

# Watercare Services Ltd Auckland New Zealand

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Presentation to National Engineering  
Lifelines Forum  
October 2009

# Building Resilience in Auckland's Bulk Water Supply System

- Southern Sources Security of Supply
  - Network Valve Automation



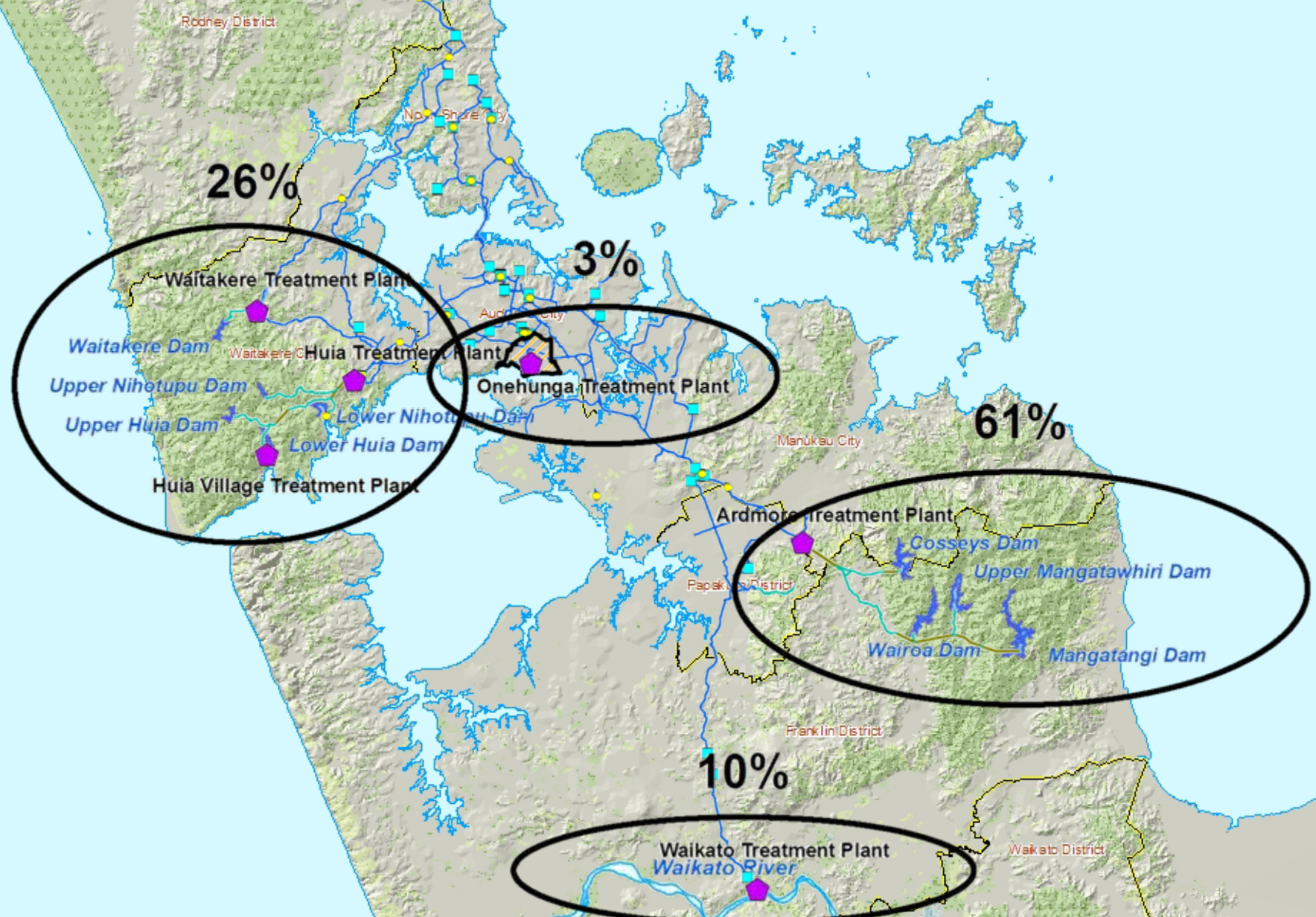
# Auckland's Water Supply Overview

- Sources
  - 9 Operational Impounded Storage Dams
  - Hunua Ranges – 61% demand
  - Waitakere Ranges – 26% demand
  - Waikato River – 10% demand
  - Onehunga U/G Aquifer – 3% demand
- 6 Water Treatment Plants
  - Max. Design Capacity 570MLD
  - Ave demand 365MLD
  - Peak day 470MLD

# Water Supply Overview – cont.

- Trunk Watermains Network
  - 80km Raw Watermains, Tunnels & Aqueducts
  - 450km Treated Watermains
  - 31 Pump Stations
  - 53 Treated Water Storage Reservoirs
- Local Network 8,200km

# WATER SUPPLY NETWORK



# Southern Sources Security of Supply

Enabling  
Wairoa & Mangatawhiri Tunnels  
Inspection

# Risk Issues

- Presented to the Board of WSL in July 04
- Criticality/Dependency
  - Mangatawhiri & Wairoa Tunnels & Otau Aqueduct
  - Conveys 50% regions water supply
  - Flows up to 295MLD
  - Ardmore WTP 330MLD >60% regions water

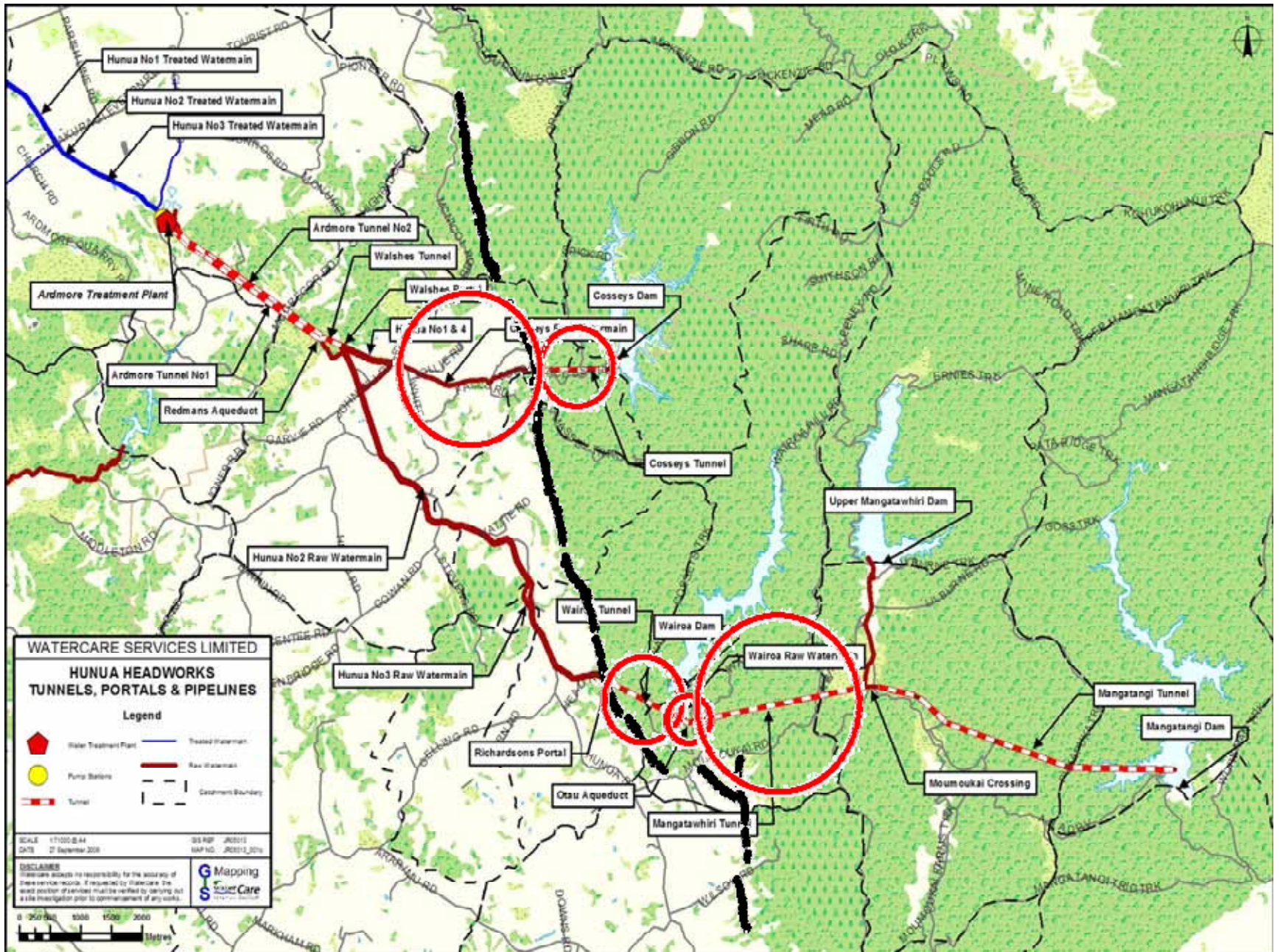
# Risk Issues

- Asset Condition Knowledge
  - Wairoa and Mangatawhiri Tunnels unable to be inspected for 30 years due to lack of redundant capacity – “headroom”
- Structural Seismic Issues
  - Otau Aqueduct
- Consequence of failure Wairoa Tunnel very severe – loss of Ardmore rapid regional supply impact



# Risk Issues

- Cosseys Dam Independent Source
  - Abstraction capacity less than Ardmore minimum production 140MLD
  - Ageing Assets
    - Cossey's Tunnel
    - Cossey's Raw watermains – RCRRJ & Old CLS
  - Remote location time lag in incident detection



# Hunua Headworks Supply System and Lakes

## Imperial Equivalents

Tunnels	Imperial	Nearest 10mm
1,580	5'2"	610
1,930	6'4"	690
2,300	7'6"	810

Pipes	Imperial	Nearest 10mm
610	24"	610
686	27"	690
762	30"	760
813	32"	810
838	33"	840
1067	42"	1070
1295	51"	1300
1902	75"	1900

## Level Controls (Mid 75) marked

Location	Level	Size
Reids	125.30	6.06m weir
Walshes	126.26	5.71m weir
Richardsons	132.05	Siphon 120 x 10 <sup>3</sup> m <sup>3</sup> /d
Otau	133.19	3.32m circum weir
Moumoukai W	134.83	3.35m circum weir
Mines West	136.61	Siphon 110 x 10 <sup>3</sup> m <sup>3</sup> /d
Mines East	136.98	Siphon 110 x 10 <sup>3</sup> m <sup>3</sup> /d

## Portal Line Valves marked

Walshes 760 on each Cosseys Main  
1070 on Hunua No 2  
1070 on 1300 link from No 3

Richardsons  
1070 penstock on Hunua No 2  
Two 1070 penstocks to manifold Hunua No 3

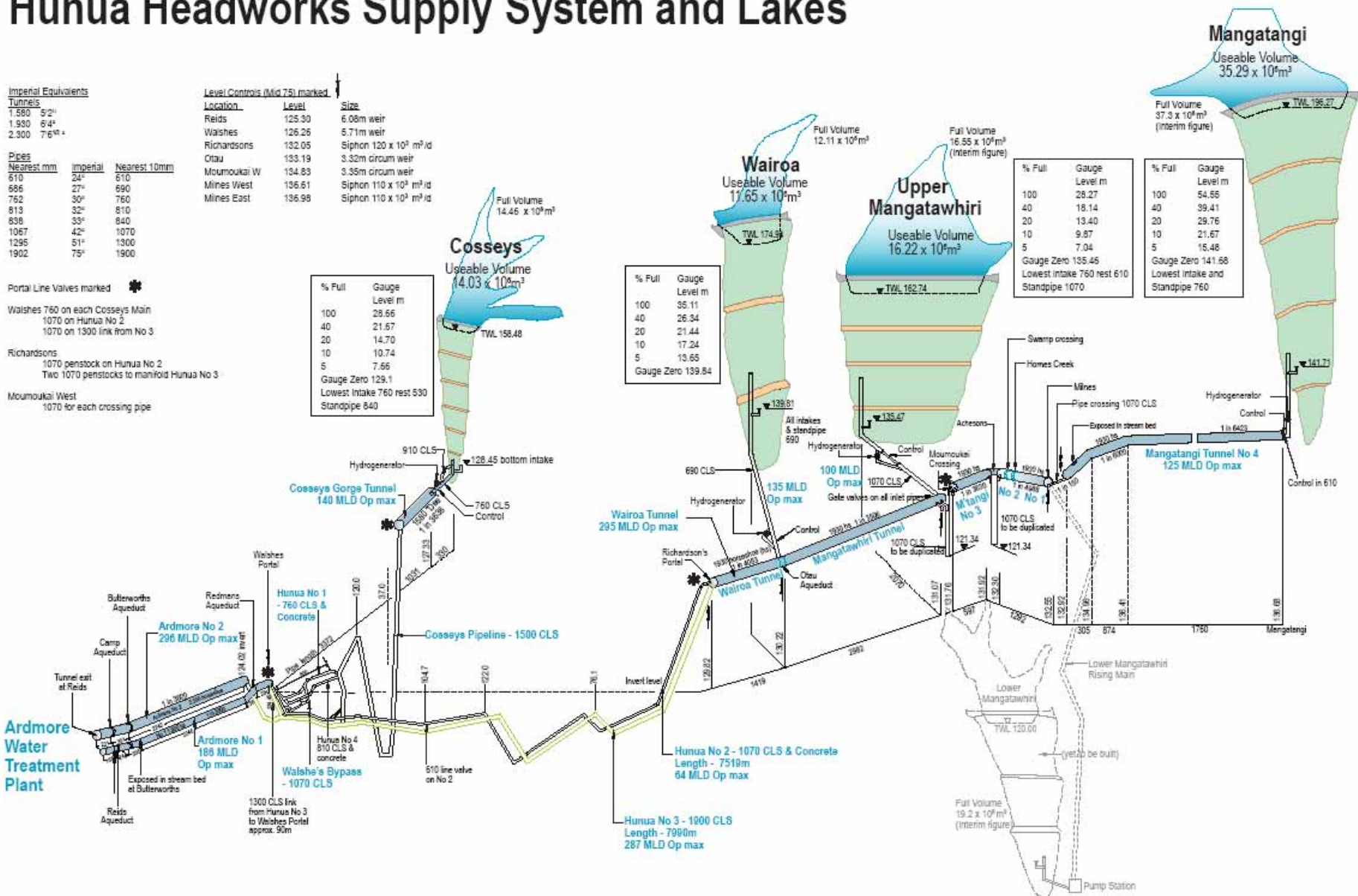
Moumoukai West  
1070 for each crossing pipe

% Full	Gauge Level m
100	28.66
40	21.57
20	14.70
10	10.74
5	7.66
Gauge Zero	129.1
Lowest Intake	760 rest 530
Standpipe	840

% Full	Gauge Level m
100	35.11
40	26.34
20	21.44
10	17.24
5	13.65
Gauge Zero	139.84

% Full	Gauge Level m
100	28.27
40	18.14
20	13.40
10	9.87
5	7.04
Gauge Zero	135.46
Lowest Intake	760 rest 610
Standpipe	1070

% Full	Gauge Level m
100	54.55
40	39.41
20	29.76
10	21.67
5	16.48
Gauge Zero	141.68
Lowest Intake	and Standpipe 760

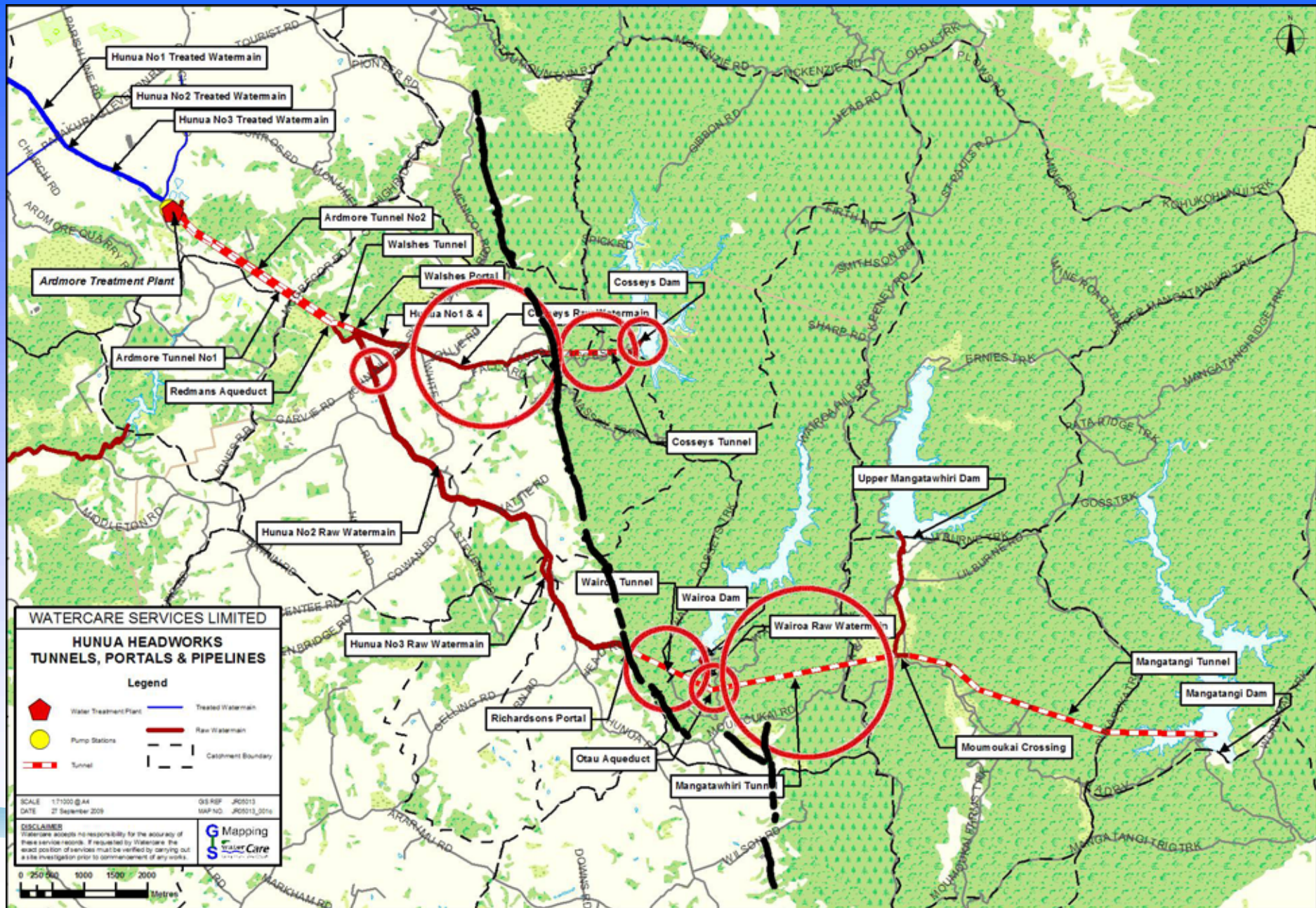


# Mitigation Objectives

- To provide contingent capacity in the event of Wairoa Tunnel failure
- To facilitate Wairoa Tunnel condition assessment and maintenance
- Upgrade Otau Aqueduct to seismic code & protect against heavy traffic loads
- Provide early warning of failure
- Contingency plan

# Mitigation Strategy

- Increase abstraction capacity from Cossey's Dam – 65MLD to 140 MLD “mine” source
  - Upgrade Cossey's Tunnel allow surcharge to 140MLD
  - Replace 2 Cossey's raw watermains – from 810 & 760 to 1500mm dia
- Install remote level/flow monitoring Wairoa Tunnel & Otau Aqueduct for early detection
- Seismic upgrade & bridge the aqueduct



# Otau Aqueduct

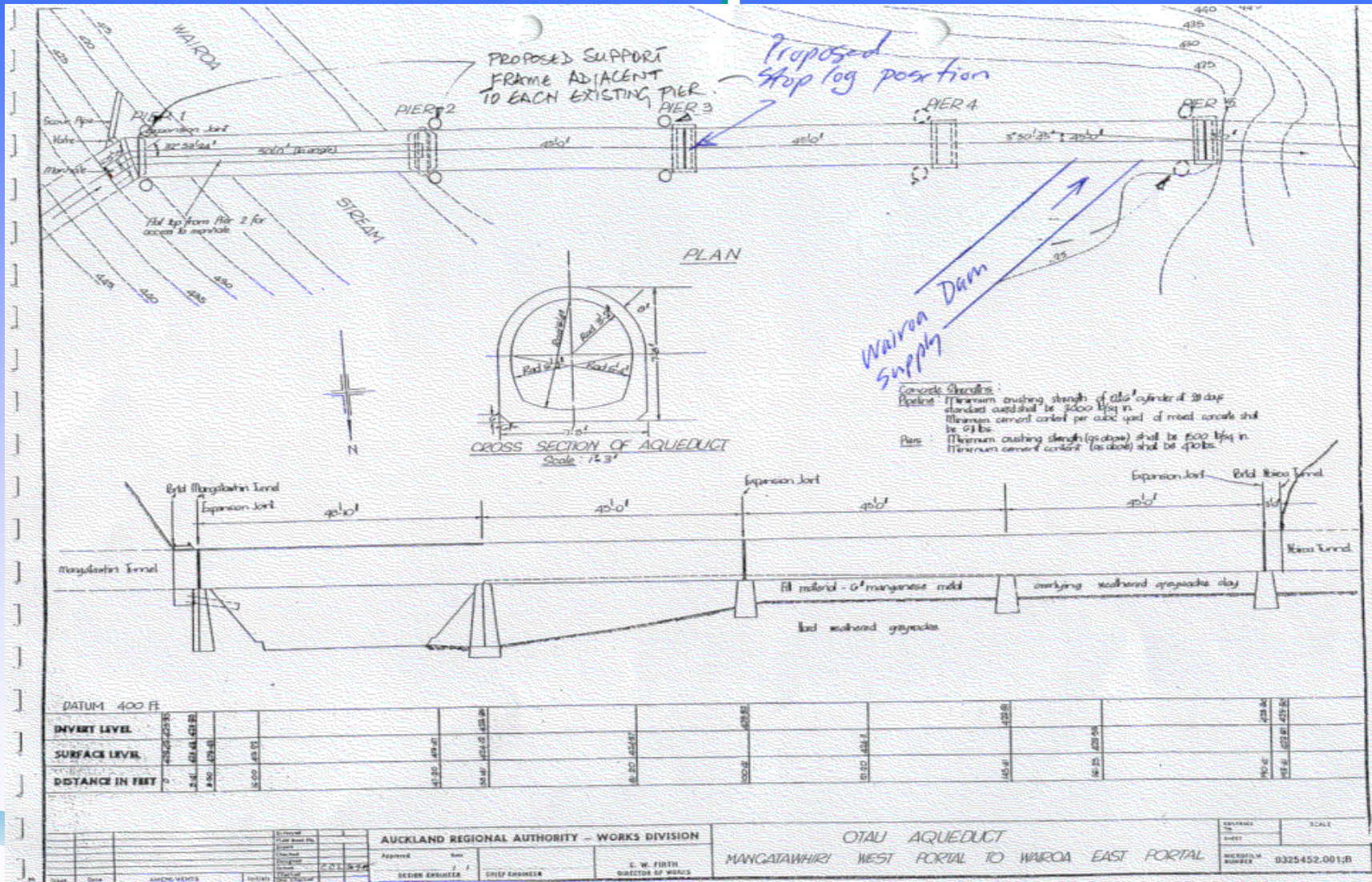


# Otau Aqueduct

- Built in 1965
- Located across the Wairoa Stream below the Wairoa Dam in the Hunua Ranges
- 1.9m "Horseshoe" shape RC aqueduct on piers between two tunnel portals
- Transports water from Wairoa, Mangatangi and Upper Mangatawhiri dams.
- Carries ave. 190MLD and up to 295MLD
- 50% of Auckland's water supply
- From Mangatangi, U Mangatawhiri & Wairoa dams



# Otau Aqueduct



# Contingency Plan

- Otau Aqueduct Failure
  - Strategy to bring on Wairoa source ASAP (135MLD)
  - Purchased “vetter” bag
  - Fabricated a “stop log”
  - 1700mm nom. dia pipe “sleeve” & support system
- Wairoa Tunnel
  - 1700mm dia pipe “sleeve”

# Exercise

- AWICP Exercise Scenario
  - Assumed collapse of river span
  - Projects - heavy demolition & construction
  - Operations - network configuration
  - LNO's & Public Health







# Cosseys Raw Watermains

- Capex \$16M approved 03/07 for construction of 3200m of 1500mm dia pipeline
- Objectives
  - Provide 140MLD abstraction capacity from Cosseys Dam
  - Replace aging Hunua No 1 & No 4 raw watermains













# Challenges

- May/July 2008 Major network cut-overs into:
  - Hunua No 2 1070mm – no constraints
  - Hunua No 3 1900mm – major operational constraints
    - Ardmore on min. flow 140MLD
    - Reliant on Cosseys 65MLD & Hunua No 2 64MLD (ex Wairoa Tunnel)
    - 10% headroom demand/supply
    - Other WTP's at max. production
    - Waikato WTP (75MLD) power critical
    - Max. utilization of network reservoir storage

# Cosseys Dam Abstraction Upgrade

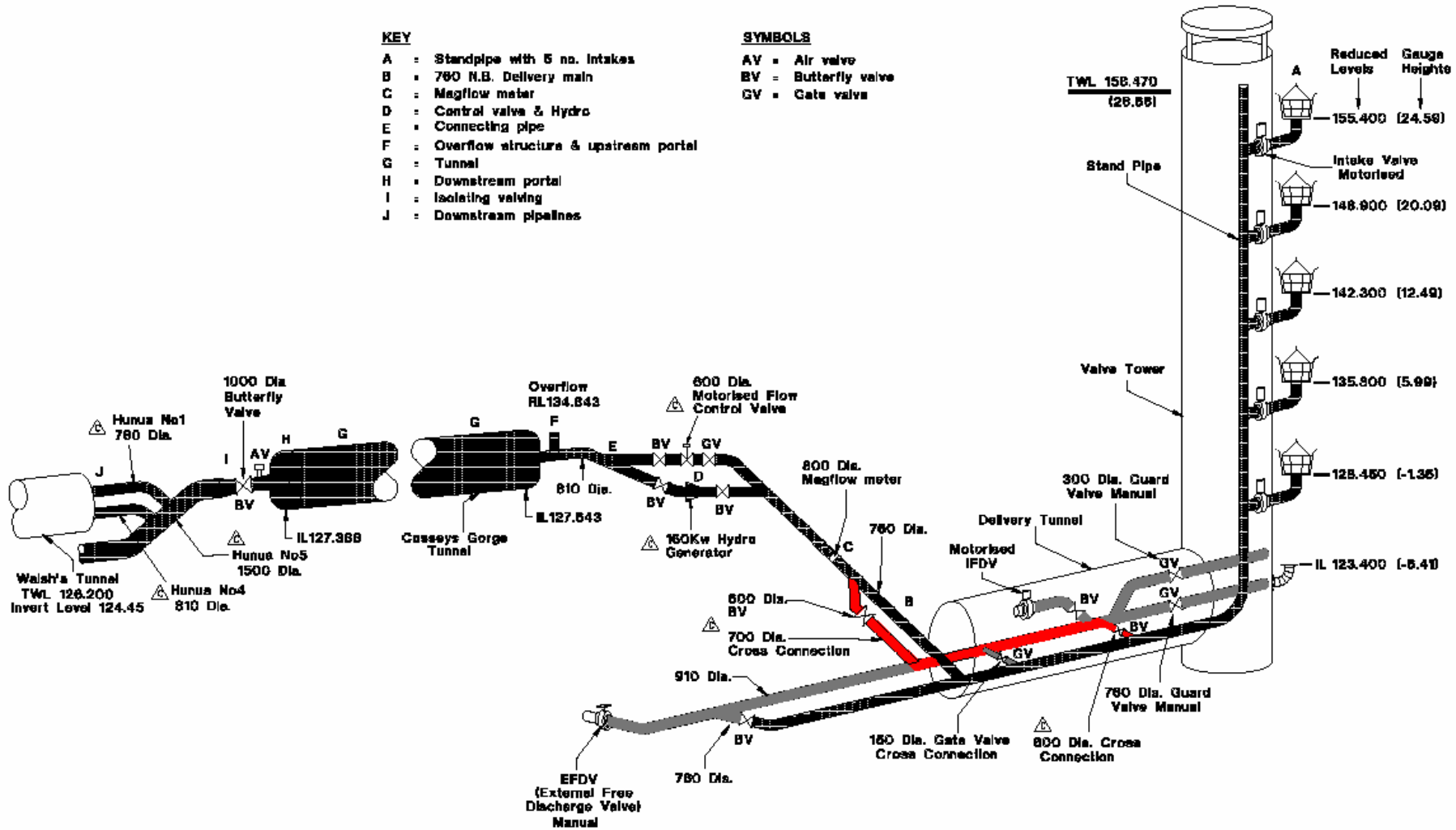
- Concurrent with raw watermain works
- Upgrade abstraction from 65MLD to 140MLD
- Enable “mine” the source if required
- Up to six months resource available
- Cross-connection delivery pipe and scour pipe
- Valving automated and remote operation

**KEY**

- A : Standpipe with 5 no. Intakes
- B : 780 R.B. Delivery main
- C : Magflow meter
- D : Control valve & Hydro
- E : Connecting pipe
- F : Overflow structure & upstream portal
- G : Tunnel
- H : Downstream portal
- I : Isolating valving
- J : Downstream pipelines

**SYMBOLS**

- AV = Air valve
- BV = Butterfly valve
- GV = Gate valve



DESIGNED	T. OMBEL	1-05			
DES. CHECKED					
DRAWN	L.A. VOLUME	1-05			
CHKD					
INSTR. CHECKED					
PROJECT LEADER					
NO APPROVED					
BY					
DATE					

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HUNUA No1 WATERMAIN  
 WALSH'S PORTAL TO COSSEYS DAM  
 LONGITUDINAL SECTION & SCHEMATIC DETAILS

GND FILE 2003197 ORIGINAL SCALE AT AS SHOWN	DATE 22-08-08 CONTRACT No. -
DRAWING No. 2003197	ISSUE C





# Cosseys Tunnel Upgrade

- 1950's 1.5 m tunnel
- Poor condition concrete lining
- Portals previously damaged in surcharging incident 1980ish due to operator error
- Upgrade to provide surcharged 140MLD capacity







# Mangatawhiri & Wairoa Tunnel Shut

29 June to 2 July 2009



# Shutdown Complexity

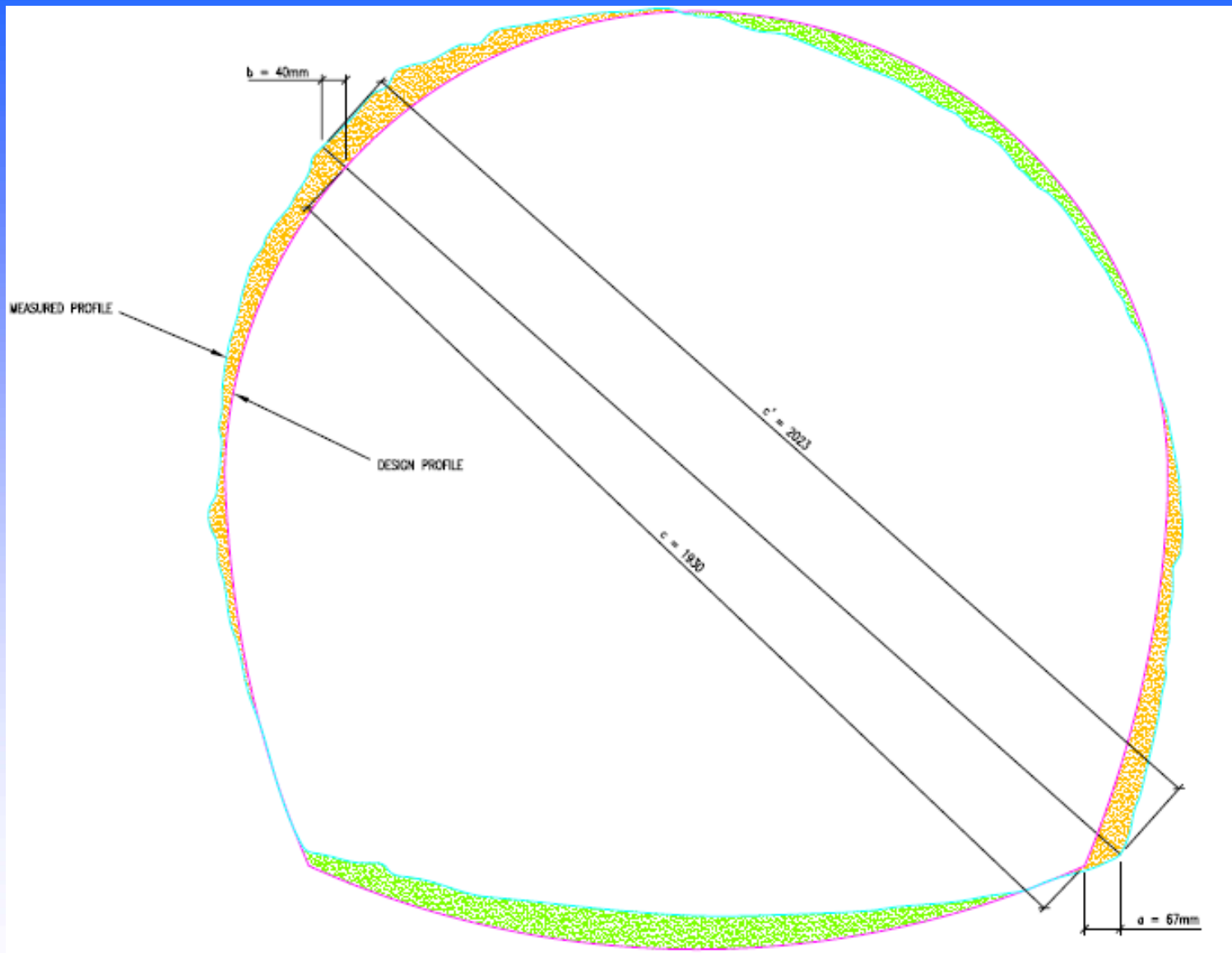
- Similar issues to previous Cossey's raw water main into Hunua No. 3
- Ardmore on min. flow 140MLD
  - Reliant solely on Cosseys source
  - 10% headroom demand/supply
  - Other WTP's at max. production
  - Waikato WTP (75MLD) power critical
  - Max. utilization of network reservoir storage

# Shutdown Objectives

- Shutdown for internal inspection Wairoa & Mangatawhiri Tunnels & Otau Aqueduct
- Condition & structural assessment
- Laser profiling of tunnel to compare against design profile (no as built) & future reference
- Installation of stop-log at Otau crossing to allow feed from Wairoa Dam and future maintenance of Mangatawhiri Tunnel
- Maintenance of penstocks at tunnel discharge portal







# Otau Aqueduct Stop-log



**Install stop log to isolate Wairoa Tunnel from upstream system**



**New Stop log during installation**



# Opportunity



- Hunua Fire brigade had a rescue in a tunnel with over 20 fireman

# Costs

- Remote monitoring - \$150k
- Cosseys Tunnel Upgrade - \$1.95m
- Cosseys Dam Increased Abstraction - \$500k
- Cosseys Raw Watermain Capacity Upgrade - \$16.6m
- Otau Crossing Seismic/Structural - \$500k
- Bridge Otau Crossing - \$100k
- Total - \$19.8m

# Achieved

- Inspection and condition assessment of Wairoa & Mangatawhiri Tunnels
- Seismic & structural resilience of Otau Aqueduct
- Provided operational headroom
- Replaced aging infrastructure
- Identified structural issues Wairoa Tunnel
- Installed remote monitoring
- Enabled future inspection & maintenance of Mangatawhiri tunnel
- Maintained assets previously deferred due to lack of systems headroom

# Network Valve Automation

# Network Valve Automation

- Objectives:
  - To facilitate prompt and efficient water network reconfiguration in planned operations and in response to emergency situations
  - Remote operation for CCR
  - Protect against network drawdown & loss in major pipeline failure incidents



# Current & Planned

- Historically 2 installed at Khyber Res
- Hunua No 3 & Huia No 2
- 3 installed 2008/09 year approx. \$300k ea.
- Capex approved for a further 5 at \$1.9m
- Plus 4 on 2 Auckland Harbour Br. watermains



1200mm valve being installed in Huia No 2 watermain in  
Titirangi August 09

