Pressure Management and Fire Supplies from a Network Perspective

Drinking Water Protection Conference
1 & 2 August 2023

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Thomas Consultants Ltd, Auckland

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Water Supply – Levels of Service

Key Service Areas and Levels of Service:

- **Water quality – Meet the requirements of the Drinking Water Standards for NZ**
- **Supply flow and pressure – 25 litres/min and <u>250 kPa (at the meter)</u>, meet NZ Fire Service Code of Practice hydrant flows**
- **Continuity of supply – Reliability of the network (condition, number of network faults), Response to Faults/Complaints**
- **Adequacy of Supply – Efficient use of water, water loss, drought standards**

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Water Supply – Levels of Service

QUESTION

Do you know what your Council's level of service is for supply pressure?

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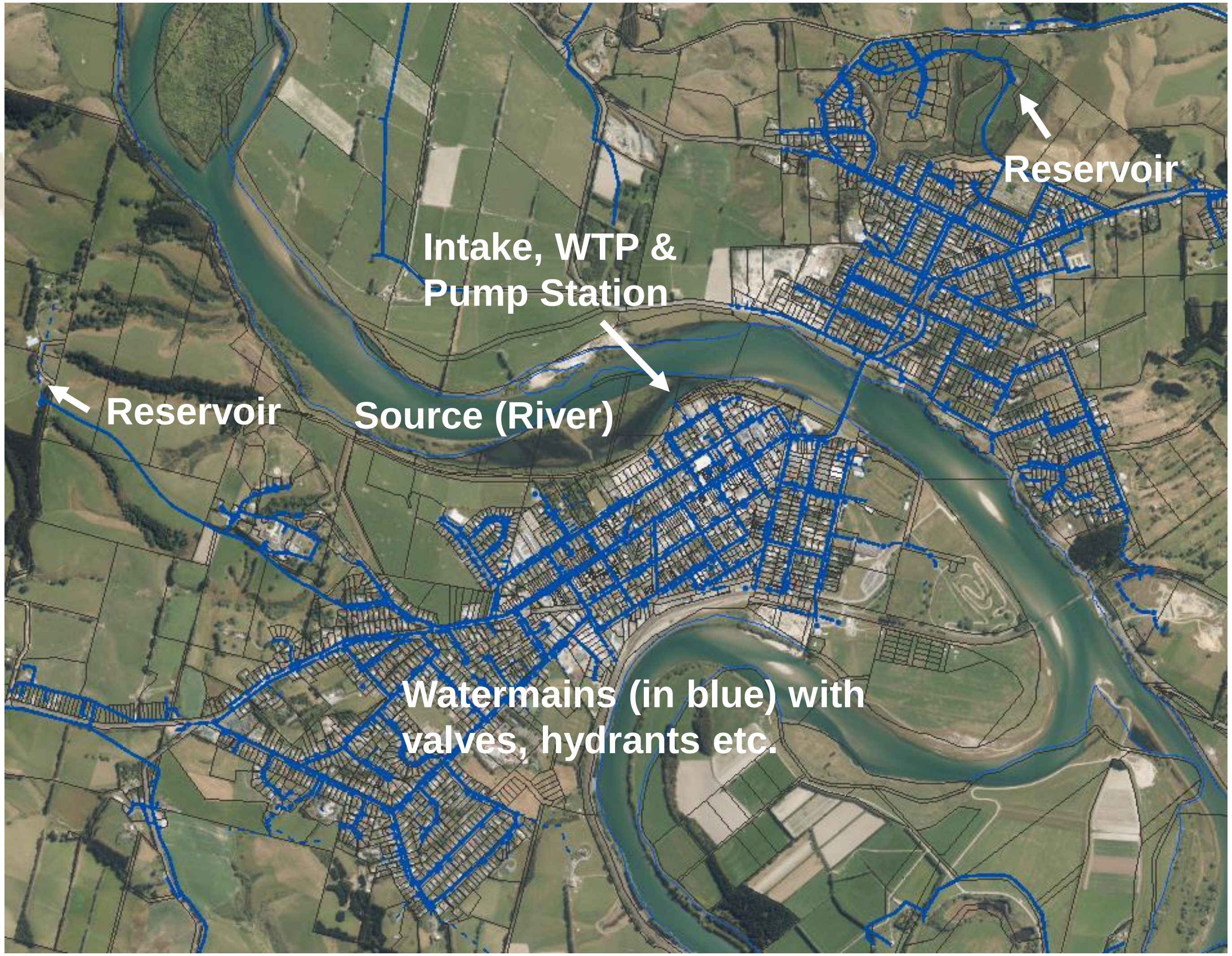
Typical Water Supply System



This town (Balclutha population 4,000) has watermains 50mm – 300mm diameter (NB).

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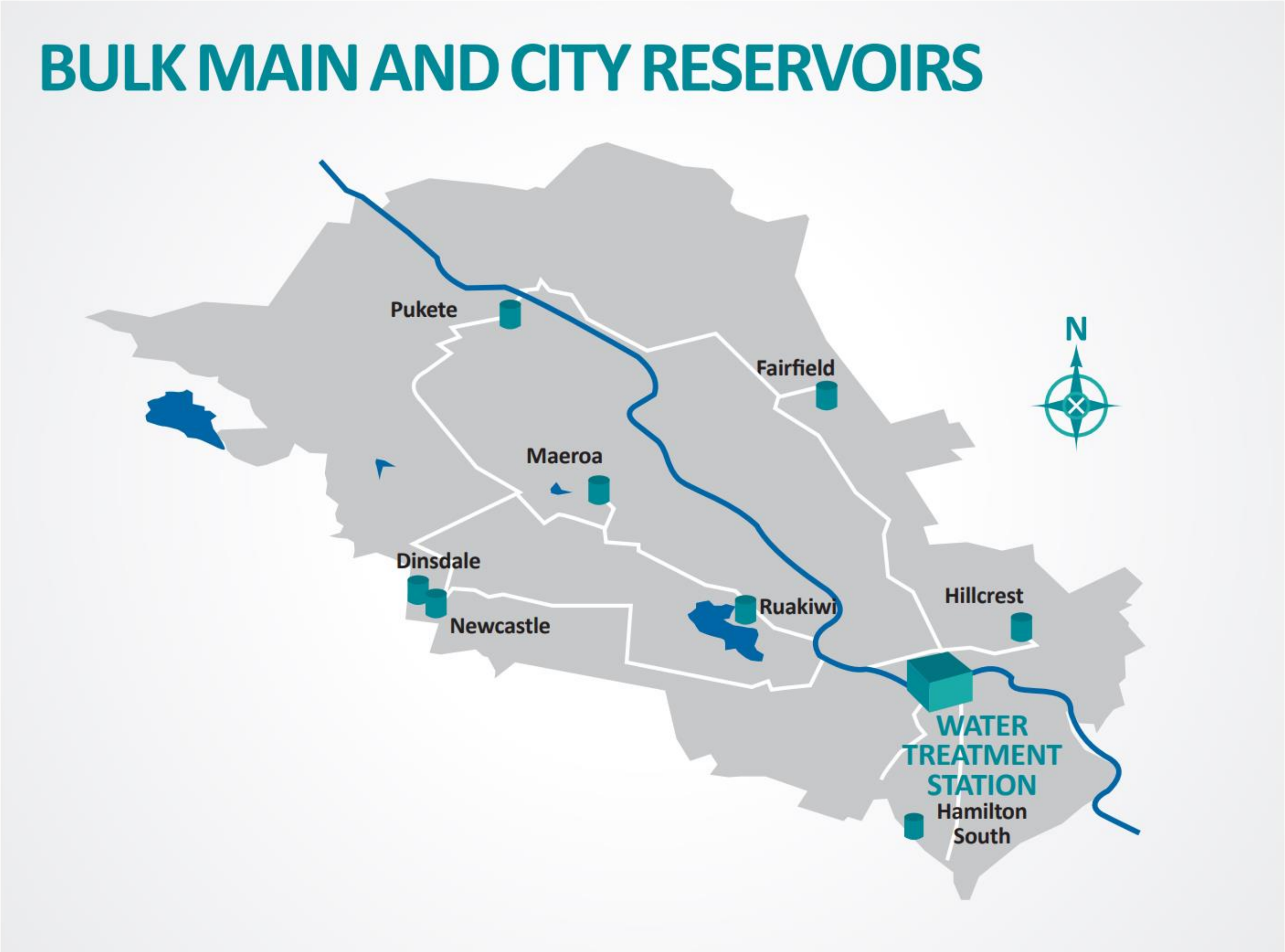
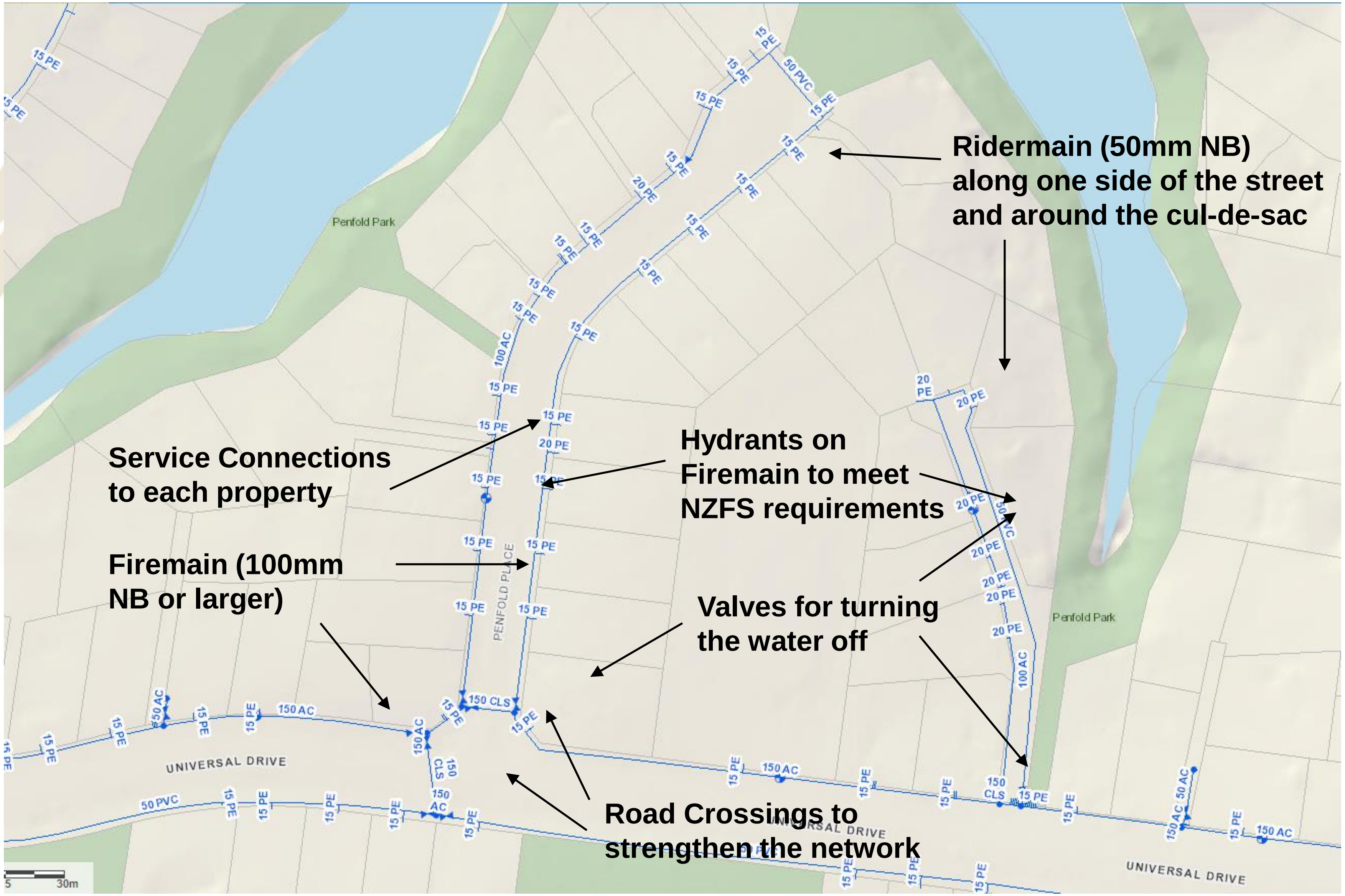
Example of a Medium Water Supply System



Hamilton, population 185,000

Has a 620mm NB Ring Main

General Layout – Showing Typical Street (ex GIS)



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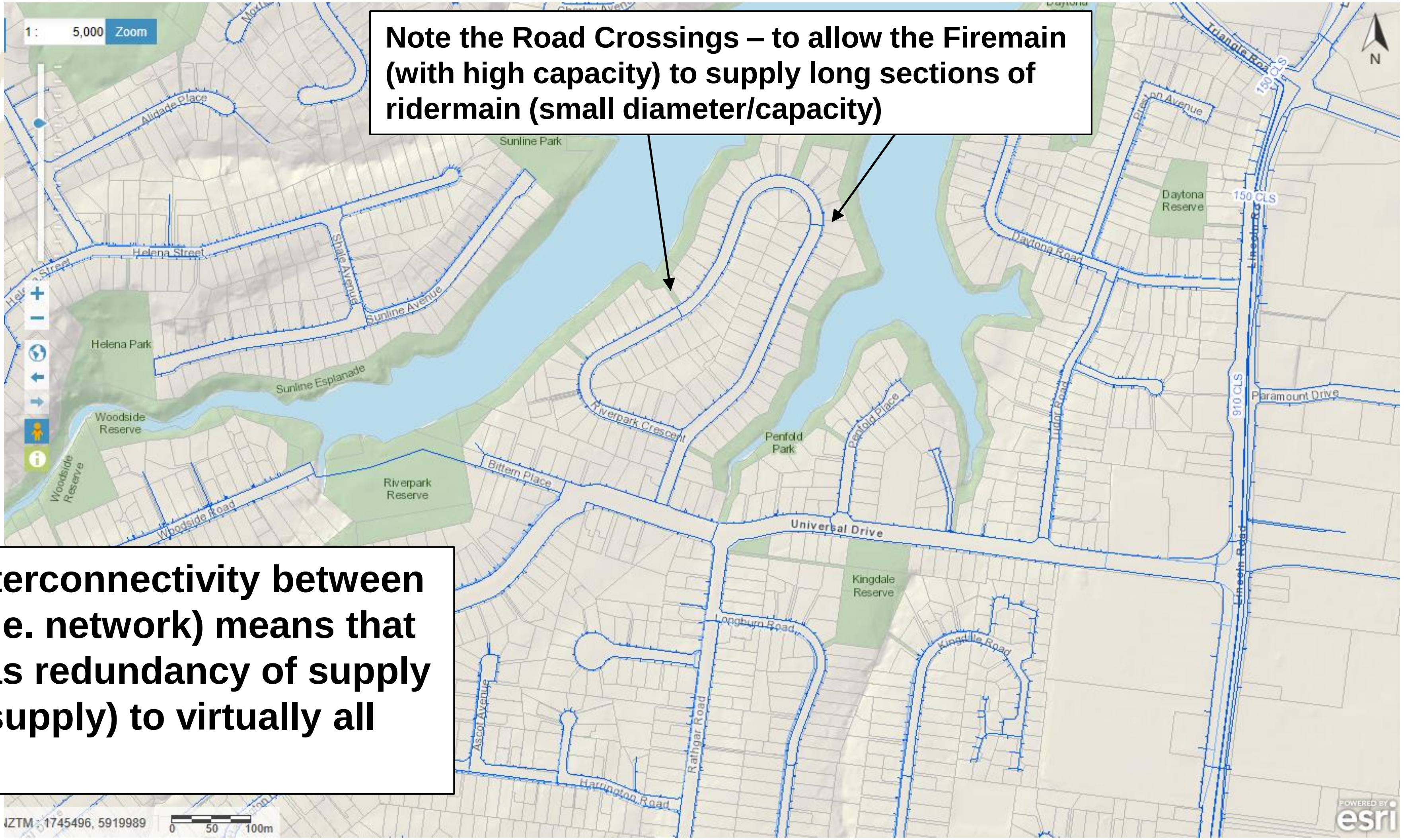
General Layout – Example Showing the Typical Interconnectivity Between Watermains (ex GIS)



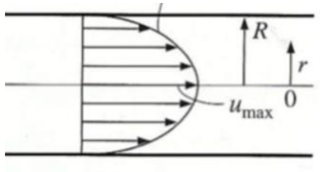
Note the Road Crossings – to allow the Firemain (with high capacity) to supply long sections of ridermain (small diameter/capacity)

The strong interconnectivity between watermains (i.e. network) means that the system has redundancy of supply (i.e. two way supply) to virtually all properties.

PIPELINE SYSTEMS – Pressure or Gravity?

Gravity systems rely on water flowing downhill, and pipelines are designed to run part full or ‘just full’ (or they surcharge). Pipelines are laid to a grade between manholes.

Water supply networks are pressure systems. The pipes are always full and under pressure. Water can flow uphill and downhill driven by ‘pressure’. But there are friction losses (or headlosses) as water travels through the pipes.



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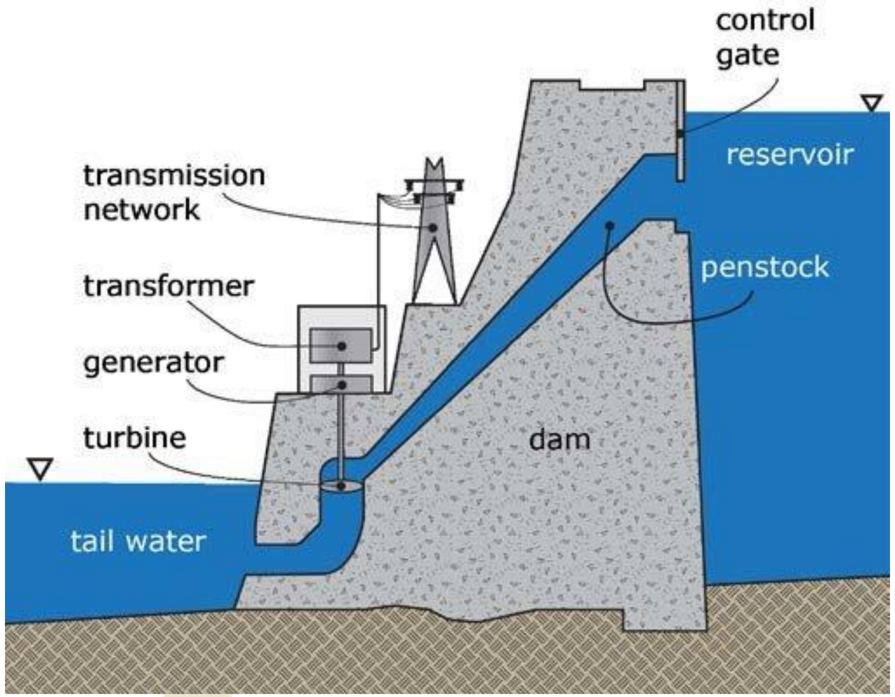
Concept of Hydraulic Grade Line



Water held at an elevation is stored energy. Hydro schemes convert some of this energy into electricity.

Pump stations work in reverse – electricity is used to 'elevate' water.

The 'stored' or 'potential energy' of water can be expressed as an elevation (i.e. in metres) as the Hydraulic Grade Line (HGL). <u>Due to the friction losses (headlosses) occurring with flow in a pipeline, the HGL of the water reduces as it travels along the pipeline</u>.

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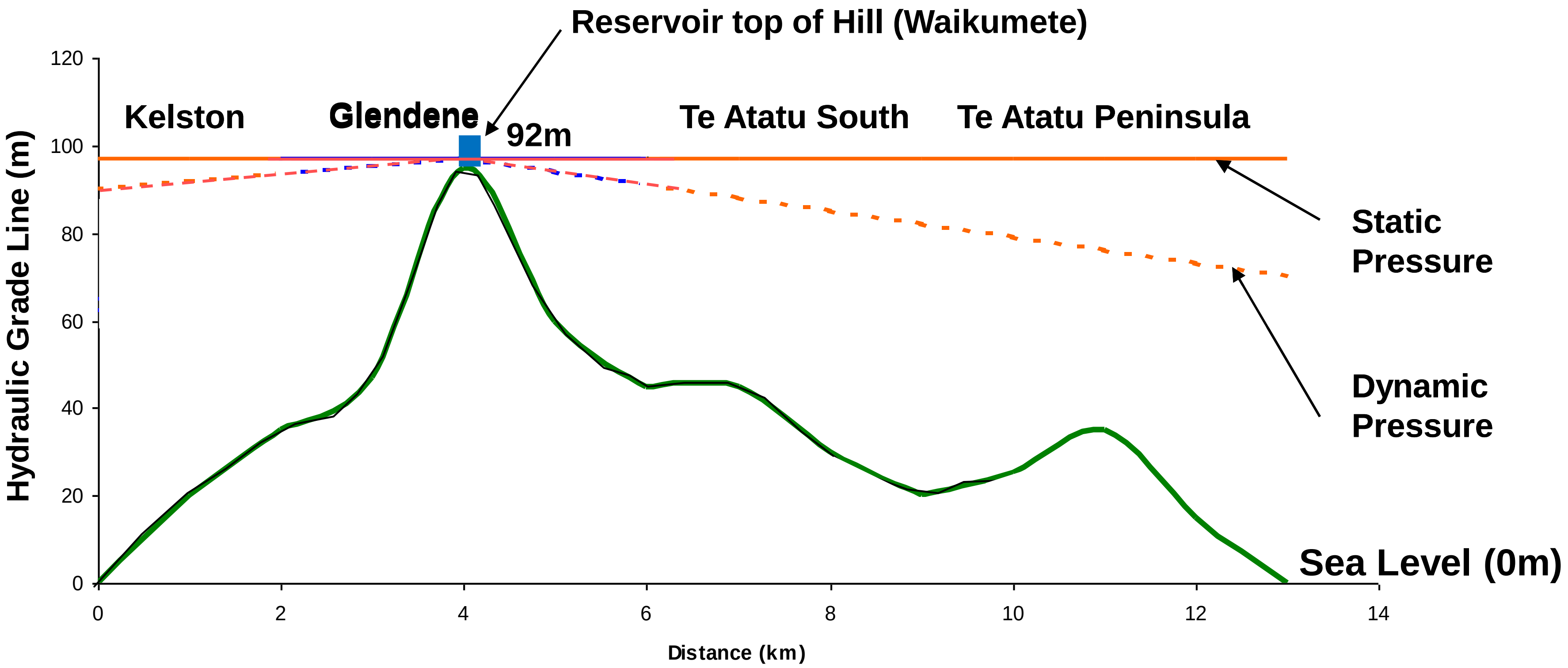
Example of Hydraulic Grade Line



The HGL is 92m (water level at the reservoir)

- The Static Pressure (with no flow or headlosses) is at a HGL is 92m
- With Demand (i.e. water use) the HGL reduces due to headlosses – i.e Dynamic Pressure line

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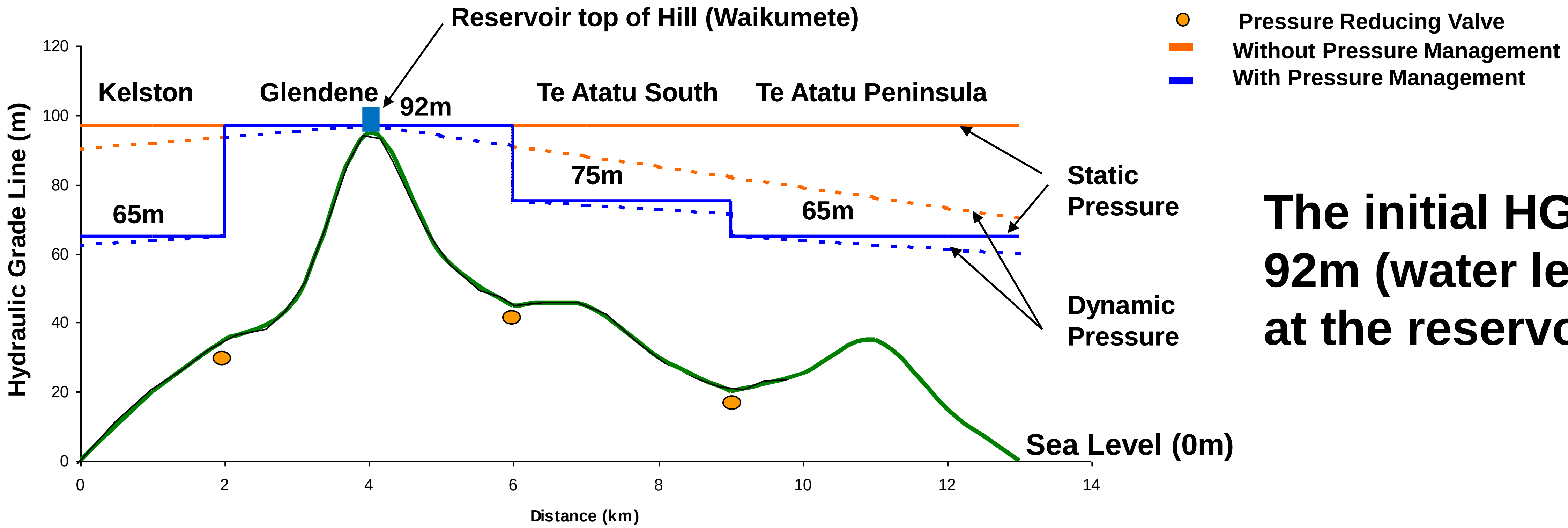
Example of Hydraulic Grade Line & Pressure M/ment



The initial HGL is 92m (water level at the reservoir)

- **The Static Pressure (with no flow or headlosses) is at a HGL is 92m**
- **With Demand (i.e. water use) the HGL reduces due to headlosses**
- **With Pressure Management PRV's 'step down' the HGL (pressure)**

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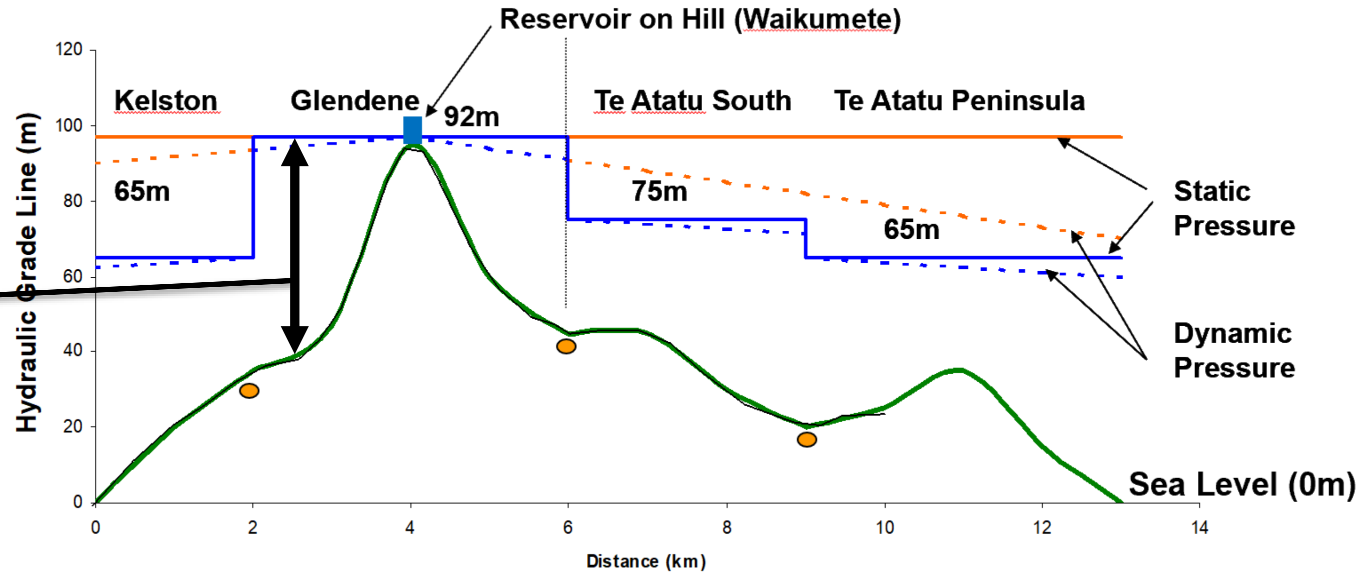
Water Networks – Calculating Pressure

The water pressure at a property is calculated as follows:

The HGL (at the location) – Ground Elevation = Pressure at the property

i.e. 92m (HGL) – 40m (Ground Elevation) = 52m Pressure (or 520 kPa)

52m Static Pressure (Dynamic Pressure will be less – with Demand)



Why do Water Suppliers reduce supply pressures?

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Benefits of Pressure Management

- The level of leakage is reduced – immediately!
- The ‘Rate of Rise’ of leakage in the network is reduced
- Watermain burst rates will be reduced (with cost and customer service benefits)
- The ‘loss of water’ from every burst and leak will be reduced
- The ‘life expectancy’ of watermains and service pipe assets will be extended - watermain renewal programmes can be extended and depreciation costs reduced
- Customer pressure-related water demand is reduced
- Less stress on private plumbing (less private leaks)

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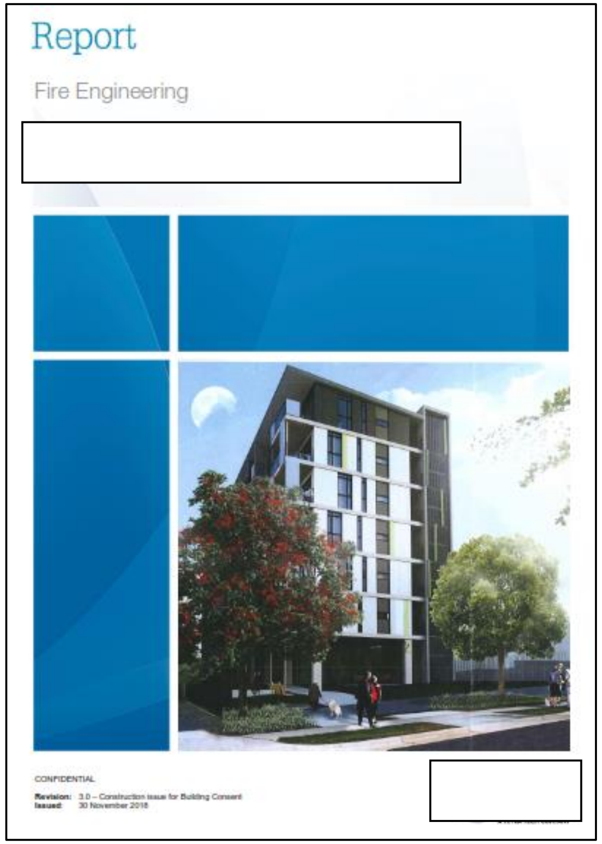
Fire Sprinkler Systems

What I've Learnt

- Fire Engineering is a specialist field of engineering
- Communication between civil/water supply' engineers and fire engineers is generally unsatisfactory and problematic
- Water supply issues with fire sprinkler systems are MAJOR issues (building won't get compliance, new buildings can't be occupied or insured)



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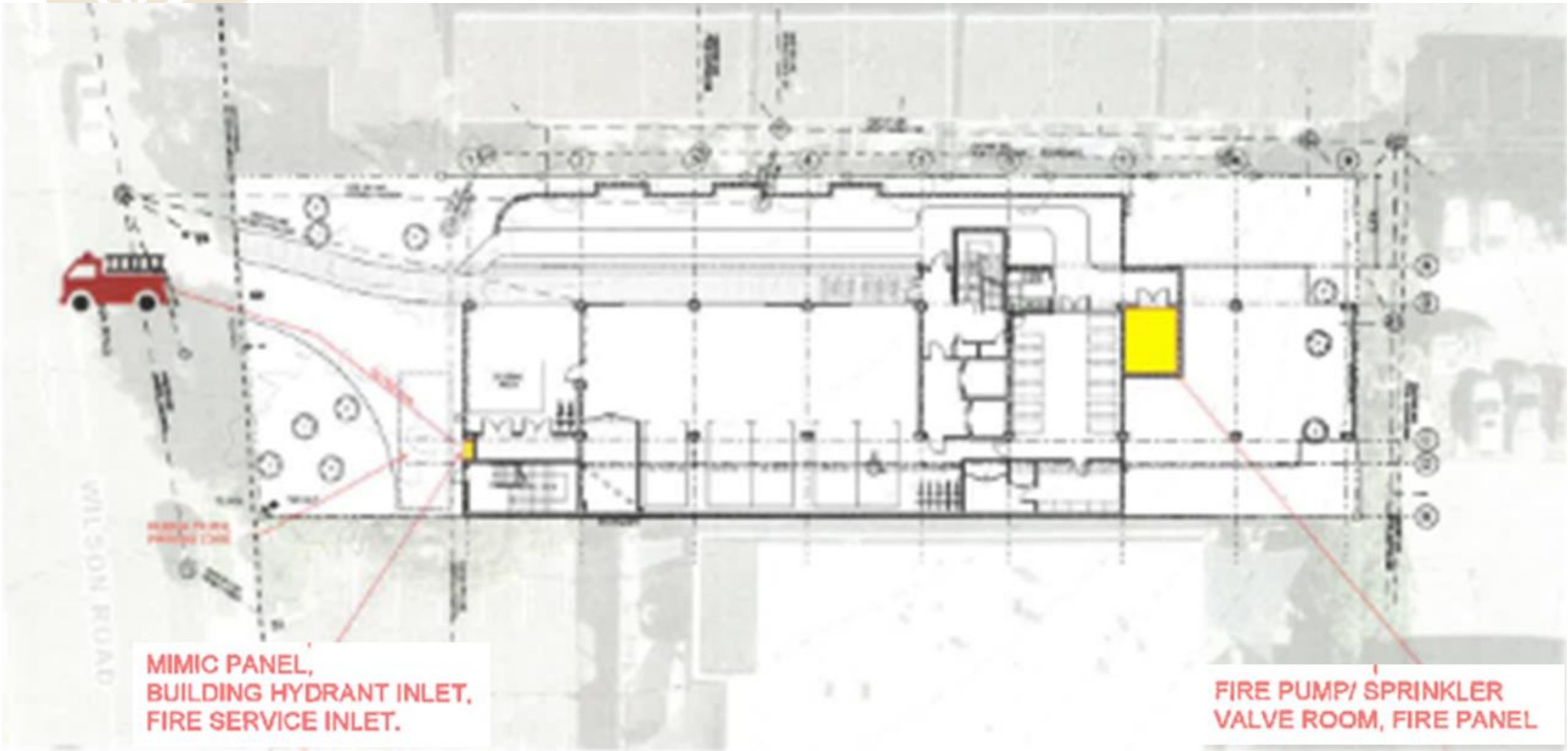
Fire Sprinkler Systems – Key Features

Sprinkler Valve Room (SVR), Water Connection (with Detector Check Valve and metered bypass) and the 'Block Sheet' (showing the design points)



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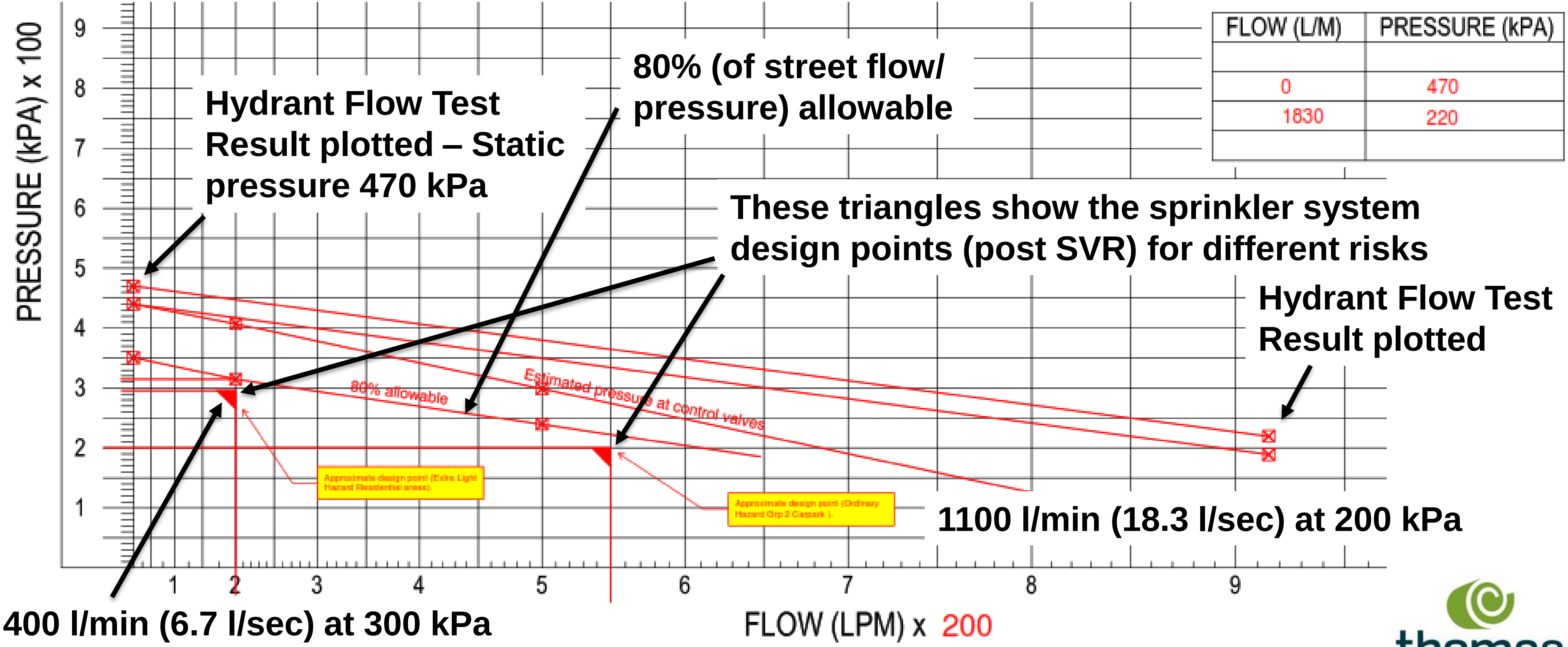
Fire Sprinkler Systems – Block Sheet



FLOW (L/M)	PRESSURE (kPA)
0	470
1830	220

Note the unusual scale and the units (litres per minute)

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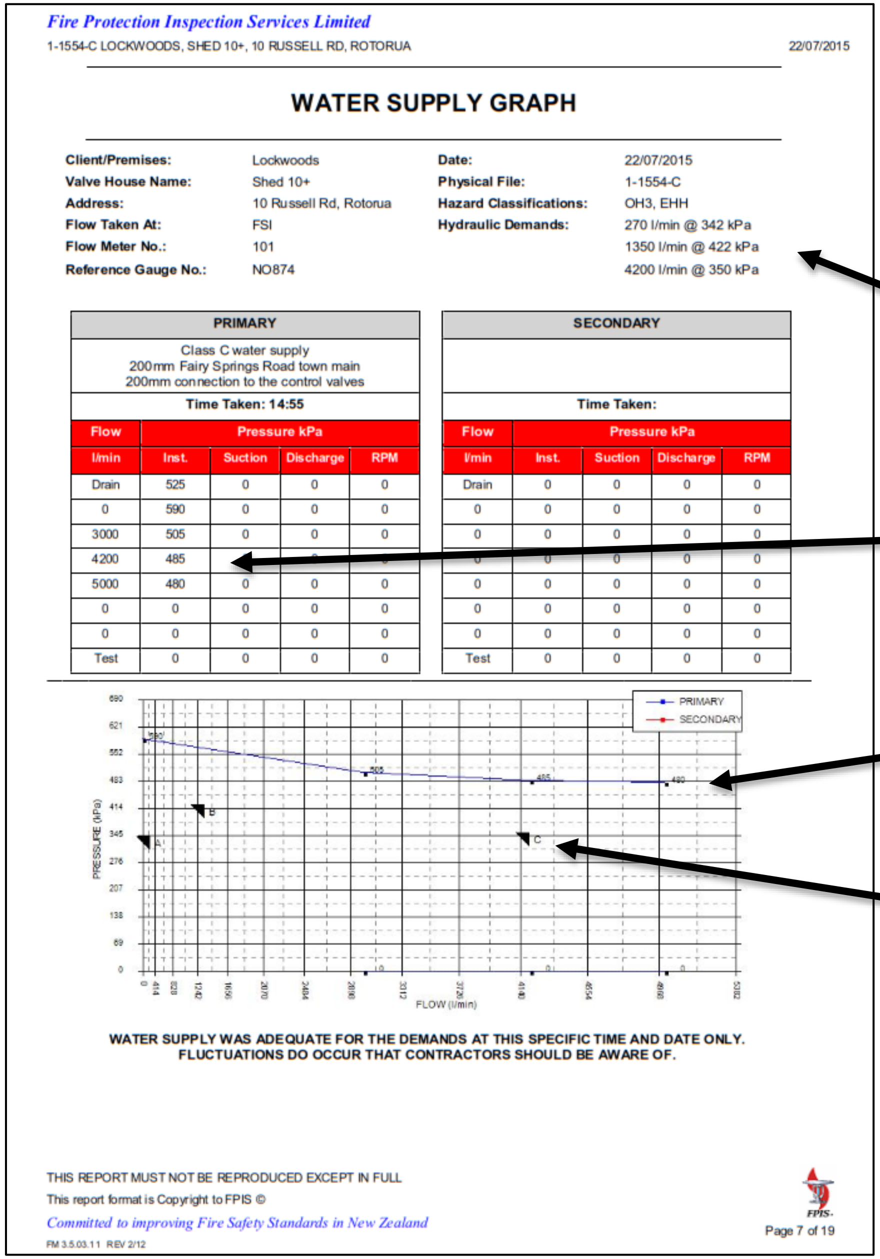
Fire Sprinkler Systems – Block Sheet (Water Supply Graph)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1-1554-C LOCKWOODS, SHED 10+, 10 RUSSELL RD, ROTORUA 22/07/2015

WATER SUPPLY GRAPH

Client/Premises:	Lockwoods	**Date:**	22/07/2015
Valve House Name:	Shed 10+	**Physical File:**	1-1554-C
Address:	10 Russell Rd, Rotorua	**Hazard Classifications:**	OH3, EHH
Flow Taken At:	FSI	**Hydraulic Demands:**	270 l/min @ 342 kPa
Flow Meter No.:	101		1350 l/min @ 422 kPa
Reference Gauge No.:	NO874		4200 l/min @ 350 kPa

PRIMARY					SECONDARY				
Class C water supply 200mm Fairy Springs Road town main 200mm connection to the control valves									
Time Taken: 14:55					Time Taken:				
Flow	Pressure kPa				Flow	Pressure kPa			
l/min	Inst.	Suction	Discharge	RPM	l/min	Inst.	Suction	Discharge	RPM
Drain	525	0	0	0	Drain	0	0	0	0
0	590	0	0	0	0	0	0	0	0
3000	505	0	0	0	0	0	0	0	0
4200	485	0	0	0	0	0	0	0	0
5000	480	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
Test	0	0	0	0	Test	0	0	0	0

WATER SUPPLY WAS ADEQUATE FOR THE DEMANDS AT THIS SPECIFIC TIME AND DATE ONLY. FLUCTUATIONS DO OCCUR THAT CONTRACTORS SHOULD BE AWARE OF.

Committed to improving Fire Safety Standards in New Zealand

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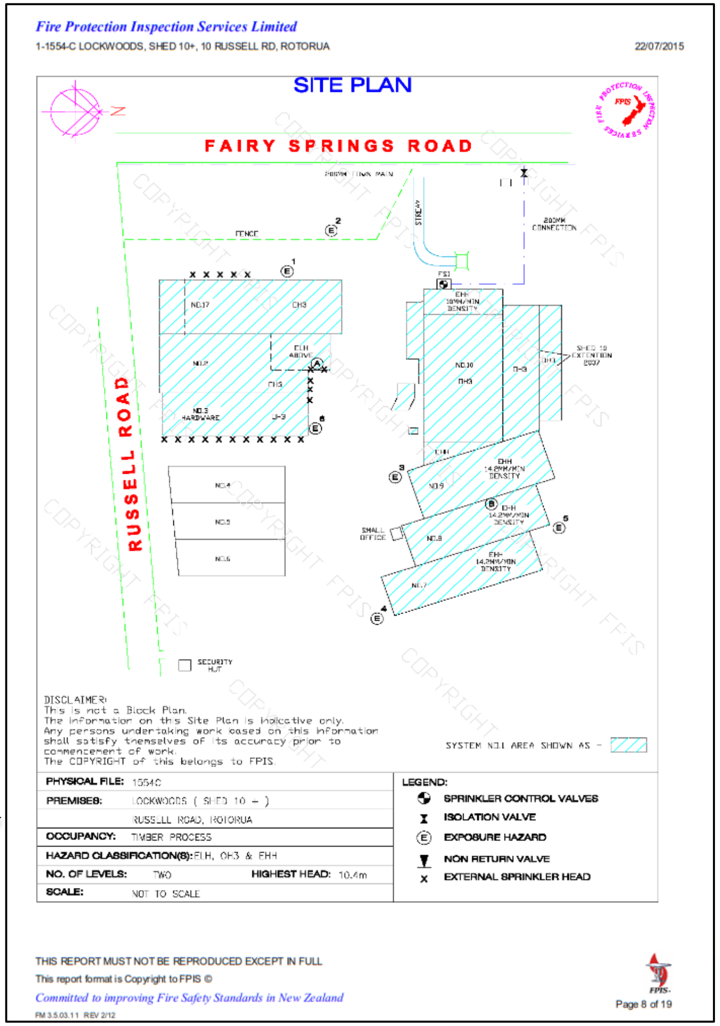
Sprinkler system demands listed

Water supply results in a table

Water supply results plotted

Sprinkler system demands plotted

Sometimes a site plan is provided



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10281 CATHERINE COURT REST HOME 19 DENVER AVE, HENDERSON, AUCKLAND 12/11/08

WATER SUPPLY GRAPH

Client/Premises:	Catherine Court Rest Home	**Date:**	12/11/08
Address:	19 Denver Ave, Henderson, Auckland	**Filecode(s):**	10281
Flow Taken At:	Test Point	**Hazard Classifications:**	*RES
		Hydraulic Demands:	45 l/min @ 84 kPa
Flow Meter No.:	Res2		115 l/min @ 91 kPa
Reference Gauge No.:	H996		0 l/min @ 0 kPa
			0 l/min @ 0 kPa

PRIMARY

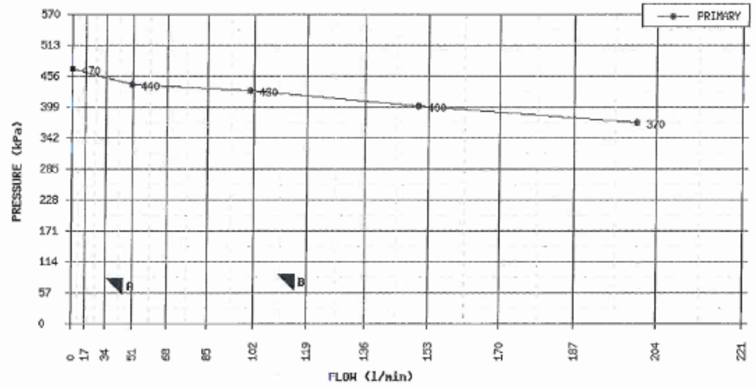
This is a single water supply from the Denver Ave town main, with a 50mm connection to the control valves.

Time Taken: *0945*

Flow	Pressure kPa			
l/min	Inst.	Suction	Discharge	RPM
Drain	360	0	0	0
0	470	0	0	0
50	440	0	0	0
100	430	0	0	0
150	400	0	0	0
200	370	0	0	0
0	0	0	0	0
Test	0	0	0	0

Time Taken:

Flow	Pressure kPa			
l/min	Inst.	Suction	Discharge	RPM
Drain	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
Test	0	0	0	0



WATER SUPPLY IS ADEQUATE FOR THE DEMANDS

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4-6420-B WOOL EQUITIES, 11-17 EDWARD STREET, MILTON 2/07/2015

WATER SUPPLY GRAPH

Client/Premises:	Wool Equities	**Date:**	2/07/2015
Valve House Name:	Wool Equities	**Physical File:**	4-6420-B
Address:	11-17 Edward Street, Milton	**Hazard Classifications:**	OH3
Flow Taken At:	FSI	**Hydraulic Demands:**	1350 l/min @ 423 kPa 1350 l/min @ 255 kPa 1350 l/min @ 282 kPa
Flow Meter No.:	GHFP44		
Reference Gauge No.:	WGTN HP2		

PRIMARY

This is a 'Class A' water supply (FOC rules). The primary supply is from the petrol motor fire pump with a storage capacity of 45,000 litres and automatic top-up facility.

Time Taken: 10.00am

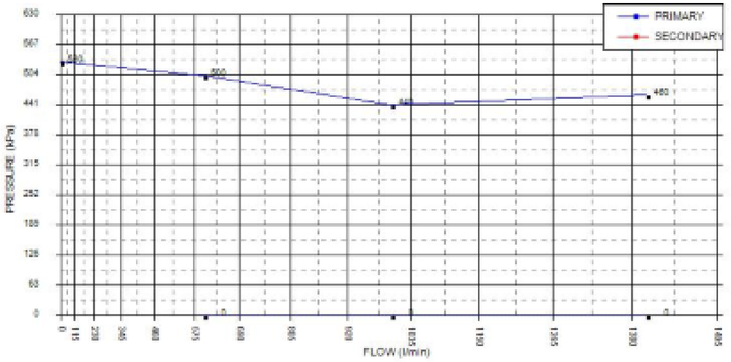
Flow	Pressure kPa			
l/min	Inst.	Suction	Discharge	RPM
Drain	0	0	0	0
0	530	0	0	0
600	500	0	0	0
1000	440	0	0	0
1400	460	0	0	0
0	0	0	0	0
0	0	0	0	0
Test	490	0	0	0

SECONDARY

The Secondary Supply is from an Electric Motor driven pumpset with a storage capacity of 90,000 litres and automatic top up facility.

Time Taken:

Flow	Pressure kPa			
l/min	Inst.	Suction	Discharge	RPM
Drain	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
Test	0	0	0	0



WATER SUPPLY WAS INADEQUATE FOR THE DEMANDS AT THIS SPECIFIC TIME AND DATE ONLY. FLUCTUATIONS DO OCCUR THAT CONTRACTORS SHOULD BE AWARE OF.

<u>NOTE</u> – A PUMP generally means network pressure is not critical

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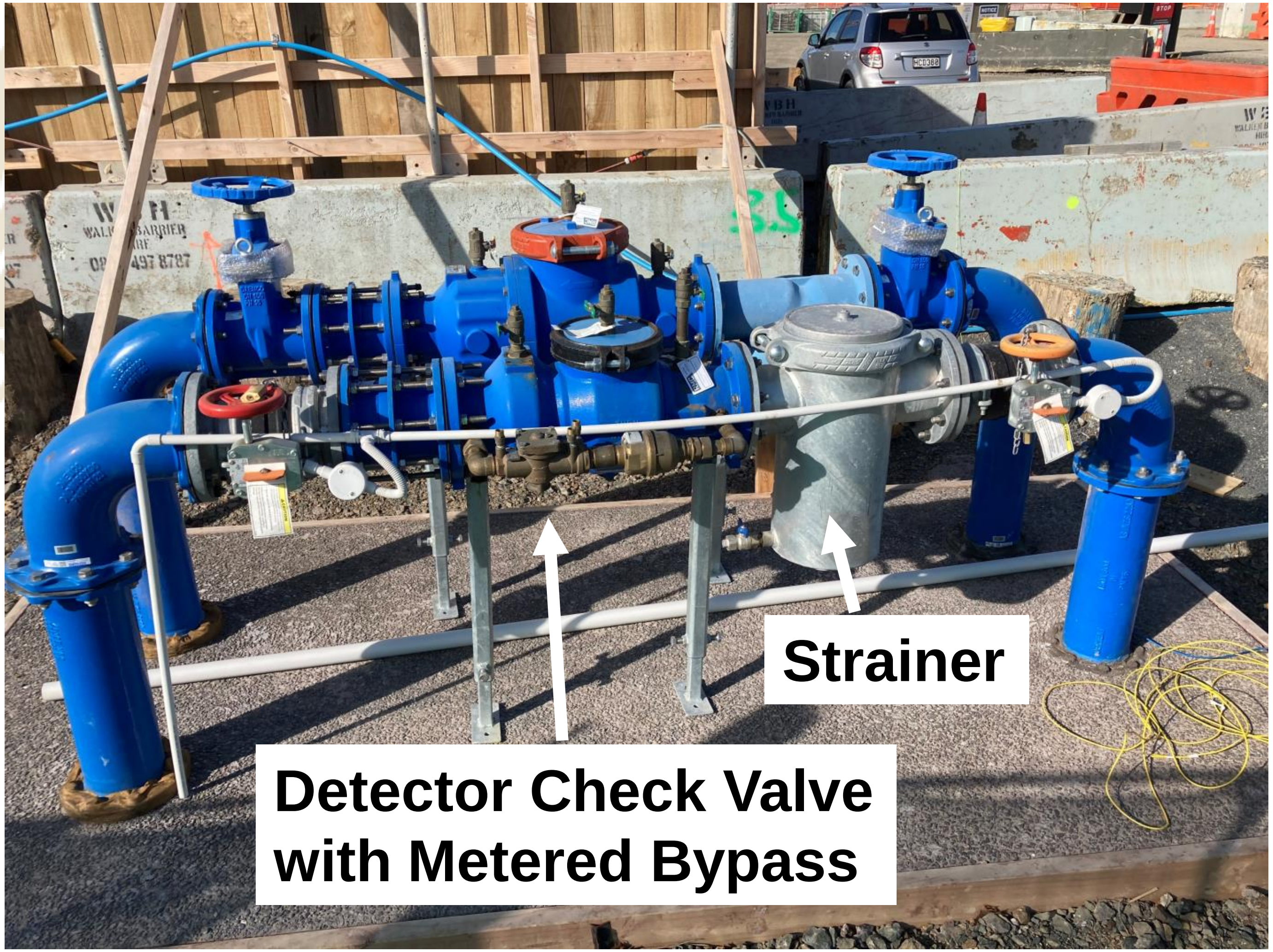
Fire Sprinkler Systems – Head Losses

Headlosses occur in all of the following areas. It is important to understand this with design and/or dealing with issues:

- **Losses in the public network up to the connection point (at the boundary)**
- **Head losses through the detector check valve**
- **Losses on the internal watermain to the SVR**
- **Losses through the valves (including non-return valve) in the SVR**
- **Losses in the sprinkler system pipework from the SVR to the sprinkler head**
- **Losses through the sprinkler head itself**

Metering of a Fire Sprinkler System

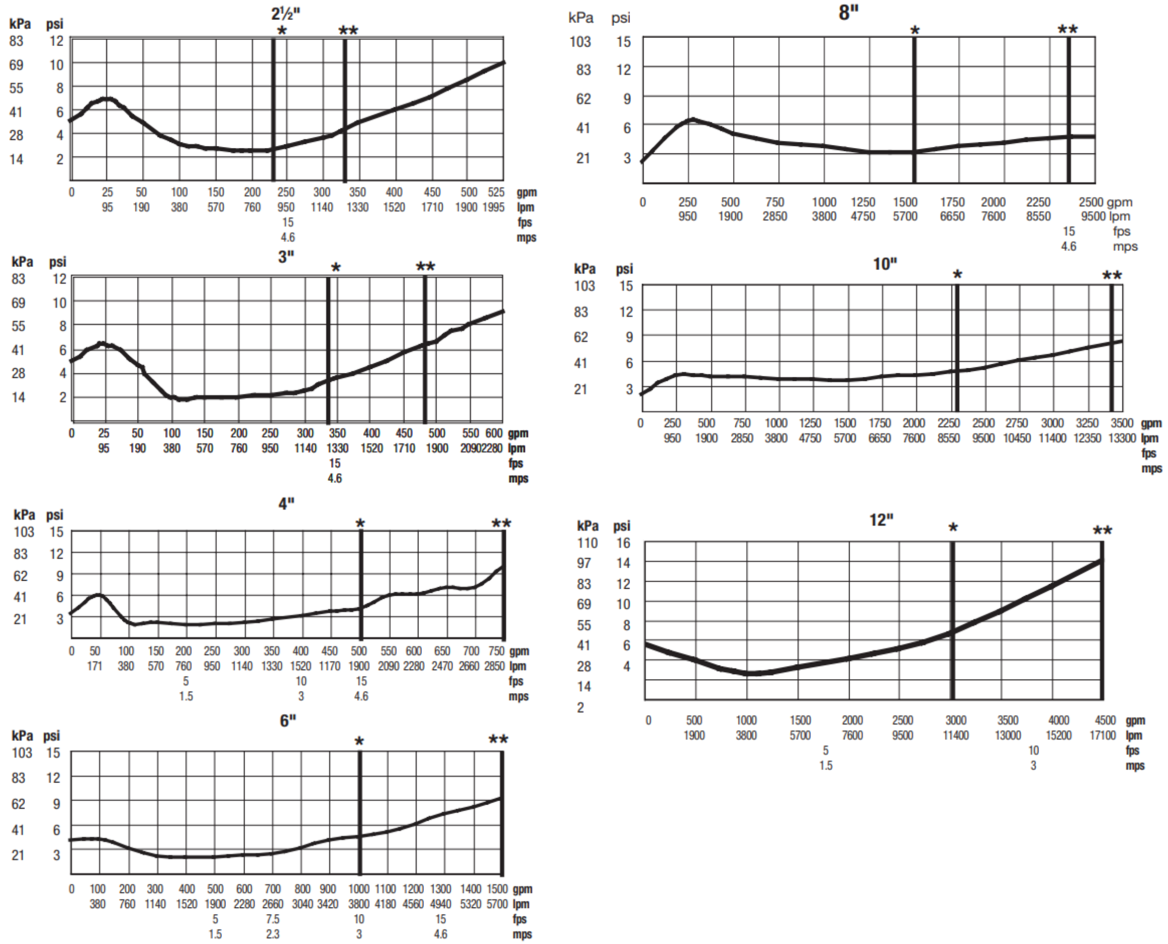


Flow direction is Right to Left

Graphs of Headloss through a Detector Check Valve

Capacity

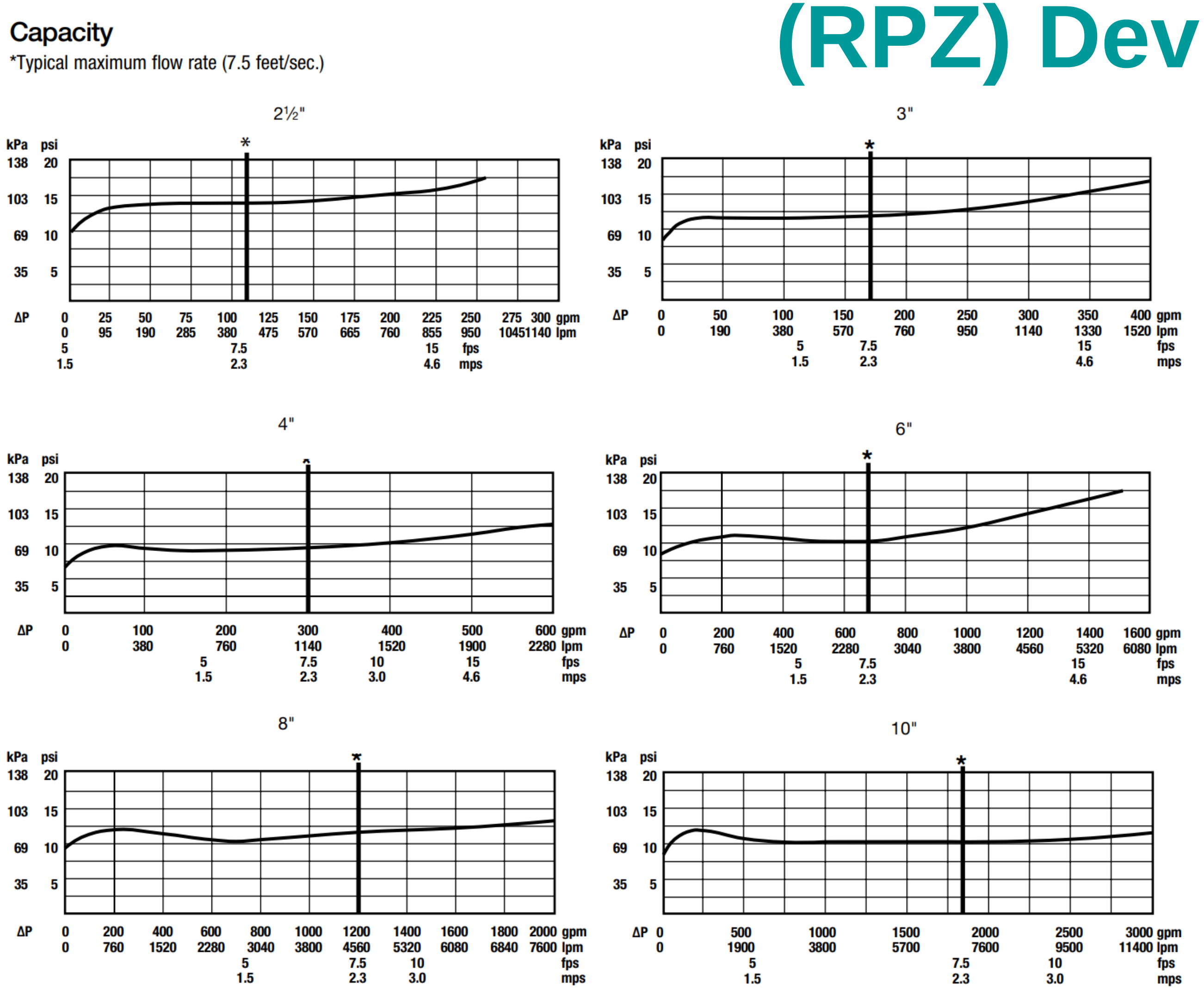
Rated working pressure 175psi (12.06 bar) * Rated flow **UL Tested



Typically around 4 psi = 28 kPa (but varies 2 - 6psi = 14 - 40 kPa)

And for a Reduced Pressure Zone Device …

Graphs of Headloss for an Reduced Pressure Zone (RPZ) Device



Typically around

10-12 psi = 70 - 80 kPa

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Water Services Act 2021

27 Duty to protect against risk of backflow

(1) If a drinking water supply includes reticulation, the drinking water supplier must ensure that the supply arrangements protect against the risk of backflow.

(2) If there is a risk of backflow in a reticulated drinking water supply, the drinking water supplier may—

(a) install a backflow prevention device and require the owner of the premises to reimburse the supplier for the cost of installation, maintenance, and ongoing testing of the device; or

(b) require the owner of the premises to install, maintain, and test a backflow prevention device that incorporates a verifiable monitoring system in accordance with any requirements imposed by the supplier.

(3) A person who installs a backflow protection device must take all reasonable steps to ensure it operates in a way that does not compromise the operation of any fire extinguisher system connected to the drinking water supply.

Compare: 1956 No 65 s 69ZZZ

My view is that water suppliers can control/reduce supply pressures but must give reasonable notice so building owners have time to make necessary changes/adjustments

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Example of a Fire Sprinkler System Issue in Rotorua (supermarket)

Sprinkler system has a hydraulic demand of 40.2 litres/sec (at 415 kPa).

This flowrate through a 100mm road crossing (and 100mm B/F assembly I think) is unsatisfactory (Velocity > 5 m/s).

Upsizing of the road crossing (and the B/F assembly, and possibly the internal main) is required.

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Fire Sprinkler Systems – Final Comments

Some final thoughts:

- **The flow available at the Sprinkler Valve Room is physically checked annually. <u>Non-compliance can be caused by network valves being left in the 'OFF' position</u> after maintenance work.**

- **My information from the 1990's was that the '80% allowable' figure was based on 10% daily fluctuation in (street) pressure and 10% future long term deterioration in pressure with 'growth' in demand. I was advised that within a pressure managed area/zone, the latter 10% could be disregarded, and hence 90% allowable pressure was acceptable (to the Insurance Council)**

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Any Questions?

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