Water Supply Trunkmains

Queenstown Lakes District Council Land Development and Subdivision Code of Practice Addendum

Date: February 2022

QUEENSTOWN LAKES DISTRICT COUNCIL

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INTRODUCTION

1.1. SCOPE

This document forms an addendum to the Queenstown Lakes District Council's (QLDC) Land Development and Subdivision Code of Practice (CoP) to cover specific requirements relating to the design and construction of bulk supply mains for potable water. These are referred to as trunkmains or falling mains throughout this document. The distinction between a trunkmain and a falling main is:

- **Falling Main** – Pipeline from the reservoir feeding into the **trunkmain.** The falling main may be above or below level of service pressure (300 kPa – 900 kPa) and shall have no offtakes.
- **Trunkmain** – Pipeline that is within the level of service window (300 kPa- 900 kPa) and may have offtakes for water supply. May be supplied via a **falling main**.

This addendum is not intended as a standalone document and must be used in conjunction with the QLDC CoP and standard design/project management practices. Unless otherwise specifically noted within this document all trunkmain designs must comply with the requirements outlined in the most up to date version of the QLDC CoP. Water supply requirements are outlined in Section 6 of the CoP.

For ease of reference the headings in this document have been amended to reflect the corresponding sections of the QLDC CoP.

Where smaller infrastructure is directly associated with a transmission system it must be completed to the transmission standards of the larger infrastructure that is connected to, e.g. the smaller sizes of a trunkmain system such as bypasses around line valves or the supply to a bulk supply point.

This addendum includes considerations for:

- Criticality and resilience
- Hydraulic design
- Location, layout and clearances of pipelines and associated infrastructure
- Pipe structural design

This addendum excludes specific requirements for:

- Pump stations
- Treatment plants and processes
- Structural design of associated structures such as bridges or buildings that are covered by the New Zealand Building Act
- Electrical and control/automation design
- Reservoir facilities – these are covered in a separate addendum

1.2 REFERENCED STANDARDS

This addendum must be read in conjunction with the Queenstown Lakes District Council's *'Land Development and Subdivision Code of Practice',* national, and international standards listed below. Where conflict or ambiguity exists this addendum shall take precedence. Where

this is conflict between referenced standards, the higher level of standard shall take precedence.

1.2.1 NATIONAL AND INTERNATIONAL STANDARDS

NZS 1170 Structural design actions
Part 5 Earthquake actions – New Zealand
Part 5 Supp 1 Earthquake actions – New Zealand – Commentary

AS/NZS 4219 Seismic performance of engineering systems in buildings

AZ/NZS 2566 Buried flexible pipelines
Part 1 Structural design
Part 1 Supp 1 Structural design – Commentary

1.2.2 OTHER PUBLICATIONS

Menon, E Shashi, 2015. Transmission pipeline calculations and simulations manual

American Lifelines Alliance, 2005. Seismic Guidelines for Water Pipelines

NICEE, 2007. Guidelines for Seismic Design of Buried Pipelines

Opus International Consultants, Water NZ, 2017. Underground Utilities – Seismic assessment and design guidelines

Roberts, R, New Zealand Geotechnical Society, 2017, New Zealand Ground investigation specification, Volume 0, 1, 2 and 3

Moore, I.D, 1993. Structural design of profiled polyethylene pipe

Gumbel, J.E and Wilson J, 1981. Interactive design of buried flexible pipes – a fresh approach from basic principles, V14 No.4

Mott, R L, 1994. Applied fluid dynamics, 4th Ed.

1.2.3 WATERCARE STANDARDS

DP - 10 Safety in Design guide

DP - 11 Watercare, 2017. Health and Safety in Facility Design DP-09 Electrical design standard

CG - General civil construction standard

ME - General mechanical construction standard

MS - Material supply standard 7363 - Watercare CAD manual

AI - Data and Asset Information standard

DW05 - Access structure drawings for wastewater infrastructure DW06 - Access structure drawings for water infrastructure

DW07 - Access structures general drawings for public and non-public areas

DW10 - pipelines for water greater than 250mm diameter drawing set DW11 - Valve chamber detail drawings for transmission water

DW12 - Water stand-alone sampling and rainfall metering COP-03 Code of Practice for commissioning

COP-04 Code of Practice for disinfection of water systems

1.3 EXISTING INFRASTRUCTURE

Replacing existing or installing new trunkmain infrastructure will typically involve connecting to or undertaking work on existing infrastructure. The age and operational changes to its original design may impact on the new infrastructure connecting to it. The designer shall include in their design appraisal of the following factors and information (to be provided by QLDC):

- As-built drawings
- Existing calculations
- Site testing records
- Field investigations
- Commissioning records
- Geotechnical reports
- Operation and Maintenance manuals
- Standard operating procedures

2 SCOPE

The following section contains notes for existing clauses; amendments to existing clauses; or additions to clauses of the QLDC CoP. For ease of reference, the numbering of clauses are consistent with those within the 2020 QLDC CoP. Where a clause is not listed in this addendum, the design guidance noted in the CoP shall be used.

6 WATER SUPPLY

6.2 General requirements

6.2.1 Objectives

(a) and (b) are not applicable to trunkmains.

6.2.2 Reference documents and relevant guidelines

Additional reference documents are noted in Section 1.2 of this document.

6.3 Design

6.3.4 System design

Water demand shall be specified by QLDC for all trunkmain infrastructure. The designer shall be responsible for requesting this information from Council.

6.3.5 Design criteria

6.3.5.2 Network analysis
Network analysis is required for all trunkmain infrastructure.

6.3.5.5 Minimum flows
Trunkmains shall not have maximum flow velocities less than 0.5 m/s.

6.3.5.6 Minimum water demand
Minimum water demand is to be discussed and confirmed with QLDC for each trunkmain project.

6.3.5.7 Sizing of mains
Sizing of mains are to be determined based on the trunk main's function and confirmed with QLDC for each trunkmain.

The sizing should consider:

- If the trunkmain is upstream or downstream from the reservoir
- The zoning of area that it services (commercial, industrial, residential)

The flow rates for calculating the size of the trunk main shall be calculated by considering the current water demand usage with the consideration of water demand management over time.

6.3.5.8 Pressure zones
Pressure zone requirements are to be discussed and confirmed by QLDC for each trunkmain project.

6.3.5.9 Maximum pressure requirements
Maximum pressure requirements are to be discussed and confirmed by QLDC for each trunkmain project.

6.3.7 Flow velocities

6.3.7.1 Surge analysis

A surge analysis shall be undertaken for all trunkmain projects. The source of any significant pressure surges or high-pressure areas shall be identified and remedial measures to minimise pressure surges designed and specified.

6.3.8 System Layout

6.3.8.1 General

Trunkmain layout shall consider the road layout and existing services. Layout of the trunkmain must be demonstrated to be the most appropriate option for the road category, and agreed with the Chief Engineer.

6.3.8.2 Reticulation layout

Not applicable for trunkmain projects.

6.3.8.4 Water mains in private property

No trunkmains or critical infrastructure are to be installed in private property.

6.3.8.6 Water mains near trees

No trunkmains are to be installed within the root zone of trees.

6.3.8.7 Shared trenching

No trunkmains are to be installed in a shared trench.

6.3.8.8 Rider mains and duplicate mains

Outside the scope of this document

6.3.9 Clearances

6.3.9.2 Clearance from structures

No trunkmains are to be installed in the ‘zone of influence’ of any building foundations. Trunkmains must have a minimum clearance to a wall or building of 3m (retaining walls or roading ancillary structures only).

6.3.9.4 Deviation of mains around structures

Trunkmains shall normally follow the road layout. Deviation of a pipeline to follow the road can be achieved by deflection of the pipeline at joints, to the angular deflection limits stated by the pipe joint manufacturer and with suitably restrained fitting bends. Permitted angular deflection varies with pipe material, pipe wall thickness, pipe PN class, joint type, design, and geometry. Some joint types are specifically designed to accommodate angular deflection. PE pipes may also be curved along the pipe barrel, between joints, to a minimum radius of curvature not less than that stated by the pipe manufacturer.

6.3.10 Pipe selection

6.3.10.1 Standard pipe sizes

This clause is not applicable for trunkmains. The trunkmain is to be sized appropriately for the network requirements, and specific pipe ordered for the project.

6.3.10.3 Pipe PN class (pressure rating)

The minimum pipe and fittings PN to be used for trunkmains shall be PN 16 unless proof can be provided that PN 16 is unnecessary.

6.3.12 Structural design

6.3.12.2 Seismic design

All trunkmains shall be of pipe function class '3 – Critical' and shall be designed in accordance with the design safety factors set out in Table 1 below:

Table 1. Design Safety Factors

Pipe Function Class	Description	Design Safety Factors				Seismic return period factor (NZS1170) R_u
		Peak ground acceleration	Liquefaction /subsidence	Landslide /lateral movement	Surface loading	
3 Critical	Pipelines servicing larger numbers of customers (>10,000 people) that if lost causes significant economic impact or hazard to human life, the natural environment and properties.	**1.8**	**1.35**	**1.6**	**1.5**	**1.8**

6.3.12.8 Above ground water mains

This clause is not applicable for trunkmains. No trunkmains are to have above ground infrastructure.

6.3.12.9 Trenchless technology

Trenchless technology requires specific discussion with QLDC.

6.3.12.10 Embedment

6.3.12.10.1 Minimum pipe cover

All trunkmains shall have minimum 1.0 m cover. This depth may need to be increased for larger pipe diameters (typically over 800 mm) where impediments such as air valves or utility services exist. The pipe depth shall also consider existing and future connections to the trunkmains.

6.3.12.10.2 Minimum trench width

Pipe trench width design considerations shall be based on the minimum side clearances detailed in Appendix A**.**

6.3.12.11 Pipeline restraint

6.3.12.11.3 Restrained joint water mains

These systems are not appropriate for trunkmains. Refer to requirements outlined in 6.3.12.11.1 and 6.3.12.11.2.

Additional clauses as below:

6.3.12.12 Buoyancy prevention

(a) Buried structures and pipelines susceptible to hydraulic uplift shall be designed with buoyancy prevention to a safety factor of 1.5.

(b) The designer shall consider that filled pipes may require emptying for maintenance purposes. Hydraulic uplift shall consider all structures and pipelines in an empty state.

(c) The effects of liquefaction on filled, partially filled, and empty structures and pipes shall also be considered when determining suitable weighing or anchoring solutions.

6.3.13 Reservoirs and pumping stations

Design and construction of reservoirs and pumping stations fall outside the scope of this document. Refer CoP addendum for Reservoirs.

6.3.14 Valves

6.3.14.1 General

In addition to the CoP the following requirements apply to trunkmains:

If actuator valves are installed, these must be connected to SCADA for monitoring. If no actuator is being installed there is no requirement for a SCADA connection.

For trunk mains over 600 mm (ID), the isolation valve shall include an isolation bypass to allow for recharge and/or draining. Where an isolation valve is at a low point of the trunkmain, a double isolation bypass setup is required to allow drainage of either side of the isolation valve. Otherwise, only a single isolation bypass is required.

Gate/sluice valves are to be used for pipe sizes up to 300 mm and geared butterfly valves for larger sizes (note that these require chambers).

For trunk mains larger than 600 mm (ID) the trunk main pipe diameter may be locally reduced for the economic benefit of a smaller isolation valve **if** hydraulically feasible.

Valve trains in sequence shall be of the same size.

Bypass valves are typically smaller than the main isolation valve to facilitate mainline charging and drainage. Bypass pipework shall be PE100.

Where the supplier does not have a standard valve set with a built in bypass, the horizontal clearance between the main line and bypass shall be 300 mm minimum at the closest point.

Handwheels shall be at least 300 mm clear of obstacles.

Where pipe reducers are used they shall be eccentric reducers tapering down from the bottom of the pipe.

Drain/charge points shall be provided at each end of the trunkmain installation, the valves may be direct buried outside the chamber.

Pipework shall be designed to allow for vertical lifts on equipment that requires ongoing maintenance.

Above ground isolation valves on control valve trains shall be fitted with handwheels.

6.3.14.2 Siting of valves

In addition to the requirements outlined in the CoP, the following requirements apply to trunkmains:

(e) Mainline isolation (line valves) are to be spaced to provide drain down time within 6 hours. Some standard spacings are shown below in Table 2.

(f) Mainline isolations are to be installed at bulk supply points to maintain continuity of water supplies and good locations for discharge of pipe drainage to stormwater or permeable ground.

(g) Isolation valves are to be installed in dry chambers or direct buried. The installation location must be demonstrated to be the best practicable option with consideration to:

- The need for ancillary equipment such as actuators.
- The type of valve being installed. Typically gate valves are best suited for buried applications.
- The whole of life cost benefit for the proposed installation method.

6.3.14.3 Gate valves
Valves 80≤ DN ≥300 shall be gate valves.

6.3.14.3.5 Valves
Butterfly or gate valves shall not be used for flow or pressure modulation. Fit for purpose control valves shall be used.

Control valves shall typically be SCADA monitored and may require to be fitted with an actuator for remote operation. All control valves shall be connected to RTU via fibre network if available.

Control valves shall be installed in an above ground building or dry chamber (dry chambers must include a drain to remove any moisture or water leaks). The installation location must be demonstrated to be the best practicable option.

Valve trains installed in sequence shall be of the same diameter, however where it may be considered that a future upgrade will require the valve train to be up-sized the isolation valves may be selected to be greater in diameter.

6.3.14.5 Pressure reducing valves
All pressure reducing valves are to have bypasses installed.

PRV bypass pipework shall be designed for the maximum ultimate flow rate in the pipeline at the projected minimum pressure differential.

6.3.14.6 Air valves

6.3.14.6.1 Installation design criteria
In addition to the requirements of the CoP, the following applies:

(a) Air valves shall be installed in dry chambers

(b) Air release valves shall be installed with eccentric reducer at the pipe soffit. The eccentric reducer shall be sized for optimal collection.

(c) Air valves shall be fitted with an isolation valve to allow the valve to be removed or replaced without isolating the main. Isolation must be below ground if the air valve is above ground.

(d) The air release valve vent shall be above the groundwater and 100 year flood levels. Direct connection to a surface vent may be required, or the valve must be vented through a flood-safe valve.

(e) Where air valves are installed underground within chambers the lid arrangement does not typically allow for adequate air flow rate. An air vent is required to be installed in the back berm and connected to the underground air valve chamber.

(f) Where the flow velocity in the pipeline is more than 2.4 ms-1 the air valve shall be fitted with an anti-slam device/feature.

6.3.14.7 Scours and pump-out branches
Change (a) to:

Scours shall drain the water main by gravity or have provision for pump-out within a period of 6 hours.

6.3.14.7.1 Scour Sizes

Scours must be sized appropriately to provide drain down time within 6 hours. Example spacings and sizes are shown below in Table 2.

Table 2. Minimum Scour Diameter for Trunk Mains

Trunk Main Diameter, mm	Minimum Scour Pipe Internal Diameter, mm	Maximum Pipe Length, m
DN ≤ 450	80	5000
450 < DN ≤ 630	100	4000
630 < DN ≤ 800	150	3000

Notes:
1. This table provides guidance for sizing scour points on trunk mains to comply with the maximum allowable drain time noted in clause 6.3.14.2 and 6.3.14.7.1. The table values have been calculated using an indicative initial 10 m hydraulic head above the scour point. Designers should satisfy themselves that any significant deviations from these guidance parameters in their design do not incur an exceedance of the maximum drain time. Any deviation from the guidance parameters will require validation with QLDC.
2. The calculation parameters assume pipe friction and turbulence are negligible
3. Maximum pipe length is the length of pipe that will drain through the scour should it be opened, i.e. the length between significant high points either side of the scour point.
4. Trunk main diameters are based on PE100 PN16 pipes.
5. Scour diameters based on standard DI fittings.
6. The draining pipe is assumed to operate under atmospheric pressure, noting air valves will be open when draining.

6.3.14.7.2 Scour locations
Replace (c) to (f) with:

(c) Scour design to flush mains and remove sediment shall be in a suitable location for high velocity discharge at a minimum mainline velocity of 0.8 ms^{-1}. Scour valves selected shall be suitable for the design target velocity.

(d) The scour discharge shall allow for adequate attenuation of the discharge energy such as rip-wrap or a stilling chamber. The location shall be suitable for the maximum volume to be discharged.

(e) Scour points for treated water shall consider de-chlorination requirements and provide a suitable mixing point or structure.

(d) Access to scour valves shall be off the carriageway and footpath.

(e) Scour valves are to be installed on lines greater than 300 mm.

6.3.14.8 Non Return Valves

(a) Non-return valves shall be installed as part of an isolation valve train to allow the valves to be taken out of service for maintenance.

(b) Where reverse flow in the main may occasionally be required, an unobstructed bypass around the NRV may be installed and isolated during normal flow direction.

(c) The design shall consider the need for an anti-slam device.

6.3.16 Connections

The water bulk supply point shall be located at a mainline isolation point for bi-directional feed from the bypass pipework to provide security of supply.

Where there is a take-off from the trunk main, each side of the 'T' shall have a valve installed to allow for future connections. Each take-off location shall include one hydrant in between the three-valve setup.

6.3.18 Water Meters and Backflow Prevention

All pressure zones within the network must include source totalling meters installed as appropriate to quantify the zone flows.

(a) The meter must be selected at a suitable flow velocity for optimal accuracy (to be confirmed with QLDC). This often requires that the pipeline be reduced in diameter. Reducers shall be concentric.

(b) Meters for trunkmains shall be electromagnetic type.

(c) The meter manufacturer's clear upstream and downstream diameter to length ratio shall be observed, taking into account the effect of reducers which may require greater clearance than valves and other fittings.

(d) Valve trains installed in sequence, including meters and strainers, shall be of the same diameter. However, where it may be considered that a future upgrade will require the valve train to be up-sized the isolation valves may be selected to be greater in diameter.

(e) Meters are to be installed in a dry chamber or above ground building.

6.3.19 Building over Council Infrastructure

This clause is not applicable for trunkmains.

6.5 Construction

6.5.2 Embedment

Embedment detail shall be as per Appendix A.

6.5.3 Backfilling and reinstatement

6.5.3.2 Berms

Trunkmains are not to be laid in berms.

6.5.5 Disinfection of water mains

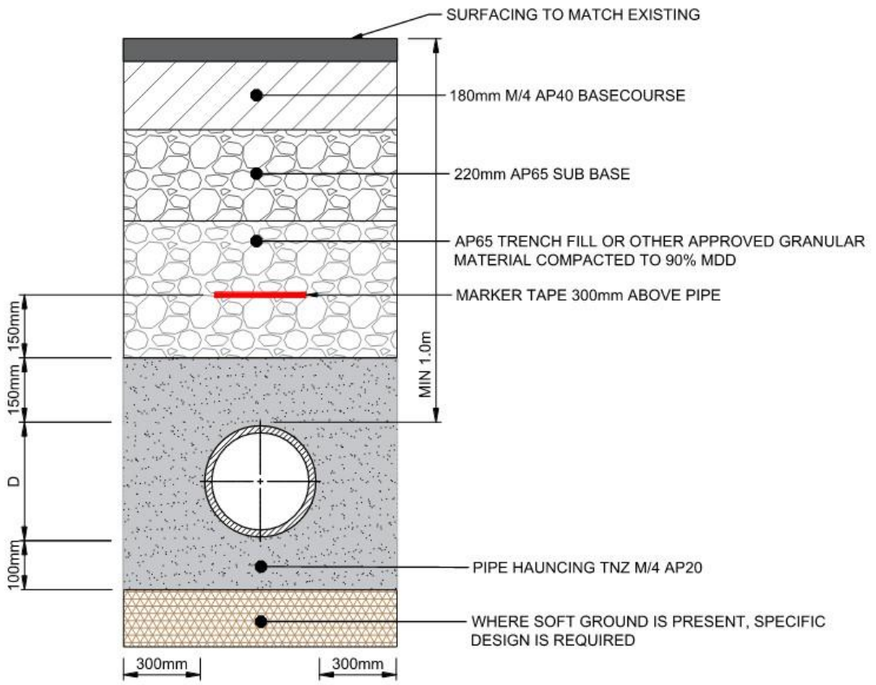
Disinfection of all trunkmains shall be in accordance with the QLDC Land Development and Subdivision Code of Practice:2018 Appendix D – Water Supply Disinfection Specification.

6.5.8 Pipe trench dewatering

(a) Where the pipe runs along a steep slope (≥15°) or where there is a high water table, the use of trench stops with suitable draining solutions must be considered.

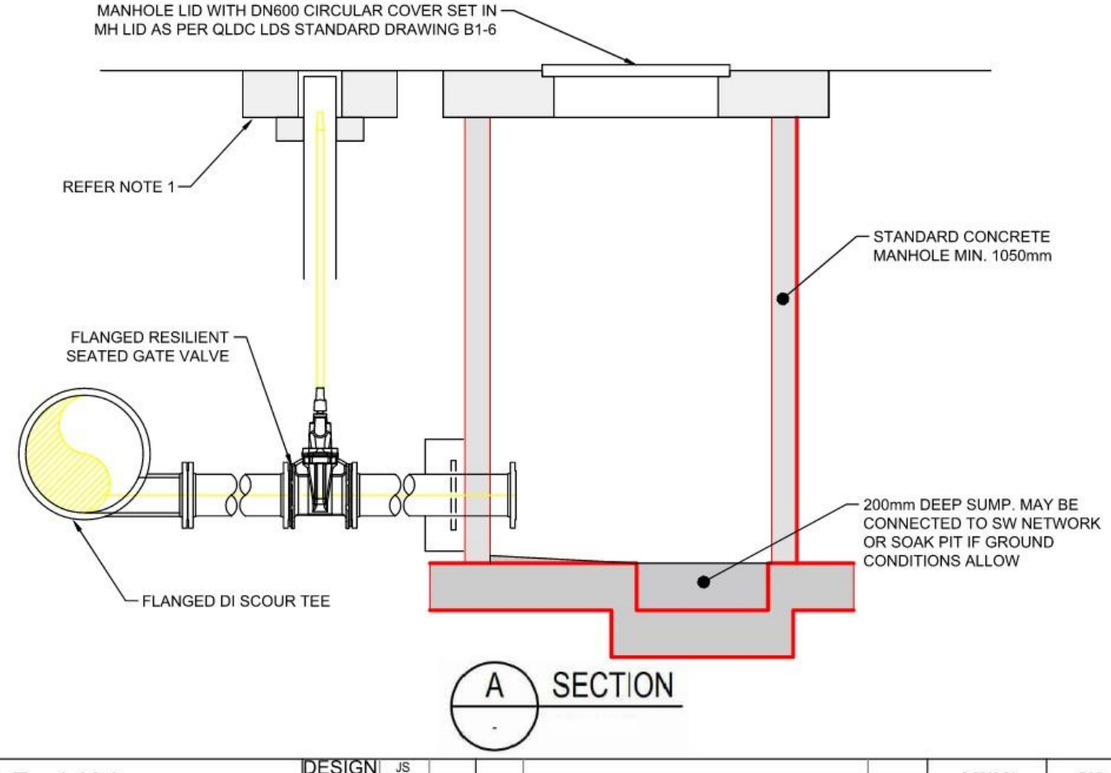
(b) Where dewatering is not practical, alternative solutions (such as specific trench design with suitable geotextile lining or pipe anchorage) for effects of hydraulic uplift must be addressed in the design

APPENDIX A. TYPICAL DETAILS



TRENCH EMBEDMENT DETAIL

TYPICAL SCOUR VALVE DETAILS



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QLDC Water Supply Trunk Main
Typical Scour Valve and Trench Embedment Details

DESIGN	JS			2-0343.01	FOR APPROVAL
DRAWN	BS			DWG No.	
APRVD	JS			N.T.S	A
PROJECT #: 2-0343		A	Initial design	21/01/2022	
		REV	DETAILS	DATE	SCALE / REVISION