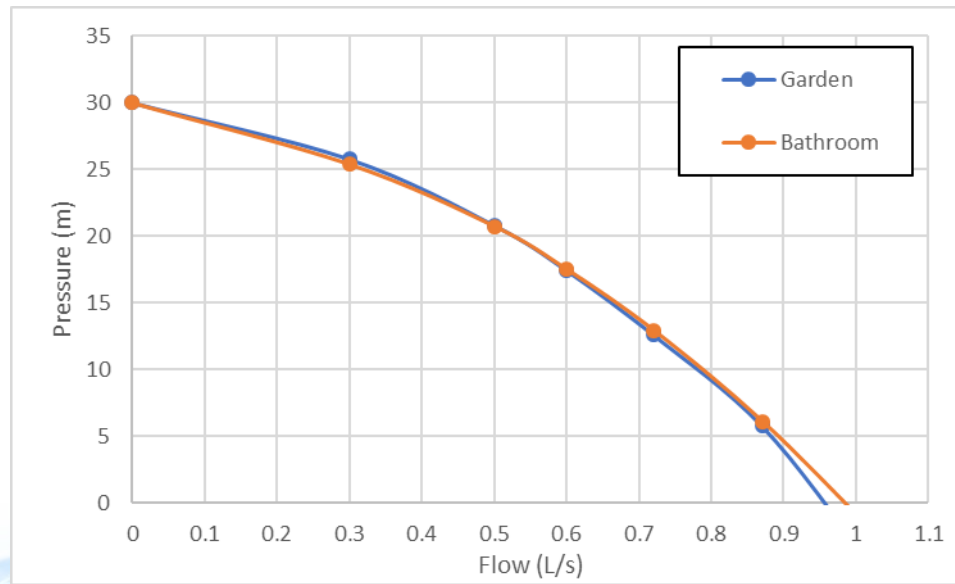
Service Line Roughness

20mm service, 0.06mm roughness, 30m supply pressure



Results – Service Roughness

20mm service, 1.0mm roughness, 30m supply pressure

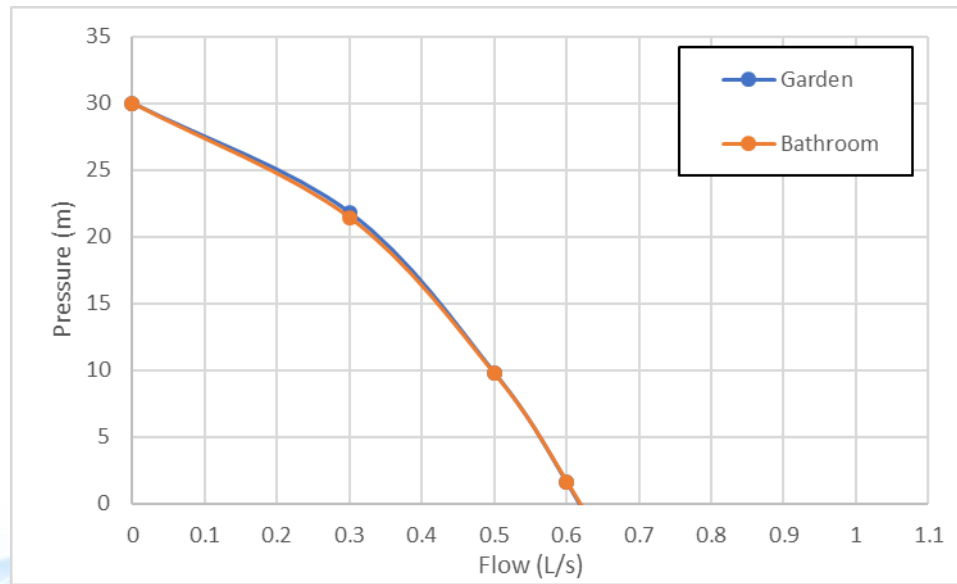




What
roughness
should be
applied?

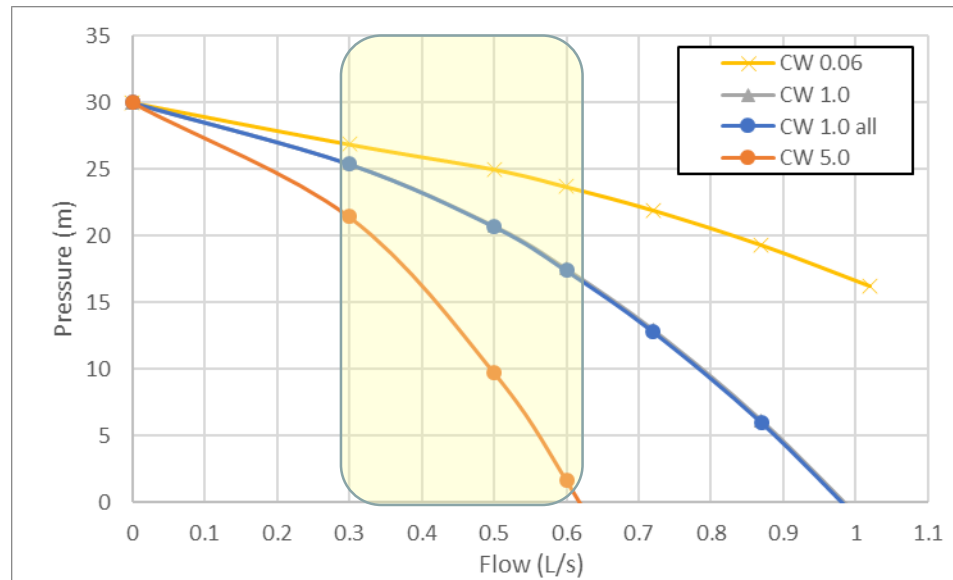
Results – Service Roughness

20mm service, 5.0mm roughness, 30m supply pressure



Results – Service Roughness

20mm service, **changing** roughness, 30m supply pressure

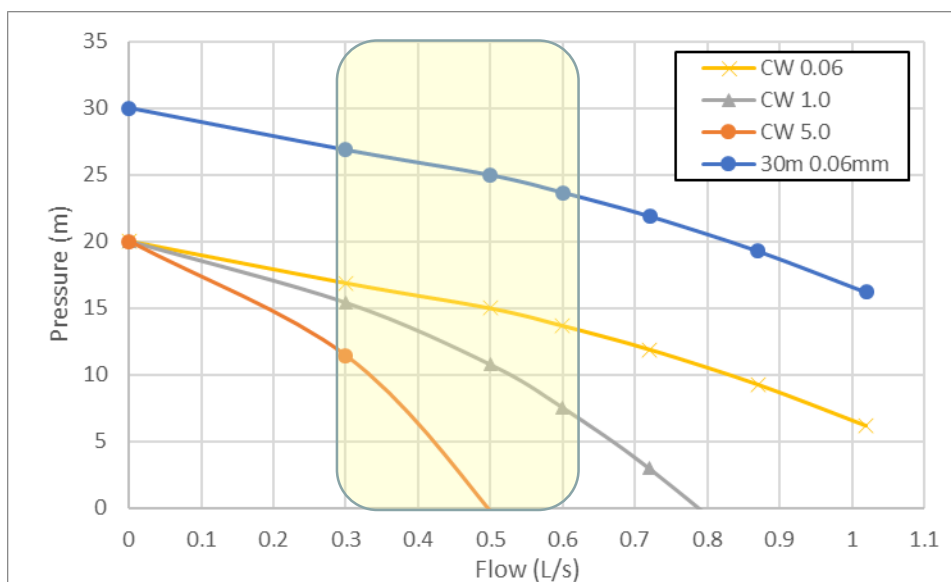


Service Line condition has a significant impact on internal pressure

Shower event flow approx. 20 L/min, 0.3 L/s
Customers expect >30 L/min (0.5 L/s)

Lower Supply Pressure Impact

20mm service, 0.06mm roughness, 20m supply pressure

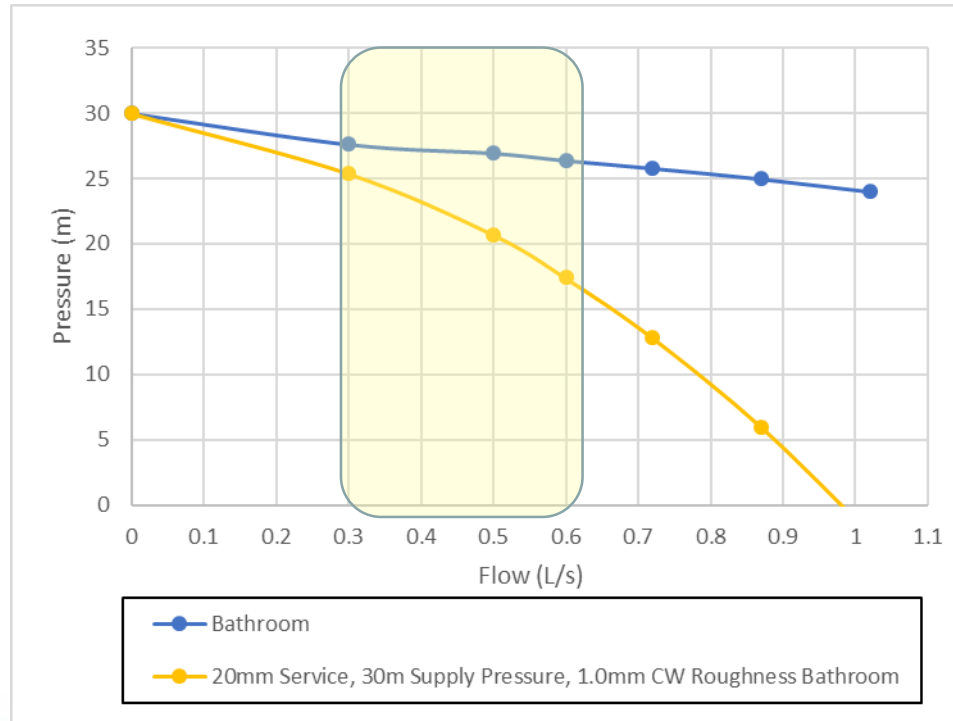


Service Line condition has a significant impact on internal pressure exacerbated by lower supply pressure

Shower event flow approx. 20 L/min, 0.3 L/s
Customers expect >30 L/min (0.5 L/s)

Increase Service Size

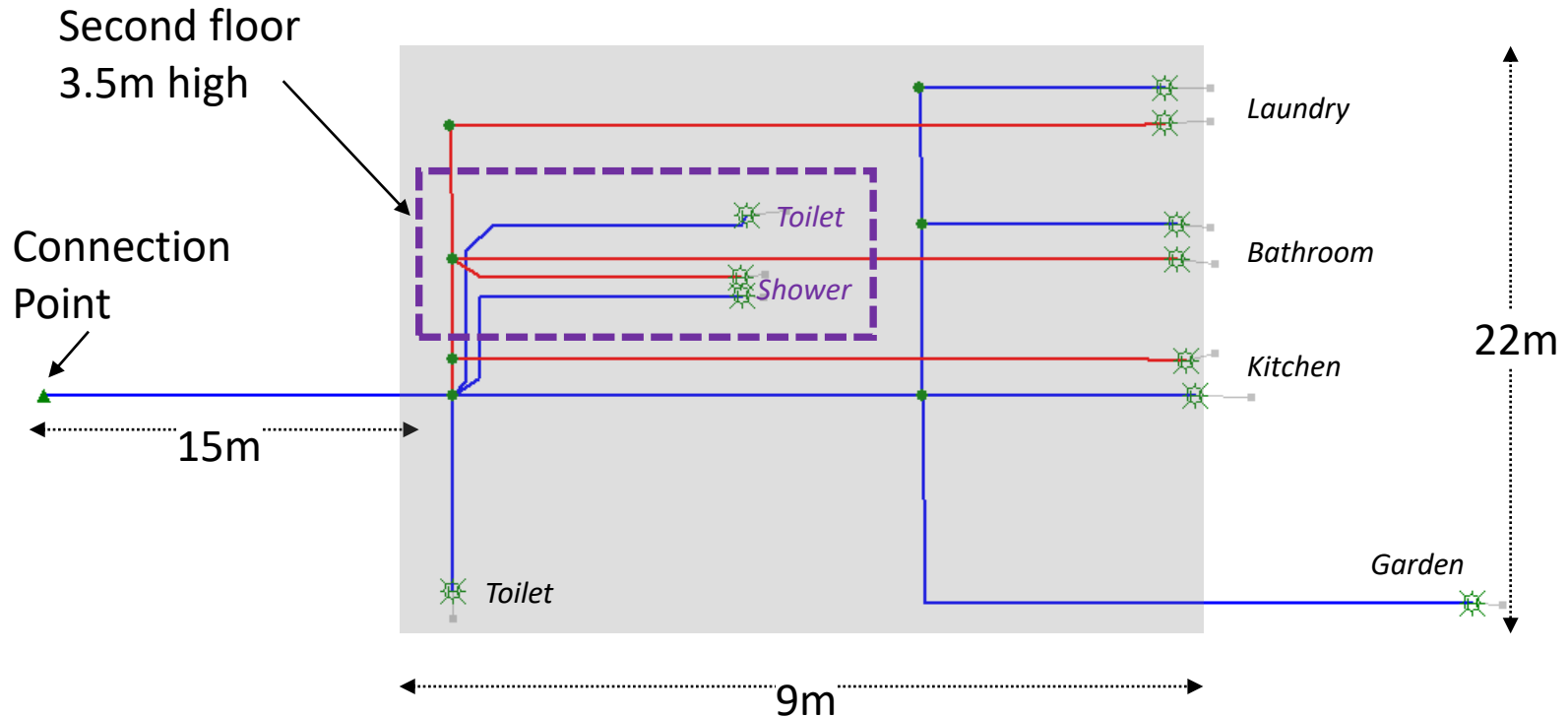
25mm service, 1.0mm roughness, 30m supply pressure



Increasing Service Size can overcome Service Line condition

Shower event flow approx. 20 L/min, 0.3 L/s
Customers expect >30 L/min (0.5 L/s)

Double Storey House

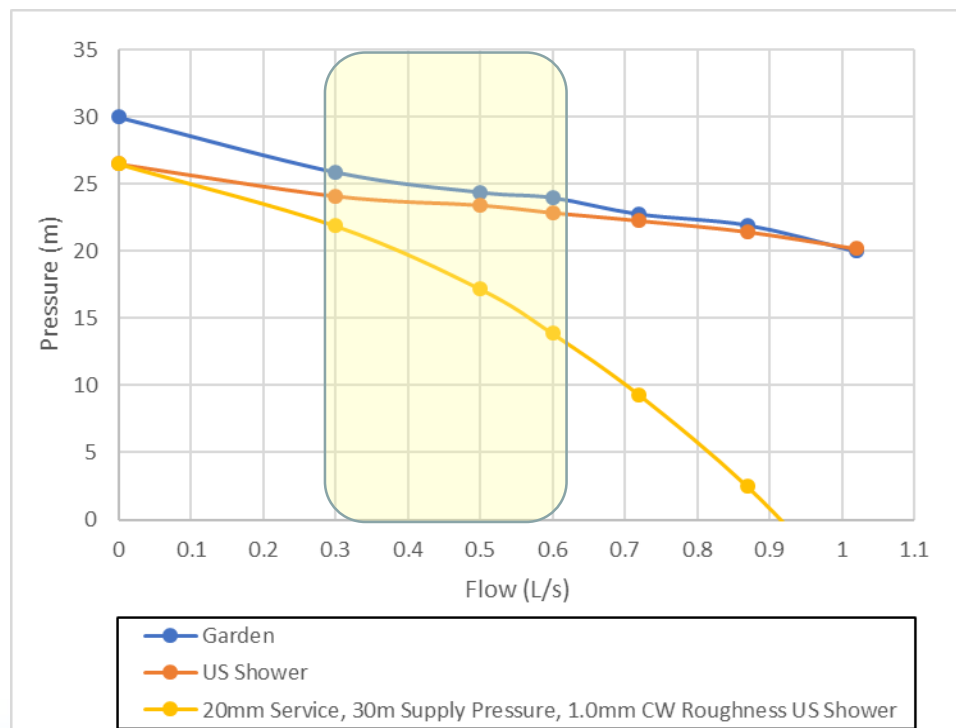


US Shower: 2m high
US Toilet: 1m high

20mm pipes in good condition
(CW = 0.06mm)

Results

25mm service, 1.0mm roughness, 30m supply pressure



Similar to single storey.

Increasing Service Size can overcome Service Line condition

Shower event flow approx. 20 L/min, 0.3 L/s

Customers expect >30 L/min (0.5 L/s)

Impact of Competing Demands

- Typical country town pressure where water is supplied by discrete towers: 20m
- 100% Pressure Related Demands
- As pressure decreases demand is reduced



Competing Demands

- Model shower as 75% hot 25% cold
Flow of 0.1 L/s > 6 L/min
Water efficient shower

 Household Demand requested

 Shower Cold Flow

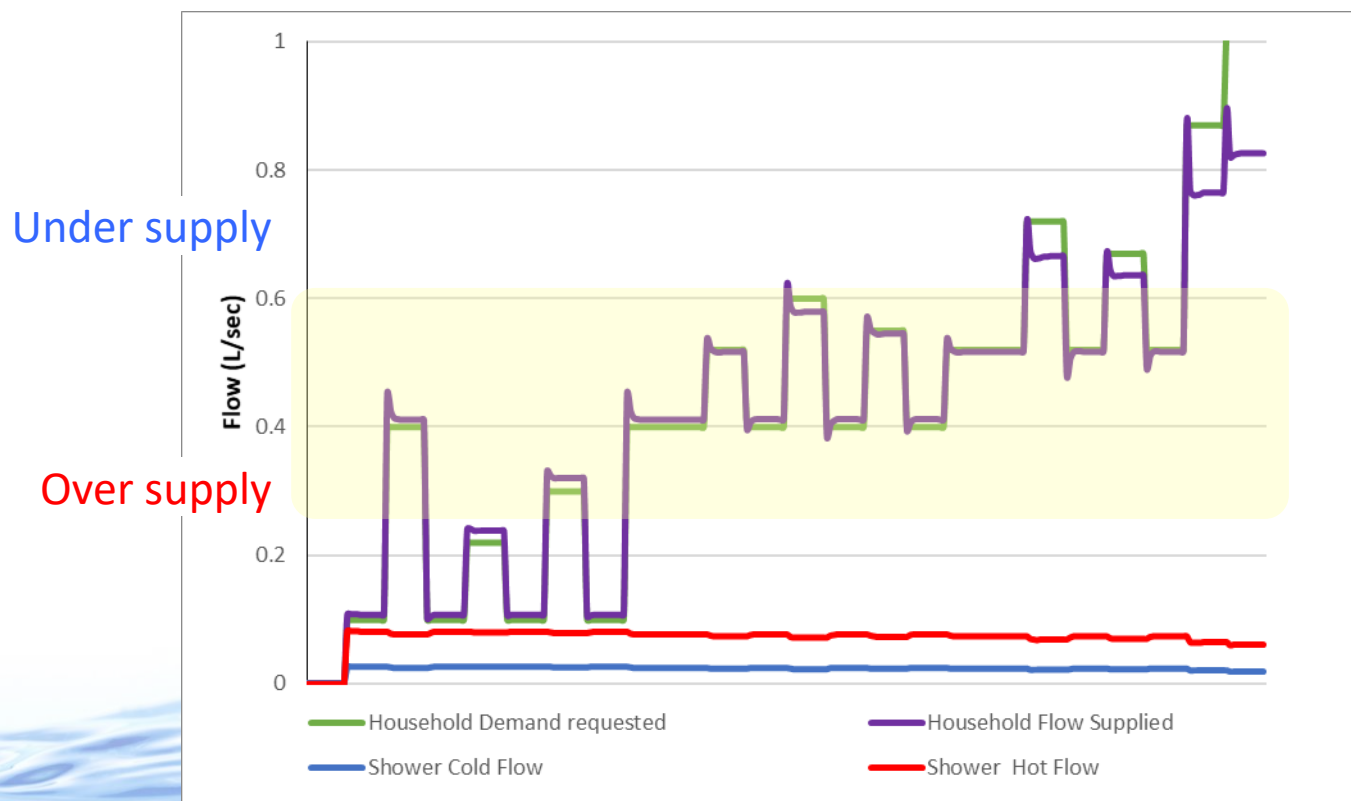
 Household Flow Supplied

 Shower Hot Flow



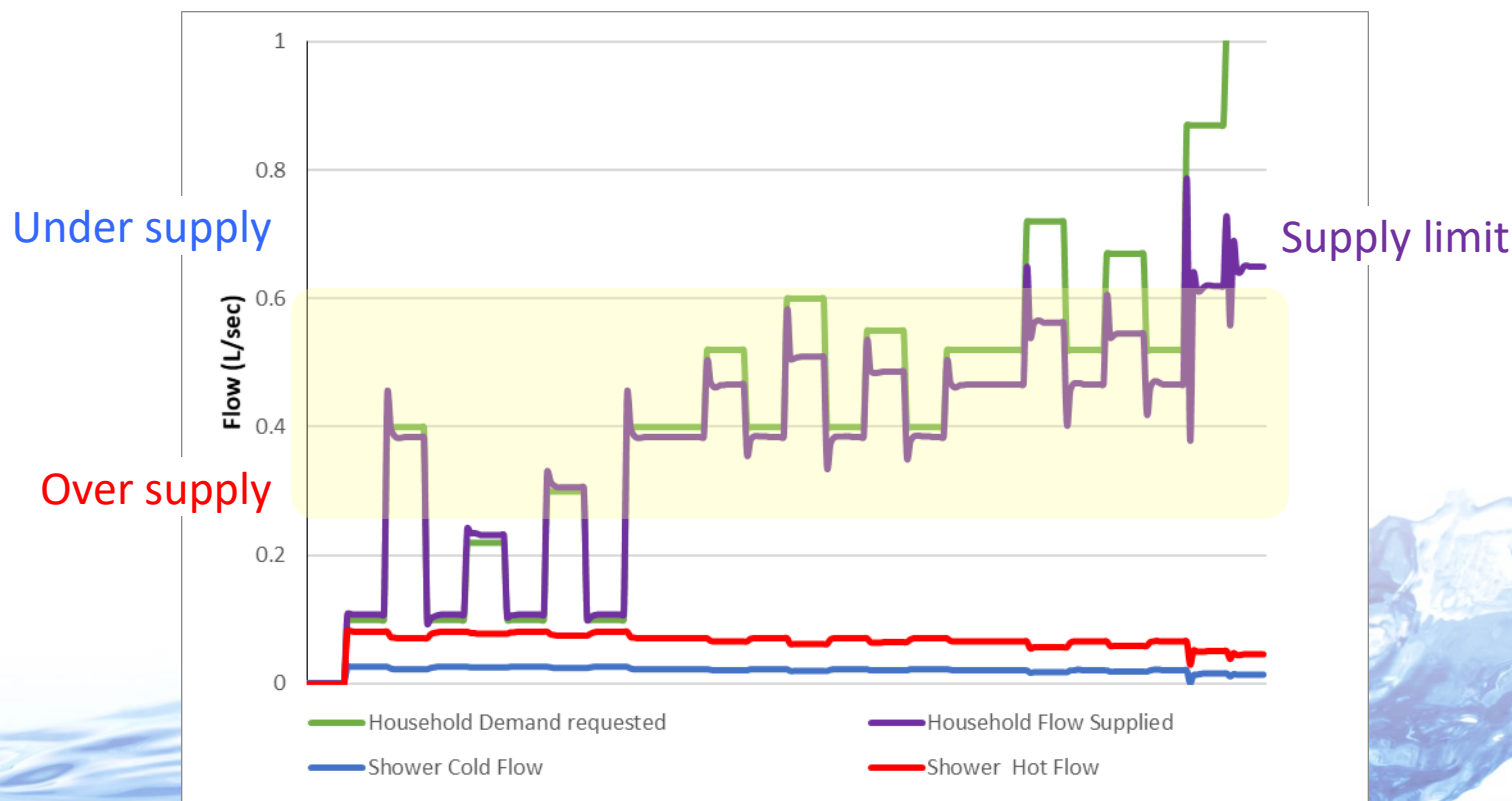
Pressure Varied Demands

20mm service, 0.06mm roughness, 20m supply pressure
6 L/min Shower



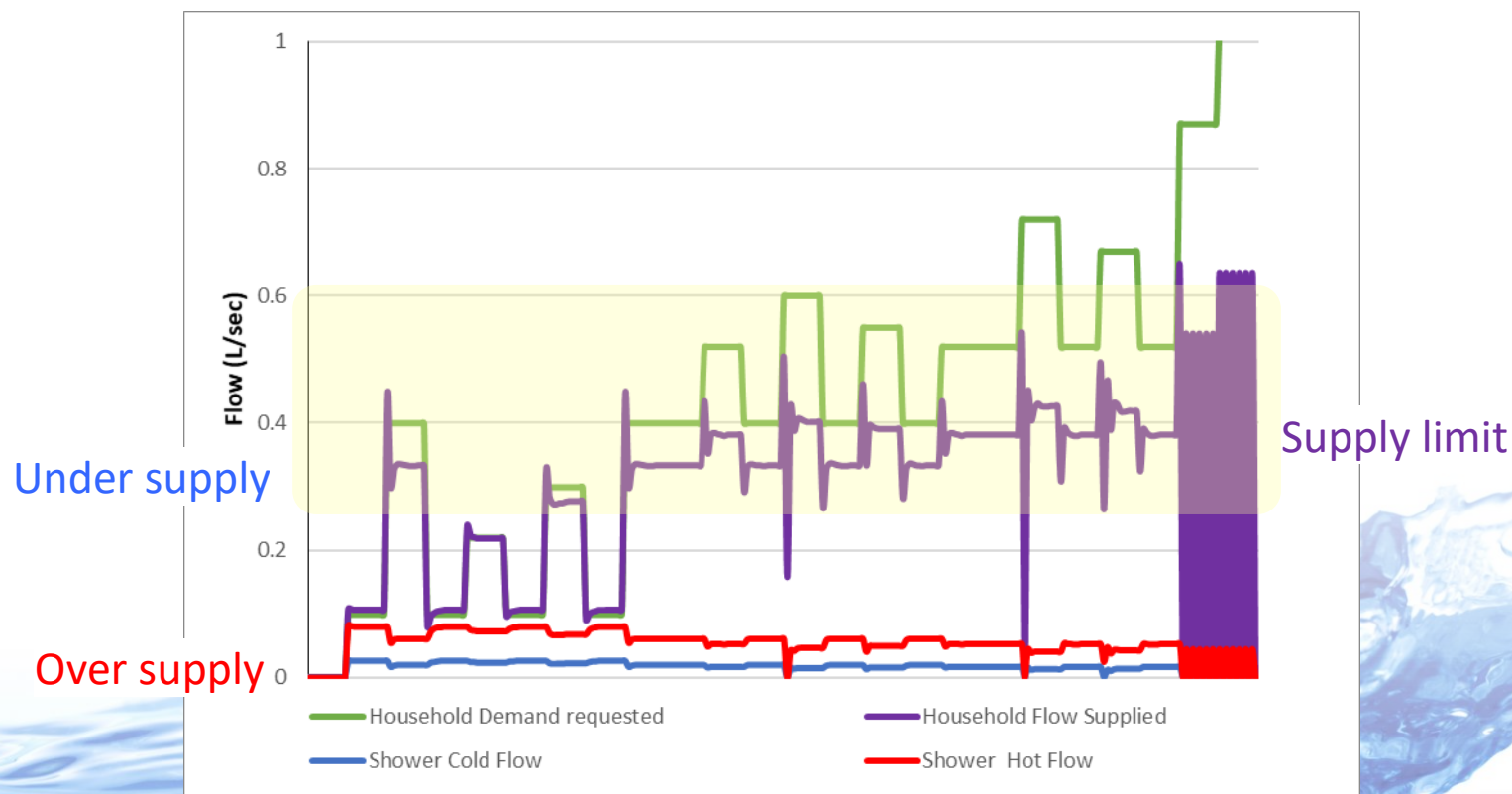
Pressure Varied Demands

20mm service, 1.0mm roughness, 20m supply pressure
6 L/min Shower



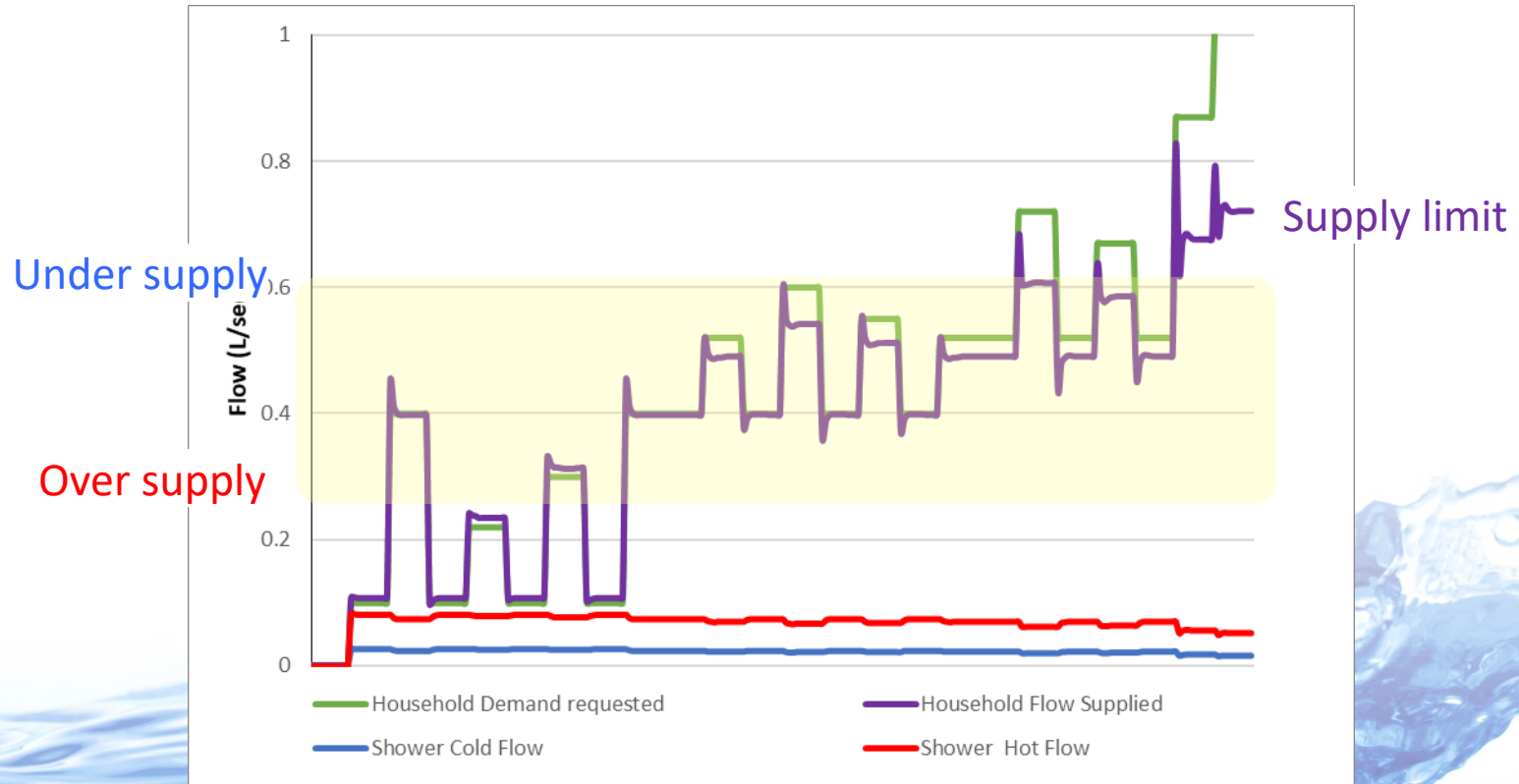
Pressure Varied Demands

20mm service, 5.0mm roughness, 20m supply pressure
6 L/min Shower



Pressure Varied Demands

25mm service, 5.0mm roughness, 20m supply pressure
6 L/min Shower



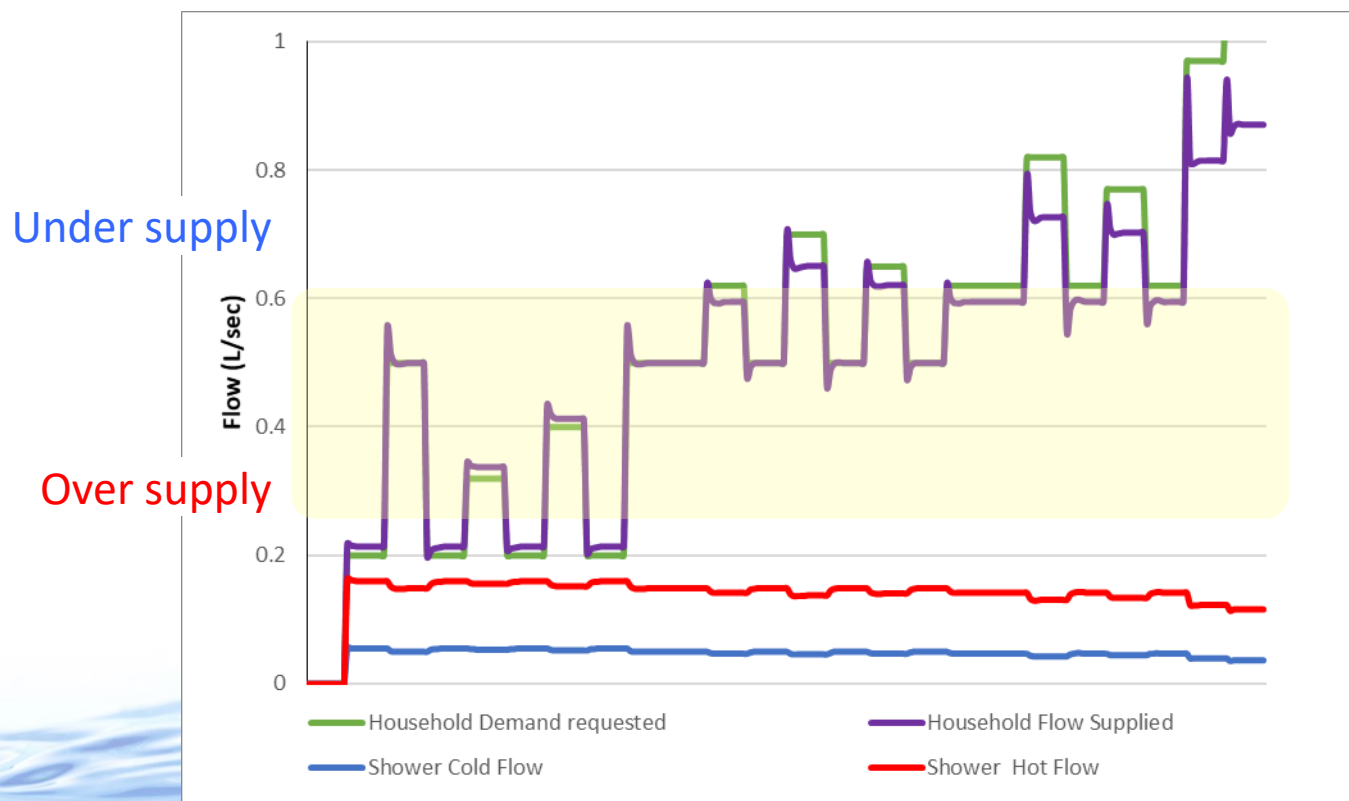
Competing Demands

- Model shower as 75% hot 25% cold
Flow of 0.2 L/s > 12 L/min



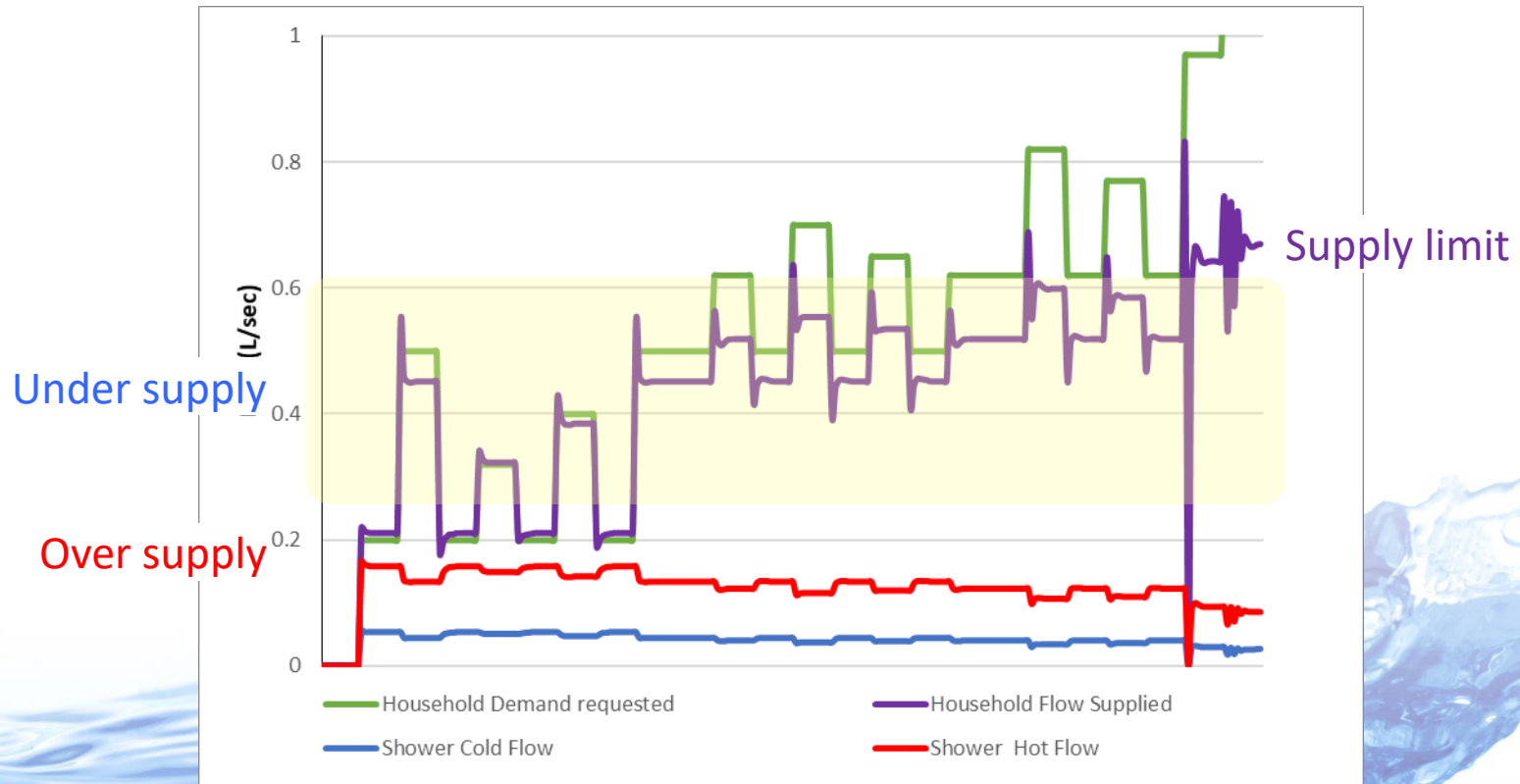
Pressure Varied Demands

20mm service, 0.06mm roughness, 20m supply pressure
12 L/min Shower



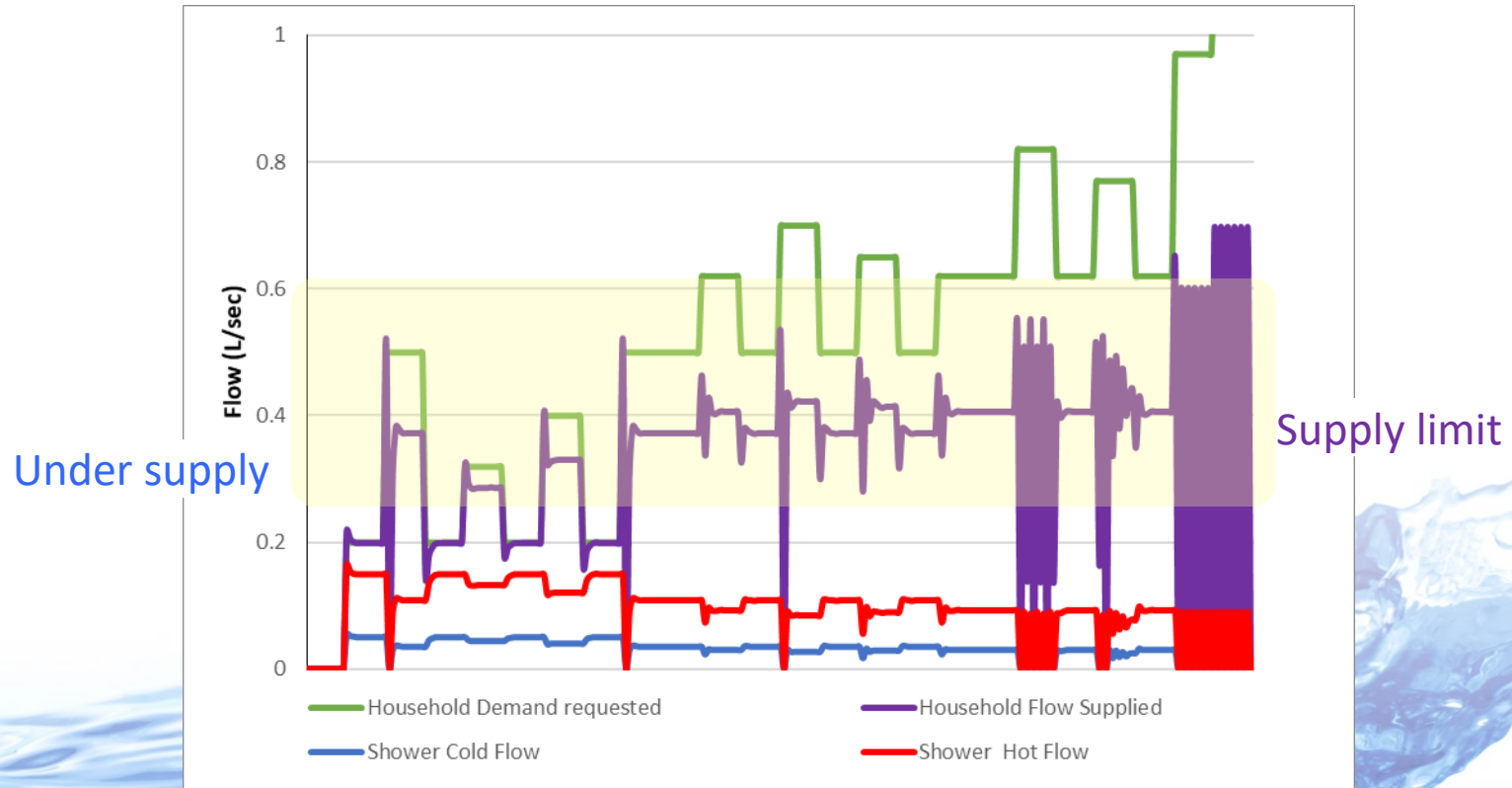
Pressure Varied Demands

20mm service, 1.0mm roughness, 20m supply pressure
12 L/min Shower



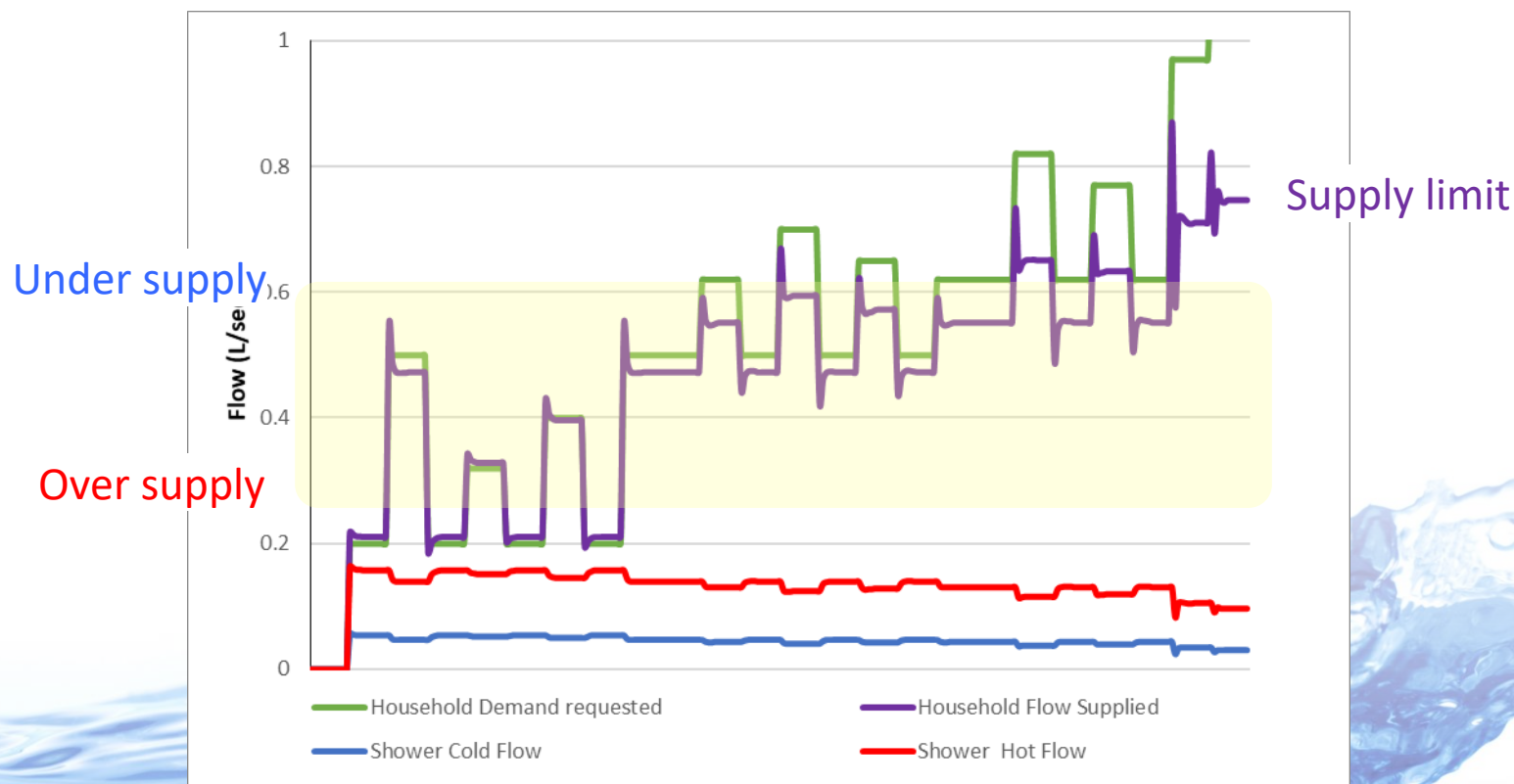
Pressure Varied Demands

20mm service, 5.0mm roughness, 20m supply pressure
12 L/min Shower



Pressure Varied Demands

25mm service, 5.0mm roughness, 20m supply pressure
12 L/min Shower



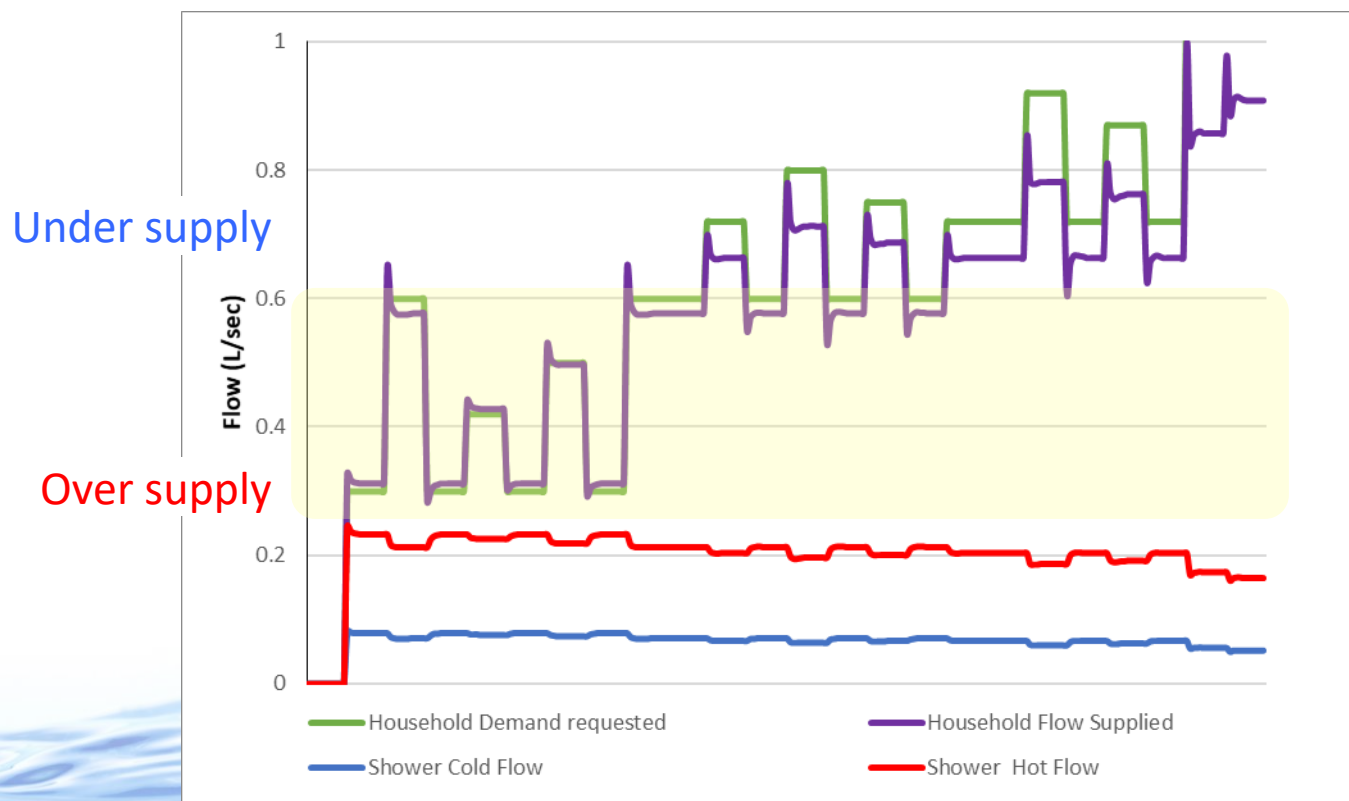
Competing Demands

- Model shower as 75% hot 25% cold
Flow of 0.3 L/s > 18 L/min
Inefficient Shower



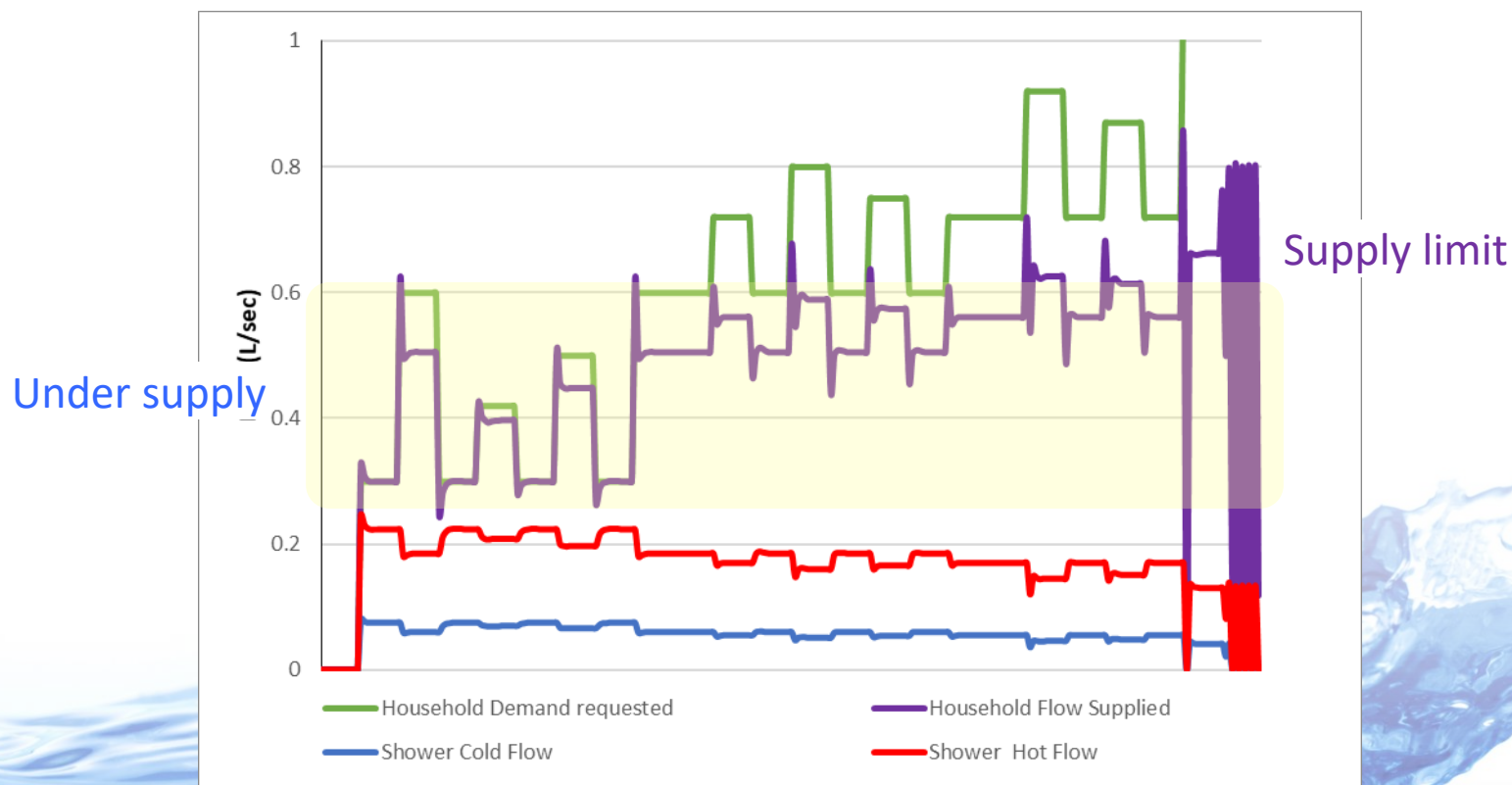
Pressure Varied Demands

20mm service, 0.06mm roughness, 20m supply pressure
18 L/min Shower



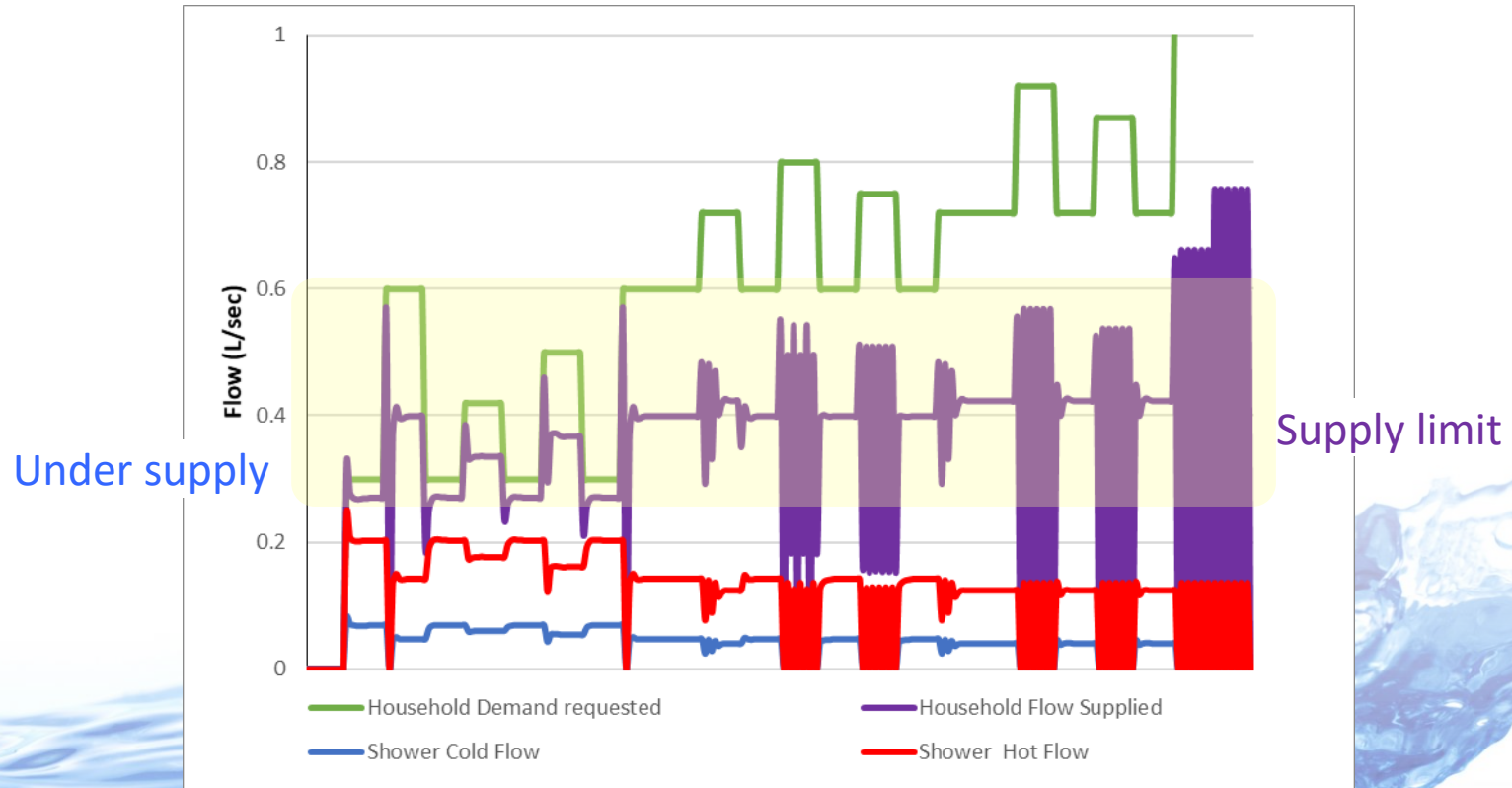
Pressure Varied Demands

20mm service, 1.0mm roughness, 20m supply pressure
18 L/min Shower



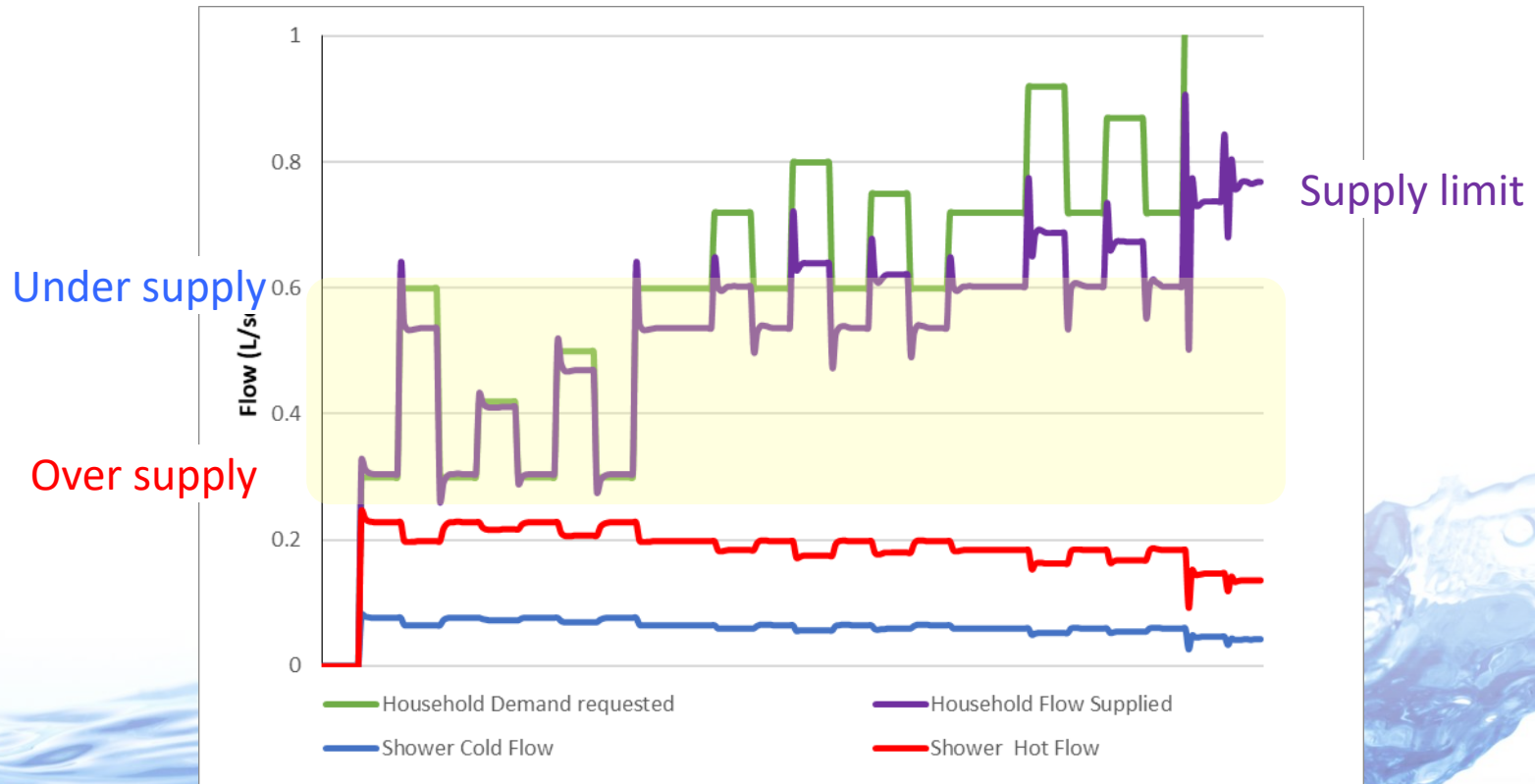
Pressure Varied Demands

20mm service, 5.0mm roughness, 20m supply pressure
18 L/min Shower



Pressure Varied Demands

25mm service, 5.0mm roughness, 20m supply pressure
18 L/min Shower

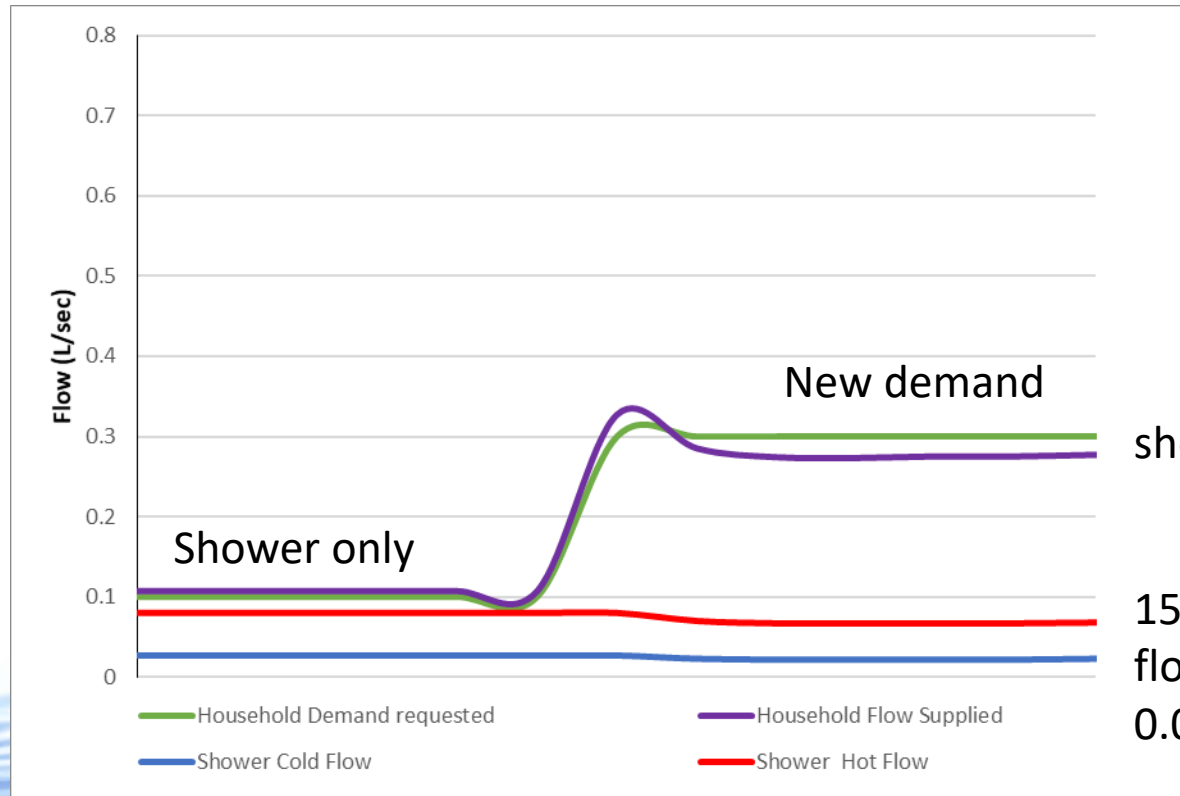


Comparing the “shower experience”

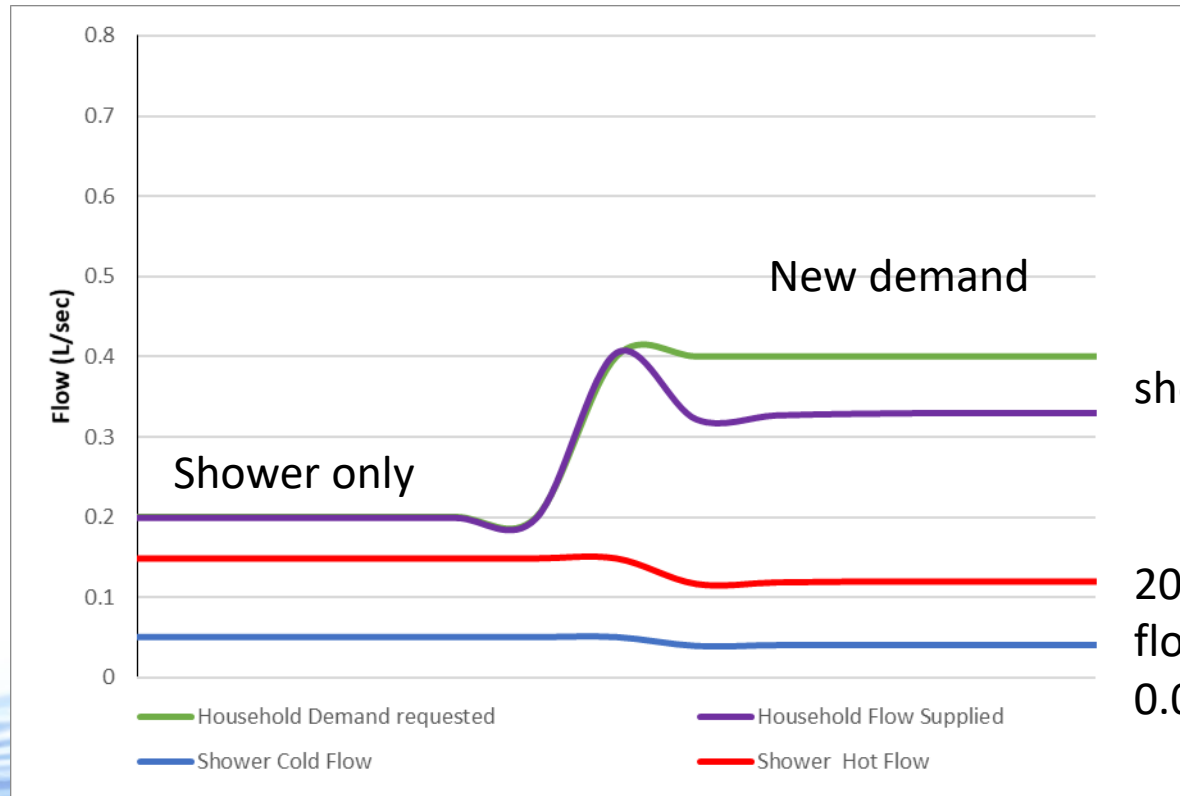
- Review the instantaneous change
- 0.2 L/s demand added
- Efficient shower
- 20mm service
- 5.0mm roughness



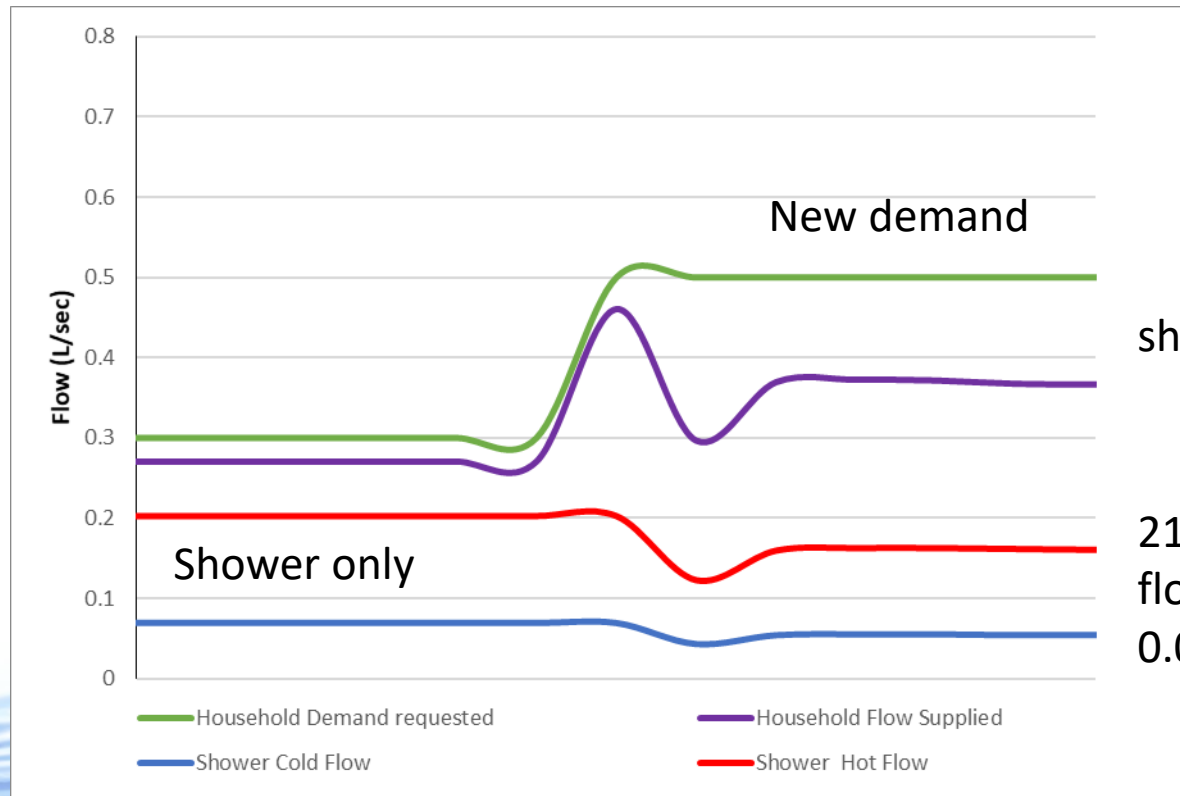
6 L/min shower



12 L/min shower



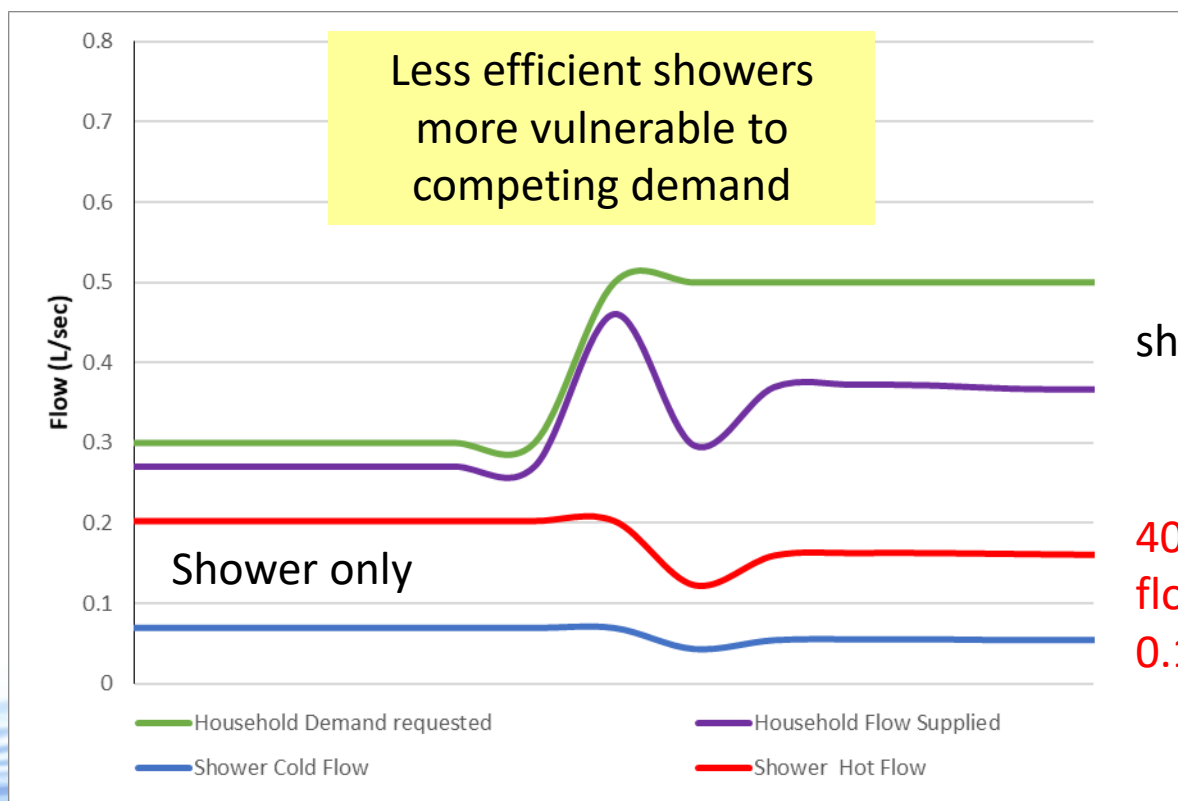
18 L/min shower



shortfall

21% change in shower
flow,
0.06 L/s

18 L/min shower

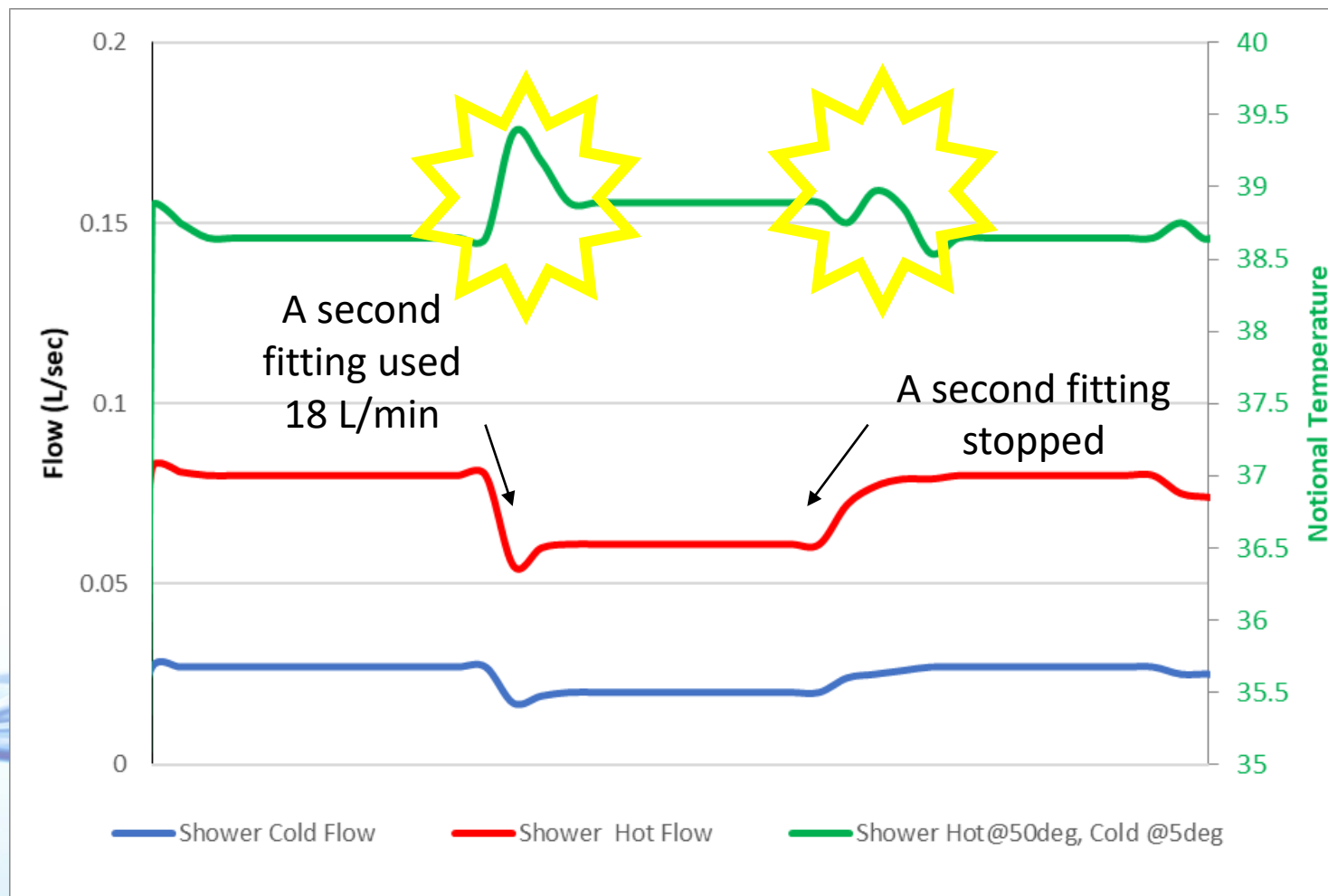


shortfall

40% change in shower
flow,
0.12 L/s

Pressure Varied Demands

20mm service, 5.0mm roughness, 20m supply pressure
0.1 L/s, 6 L/min shower flow



In summary

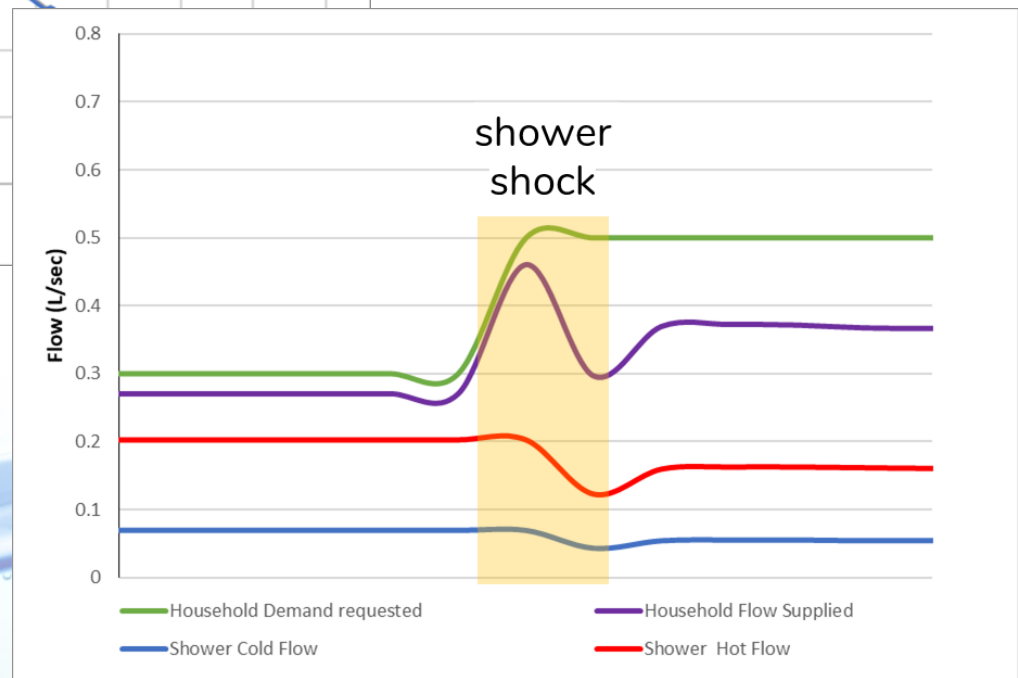
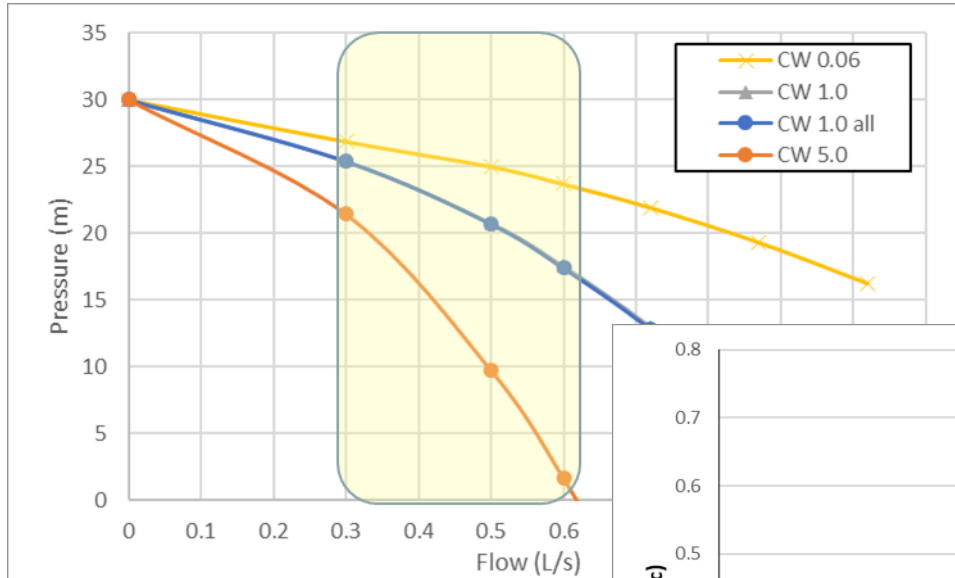
- Most impact
 - Condition of customer assets
 - Type of appliances and water user behaviours
 - Supply pressure



In summary

- Increasing supply pressure
 - unlikely to make much difference in older networks
 - Increase operational expense
 - Increase leakage
 - Increase customer bills (usage increase)
- Increasing service diameter
 - potentially will have significant impact for customer

Thank you, questions ?



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