Wellington Water

Regional Standard for Water Services

STD_0001

December 2024 Version 3.1

Our water, our future. Our water, our future.

This document was developed for Porirua, Hutt, Upper Hutt and Wellington city councils, South Wairarapa District Council, Greater Wellington Regional Council and Wellington Water Limited.

Document Control

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Description	Name	Date	Signature
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1 INTRODUCTION

Wellington Water Limited is a shared service, council-controlled organisation, which is jointly owned by Hutt, Porirua, Upper Hutt and Wellington City Councils, South Wairarapa District Council and Greater Wellington Regional Council. On behalf of these councils, the three waters network (stormwater, wastewater and water supply) is managed under a trusted advisor model.

The STD_0001 Regional Standard for Water Services (version 3.1) serves as an updated version of three waters infrastructure standards, to ensure a regionally consistent method of design and implementation of water services to meet outcomes of:

- Safe and healthy water,
- Respectful of the environment, and
- Resilient networks support our economy.

This revision also reflects changes to legislative responsibilities since the introduction of Taumata Arowai (the national regulator for water services) and the Water Services Act 2021.

This document promotes consistency within the local industry for the benefit of developers, designers, suppliers, and councils. There are a few clauses particular to each city, but it is expected these differences will reduce over time as design philosophies consolidate through collaborative consideration.

The document provides minimum standards for the design and construction of proposed three waters infrastructure that will be vested in council, and to the maintenance, renewal, upgrade or decommissioning of existing public infrastructure. It is also expected that developers may seek innovative solutions to design issues, in particular carbon emissions, wherever possible in the achievement of a higher standard.

The *Regional Standard for Water Services* (RSWS) is to be used in conjunction with the STD_0002 *Regional Specification for Water Services* (R.Spec) (available on the Wellington Water website. The *Regional Specification for Water Services* contains the minimum technical specifications for the materials, construction, installation, testing and commissioning of the stormwater, wastewater, and water supply networks.

1.1 Review of standard

The *Regional Standard for Water Services* will be reviewed and revised as needed, particularly as policy and technology evolves. Users of this document should ensure that the latest published version is used.

Feedback on the standard can be made to the following email: standards@wellingtonwater.co.nz.

2 USING THE REGIONAL STANDARD FOR WATER SERVICES

The *Regional Standard for Water Services* provides minimum standards that must be applied to the design and construction of proposed stormwater, wastewater and water supply infrastructure that will be vested in council, and to the maintenance, renewal, upgrade or decommissioning of existing public three waters infrastructure.

This standard supersedes the *Regional Standard for Water Services* V3.0 (December 2021). Departures from this standard require the written permission of Wellington Water.

2.1 Document structure

This document is structured such that provisions specific to stormwater, wastewater and water supply are divided into four sections:

1. **Objectives:** The objectives outline the broad, overarching objective of the network.
2. **Performance Criteria:** The performance criteria outline the minimum operational and functional levels of service expected from proposed developments and/or upgrades.
3. **Design Methods:** Design methods describe the design methodology that is considered acceptable for the purposes of establishing the effectiveness of proposed solutions.
4. **General Specifications:** General specifications describe acceptable engineering methods that constitute a standard acceptable method of compliance with the objectives and performance criteria. This section should be read in conjunction with the *Regional Specification for Water Services*.

2.2 Definitions

For the purposes of this document, the following definitions and abbreviations shall apply.

2.2.1 Nominal pipe diameter

All pipe diameters referred to in this document are in millimetres (mm) and are nominal internal diameters unless specifically noted otherwise. Only polyethylene (PE) pipes are denoted with a nominal outside diameter and this should be post-fixed with the letters OD. For example:

63 OD is 63 mm nominal outside diameter; and

100 mm is 100 mm nominal internal diameter.

2.2.2 Definitions

Table 2-1 provides the terms used in this document:

Table 2-1 – Definitions

Term	Description
Annual exceedance probability	The probability of an event happening in any one year, typically expressed as a percentage (10%) as opposed to a ratio (1 in 10 years).

Term	Description
Aquatic receiving environment	Waters, including wetlands, which serve as a habitat for interrelated and interacting communities and populations of plants and animals.
Average dry weather flow (ADWF)	The average sanitary flow in the wastewater sewer over a 24-hour period during Dry Weather.
Building line restriction (BLR)	An angled line projecting up to the surface from below the pipeline.
Building in close proximity	Building works near new or existing public pipelines, and/or laying new or upgraded public pipelines near an existing structure or retaining wall.
Building near	Building in close proximity within a horizontal distance of 3 m measured from the outside of pipe, or within 5 m for pile driving (see **Figure 3-2**).
Building over	Building in close proximity within a vertical height above the finished ground over a pipe that equals the depth to pipe invert plus 1 m, with a minimum height of 2.4 m, and a vertical depth of 300mm below the pipe invert (see **Figure 3-2**).
Building over and near	Building works within a zone around a pipe bounded horizontally by the lateral distance defined as building near, and the vertical height and depth defined as building over (see **Figure 3-2**).
Building works	Structures, retaining walls, or any other works which may compromise the integrity, durability or accessibility of a pipe, or be compromised by a pipe. This includes new buildings and structures, modification of existing structures, demolition, temporary works including heavy machinery, excavation works and any work that changes the current form and shape of the ground.
Bulk water pipeline	Water supply pipeline from the water treatment plants to the network. The pipes are usually larger than 375 mm and can be as large as 1400 mm in diameter. Also referred to as “bulk main”.
Commissioning	In regard to water supply, a process by which agreement is reached that the installed system meets the design performance specification.
Council	The participating territorial authority within which the boundaries of the proposed scheme or renewal is located; or a delegated representative thereof (e.g., Wellington Water).
Culvert	A pipe, typically passing under a road or embankment, which links two open watercourses.
Designer	The developer’s professional advisor, appointed by the developer to complete the investigation, design, contract administration, construction supervision, and certification of the works on completion.

Term	Description
Developer	An individual or organisation having the financial responsibility for the project and includes the owner, contractor and constructor.
Drainage	Wastewater or stormwater pipework, channel or stream, and drain has a corresponding meaning.
Drinking water	Water that— (a) is safe to drink; and (b) complies with the drinking water standards made under section 47 of the Water Services Act 2021.
Grey water	The wastewater from sinks, basins, baths, showers and similar appliances but not including any toilet waste.
Household unit or dwelling unit	Any building or group of buildings, or part thereof used or intended to be used, principally for residential purposes and occupied or intended to be occupied by not more than one household.
Hydraulic neutrality	Land development, including increased imperviousness, does not increase the peak design discharge (post development) to greater than the peak design discharge (pre-development) for all events up to and including the 1% AEP rainfall including the predicted impacts of climate change.
Lateral	The private, domestic drain connecting to the public wastewater or stormwater network.
Local/minor roads	All other roads which are not primary or secondary arterial roads.
Network	All pipes, pumping stations, fittings, reservoirs, structures, treatment facilities and any other appurtenant components or facilities directly associated with water supply, wastewater or stormwater.
Manifold	A fitting on a water supply service pipe that typically incorporates one or more sets of a service valve, backflow protection device and meter.
Maximum day	Shall be a day where the water demand is greatest and the hydraulic grade line of the network is drawn down to its lowest operating level. A Maximum Day would typically be a hot, dry day in the February – March period of summer.
On-site disposal	The treatment and disposal of wastewater or stormwater within the boundaries of a private lot, typically residential.
Overland flow	See ‘secondary flow’.
Potable water	The same meaning as ‘drinking water’.
Point of supply	The legal boundary between private and public water supply as defined in each councils’ water supply by-law.

Term	Description
Primary flow	The estimated stormwater flow resulting from the event outlined by the primary level of service, and is typically fully contained within the Primary Network.
Primary network	The stormwater network designed to collect and dispose of the primary flow without surcharging/overflowing.
Primary arterial	Roads providing interconnections between major sectors of a large area linked with external areas, and that distribute traffic from major intercity links. Defined by the roading and traffic department, but typically has traffic volumes of 7,000 to 10,000 vehicles per day with a significant number of heavy vehicles. Includes state highways.
Principal main	A water main, typically 100 to 200 mm in diameter, that provides the firefighting and majority of supply in a street. Sometimes called a distribution or secondary main.
Pumping station (in water supply)	A facility for mechanically increasing pressures in a pipeline. Typically used to fill reservoirs or increase pressures in a distribution zone.
Pumping station (in wastewater)	A facility for mechanically increasing pressure in a pipeline, or to lift effluent to a higher elevation in an adjacent manhole (lifting station). Typically used to convey collected effluent to an adjacent catchment or large sewer.
Pumping station (in stormwater)	Similar to pumping station (wastewater) but designed to convey the stormwater to a safe discharge point.
Regional plan	Planning document developed to assist a regional council to carry out any of its functions in order to achieve the purpose of the Resource Management Act 1991.
Reservoir	A large, typically larger than 30 m^3, enclosed tank used to store drinking water associated with the public drinking water supply.
Reticulation main	A water main that distributes water to customer connections. Could be either a principal main or rider main.
Rider main	A water main, typically less than 100 mm in diameter, and secondary to any principal main in a street.
Rising main	A dedicated pipeline running between a pump's discharge and a nominated discharge point; typically a reservoir in water supply systems, or a manhole on a gravity drain for wastewater systems.
Supervisory control and data acquisition (SCADA)	The council owned and operated telemetry and control systems used to remotely monitor and control facilities such as pumping stations, reservoirs, large-scale metering installations etc.
Secondary arterial	Roads providing access to primary arterial roads. They have a dominant through vehicular movement and carry the major public transport routes. Defined by the roading and traffic department.

Term	Description
Secondary flow	The excess stormwater flow that cannot be contained by the primary network, typically due to extraordinary design storm or network blockage. Also referred to as overland flow or secondary overland flow.
Serviceability limit state (SLS)	In relation to seismic resilience, is defined in **Section 3.7.3.1 Definition of limit states**.
Service pipe	The section of pipe between a public drinking water reticulation main and the service pipe valve.
Service valve	An isolation (water shut off) valve on a service pipe where a connection is made between the Drinking Water Supply (in the street) and the private dwelling or commercial building. Sometimes referred to as a “toby”.
Seismic criticality	The asset criticality following a seismic event. Seismic criticality is determined by the possible consequences of failure, both immediately after the event and during recovery.
Sewer	A pipe that conveys wastewater/sewage, typically using gravity. Could also be called a sewer drain.
Stormwater	Rainwater that does not soak into the groundwater or evaporate, but flows via overland flow, interflow, channels or pipes into a defined channel, open watercourse or a constructed infiltration facility.
Subdivision	The subdivision of land as defined in the Resource Management Act 1991.
Subsoil drain	A drain that is designed to control groundwater levels. It achieves this through the infiltration of groundwater into the pipe, typically through perforated walls or porous joints. It does not collect and transport surface runoff.
Toby	The water shut-off valve, generally located at the boundary of a property, that sits between the public water main and a private water pipe.
Trunk main (in water supply)	A water main typically 300 mm or greater in diameter designed to transport water between reservoirs, distribution zones, source waters and reticulation mains. Sometimes called a transmission main or primary main.
Ultimate limit state (ULS)	In relation to seismic resilience, is defined in **Section 3.7.3.1 Definition of limit states**.
Wastewater (sewage)	Water that has been used and contains unwanted dissolved and/or suspended substances from communities, including homes and businesses and industries.
Water supply	Water distributed for domestic, commercial, industrial and firefighting purposes.

Term	Description
Wellington Water	Wellington Water (abbreviated from Wellington Water Limited), when referred to as an entity, shall also mean the relevant territorial authority in relation to water services asset ownership and approvals; or the Engineer or Principal in relation to contractual approvals.

2.2.3 Abbreviations

Table 2-2 provides the abbreviations used in this document:

Table 2-2 – Abbreviations

Abbreviation	Description	Unit
ADWF	Average dry weather flow	L/s
AEP	Annual exceedance probability	%
ARI	Average recurrence interval	years
AS	Australian Standard	
AS/NZS	Australian/New Zealand Standard	
BLR	Building line restriction	
CBD	Central business district	
DN	Nominal diameter	mm
DICL	Concrete lined ductile iron	
GWRC	Greater Wellington Regional Council	
h_d	Head loss due to change	m
h_f	Head loss	m
h_j	Head loss due to junction	m
h_n	Nominal head loss	m
hr	Hour	hour
H	Head (water column measured in metres)	m
ha	Hectare	ha
HCC	Hutt City Council	
km	Kilometre	km
kPa	Kilopascal	10^3Pa
L	Litre	L
LINZ	Land Information New Zealand	
m	Metre	m

Abbreviation	Description	Unit
mPa	Megapascal	10^6Pa
m/s	Metres per second	ms^{-1}
m³/s	Cubic metres per second	m^3s^{-1}
mm	Millimetres	mm
MHWS	Mean high water springs	m
MSL	Mean sea level	
NCD	WCC New City Datum (same datum as MSL)	
NPV	Net present value	
NZBC	New Zealand Building Code	
NZS	New Zealand Standard	
NZTM	New Zealand Transverse Mercator	
NZVD2016	New Zealand Vertical Datum	m
OD	Outside diameter	mm
PCC	Porirua City Council	
PDWF	Peak dry weather flow	L/s
PE	Polyethylene (generic)	
PE80b	Medium density PE (MDPE)	
PE80c	High density PE (HDPE)	
PE100	High performance PE (HPPE)	
PN	Nominal pressure	bar
PP	Polypropylene	
PRV	Pressure reducing valve	
PVC	Polyvinyl chloride (generic)	
PVC-M	Modified polyvinyl chloride	
PVC-O	Molecularly oriented polyvinyl chloride	
PVC-U	Unplasticised polyvinyl chloride	
PWWF	Peak wet weather flow	L/s
RRJ	Rubber ring joint	
R.Spec	Regional Specification for Water Services	
RSWS	Regional Standard for Water Services	
s	second	s
SCADA	Supervisory control and data acquisition	

Abbreviation	Description	Unit
SDR	Standard dimension ratio	
SLS1	Serviceability limit state 1	
SLS2	Serviceability limit state 2	
STCL	Concrete lined steel	
SWDC	South Wairarapa District Council	
T_c	Time of concentration	T_c
T_f	Time of pipe and channel flow	T_f
T_g	Time of gutter flow	T_g
T_o	Time of overland flow	T_o
UHCC	Upper Hutt City Council	
ULS	Ultimate limit state	
v:h	Vertical to horizontal	v:h
WCC	Wellington City Council	

* Local sea levels vary around the coast, hence tide tables have to be referenced specific to the location. Tide levels listed in Tide Tables published by LINZ use a Wellington Standard Port zero datum equivalent to -0.929 m MSL or 3.551 m below benchmark K80/2 (LINZ code ABPC – updated Feb 2018). The actual average measured sea level is currently measured at around 1.12 m above Wellington Standard Port datum or 0.191 m MSL (1953 Wellington Vertical Datum).

2.2.4 Pipe gradients

This document generally uses a percentage to represent pipe or channel grades as opposed to a ratio (i.e., 1% instead of 1 in 100 (v:h)). The percentage grade can be calculated by dividing the ratio's vertical component by the horizontal component and multiplying by 100. Conversions are presented in **Table 2-3**.

Table 2-3 – Conversion table

Grade %	Grade ratio
0.33%	1 in 300
0.5%	1 in 200
1%	1 in 100
2%	1 in 50
5%	1 in 20
10%	1 in 10
20%	1 in 5
25%	1 in 4
50%	1 in 2

2.3 References

Various documents and standards including, New Zealand (NZS), Australian (AS) and joint (AS/NZS) standards are referenced in this document. Where a standard's year has been nominated, then that specific issue is to be used. Where no year is nominated, the latest version is to be used. Standards and documents relevant to this document are listed in **Table 2-4.**

Table 2-4 – Referenced documents and standards

Reference	Title
STD_0002	Regional Specification for Water Services (R.Spec)
DESR_0001	Register of Approved Products for use in Water Services Infrastructure
STD_0003	Regional As-Built Specification for Water Services
ICT_0004	Regional Draughting Manual for Water Services
AS/NZS 1170	Structural design actions
AS/NZS 2845.1	Water supply – Backflow prevention devices, Part 1: Materials, design and performance requirements
C-SP-AE-64322	KiwiRail – Civil specification installation of utility structures on railway land
GD2021/007	Stormwater soakage and groundwater recharge in the Auckland Region
ISO 16134	Earthquake- and subsidence-resistant design of ductile iron pipeline
NZBC	New Zealand Building Code
NZS 3106	Design of concrete structures for the storage of liquids
NZS 4517	Fire sprinkler systems for houses
NZS 4541	Automatic fire sprinkler systems
SNZ PAS 4509	New Zealand Fire Service Firefighting Water Supplies Code of Practice
SP/M/022	Waka Kotahi NZ Transport Agency Bridge Manual
TR2013/035	Auckland Council Unitary Plan stormwater management provisions: Technical basis of contaminant and volume management requirements

3 GENERAL REQUIREMENTS

This document is governed by the requirements of the Local Government Act 2002 and is given effect through resource consent conditions, regional and district plans and bylaws.

Reference shall be made to this document when planning and designing new stormwater, wastewater and water supply infrastructure and for the renewal, upgrade or decommissioning of existing infrastructure. Where council's subdivision or development codes of practice are inconsistent with this document, the provisions within this document shall take precedence.

3.1 Subdivision requirements

Requirements relating to the overall subdivision process, urban planning and other council utilities and services can be found in each council's subdivision codes and policy documents. Reference shall be made to these documents and their requirements when using this document.

3.2 Legislative and regulatory requirements

The requirements of this Regional Standard of Water Services (RSWS) shall be read subject to the provisions of the latest versions and amendments of any applicable legislation and regulations, including, but not limited to:

(a) Building Act 2004, Building Regulations, and New Zealand Building Code (NZBC) 1992
(b) Civil Defence Emergency Management Act 2002
(c) Climate Change Response (Zero Carbon) Amendment Act 2019
(d) Energy Efficiency and Conservation Act 2000
(e) Fire and Emergency New Zealand Act 2017
(f) Water Services Act 2021
(g) Water Services (Drinking Water Standards for New Zealand) Regulations 2022
(h) Health and Safety at Work Act 2015 and related regulations
(i) Land Drainage Act 1908
(j) Local Government Act 1974 and Local Government Act 2002, and related council by-laws and policies
(k) Resource Management Act 1991, including all applicable National Environmental Standards, regulations and regional and territorial planning documents
(l) Soil Conservation and Rivers Control Act 1941
(m) Utilities Access Act 2010, National Code of Practice for Utility Operators' Access to Transport Corridor and the Installation of Utility Structures on Railway Land.

Other documents are referenced throughout this document at the relevant section.

3.3 Alternative solutions and dispensation

Innovative, alternative solutions are encouraged and will be considered where the proposed scheme can demonstrate compliance with both the objectives and performance criteria as set out in this document. It must be proven that the performance, maintenance and long-term economic outcomes are equivalent, if not better than the 'standard' solutions presented in the Design Methods and General Specifications sections within this document, as well as complying with the urban planning objectives set by the council.

Acceptance of alternative solutions will be at the discretion of Wellington Water in accordance with the Dispensation Procedure. The form of alternative solutions should be discussed with Wellington Water at an early stage of design.

In addition to alternative solutions, any deviation from the minimum requirements in this document will be at the discretion of Wellington Water in accordance with the Dispensation Procedure.

3.3.1 Carbon reduction

The Climate Change Response (Zero Carbon) Amendment Act 2019 sets a domestic greenhouse gas emission target for New Zealand to reduce net emissions of all greenhouse gases (except biogenic methane) to zero by 2050, and to reduce emissions of biogenic methane to 24–47 per cent below 2017 levels by 2050, including to 10 per cent below 2017 levels by 2030. To help achieve this target, Wellington Water will specifically encourage alternative solutions that reduce carbon emissions.

3.3.2 Pipe rehabilitation

Pipe rehabilitation as an alternative to replacement requires approval in accordance with the Dispensation Procedure and is at the discretion of Wellington Water.

Pipe rehabilitation using methods such as cured in place pipe (CIPP) lining, spiral wound lining, and fold and form lining typically would not achieve the design life requirements of a new pipe. Therefore rehabilitation should only be considered where replacement options are severely constrained and must consider other performance criteria, such as lifecycle costs, operations and maintenance needs, future network configurations and seismic resilience (see **R.Spec Section 4.18 Lining as pipe rehabilitation**).

Pipe rehabilitation of AC pipes should be considered only where there is no other practicable alternative because the AC host pipe constitutes an ongoing hazard for those working on the rehabilitated pipeline (see **R.Spec Section 4.4.1 Design for replacement of asbestos cement pipes**).

3.4 Health and Safety in Design obligations

The requirements of the Health and Safety at Work Act 2015 and the Health and Safety at Work Regulations shall be observed at all times. Designers shall follow a Safety in Design Process approved by Wellington Water. Wellington Water's Safety in Design process is available on the Wellington Water website.

All designers so far as reasonably practicable must design all plant, substances or structures without risk to the health and safety of persons who use, handle, store, construct, or who carries out any foreseeable activity for inspection, cleaning, maintenance, or repair for the plant, substance or structure as designed, in accordance with the Health and Safety at Work Act 2015.

Infrastructure shall be designed so that:

(a) No harm shall occur to design staff.

(b) No harm shall occur to workers during its construction.

(c) No harm shall occur to public during its construction.

(d) No harm shall occur to workers and the public during its operation.

(e) No harm shall occur to workers during or following its de-commissioning and removal.

3.5 Application and approvals

Developers are encouraged to discuss their proposed scheme with Wellington Water prior to concept design to ascertain requirements or pertinent considerations relating to their proposal.

This document does not cover the applications and approvals process. Each council has its own subdivision application and approvals process by which the applicant must abide. Compliance with the provisions in this standard does not imply acceptance of the asset for vesting or compliance with the subdivision consent.

3.6 Customer outcomes and service goals

The *Regional Standard for Water Services* provides developers with the design standards so that Wellington Water can manage the three waters infrastructure to meet Wellington Water's customer outcomes and service goals outlined in **Figure 3-1**.

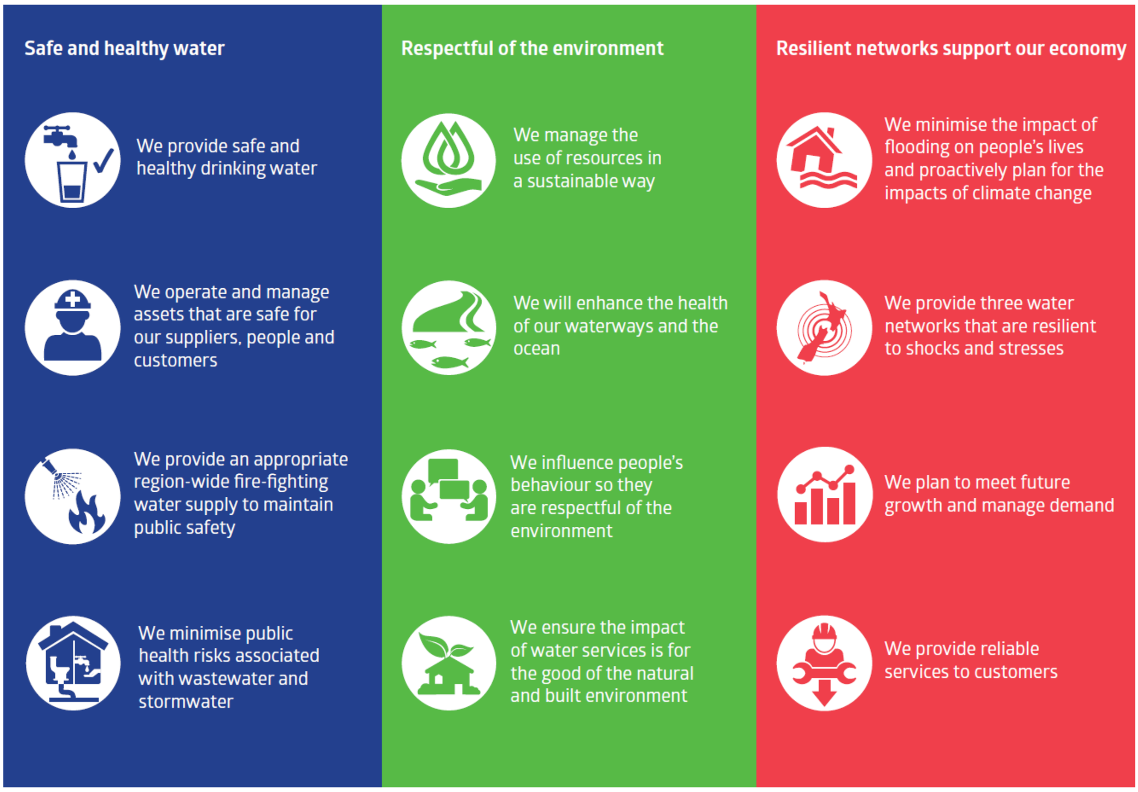

Figure 3-1 – Wellington Water's customer outcomes and service goals

3.7 Seismic resilience

The following applies to seismic resilience:

(a) Seismic resilience is required to be considered for the design of new and upgraded assets.

(b) Seismic resilience extends to pipelines, structures, other facilities and any associated fixtures and fittings.

(c) Design of a seismically resilient asset shall consider:

- (i) Design earthquake (i.e., magnitude);
- (ii) Ground conditions (i.e., risk of liquefaction);
- (iii) Proximity to faults; and
- (iv) Required level of resilience.

(d) The required level of seismic resilience is dictated by the seismic criticality, which is the asset criticality following a seismic event (see **Section 3.7.4 Determination of seismic criticality**).

(e) A seismically critical asset must be afforded greater resilience in design than a seismically non-critical asset.

(f) Seismic criticality is determined by the possible consequences of failure, both immediately after the event and during recovery.

3.7.1 Design earthquake

The design earthquake will be as defined in AS/NZS1170 or the Waka Kotahi NZ Transport Agency Bridge Manual as appropriate. Consideration should also be given to ground displacements.

Known fault zones can be accessed from the Greater Wellington Regional Council open data source.[1]

3.7.2 Risk of liquefaction

The risk of liquefaction shall be determined using:

(a) The Greater Wellington Regional Council liquefaction potential mapping, which can be accessed from the Wellington Region Liquefaction Potential open data source[2].

- (i) Ground that has moderate, high, or very high liquefaction risk is considered liquefiable.

(b) Geotechnical analysis for large projects shall be used to determine whether the ground is liquefiable or non-liquefiable.

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[1] https://data-gwrc.opendata.arcgis.com/datasets/fault-hazard-zone-for-the-wellington-fault-wellington-nz-1

[2] http://data-gwrc.opendata.arcgis.com/datasets/wellington-region-liquefaction-potential

3.7.3 Design standards

There are two main design standards in New Zealand for design of seismically resilient structures: AS/NZS 1170 and the Waka Kotahi NZ Transport Agency Bridge Manual. In addition, NZS 3106 is relevant for the design of concrete structures holding liquids (such as reservoirs). The NZBC and NZS 4219 are also relevant.

3.7.3.1 Definition of limit states

In addition to the definitions from AS/NZS 1170 for seismic resilience, the following definitions are specific to reservoirs:

(a) The serviceability limit state 2 (SLS2) of a reservoir shall be defined as the reservoir retaining its contents with no leakage following a SLS2 level of shaking.

(b) The ultimate limit state (ULS) of a reservoir (inclusive of roof) shall be defined as limited cracking and leakage, and the structure's stability is not seriously affected by the damage.

3.7.4 Determination of seismic criticality

A pipeline or structure is considered seismically critical if any of the following criteria apply:

(a) Water supply pipes and structures supplying drinking or firefighting water to 500 or more people (or 175,000 L/day if non-residential).

(b) Any pipe or structure specified by Wellington Water as seismically critical.

(c) Note that wastewater and stormwater assets are not generally considered seismically critical unless specifically identified as per (b) above.

Refer to **Section 3.7.6 Seismically resilient structures** for examples of what is considered a structure.

3.7.5 Seismically resilient pipelines

A pipeline is a linear asset intended to convey a fluid such as water. Wellington Water pipeline assets are typically buried underground. For the purposes of this clause, above ground pipelines are considered structures.

The following applies when designing new pipelines:

(a) Designers shall consider ground conditions and choose a seismically resilient solution appropriate to the ground conditions (refer to **Table 3-1**).

(b) The behaviour of pipelines laid in liquefiable ground is significantly different to pipelines laid in non-liquefiable ground. Experience during previous earthquakes is that approximately 80% of pipe failures occurred in liquefiable ground.

(c) For seismic resilience, pipelines shall be designed to resist the effects of:

   (i) Ground shaking

   (ii) Liquefaction

   (iii) Lateral spreading

   (iv) Slope failure (including under-slip and over-slip)

(v) Tsunami (including inundation by the advancing wave and scour due to the receding wave)

(vi) Settlement (including differential settlement).

(d) For the purposes of seismic resilience design, above-ground pipes are to be considered structures (see **Section 3.7.6 Seismically resilient structures**).

3.7.5.1 Definition of a seismically resilient pipeline

A 'seismically resilient pipeline' refers to a pipeline that can:

(a) Reasonably expected to achieve a minimum level of service specified for the type of pipeline following a severe movement of the Wellington Fault, or another relevant fault, where:

(i) The minimum level of service for a pressure pipeline is specified as: the pipeline shall remain in full operation without significant deformation or leakage.

(ii) The minimum level of service for a gravity sewer pipeline is specified as: the pipeline shall remain in partial operation and be resilient to significant infiltration.

1. Where partial operation is defined as: being able to continue to transport limited flows, even where loss of grade results in some back-up. Such a pipeline may require regular jetting to remain operational, but will contribute to the removal of sewage flows from secondary (overland) flow paths.

2. Where resilient to significant infiltration is defined as: where pipes are constructed in liquefiable ground that may cause unrestrained pipe joints to open, the pipe is continuous, has restrained joints or is protected from inflow of liquefied soils which may temporarily, or permanently block the pipeline.

(iii) A severe movement of the Wellington Fault is defined as: An event where ground displacements of at least 4-5 m in the horizontal direction and 1 m in the vertical direction occur at one or more locations along the fault.

(b) Be easily and quickly repaired with limited materials and plant that can reasonably be expected to be readily available following a severe seismic event.

(c) Be easily maintained during the normal operational life of the pipeline.

(d) Have manholes designed in accordance with the *Regional Specification for Water Services*.

This definition:

(e) Acknowledges that pipelines in the following locations will require significant specialist design to create a seismically resilient pipeline:

(i) Immediately adjacent to any fault (considered to be within 75 m of the fault)[3]

[3] *These pipelines are expected to experience ground shear and shall be assessed individually. Refer to* ***Section 3.7.1 Design earthquake.***

(ii) Laid across any active fault[4]

(iii) Laid along any active fault[5]

(iv) Installed on a structure such as a bridge

(v) Installed inside host, encasement or carrier pipes[6].

(f) Focuses on the structural resilience of the pipeline rather than the configuration of the network. For example, redundancy loops and location of valves are not relevant to this definition.

(g) Applies to the pipelines and their embedment rather than ancillary structures such as pump stations and large valve chambers, which constitute transitions between mobile and fixed elements. Bedding types can result in specific vulnerabilities. These must be assessed individually.

3.7.5.2 Design of seismically resilient pipelines

The following applies to the design of seismically resilient pipelines:

(a) Design is dependent on two factors:

(i) Seismic criticality of the pipeline (see **Section 3.7.4 Determination of seismic criticality**)

(ii) Seismic hazard of the ground surrounding the pipeline.

(b) As part of post-disaster planning, Wellington Water has determined that all water supply and wastewater pipes are to be resilient, irrespective of seismic criticality. For these pipes, the seismic hazard of the ground is the determining factor.

(c) Pipe materials are to be selected as outlined in **Table 3-1.**

(d) For drainage pipes where the embedment of the pipe is wrapped, it is not a requirement to wrap joints with filter fabric to prevent the ingress of material due to joint separation. If embedment wrap is not specified, unrestrained joints shall be wrapped where pipes are constructed in liquefiable ground.

(e) In addition, the designer shall provide consideration of:

(i) Where possible, minimising the depth of services to facilitate repair.

(ii) Specification of inserts for mechanical joints in PE pipes. The inserts achieve fully end load resistant joints so that displacement can be transferred from the joint or fitting into the barrel of the pipe. The pipe barrel can accommodate greater deformation, so this reduces the risk of failure.

(iii) Alternative technologies where they would significantly increase resilience or reduce time to repair (e.g., pressure sewer systems).

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[4] *These pipelines are expected to experience ground shear and shall be assessed individually. Refer to **Section 3.7.1 Design earthquake.***

[5] *These pipelines are expected to experience ground shear and shall be assessed individually. Refer to **Section 3.7.1 Design earthquake.***

[6] *These pipelines are expected to experience ground shear and shall be assessed individually. The shear conditions entering and exiting are uncontrolled.*

(iv) Network resilience (e.g., additional isolation valves for pressure systems at the transition between high and low hazard areas to enable quick isolation of damaged sections and continued functionality of undamaged sections).

Table 3-1 – Selection of resilient pipe materials

<table>
<tr><th></th><th>Seismic criticality</th><th>In liquefiable ground</th><th>Non-liquefiable ground</th></tr>
<tr><td rowspan="3">Water supply</td><td>Distribution network</td><td>• Steel with fully restrained joints[1]
• Welded PE
• DI with seismically resilient joints (refer to Section 3.7.5.3 Ductile iron pipe joints)</td><td>As per Approved Products Register</td></tr>
<tr><td>Bulk water network ≤ DN 300</td><td>• Steel with fully restrained joints[1]
• Welded PE (including 355 mm OD)
• DI with seismically resilient joints (refer to Section 3.7.5.3 Ductile iron pipe joints)</td><td>• Steel with fully restrained joints[1]
• Steel with unrestrained joints
• Welded PE (including 355 mm OD)
• DI with fully restrained joints</td></tr>
<tr><td>Bulk water network > DN 300</td><td colspan="2">• Steel with fully restrained joints[1]
• DI with seismically resilient joints (refer to Section 3.7.5.3 Ductile iron pipe joints)
• Welded PE (refer to Table 6-3 for allowable nominal pipe diameters)</td></tr>
<tr><td>Wastewater</td><td>All pipes</td><td>Welded PE</td><td>As per Approved Products Register</td></tr>
<tr><td>Stormwater</td><td>All pipes</td><td>As per Approved Products Register[2]</td><td>As per Approved Products Register</td></tr>
</table>

[1] Steel pipe with fully restrained joints (butt weld, lap joint with internal and external welds, welding band with internal and external welds, flange joint)

[2] In areas subject to liquefaction where the ground containing the pipeline could suffer from lateral spread, the designer should give consideration to use of welded PE or end restraints.

Note: Pipes under or near buildings are to have special consideration of materials, installation, and future repair (see **Section 3.8 Building in close proximity to public pipelines**).

(f) Where pipe lining for wastewater pipes is determined to be the preferred renewal methodology, pipes that are rehabilitated with a fully structural liner will be considered to comply with the seismic resilience requirements in this clause and will not require a deviation from the standard.

(g) Pipe lining of water supply pipes as a preferred renewal method will be considered on a case-by-case basis in relation to seismic resilience requirements.

3.7.5.3 Ductile iron pipe joints

The following applies to seismically resilient ductile iron pipe joints:

(a) Seismically resilient ductile iron pipe joints shall comply with ISO 16134 *Earthquake- and subsidence-resistant design of ductile iron pipelines* and the class of pull-out resistance, rotation and elongation identified.

(b) In liquefiable ground, ductile iron pipe joints should be able to meet:

  (i) The highest classification of ISO 16134 at Class S-1 for expansion/contraction performance.

  (ii) Class A for pull out resistance.

  (iii) A minimum joint deflection angle of 3 degrees.

3.7.5.4 Pipes at fault crossings or in areas with lateral spread

The following applies to pipes at fault crossings or with lateral spread:

(a) Standard design approaches may not be appropriate, and a more considered review of the design is required to assess pipe seismic resilience, where pipes are laid:

  (i) Across, along, or within 75 m of an active fault line or

  (ii) In an area where significant slope failure, ground settlement or lateral spread is expected.

(b) If these pipes are seismically critical (see **Section 3.7.4 Determination of seismic criticality**), the designer shall undertake a specific design to allow for the expected ground movement. This design shall be undertaken in consultation with Wellington Water.

(c) Where a pressure pipe is expected to fail due to significant ground movement, the designer should specify isolation valves spaced at least 75 m either side of the fault to allow for isolation of the damaged pipe.

3.7.6 Seismically resilient structures

A structure is typically a non-linear asset. Structures that form part of the three waters network include pumping stations, reservoirs, telemetry buildings, treatment plants, pipe bridges, valve chambers, above-ground pipes and emergency stores. For the purposes of this clause, standard manholes are not considered to be structures.

For assets that are comprised of more than one structure, such as wastewater and water supply treatment plants, the designer shall undertake an assessment of individual buildings and determine the seismic criticality of each building in consultation with Wellington Water.

3.7.6.1 Definition of seismically resilient structures

Structures are considered seismically resilient if they meet the requirements of AS/NZS 1170 for serviceability limit states (SLS1 and SLS2) and ULS relating to earthquake loading. Note that Wellington Water has modified the SLS2 return period for reservoirs in **Table 3-2**.

3.7.6.2 Design of new resilient structures

The following applies when designing new resilient structures:

(a) New structures are to be designed in accordance with Table 3-2, based on the requirements of AS/NZS 1170. Refer to Section 3.7.3.1 Definition of limit states for definitions of SLS1, SLS2 and ULS.

Table 3-2 – Design criteria for new structures

	Seismic criticality	IL	Design working life	SLS1	SLS2	ULS	Durability requirements
Water supply	Seismically critical	IL4	100 years	1/25	1/1000	1/2500	100 years
	Seismically non-critical	IL3	100 years	1/25	-	1/2500	100 years
	Ancillary structures[1]	IL2	50 years	1/25	-	1/500	50 years
Wastewater/ stormwater	Seismically critical[2]	IL4	100 years	1/25	1/500	1/2500	100 years
	Seismically non-critical	IL3	100 years	1/25	-	1/2500	100 years
	Ancillary structures[1]	IL2	50 years	1/25	-	1/500	50 years

[1] Ancillary structures shall be defined as any structures which are not required for the operation of the network, either during normal operation or following a seismic event. The designer must have agreement in writing with Wellington Water prior to designating any structures as ancillary for seismic design.
[2] As determined on a case-by-case basis under **Section 3.7.4 Determination of seismic criticality.**

(b) When designing for SLS2 limit states, it should be noted that all permanent internal fixtures (switchboards, HVAC systems, etc.) which are required for the operation of the structure must also meet the SLS2 requirements.

(c) Where possible, the designer shall avoid placing structures within 75 m of a known fault (refer to **Section 3.7.5.1(e) Definition of a seismically resilient pipeline**).

(d) When designing structures in tsunami-prone areas, the effects of a tsunami should also be considered.

(i) Specifically, pipe bridges may be high risk due to their location.

(ii) Where required, specialist design of structures for tsunami resilience is to be agreed with Wellington Water.

(e) Liquid-retaining, concrete structures shall be designed in accordance with NZS 3106, for liquid tightness:

   (i) Class 2 (i.e., leakage to be minimal and appearance not to be impaired by staining) for:

      1. Reservoir walls, floors and roofs
      2. Wastewater storage structure walls and floors

   (ii) Class 1 (i.e., leakage to be limited to a small amount. Some surface staining or damp patches acceptable) for:

      1. Wastewater storage structure roofs.

(f) Site-specific seismic hazard analysis.

The following applies to site-specific seismic hazard analysis:

(a) For in-ground (earth retaining) structures and retaining walls, a site-specific seismic hazard analysis shall be undertaken where required by the Waka Kotahi NZ Transport Agency Bridge Manual based on the value of the structure.

(b) For all other structures, a site-specific hazard analysis shall be undertaken where required by AS/NZS 1170. For IL4 structures with a design working life of 100 years or more, the design events are determined by a hazard analysis but need to have probabilities less than or equal to those for IL3 (return periods greater than or equal to those for IL3).

(c) If the designer considers that a site-specific seismic hazard analysis is recommended for a project where not required by the applicable standard, they should make this recommendation to Wellington Water and a project-specific decision can be made.

3.7.6.3 Upgrade of existing structures

The retrospective strengthening of existing seismically critical structures to IL4 will be subject to a value assessment. Wellington Water will determine the design standard for upgrading existing structures on a case-by-case basis, taking into account remaining life expectancy and seismic criticality.

In general, the following guidance will apply:

(a) Where the remaining useful life is less than ten years, the asset should be replaced with a new structure, either immediately or as part of the long-term planning.

(b) Where the remaining useful life is more than 25 years, the asset should be strengthened to the standard required for new builds.

(c) Where the remaining useful life is between ten and 25 years, the design standard is to be assessed and brought to Wellington Water for approval, taking into account the following factors:

   (i) Can the required level of service be met if this structure fails?

   (ii) Time to repair following a seismic event.

   (iii) Seismically critical facilities served by the structure.

3.7.7 Connections from pipes to structures

It is intended that pipelines connected to structures such as valve chambers, scour chambers, pump stations, manholes and reservoirs shall be able to accommodate differential settlement and differential lateral movement without failing at the connection point.

3.7.7.1 Geotechnical input

In non-liquefiable ground, structures are expected to have a much lower level of differential settlement due to ground shaking. Standard designs are typically sufficient to allow for this movement.

Geotechnical analysis is required for the following situations:

(a) In liquefiable ground, structures require site-specific geotechnical analysis to determine the differential settlement expected from a seismic event. In some cases, ground improvements may be suitable to reduce the differential settlement, however this is to be agreed with Wellington Water.

(b) Dewatering during construction may also cause ground settlement and geotechnical input is required on ground settlement due to dewatering so that it can be considered in the design.

3.7.7.2 Design of connection points

The design of connection points between pipes and structures must take into account the expected level of movement along with the seismic criticality of the structure. Connection details are to be designed as described in **Table 3-3**.

Table 3-3 – Design criteria for connection points to structures

	Liquefiable ground	Non-liquefiable ground
Seismically Critical	• Specialist design of the connection points is required to ensure sufficient flexibility for the expected differential settlement. • Flanged flexible joints detailed as suitable for seismic flexibility in the Approved Products Register such as “Flex-tend” or “GeoFlex” flexible joints may be suitable for these connections. A cost-benefit analysis will be required for these joints, especially for large gravity pipes. • Designs are to be agreed with Wellington Water. Note that the backfill must also be designed to allow for the expected movement.	• Rocker pipe assemblies* are to be specified at connection points. • For critical structures with pressure pipe connections, tie rods are required on the rocker pipe assembly.
Seismically non-critical	• Rocker pipe assemblies* are to be specified at connection points. • In addition, the risk of failure shall be mitigated by a ‘fuse’ joint (an easily repairable weak spot in the system,	• Rocker pipe assemblies* are to be specified at connection points.

	Liquefiable ground	Non-liquefiable ground
	designed to be the point of failure) or other means so that breaks in the main can be easily isolated and repaired. • Designs are to be agreed with Wellington Water.	
Standard manholes	• For gravity systems with standard manholes, flexible connections are required as shown in the **Standard Detail DR01 – Manhole Details** in the *Regional Specification for Water Services*. • Rigid pipelines shall have a flexible connection within the lesser of 650 mm or twice the pipe diameter of the manhole wall. Manhole connectors shall be used for PVC pipes.	

* Rocker pipe assemblies are not typically required for PE pipes. Note: Typical details for flexible connections between structures and pipes are available from Wellington Water on request.

3.7.7.3 Power and communications supply to structures

The following applies to power and communications supply to structures:

(a) For structures that require power and/or communications to operate, the designer shall provide consideration of how these connections will be maintained following a seismic event. This could include:

  (i) Leaving an expansion loop at the connection to provide flexibility

  (ii) Permanent back-up generators

  (iii) Back-up batteries

  (iv) Redundant connections

  (v) Provision for the connection of a generator in the event of a power failure.

(b) Care shall be taken where cable ducts enter buildings to ensure ducting is not at risk of shear due to differential movement between the structure and surrounding soils. Additional slack in the cable is to be provided to accommodate movement during a seismic event.

3.8 Building in close proximity to public pipelines

Written approval is required from Wellington Water for any building work over or near a public pipe. Written approval must be supported by an assessment against the requirements of Sections 3.8.1(a) and (b) below. Written approval may be withheld if the function and operability of the public main are unduly compromised by the proposal.

Written approval is typically not granted for works in Porirua City Council or Upper Hutt City Council as these councils do not support building over public mains.

This section applies to what is commonly referred to as “building over or near a public pipe”. This section also applies to laying new or upgraded pipelines near existing structures and retaining walls. This section should be read in conjunction with the relevant sections in the *Regional Specification for Water Services*.

Several specific terms used in this section are defined in **Section 2.2.2 Definitions**, including:

- Building in close proximity
- Building over (shown in **Figure 3-2**)
- Building near (shown in **Figure 3-2**)
- Building over and near (shown in **Figure 3-2**)
- Building works

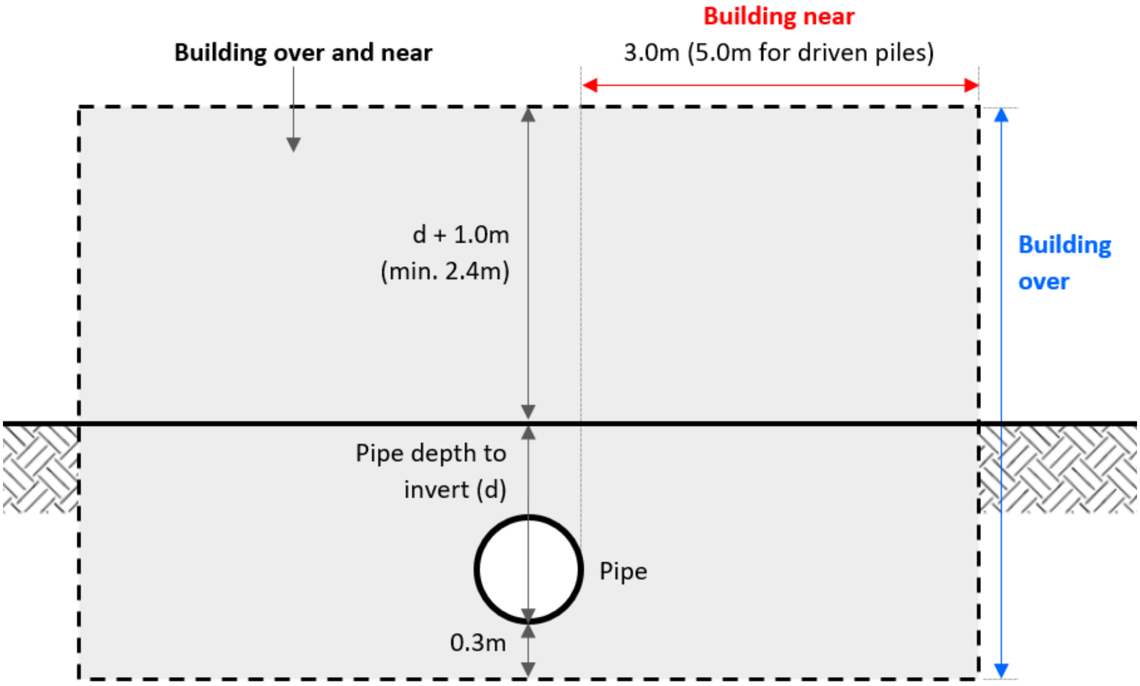


Figure 3-2 – Illustration of zones used in definitions of "Building over and/or near"

(a) This section applies to building in close proximity to live, abandoned and decommissioned public:

  (i) Wastewater pipes

  (ii) Stormwater pipes

  (iii) Water supply pipes.

(b) This section **does not** apply to:

  (i) Small buildings and decks that:

    1. Do not exceed 1 storey or 10 square metres in floor area or total deck area; and
    2. Do not contain sleeping accommodation, sanitary facilities, or facilities for the storage of drinking water; and
    3. Do not have a permanent foundation; and
    4. Can be easily relocated by the owner when work is required on the pipeline underneath the building; and
    5. Are not positioned over access chambers or service connections.

  (ii) Private pipes, such as wastewater or stormwater laterals.

(iii) Private or common (shared) wastewater or water supply pipes.

(iv) Abandoned or decommissioned pipes that have been grout filled along the entire length that is in close proximity, to a minimum of 3 m longitudinally from any building works, and 5 m longitudinally from any pile driving.

(v) Building works outside the building over and near zone (**Figure 3-2**) except for the requirements in **Section 3.8.1(d) General requirements** and **Section 3.8.1.1 Building line restriction**.

3.8.1 General requirements

The following are general requirements for building in close proximity:

(a) Building in close proximity **should be avoided where possible.** This is to prevent the possibility of:

(i) Compromising the durability of the pipe.

(ii) Interfering with future maintenance, including the ability of the network to meet future demands or levels of service.

(iii) Compromising the long-term integrity of the proposed building should the pipe fail or when work is carried out on the pipe.

(b) Where building in close proximity cannot be avoided, proposals will be assessed by Wellington Water based on council policy and consideration of the possible adverse outcomes listed in (a) above and all relevant requirements in the *Regional Standard for Water Services* and *Regional Specification for Water Services*. A proposal must address the following:

(i) All practicable alternatives to relocate the pipe or relocate the structure/retaining wall must be considered at the developer's expense.

(ii) Relaying with or without sleeving of the pipe at the developer's expense is generally required as detailed in the *Regional Specification for Water Services*. Geotechnical investigation or confirmation of the soil type may be required at the discretion of Wellington Water.

(iii) Prior to any works, all pipes and easements must be identified, including manholes and connections in the area. The property may also have services that Wellington Water does not manage and which need to be protected, such as utilities and easements for electricity, gas and broadband.

(iv) For pipe installations under roads or rail embankments, design and construction shall comply with the latest revisions of the NCOPUATTC and the KiwiRail Civil Specification for Installation of Utility Structures on Railway Land. In the event of any ambiguity or contradictions between this specification and the specifications named above, the more stringent requirements shall take precedence.

(v) Design of the works:

1. Shall include consideration of seismic resilience of both the pipeline and building works, in accordance with **Section 3.7 Seismic resilience**.
2. Should provide for a secondary flow path if needed and as far as practicable, in accordance with **Section 4.4.12 Easements**.

3. Should maximise the ease with which the pipe can be maintained and replaced.
4. Must take into account network structures such as chambers and manholes, maintenance access for machinery at a future date, and access to manholes.

In addition to the requirements of Sections 3.8.1(a) and 3.8.1(b) above, the following restrictions apply:

(c) It is **not permitted** under any circumstances to "build over" a service connection, change in grade or change in direction within the following distances (see **Figure 3-3**):

(i) (Perpendicular to pipe alignment) 1.5 m horizontally from the outside of the pipe.

(ii) (Longitudinally along the pipe alignment) The greater of:

1. 1.5 m.
2. Half the pipe depth to invert.

(iii) Half the pipe depth to invert.

(d) Building works will **generally not be permitted**:

(i) from any height above a depth of 300 mm below the pipe invert and:

1. Within a horizontal distance of 1.5 m, measured from the outside of pipe perpendicular to the pipe alignment (see **Figure 3-4**), from:
   A. Pipelines that normally operate under pressure, such as water mains or drainage rising mains.
   B. Gravity pipes with diameters of 300 mm or greater.
2. Within a radius of 1.5 m along the horizontal plane from the centre of a manhole cover to provide access to the manhole (see **Figure 3-5**).

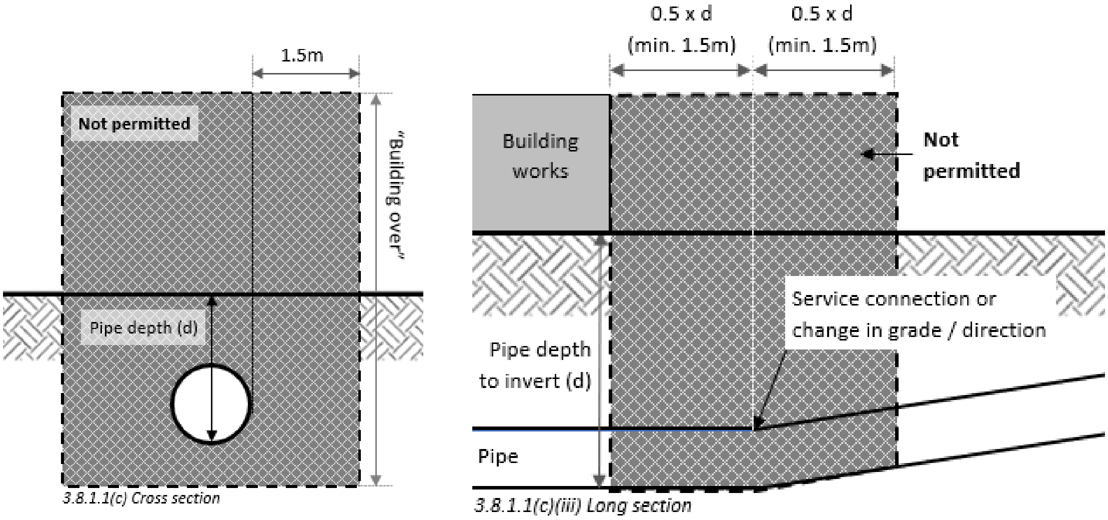
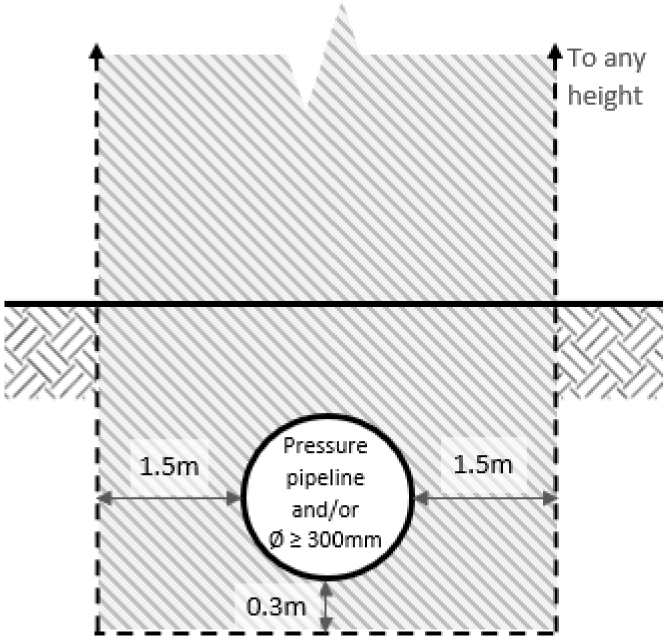
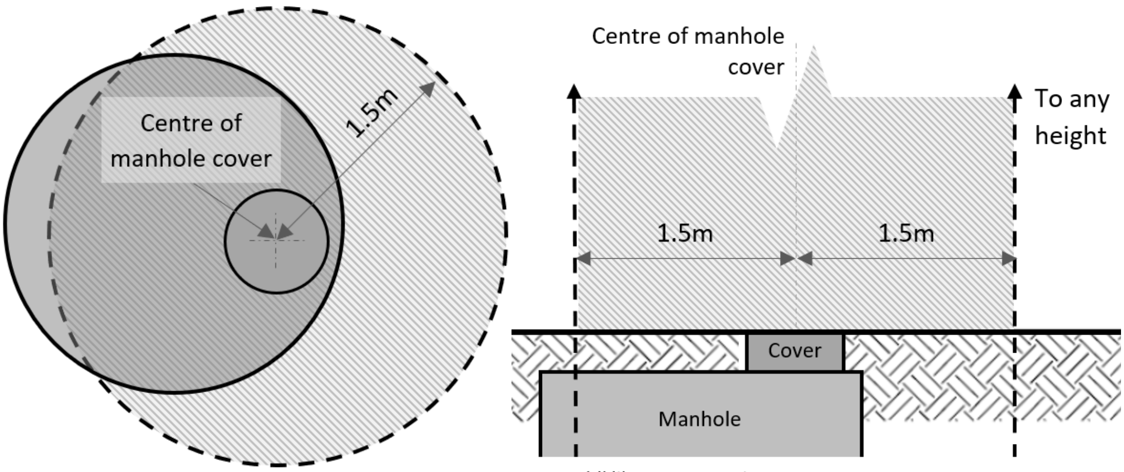


Figure 3-3 – Restrictions for building over service connections, changes in grade/direction



3.8.1.1(d)(i)1. Cross section

Figure 3-4 – Restrictions for building over pressure pipelines and gravity pipes ≥ 300 mm



3.8.1.1(d)(i)2. Plan view

3.8.1.1(d)(i)2. Cross section

Figure 3-5 – Restrictions for building over service connections and changes in grade/direction

3.8.1.1 Building line restriction

For all building works and pipelines:

(a) Where the trench will be open less than 48 hours:

(i) The origin of the building line restriction (BLR) shall be located at a point 300 mm below the invert of the pipeline and offset 0.5 x pipe OD from the pipe centreline.

(ii) From the origin, the BLR shall extend to the surface as determined by geotechnical testing or at the following typical angles:

1. Cohesive soils: 45 degrees (1 horizontal:1 vertical)
2. Non-cohesive soils: 2 horizontal:1 vertical

(b) Where a trench is likely to be open for longer than 48 hours:

(i) The origin of the BLR shall be located:

1. Vertically, at a depth of 300mm below the invert of the pipeline or at the trench base, whichever is deeper
2. Horizontally, at the edge of excavation of the trench.

(ii) The clearance required by the BLR shall be increased to comply with NZBC Clause E1/AS1. This shall be applied to all structures and retaining walls.

(c) Load bearing foundations and piles shall terminate below the BLR of any nearby public pipelines (refer to **Standard Detail DR09 – Building in Close Proximity** in the *Regional Specification for Water Services* and **Section 3.8.2 Laying new or upgraded pipelines near existing structures or retaining walls**).

(d) The design shall ensure no additional surcharge load is imposed on an existing or new pipe and an excavation could be made to maintain or replace a pipe without undermining the foundations of any structure.

(e) Skin friction on any segments of piles above the BLR line shall be excluded from any calculations.

(f) No horizontally orientated structural elements that apply tensile loading into the ground (e.g., tie-backs, deadmen) shall be installed where a drainage or water supply main would be within the zone of influence of the structural element.

3.8.2 Laying new or upgraded pipelines near existing structures or retaining walls

(a) Public pipes shall not be laid within 1.5 m of the structure or retaining wall (see **Section 4.4.5.4 Location**).

(i) When both the pipe and structure / retaining wall are existing, an exception to this requirement may be granted at the discretion of Wellington Water. To obtain this approval, the developer must meet the following conditions:

1. All practicable alternatives to relocate the pipe or relocate the structure/retaining wall must be considered at the developer’s expense.
2. The reasons necessitating an exception and all alternative options considered shall be detailed in the proposal submitted to Wellington Water (**Section 3.8.1 General requirements**).

(b) Where a pipe is laid deeper than 1 m, it shall be located so all existing load bearing foundations and piles terminate below the BLR (refer to **Standard Detail DR09 – Building in Close Proximity** in the *Regional Specification for Water Services*).

4 STORMWATER

4.1 Objectives

To safeguard people, property, infrastructure and the environment from the adverse effects of stormwater, contaminated or otherwise, comply with goals outlined in **Section 3.6 Customer outcomes and service goals** and meet the performance criteria outlined within this document.

4.2 Performance criteria

Any scheme must demonstrate consideration and compliance with the criteria listed below.

4.2.1 Functionality

The following shall be designed for stormwater functionality:

(a) All new stormwater systems, or existing systems modified to accommodate new works, shall be designed to protect property and infrastructure from inundation or damage to the Minimum Level of Service specified in **Section 4.2.7 Secondary system level of service** and **Section 4.2.8 Freeboard**.

(b) The stormwater system shall be designed to allow for all reasonably predictable development within the upstream catchment to the level of development allowed for within the council’s district plan.

(c) The network shall be a gravity network formed of pipes, channels and defined watercourses to approved discharge points within, as far as practicable, the catchment as it exists at the time of development.

(d) The system shall be designed such that there is no direct cross-contamination between the wastewater and stormwater systems or any other source of hazardous substances.

(e) No development or new drain shall cause water to be diverted from one catchment to another, either directly or indirectly and pre-application advice should be sought from Greater Wellington Regional Council.

(f) Retention or attenuation/detention facilities are required for all new development connecting to existing infrastructure and shall be designed to limit the design peak discharge from the development (post-construction) to not greater than the existing design peak discharge (pre-development) from the site for all events up to a 1% annual exceedance probability (AEP) event which shall include the predicted impacts of climate change.

   (i) Wellington Water has the right to nominate an alternative design event and event duration to mitigate specific downstream risks.

(g) The stormwater system shall be designed with adequate flexibility and special provisions to minimise the risk of damage during an earthquake or from differential settlement (see **Section 3.7.5 Seismically resilient pipelines** and **Section 3.7.6 Seismically resilient structures**).

(i) Flexible joints are required at all junctions between rigid structures (wet wells, manholes, drywells, pumping stations, stream and bridge crossings etc.) and natural or engineered ground.

(ii) Rigid pipelines shall have a flexible connection within the lesser of 650 mm or twice the pipe diameter of the structure wall.

(iii) Manhole connectors shall be used for polyvinyl chloride (PVC) pipes.

4.2.2 Access

The following applies to access:

(a) Any proposed system shall not unduly restrict the location of any potential building or development or restrict potential development elsewhere in the catchment.

(b) Where practicable, stormwater assets shall be placed in land that is public (see **Section 4.4.5.4 Location**) or proposed to be vested. Where this is not practicable, Wellington Water may require the public stormwater asset to be protected by an easement (see **Section 4.4.12 Easements**). This criterion also applies to watercourses and secondary flow paths.

(i) Open watercourses and secondary flow paths shall also be located on public land where practicable or protected by an easement in favour of the council.

(c) Systems shall be designed such that reasonable access for regular maintenance can be made without significant damage or disruption to other utilities, land use activities and landscape values.

(d) Secondary flow paths shall be clearly defined as no-building zones.

4.2.3 Maintenance and operation

The network shall be designed such that:

(a) It is compatible with the council’s existing systems, materials and maintenance practices.

(b) Gravel/debris obstructions, scouring and land instability are minimised.

4.2.4 Durability

The proposed scheme must be designed:

(a) With an asset life of 100 years, although it is accepted that mechanical components such as pumps and valves, and electrical equipment are likely to have lesser durability, nominally 20 years.

(b) In a way that minimises the life-cycle costs, inclusive of capital, maintenance, and rehabilitation costs and on the following basis:

(i) The life cycle shall be taken as 100 years for the purpose of this assessment.

(ii) Wellington Water may not necessarily accept the lowest cost option if it has a poor or limited track record for performance.

4.2.5 Climate change

All systems shall be designed to accommodate the predicted impacts of climate change in terms of hydrology (refer to the Wellington Water *Reference Guide for Design Storm Hydrology*, which is available on the Wellington Water website) and sea level rise (refer to **Section 4.3.2.5 Backflow effects and downstream level conditions**).

4.2.5.1 Climate change and adaptive pathways planning approach

The combined effects of climate change, sea level rise and land subsidence may put assets at risk of flooding. Designs should:

(a) Take account of the predicted flooding effects including scoping future upgrades that may be required to mitigate climate change effects.

(b) Where appropriate, designers should follow an Adaptive Pathways Planning approach [7] to consider long-term viability of proposed assets. Adaptive approaches are likely to be most successful if applied at a larger scale than the individual project.

4.2.6 Primary system level of service

The primary system typically comprises piped drainage systems, formed drainage channels and soakage systems. Each system is to be designed:

(a) To accommodate the design storm to a set level of service as defined by the annual exceedance probabilities (AEPs) listed in **Table 4-1**.

(b) To the General Catchment Level of Service, and then demonstrate that the roads, sections and other considerations internal to the catchment are not inundated when the general catchment is subjected to the assigned internal event for each consideration.

(c) The catchment is the entire drainage area above the design point of concentration.

Table 4-1 – Primary level of service (AEP)

	HCC	PCC	UHCC	WCC
General catchment level of service				
Residential	10%	10%	4%	10%
Commercial/industrial	10%	10%*	4%	10%
Rural/rural residential	10%	10%	10%	10%
Internal level of service for roads				
Primary arterial	5%	1%	1%	1%
Secondary arterial	5%	5%	5%	5%
Local/minor	10%	10%	20%	20%

[7] *Ministry for the Environment. 2024. Coastal hazards and climate change guidance. Wellington: Ministry for the Environment*

	HCC	PCC	UHCC	WCC
Bridges	2%	1%	2%	2%
Internal level of service for sections				
Open space/reserve	50%	N/A**	50%	50%
Private yards	20%	10%	20%	50%
Car parks	20%	10%	20%	20%
Internal level of service for others				
Where no secondary path is available	1%	1%	1%	1%
Key public facilities, hospitals, substations etc.	1%	1%*	1%	1%
Wastewater disposal fields	**5%**	**5%**	**20%**	**5%**

* The minimum level of service may be specified differently in the building consent depending on the buildings intended purpose. Consent requirements supersede those listed here.

** Refer to PCC parks and reserves department for required levels of service.

4.2.7 Secondary system level of service

The secondary system comprises secondary flow paths typically overland and along carriageway surfaces. The secondary systems shall:

(a) Only be required should the primary system become blocked or its capacity exceeded.

(b) Be conveyed through a combination of the primary system and secondary flow paths.

(c) Follow the required level of service for secondary systems as outlined in **Table 4-2**.

(d) Follow the maximum stormwater flow depths and velocities for access roads as outlined in **Table 4-3**.

Table 4-2 – Secondary system level of service (AEP)

	HCC	PCC	UHCC	WCC
Building floors (also see Section 4.2.9 Building floor levels to be identified)				
Housing and communal residential and communal non-residential	1%	1%	1%	1%
Commercial	1%	1%	1%	1%
Industrial	1%	1%	1%	1%
Rural residential	1%	1%	1%	1%
Roads				
Primary arterial*	2%	1%	1%	1%
Secondary arterial*	2%	1%	1%	5%

	HCC	PCC	UHCC	WCC
Local/minor*	5%	1%	1%	20%
Bridges and major culverts	1%	1%	1%	1%

* Flooding is allowed at these levels of service, but the road must be passable by light vehicles. The table below indicates acceptable depths and flow velocities as measured at the road centreline.

Table 4-3 – Maximum stormwater flow depths and velocities

	Max depth	Max velocity
Primary/secondary arterial road	0.1 m	2 m/s
Local/minor road	0.2 m	2 m/s
Steep local/minor roads	0.1 m	3 m/s
Walkways only	0.4 m	1 m/s

4.2.7.1 Secondary flow path

A secondary flow path is the path the stormwater would take if the primary drain was rendered inoperable or is overwhelmed by a flow exceeding the drain's design capacity. The secondary flow path shall:

(a) Be shown on the submitted design and subsequent as-built plans, including demonstrating that existing and proposed dwellings are not affected by the secondary flow during the design secondary storm event.

(b) Include a secondary inlet (if required by Wellington Water) where the primary drain's capacity is large and the consequence of overflow is great (primary flow is greater than secondary flow path capacity).

(c) Convey the secondary system level of service event, less the design capacity of the primary system, regardless of secondary intakes.

4.2.8 Freeboard

The minimum freeboard shall be measured from the top of the peak water level resulting from the design storm event, to the building platform level or underside of the floor joists or structural concrete slab of the building (see also **Table 4-2)**.

Unless Wellington Water has undertaken a formal assessment of an appropriate freeboard allowance based on sensitivity testing in a validated hydraulic model:

(a) Habitable building floors shall have a freeboard of 500 mm above the surface water of the secondary level of protection event.

(b) Commercial and industrial buildings shall have a freeboard of 300 mm.

(c) All other building freeboards shall be 200 mm.

(d) Open channels and streams shall have a minimum freeboard of 500 mm for the primary level of protection flow.

(e) Vehicle bridges shall have a freeboard of 600 mm to the underside of the bridge structure, or 1200 mm where there is a possibility of large trees in the waterway.

4.2.9 Building floor levels to be identified

The building platform and building floor levels that are required to meet the above secondary levels of protection and freeboard shall be identified on the subdivision plans for each lot within the subdivision. The floor levels shall be expressed in terms of mean sea level (MSL) or NZVD2016. Datums for MSL are outlined in **Section 2.2.3 Abbreviations**.

4.2.10 Water sensitive design

Water sensitive design, including the provision of stormwater treatment devices, is the recommended design approach for stormwater management to avoid adverse effects on receiving waterbodies. **Table 4-4** provides recommended guidance at each design phase.

Other treatment methods and devices will be considered on a case-by-case basis. Contact the Wellington Water Land Development Team to confirm specific design criteria.

Table 4-4 – Recommended guidance for water sensitive design by phase

Design phase	Recommended guidance*
Project scoping	Early engagement with the Wellington Water Land Development Team
Site assessment	Auckland City Council GD04[8]
Concept, preliminary and detailed design	Water Sensitive Design: Treatment Device Design Guideline

* Recommended guidance materials are subject to version updates and may be superseded by the development of new guidelines.

4.2.11 Environmental quality

The following applies to stormwater environmental quality design:

(a) For all land development work (including urban and rural subdivisions and land use change), the design shall include an evaluation of the post-development stormwater effects on the upstream and downstream existing and potential properties.

(i) Upstream increases shall be negligible or shown to have no detrimental impact.

(ii) Downstream impacts to be managed and mitigated against shall include, but are not limited to, changes in peak flow and flooding, erosion, sedimentation and contamination.

(iii) Works will be required to address any adverse effects.

[8] *Auckland City Council GD04 – Water Sensitive Design for Stormwater*

(b) In general, stormwater design should be commensurate with the intended character of the area and the environmental context. Environmental quality must be taken into account in the location and design of stormwater systems.

(c) Where practicable, and unless directed otherwise by Wellington Water, water sensitive design (see **Section 4.2.10 Water sensitive design**) should be employed to minimise the potential adverse effects of development. The following should be taken into account when considering environmental quality:

(i) Avoid adverse effects on cultural and heritage sites.

(ii) Preserve or protect areas of ecological significance, areas of significant habitat for indigenous flora and fauna and outstanding natural features.

(iii) Avoid, remedy or mitigate adverse effects on freshwater ecosystems, streams and watercourses, esplanade strips, harbours and coastal maritime areas.

(iv) Avoid, remedy or mitigate adverse effects on visual amenity.

(v) Provide for on-site silt and sediment management, erosion control and dust control during construction.

(vi) Provide passage for fish through or past proposed or existing infrastructure.

(d) Pre-application advice should be sought from Greater Wellington Regional Council (GWRC) if the proposed works involve the discharge of contaminants, including sediments, into an aquatic receiving environment.

(e) Stormwater must not be discharged to the ground in a manner that may cause or contribute to ground instability.

(f) Consideration shall be given to pre-treatment of stormwater discharges to aquatic receiving environments, including harbours and inlets, to minimise potential adverse effects.

4.3 Design methods

The design methods presented here are considered ‘acceptable solutions’ for the purposes of developing solutions compliant with the objectives and performance criteria of this standard. Deviation from these methods will be considered with suitable evidence that the alternative method is equivalent in performance, cost and application to those presented here.

Stormwater design is presented in two parts in this document:

- Hydrological design - collection and transportation of rainfall runoff overland to a nominated point in the network.
- Hydraulic design - calculating the behaviour of the flow once inside a network.

Where the council has a stormwater management plan:

(a) The proposed scheme shall be designed in line with the objectives and philosophies of the stormwater management plan, as well as the design methods and specifications outlined in this document.

(b) The council should be contacted during the early stages of design to ascertain if an operative stormwater management plan applies in the area of interest.

(c) Certified calculations shall be made available to the council as part of any application.

4.3.1 Hydrological design

The hydrological and hydraulic assessment outlined here relates to determining the peak flow and volume for a catchment for the rainfall events required to achieve the required level of service.

For storage assessments:

(a) For all catchments the hydrologic assessment method as per the Wellington Water *Reference Guide for Design Storm Hydrology* (available on the Wellington Water website) shall be used.

(b) For larger urban catchments, or where significant storage elements (e.g. ponds) are incorporated, surface water runoff can be determined using:

   (i) Wellington Water models that cover the majority of the Wellington region (WCC, PCC, HCC, UHCC and SWDC) and can be made available upon request.

   (ii) An appropriate hydrological and hydraulic model with Wellington Water's approval of the method and the proposed software to be used.

For development impact assessments or flood mitigation assessments:

(c) Wellington Water may request the modelling to be carried out as below, with (i) being the preferred method:

   (i) Wellington Water models that cover the majority of the Wellington region (WCC, PCC, HCC, UHCC and SWDC) and can be made available upon request

      1. The developer is to discuss requirements with Wellington Water prior to carrying out any modelling to confirm process and requirements if Wellington Water models are used.

      2. Wellington Water may be able to provide modelling services to the developer (depending on resource availability).

The developer may carry out their own modelling using particular software or format, but the developer is to discuss modelling requirements and software with Wellington Water prior to carrying out any modelling to confirm process and requirements.

4.3.2 Hydraulic design

(Parts of the hydraulic design presented here are also applicable to wastewater hydraulic design in conjunction with the provisions outlined in ***Section 5.3.2*** **Hydraulic design***.)*

The designer may use the Manning's Formula for hydraulic calculations as outlined in **Appendix 1**. The Colebrook-White method is not suitable for free-surface or open channel flow, but is not specifically excluded from use where a suitable situation is presented.

The hydraulic design must consider:

(a) An allowance for air entrainment.

(b) Losses at bends and changes in direction.

(c) Losses at pipe entries, junctions and exits.
(d) Losses through manholes and structures.
(e) Changes in grade, invert level or pipe size.
(f) The water level at the outlet due to:
    (i) Design high tide
    (ii) Flood levels
    (iii) Peak channel flow
    (iv) Other hydraulic influences.

4.3.2.1 Air entrainment

Where the pipe exceeds grades of 1 in 10:

(a) Allowances shall be made for bulking of the flow due to air entrainment.
(b) Special precautions shall be made to release the air and surplus energy. See **Appendix 1** for calculation methods.
(c) Special precautions may be required to release air in subsequent tranquil drain sections.

4.3.2.2 Losses through structures

Losses through a structure shall be compensated for through a drop in the invert level through the manhole. The drop shall be additional to the entry and exit slopes and shall be introduced gradually across the manhole.

The losses to be accounted for are:

(a) Head loss due to change in direction (h_d)
(b) Head loss due to junction (if applicable) (h_j)
(c) Nominal head loss across structure (h_n)

Therefore, the total drop (h_f) through the manhole to be accommodated shall follow:

Equation 1 $$h_f = h_d + h_j + h_n \quad \text{(m)}$$

See **Appendix 1** for acceptable methods for determining components of h_f.

4.3.2.3 Pipe inlets

The following applies to pipe inlets:

(a) Where an open stream or channel transitions to a pipe through a headwall or similar structure, the designer shall consider the hydraulic head required to ensure full pipe capacity is achieved in the receiving pipe.
(b) Many pipe entries will require additional energy, with a subsequent increase in the backwater curve, to transition the flow from a channel cross section to a pipe cross section.
(c) The TR2013/035 and NZBC Clause E1/VM1 details appropriate methods for determining the inlet and outlet hydraulics.

4.3.2.4 Culvert hydraulics

The hydraulic evaluation of stormwater culverts is outlined in the NZBC Clause E1/VM1. This method shall be used to evaluate the hydraulic performance of culverts. The following also applies to culvert hydraulics:

(a) Culverts under fills shall be of a suitable capacity to cope with the design storm with no surcharge at the inlet.

(b) Where the design storm is less than the 1% AEP flow, design checks shall be carried out under the 1% AEP design flow to assess the extent of the surcharge and to show that it will not present a risk to the stability of the adjacent embankments or increase the flooding risk to upstream properties, noting that:

  (i) If either of these situations applies, then the culvert size shall be increased to eliminate the risks.

4.3.2.5 Backflow effects and downstream level conditions

Backflow effects shall be considered in the design. Outlet design and water level conditions shall be considered in the design of discharges to existing stormwater systems and waterways and incorporate backflow prevention if necessary.

Where the proposed drain discharges:

(a) To the coast, assumed sea levels shall be the sum of (shown in **Table 4-5**):

  (i) Mean high water springs

  (ii) Projected sea level rise through to 2130

  (iii) Predicted land subsidence through to 2130,

  (iv) Allowance for storm surge

  (v) Local allowance for wave effect[9].

(b) To the public system:

  (i) The peak flows of both the proposed and public drains are unlikely to coincide due to the difference in times of concentration.

  (ii) The designer is required to determine the receiving waters level during the design event to facilitate backwater curve calculations.

  (iii) A conservative alternative is to assume both systems peak at the same time.

(c) To the Hutt River, discussions with Greater Wellington Regional Council shall be held to establish the downstream level of the river during the design event. GWRC has a floodplain management plan and/or flood maps for, but not limited to, the following water courses:

  (i) Hutt River

  (ii) Waiwhetū Stream

  (iii) Pinehaven Stream.

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[9] *Discharges, particularly to the beach face in open coastal areas, may need to consider additional elevated local water levels due to wave effects. Wave effects can generally be ignored for extended outfalls below MSL.*

Table 4-5 – Design sea levels allowing for climate change

	Wellington Harbour	**Porirua Harbour**
Mean high water springs (MHWS) (NZVD2016) [10]	0.537 m	0.581 m
+ Projected sea level rise (m) [11]	1.23	1.23
+ Land subsidence (m)	0.47 (York Bay)	0.29 (Pāuatahanui)
+ Storm surge allowance[12] (m)	0.25	0.25
+ Wave effect allowance (m)	0.00	0.00
= Design sea level (NZVD2016) (m)	**2.49**	**2.35**

4.3.2.6 Minimum stormwater velocity

Pipes shall be laid at a grade that reduces the potential for sediment build-up. The velocity shall be checked at half the 50% AEP design event flow:

(a) For trapped drains, the minimum velocity shall be 0.75 m/s noting:

  (i) That a trapped drain is considered as one where influent passes through a sump or sediment trap before entering the drain.

(b) For non-trapped drains, the minimum velocity shall be 0.9 m/s.

(c) Velocities as low as 0.6 m/s may be considered in areas with flat terrain on special application.

4.4 General specifications for stormwater

The following minimum specifications are designed to meet the objectives and criteria of this standard. Deviations from these specifications may be approved by Wellington Water if provided with suitable cause; however, Wellington Water reserves the right to decline alternatives if they are inconsistent with the objectives and performance criteria of this standard.

These specifications may change as technology and legislation evolve and changes may be unpublished at the time of design and application. Wellington Water reserves the right to vary these specifications to suit the application and contemporary industry practice.

All materials used for stormwater drainage works shall be new, or in as new condition when placed.

[10] *Based on LINZ's Dec 2017 revision of Standard Port Datums, converted to 2016 vertical datum*

[11] *From NZSeaRise https://searise.takiwa.co, as referenced in Interim guidance on the use of new sea-level rise projections, Aug 2022 , SSP 5-8.5 M Scenario. See also Ministry for the Environment. 2024. Coastal hazards and climate change guidance. Wellington: Ministry for the Environment.*

[12] *Storm surge includes barometric and wind effects.*

4.4.1 Information to be provided

In addition to the council's normal subdivision application requirements, the developer shall provide evidence demonstrating compliance with the objectives and performance criteria of this document.

Operations and maintenance guidelines for any water quality and/or control structures shall be submitted to Wellington Water for approval along with other required documentation.

4.4.1.1 Calculations

The design details and calculations shall be prepared by a suitably qualified person and demonstrate that required levels of service will be achieved and sustained.

(a) Calculations presented as part of any application shall include, but not limited to:
   (i) Catchment and sub-catchment attributes and details
   (ii) Rainfall intensity
   (iii) Time of Concentration
   (iv) Catchment runoff coefficients
   (v) Flood routing
   (vi) Peak discharge
   (vii) Pipe capacities
   (viii) Consideration of the receiving environment
   (ix) Structure losses
   (x) Pipe losses
   (xi) Backwater calculations.

(b) All assumptions regarding the design and calculations shall be clearly listed.

(c) Structural calculations shall be provided to support the proposed pipe class based on:
   (i) Min/max cover
   (ii) Traffic/construction loadings
   (iii) Surcharge conditions
   (iv) Bedding and surrounds.

(d) The developer shall provide calculations where scour may occur. The NZBC Clause E1/VM1 can provide guidance on this.

(e) All applications to build within a floodplain must be supported by detailed calculations and plans that outline the floodplain boundaries and levels relative to building floor levels.

(f) Any impact that the proposed works may have on adjacent areas or catchments shall be clearly indicated on the drawings and supported by detailed calculations prepared by a suitably qualified person.

4.4.1.2 Design and construction drawings

The following items shall be included in any design and construction drawings:

(a) A scale plan of the catchment and sub-catchments.

(b) A legend

(c) Details of all structures, including:

   (i) Culvert entrances and exits

   (ii) Secondary intakes

   (iii) Energy dissipating structures.

(d) The location and alignment of any:

   (i) Open channels

   (ii) Natural waterways

   (iii) River or coastal floodplains

   (iv) Secondary (overland) flow paths

   (v) Wetlands within the site or within close proximity to a boundary.

(e) The location, in plan, and the level of the water's edge and shoulder of the bank shall be indicated.

(f) Representative "typical" pre-existing and post development cross sections and long sections through any natural waterways or wetlands.

(g) The proposed proximity of buildings to the water's edge and/or shoulder of the banks.

(h) The level datum.

(i) A plan showing the proposed location of existing and proposed stormwater drains in terms of datum.

(j) Long-sections shall be drawn with the chainage starting at the downstream end of the drain and the upstream point of the drain to the right of the drawing. This represents the way the drain would normally be constructed.

(k) Long-sections shall include:

   (i) Details of all proposed and existing depths

   (ii) Diameters and levels of manholes

   (iii) Pipe materials, diameters and grades.

(l) Secondary flow paths and calculated flow depths during the design event.

Proposed works shall not begin until construction plans have been approved.

4.4.1.3 Asset operations and maintenance plan

New assets, such as water quality and/or control structures, will be accompanied by an asset operations and maintenance plan, as part of the completion documentation, which shall detail how the asset is to be operated and maintained over the life of the asset. A replacement schedule should also be included to show what works needs to be carried to ensure the asset is operable in perpetuity. The plan shall include, as a minimum:

(a) Required inspection and condition assessment schedule.

(b) Required maintenance, both regular and occasional to ensure continued operation.

(c) Required replacement schedule for components with a limited lifespan, or life span shorter than the nominal life expectancy of the asset as a whole.

(d) How the asset is to be operated or is intended to work, including:

  (i) Stages where operator input is required should be highlighted.

(e) Health and safety and operational risks intrinsic to the asset, operators and public and either:

  (i) How they have been mitigated (through design), ***or***

  (ii) How they should be mitigated (through operation).

4.4.2 Stormwater detention

Detention may take the form of oversized pipes, defined ponds, large channels/swales or ponding areas. Detention ponds or areas require specific design in conjunction with Wellington Water. The following applies to the design of stormwater detentions:

(a) The Wellington Water *Reference Guide for Design Storm Hydrology* shall be considered an acceptable method for use in flood routing.

(b) Detention areas/ponds must be provided with safe access for maintenance to at least the standard for intakes.

(c) Where an open detention pond is proposed, detention depths shall not exceed 1.2 m unless access to the pond edge is restricted.

(d) The detention structure is to be adequately designed to have a controlled discharge for an event larger than the design event.

(e) Where detention structures are to be vested to the council as part of the public stormwater network, the designer shall liaise with Wellington Water to confirm the requirements for access, control, monitoring, alarm and telemetry systems specification.

4.4.2.1 On-site stormwater management and disposal

The following paragraphs relate to on-site stormwater management and disposal:

(a) On-site stormwater management and disposal systems are required for all developments unless the developer can demonstrate that there is no increased upstream or downstream flooding.

(b) The proposed system shall be designed to achieve hydraulic neutrality by limiting the design peak discharge from the development (post-construction) to not greater than the existing design peak discharge (pre-development) in all flood events up to and including the 1% AEP rainfall event. Please refer to **Section 4.3.1 Hydrological design** and the Wellington Water *Reference Guide for Design Storm Hydrology* .

(c) Systems shall be privately owned and operated.

(d) Systems servicing single lots shall be located completely within the serviced lot.

(e) A suitable maintenance manual is required before the system is approved.

4.4.2.2 Soak pits

Typically, soak pits will only be considered acceptable on the elevated river terraces in Upper Hutt (see **Standard Detail DR06 – Possible Location for Stormwater Soakage in Upper Hutt** in the *Regional Specification for Water Services*). All other areas within Hutt, Upper Hutt, Wellington or Porirua cities are unlikely to be suitable for soakage.

The standard acceptable methods of on-site disposal are soak pits and soak trenches, include the following guidelines:

(a) These may only be used to dispose of runoff generated on the site.

(b) They are not to accept flows from adjacent lots.

(c) Suitably designed and constructed soak pits will be considered acceptable for residential applications and will be privately owned and maintained.

(d) GD2021/007 can be used for guidance in the site suitability assessment, soakage testing and the design of soakage systems.

(e) Larger installations for commercial, industrial or communal use will be at the discretion of Wellington Water.

(f) A geotechnical assessment may be requested by Wellington Water if the proposed soakage has the potential to affect land stability, but not withstanding that:

  (i) Care must be taken to ensure the stability of the adjacent ground is not compromised by the soakage.

(g) The soakage facility must be sited on private property and have adequate clearance from boundaries, dwellings, buildings, retaining walls and sanitary sewers. **Table 4-6** provides clearance distances for small installations.

(h) The top level of the soak pit is to be above the ponding level of a 20% AEP rainfall-runoff event, and the base of the soakage facility is to be a minimum of 500 mm above the winter groundwater table level.

(i) The soakage facility will be approved upon submission of results of a suitable soakage test and design. Suitable tests are outlined in Appendix A of GD2021/007. A suitable design must achieve the following outcomes:

  (i) Soakage devices that are the sole management device shall be designed to achieve a primary level of service as defined in **Section 4.2.6 Primary system level of service**. The design shall consider all storms between 10 minutes and 24 hours in duration.

  (ii) All soak pits must completely drain within 24 hours of a rainfall event to ensure they are ready for the next event.

  (iii) Additional retention devices to achieve hydraulic neutrality may also be required.

(j) A discharge permit may be required from the regional council for discharge to ground[13] and this shall be confirmed with Greater Wellington Regional Council.

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[13] *Discharge into or onto land, including stormwater collected from any road, roof, yard, paved surface, grassed surface or other structure, and discharged into a pipe which discharges into surface water.*

(k) Soakage pit entries or systems should be trapped to limit the amount of debris entering the soakage interface to extend the long-term viability of the system.

Table 4-6 – Clearance distances between soak pits and structures

Proximity to:	Required clearance
Dwellings	2.0 m
Small out-buildings	1.5 m
Boundaries	1.5 m
Retaining walls	Height of wall + 1.5 m
Sewers	1.0 m

4.4.2.3 On-site detention and attenuation

Attenuation, using on-site detention facilities, can be used to limit the discharge from the property to mitigate adverse effects on the downstream system.

These can take the form of an above-ground tank or buried tank and may be combined with soakage. The following applies to these structures:

(a) The proposed system shall be designed to achieve hydraulic neutrality by limiting the design peak discharge from the development (post-construction) to not greater than the existing design peak discharge (pre-development) in all flood events up to and including the 1% AEP rainfall event.

(b) Storage for larger, multiple lot developments requires special design, as outlined in **Section 4.4.2 Stormwater detention**.

(c) For residential detention structures, a 10% and 1% AEP event using the Wellington Water *Reference Guide for Design Storm Hydrology*, shall be used to determine runoff and detention volumes.

    (i) Wellington Water has developed a set of Approved Solutions for Hydraulic Neutrality. These approved solutions focus on stormwater detention are suitable for developments of one to ten residential buildings. The approved solutions are available on the Wellington Water website or on request.

(d) Consideration shall be made to providing suitable access for regular maintenance of the outlet and storage volume.

(e) The attenuation facility shall generally be privately owned and maintained and placed on private property, and:

    (i) The facility shall be protected by private easement where required.

(f) The secondary flow path due to outlet blockage *shall not* be a buried overflow pipe connection, but by an appropriate and visible overland flow to an approved outfall or public system. This is to provide a visible indicator to the owner for the requirement for maintenance.

4.4.3 Open watercourses

Open watercourses shall be designed to the following guidelines:

(a) Open watercourses shall be designed with a minimum freeboard of 500 mm above the design flow. Consideration shall be given to wave action and heading up at bends in the watercourse.

(b) Watercourses and their natural character shall be retained wherever possible and located in public reserves.

(c) There shall be no modification of an existing stream system unless it is for flood mitigation purposes, there are no viable alternative flood management methods available, and:

  (i) All development work should be located away from the riparian buffer where possible.

  (ii) Impediments to the natural flow with barriers to fauna should be avoided[14].

(d) Any work in a stream bed is likely to require resource consent and contact shall be made with Greater Wellington to confirm. Consent may also be required from the territorial authority as well.

(e) The extent of any stream improvement work shall be agreed with Wellington Water to achieve a satisfactory result maintaining the natural topography and vegetation, along with maintenance, hydraulic and safety considerations, including the downstream effects of the work.

(f) Ephemeral streams should be retained as secondary flow paths.

(g) Further piping of streams is not a preferred approach; however, if approved, an approved secondary flow path must be available.

(h) For watercourses with the equivalent 10% AEP event design capacity as that of a 600 mm pipe, the watercourse is required to be in an easement in favour of the council.

  (i) The easement is to include sufficient space on at least one side of the stream and flood berm (for mean annual flood) for a 4.5 m wide strip practical for maintenance access to the stream, unless otherwise specified by Wellington Water.

  (ii) The cross section of any open watercourse shall be constructed to comply with Wellington Water specific requirements.

4.4.3.1 Bridges

Where bridges or structures cross an open watercourse, the design shall:

(a) Include advice from Greater Wellington Regional Council on potential regional consent requirements.

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[14] *Users of the standard should be aware of their responsibilities for maintaining fish passage under the Freshwater Fisheries Regulations 1983 (Part 6) and Resource Management Act 1991.*

(b) Allow for a freeboard of 600 mm between the design peak water level (see **Section 4.2.7 Secondary system level of service** and **Section 4.2.8 Freeboard**) and the underside of the bridge or structure.
   (i) The freeboard shall be increased to 1200 mm where there is a possibility of large trees being carried down the waterway (from the Waka Kotahi NZ Transport Agency Bridge Manual).

4.4.4 Lateral connections to the public stormwater network

The following applies to lateral connections to public mains, watercourses and kerbs:

(a) Private connections may be required to provide stormwater treatment to reduce contaminant loading to meet bylaw or resource consent requirements.

(b) Private connections shall be a minimum size of 100 mm nominal diameter.

(c) Each proposed dwelling on a lot shall be serviced by a separate connection to the public system at a location approved by Wellington Water, except that:
   (i) Unit titled developments are exempt from this criterion and may be serviced by a single, suitably sized connection.

(d) Each connection shall be capable, as a minimum, of conveying the design level of service.

(e) Industrial and commercial lots shall have a minimum nominal diameter of 150 mm and shall connect to a stormwater pipe, swale or, where permitted under the Regional Plan, open watercourse.

(f) Connections provided to lots must be at sufficient depth that they can be extended to the building platform in a manner compliant with the NZBC.

(g) Connection of the private drainage to the lateral (livening) shall require testing (dye testing or similar) to avoid the potential for cross-connections between the stormwater and wastewater systems.

(h) Where the connection is to an empty lot (see **Standard Detail DR07 – Lateral Connections to Public Stormwater or Wastewater Mains** in the *Regional Specification for Water Services*), the terminal connection shall be:
   (i) Laid at least 1 m inside and within the boundary of the property.
   (ii) End in a method that can accept an approved spigot.
   (iii) Pipe colour-coded green, ensuring that if paint is used any rubber ring gap is taped over to protect it from the paint.
   (iv) Be blanked off or sealed with a removable cap colour-coded green.
   (v) Be marked with a securely embedded H4 treated timber post, with at least 600 mm protruding above ground, and the top 100 mm painted green.

(i) Connections larger than 150 mm shall be connected to the public system via a manhole only. Connections shall be made at angles 90 degrees or less to the direction of the flow.

(j) Connections 150 mm or less can be made directly to a stormwater main using one of the methods listed in **Table 4-7**.

Table 4-7 – Acceptable methods for lateral connection to public stormwater pipe

Public main material	Acceptable method
PVC	PVC Y-junction with rubber ring joint slip couplers
PE100	Electrofusion PE100 Y-saddle or Y-junction
Earthenware or concrete (see **Section 4.4.4.2 Earthenware saddle connections to earthenware or concrete mains**)	1. Proprietary Y-junction with mechanical elastomeric metal banded couplers 2. Earthenware saddle installed in accordance with **Section 4.4.4.2 Earthenware saddle connections to earthenware or concrete mains**
Twin wall polypropylene	Approved proprietary connector
Brick pipe, brick culverts or non-round culverts	Requires written approval from Wellington Water
AC and other pipe materials	Proprietary Y-junction with mechanical elastomeric metal banded couplers

(k) Connections shall not be made to a public pipe deeper than 3.5 m to the crown. A shallower public drain shall be provided to collect private connections before joining the deeper main.

(l) A private connection cannot cross an adjacent property without the permission of Wellington Water and the adjacent property owner. Where permission is obtained, in writing, an easement shall be obtained in favour of the connection’s lot.

4.4.4.1 Connections to kerb and channel

The following applies to kerb and channel connections:

(a) In an existing developed area, kerb and channel connections are approved on a case-by-case basis and are limited to 100 mm diameter pipes.

(b) All greenfield developments and other connections must be to a watercourse, swale or a public stormwater pipe.

(c) The pipe between the back of the footpath and the boundary may be made from an approved plastic, but beneath the footpath and to the kerb and channel must be galvanised steel or cast iron with approved steel kerb adaptors.

4.4.4.2 Earthenware saddle connections to earthenware or concrete mains

(This section also applies to wastewater design.)

The following applies to earthenware saddle connections to gravity earthenware and concrete wastewater and stormwater pipes:

(a) Wellington Water reserves the right to require proprietary Y-junctions in any circumstance.

(b) For saddles to be used, the main must be at least one size larger than the saddle connection.

(c) The saddle shall be installed as follows:
   (i) Hole in existing public main to be drilled out and finished with epoxy mortar on inside.
   (ii) Earthenware saddle to be secured using epoxy mortar.
   (iii) Joint to be backfilled with low strength 2 MPa cement stabilised flowable fill material.

(d) Connection between the saddle and lateral pipe shall use an elastomeric metal banded coupler.

4.4.4.3 Decommissioning and reuse of existing laterals

Where an existing building is demolished or replaced:

(a) The end of the lateral is to be capped at the main, relined or re-laid for future use.

(b) Wellington Water shall be advised of the final treatment.

(c) The reuse, without relining, of an existing lateral is not permitted, unless the lateral (from the building to the public main) is free from cracks and other defects as verified with the use of CCTV and is made of a resilient pipe material such as PVC, concrete or PE.

(d) The reuse of laterals made of earthenware or AC pipe is never permitted, regardless of condition, without relining.

4.4.5 Public stormwater pipes

The stormwater system shall be designed as a separate system with no cross-connections to the wastewater system.

4.4.5.1 Minimum size

The minimum nominal diameter for a public stormwater pipe is:

(a) 300 mm for stormwater mains and double sump leads

(b) 225 mm for single sump leads.

4.4.5.2 Minimum cover

The following applies to the minimum cover of stormwater pipes:

(a) Stormwater pipes shall generally be laid with a minimum cover of 600 mm where practicable.

(b) The designer is required to demonstrate suitable pipe class selection and structural trench design at all depths.

(c) Wellington Water may require additional load mitigations, such as concrete slabs, when considering a request from a designer for a lesser cover.

(d) Where dispensation is granted for a stormwater lateral laid up a legal road bank steeper than 45 degrees (1 vertical to 1 horizontal), the lateral shall be pinned to the bank and suitably protected from damage.

4.4.5.3 Materials

The permitted materials for use in the stormwater network are detailed in the *Regional Specification for Water Services* and supporting documents.

4.4.5.4 Location

The following applies to the location of pipelines:

(a) Public pipelines shall be laid in accordance with all requirements in Section **3.8 Building in close proximity to public pipelines**.

(b) Where practicable, pipes shall be located in public land, preferably within carriageways, footpaths and berms.

(c) Pipes are to be located where surface access for machinery and maintenance is possible at all times and at reasonable cost and least possible disruption to the public.

(d) Where public pipes must be located in private property, they shall be protected by an easement (see **Section 4.4.12 Easements**) and subject to the criteria outlined in **Section 4.2.2 Access** regarding easements and avoidance of existing and potential building sites.

(e) Public pipes (including manholes) shall not be located directly on a boundary line or on the alignment of a proposed fence or retaining wall.

4.4.5.5 Changes in pipe diameter

(This section applies to wastewater design also.)

The following applies to changes in the pipe diameter:

(a) Where the downstream pipe diameter increases, the pipe shall, as a minimum, be designed as soffit-to-soffit such that the hydraulic grade line through the structure is constantly falling (i.e., no heading up).

(b) A downstream reduction in pipe diameter will generally not be accepted, but if approved:

  (i) The reduction shall be made in an appropriately smooth transition structure (a manhole as a minimum).

  (ii) Specific engineering is required to eliminate heading up in the manhole, and to avoid detrimental backwater effects in the upstream pipe.

  (iii) Reductions to less than a 300 mm diameter pipe will not be considered.

4.4.5.6 Pipes at steep grade

(This section applies to wastewater design also)

Pipes laid at a steep grade shall be designed:

(a) To allow for air entrainment (see **Section 4.3.2.1 Air entrainment**)

(b) With sufficient protection to protect the drain from UV light, erosion and physical damage; with the protection of a form that is be visually acceptable within the context of the surrounds.

(c) With appropriate downstream energy dissipation that will protect the receiving structure from erosion and damage, including:

  (i) If the design velocity exceeds 3 m/s and the flow undergoes a sudden reduction in grade

  (ii) Where hydraulic design suggests significant turbulence will occur.

(d) For water stops (see **4.4.5.7 Water stops**).

4.4.5.7 Water stops (Bulkheads)

(This section applies to wastewater design also.)

Water stops shall be designed as follows:

(a) Water stops are required to reduce movement of groundwater along trenches and minimise the potential for trench scour.

(b) Manholes can be considered as water stops if constructed in a manner that restricts the passage of water past the structure.

(c) Water stops shall be constructed of 150 mm thick 17.5 megapascal (MPa) concrete, keyed 150 mm minimum into the trench walls and base and extending 300 mm above the pipe (see **Standard Detail DR03 – Typical Trench and Waterstop Details** in the *Regional Specification for Water Services*), with spacings as per **Table 4-8**.

Table 4-8 – Water stop spacing

Pipe grade	Spacing
> 20%	5 m
20% to 12.5%	7.5 m
12.51% to 6.7%	15 m
6.71% to 1%	90 m

(d) Subsoil drains (see **Section 4.4.6 Subsoil drains**) may be required where a high groundwater table or excessive infiltration is expected. These drains shall discharge to an appropriate facility, typically a downstream manhole and above nominal design flow levels. Where the subsoil drain passes through a water stop or similar, it shall be sealed to restrict bypass flow through the water stop.

4.4.5.8 Pipe junctions

(This section applies to wastewater design also.)

All public pipe junctions shall be made using a manhole (see **Section 4.4.7 Manholes and maintenance shafts**). This does not necessarily include laterals, which are subject to provisions in **Section 4.4.4 Lateral connections to the public stormwater network**. Junctions shall be appropriately benched as outlined in the *Regional Specification for Water Services*.

4.4.6 Subsoil drains

The following applies to subsoil drains in fill areas:

(a) Permanent subsoil drains shall be installed in earthfills except where all of the following criteria can be demonstrated:

(i) There are no natural springs that will discharge at the base of the fill.

(ii) Positive provisions (e.g., cut-off subsoil drain) are made to prevent surface runoff entering the fill at the exposed fill/natural ground contact.

(iii) The natural ground on which the fill is to be placed is contoured and scarified prior to the placement of fill to ensure that, over the whole base of the fill, the fill can be fully compacted to specification and continuity achieved between the fill and natural ground.

(iv) The fill material is uniform, of relatively low permeability and is not erodible.

(b) Private subsoil drains servicing earthfills (excepting those behind retaining walls) shall be laid to the same standard as if they were public drains.

(i) A Building Consent shall be obtained.

(ii) The requirements for a public drain will in general apply, though access requirements may be eased.

Subsoil drains shall be constructed as follows:

(c) They shall connect to a manhole structure at both ends. The upstream manhole can be a maintenance shaft.

(d) They should be laid in a narrow trench, though if the loading permits, they may be laid in the cleaned out bed of the old watercourse with gentle horizontal and vertical curves.

(e) There shall be no abrupt changes in grade.

(f) The drains in the main gullies shall be established through design and shall be at least one pipe size larger than any connecting branch drain.

(g) Branch drains shall be laid in all adjacent gullies and adjacent to any wet areas, such as a spring, and in accordance with the following:

(i) Branch drains shall be a minimum of 100 mm diameter.

(ii) They shall be connected to the main by means of Y junctions only.

(iii) Open butt joints will not be permitted.

(h) Where the design load allows, perforated concrete, high density polyethylene (HDPE) or ceramic pipes may be used:

(i) These pipes must all be bedded and surrounded with a minimum of 150 mm of suitable graded filter material.

(ii) Alternatively, a suitable permanent filter fabric may be placed around granular pipe bedding in lieu of the graded filter material.

(i) Where the design load precludes the use of these pipes or where significant localised inflows or ground water are to be intercepted then the drain shall be laid as a sealed drain of adequate strength and may have multiple branches with multiple inlets to collect ground water.

(j) Where perforated pipes cannot be used, stones larger than the pipe diameter shall be hand placed over the inlets:
   (i) The larger stones are to be covered with 50 mm of ballast.
   (ii) A suitable graded filter material shall be placed over this ballast.

(k) Where perforated pipes are used, the ends of the branch drains shall be sealed off and the drain backfilled as normal.

(l) Subsoil drains shall be clearly identified on as-built plans.

(m) There shall be no direct stormwater connection or opening to a subsoil drain.

4.4.7 Manholes and maintenance shafts

(This section also applies to wastewater design.)

4.4.7.1 Manholes

Manholes are required to allow physical entry of a person and equipment to the pipe for purposes of maintenance, investigation or connection. The following applies to the use of manholes:

(a) Manholes shall be constructed in pre-cast reinforced concrete with minimum number of risers to minimise risk of infiltration. Other materials may be accepted by Wellington Water upon application and with suitable reason.

(b) Manholes should generally be used on all public drains at:
   (i) Junctions of public drains
   (ii) Changes in grade
   (iii) Changes in direction.

(c) Stormwater branch pipelines 300 mm or smaller may be saddled onto pipes 1200 mm diameter or larger without the requirement for a manhole provided:
   (i) a manhole is constructed on the branch line within 50 m of the junction
   (ii) where suitable fittings are not available, connections should be at a manhole
   (iii) connection holes shall be core-drilled and follow one of the methods listed in **Table 4-9**.

Table 4-9 – Acceptable methods for 300 mm or smaller branch connections to stormwater pipes greater than 1200 mm

Public main material	Acceptable method
PE100	Electrofusion PE100 T-saddle or Y-saddle
Concrete	Earthenware saddle installed in accordance with **Section 4.4.4.2 Earthenware saddle connections to earthenware or concrete mains**. Direct connection and internal/external epoxy sealing for concrete branch pipes where written approval is obtained from Wellington Water.
Twin wall polypropylene	Approved proprietary connector
Brick pipe, brick culverts, non-round culverts, PVC, AC and other pipe materials	Requires written approval from Wellington Water.

4.4.7.2 Maintenance shafts

Maintenance shafts are designed to provide access to rod or jet obstructions clear of the pipe. They are also known as cleaning eyes, rodding points or lamp hole cleaning eyes.

Maintenance shafts shall:

(a) Not be used on the public main unless dispensation has been granted by Wellington Water.

(b) Be considered at the upstream termination of a short section of 150 mm drain section, typically 50 m or less.

(c) In some circumstances, be used at the top of a steep change of grade where a manhole is likely to be in an unsafe or precarious position.

(d) Be considered for approval by Wellington Water at subdivision terminal staging points or where the developer can justify their use for a special circumstance.

(e) Have no customer connections to the maintenance shaft.

4.4.7.3 Design to prevent floatation

Manholes shall be designed to prevent floatation according to the following guidelines:

(a) Manholes shall be designed to prevent floatation using a factor of safety of 1.25. The design must include consideration of groundwater table and liquefaction potential.

(b) The weight of the manhole risers, lid, slab and base shall be used for calculating the resistance against floatation, and the manhole shall be assumed to be empty.

(c) The weight and effects of the surrounding soil shall be ignored except where integrated flanged manhole bases are used, whereupon the volume and net density of the soil (density of dry soil minus the density of water) above the flange can be used to calculate additional resisting force.

The following applies to design against liquefaction:

(d) Shallow structures (less than 3 m deep) are less likely to uplift due to liquefaction than deeper structures (greater than 3 m deep), although this is still dependant on the level of the groundwater table and the potential for the material to liquefy.

(e) Areas with potential for liquefaction are published by Greater Wellington Regional Council. Reference to the latest hazard maps shall be made prior to design.

(f) The manhole excavation shall be lined with filter fabric prior to the manhole base being placed. The filter fabric shall encase the manhole and the backfill of the excavation. The calculated up-thrust from liquefied in-situ material acting against the full area of the manhole flange, shall be countered by the downward force from:

(i) The buoyant downward force of the backfill below ground level, e.g. $(wet\ density_{backfill} - wet\ density_{in-situ\ material}) * volume * g$

(ii) The weight of the manhole.

(g) The backfill shall be a compacted, non-cohesive, gap graded material (i.e. AP40 or similar). Alternatively, where this is not practical due to method of installation or retro-fitting, approved pore-pressure releasing mechanisms may be employed (float-less manhole system) or similar.

(h) The manhole shall be constructed in accordance with the *Regional Specification for Water Services*.

(i) As design against liquefaction is continuously evolving, other methods will be considered on application. All other requirements for manhole design and construction outlined within **Section 4.4.7 Manholes and maintenance shafts** still apply.

4.4.7.4 Manhole size

The following clauses apply to manhole size:

(a) Manholes shall be a minimum of 1050 mm diameter (refer to clause (h)).

(b) Manholes with a depth to invert between 2 m and 4 m shall be 1200 mm minimum diameter.

(c) Manholes with a depth to invert greater than 4 m shall be 1500 mm minimum diameter.

(d) Manholes shall be the same diameter for the full depth of the manhole.

(e) Notwithstanding the above minimum requirements, the manhole shall also be sized to accommodate the minimum dimensions outlined in **Figure 4-1**, where the dimension X is the greater of:

(i) 0.75 x OD of inlet/outlet pipe where pipes are same diameter

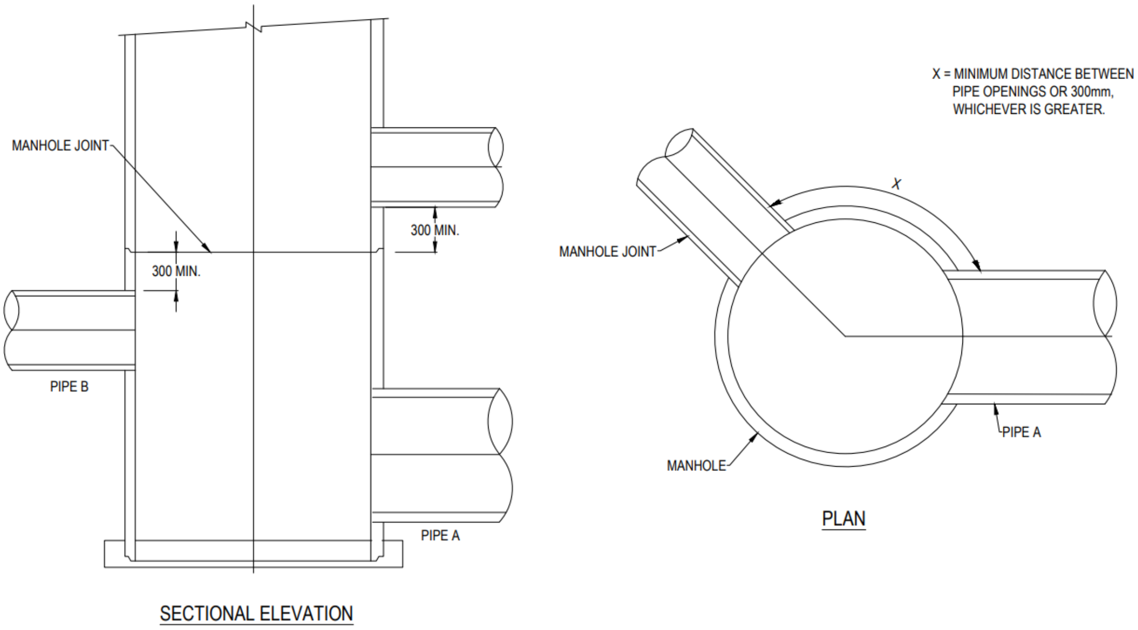
(ii) 0.65 x OD of largest inlet/outlet pipe where pipes are different diameter

(iii) 300 mm.

(f) Manholes shall be large enough to appropriately admit connecting pipelines and any required change in direction.

(g) Manholes shall also be large enough to accommodate landings with room for manoeuvring and equipment if required (refer to **Section 4.4.7.6 Deep manholes**).

(h) 600 mm diameter manholes may be considered where the pipe invert is less than 1 m from the finished ground level, the manhole is not located in the carriageway, and there are other special circumstances.



Source: CPAA Guidance Note: Loads on Circular Precast Concrete Manholes and Access Chambers: March 2016

Figure 4-1 – Manhole layout

4.4.7.5 Manhole safety grilles

Manhole safety grilles shall be fitted into manhole access lid frames for all new manholes deeper than 3 m and for any manhole where a specific safety risk is identified. The safety grilles are intended to prevent the risk of falls greater than 3 m and to act as a signal that access to the manhole will require additional safety equipment such as a winch and safety harness.

4.4.7.6 Deep manholes

Deep manholes:

(a) Are greater than 3 m in depth and shall be specifically designed to take into consideration access, health and safety, maintenance, and rehabilitation.

(b) Do not require landings as they may interfere with safety equipment and rescue operations in confined spaces. If the designer chooses to specify a landing in a manhole for a specific purpose, this shall first be agreed in writing by Wellington Water.

4.4.7.7 Connections to manholes

The following applies to manhole connections:

(a) A 600 mm manhole can accept a maximum of two incoming pipes.

(b) A 1050 mm manhole shall have no more than 3 incoming pipes and 1 outgoing pipe. This includes sump leads, private connections and main pipelines.

(c) Where more connections are required, a larger manhole may be required to comply with the manufacturer's recommendations for connection spacings.

4.4.7.8 Drops at manholes

The following applies to manholes drops:

(a) All pipe entries shall be haunched to the manhole invert to avoid cascades; except that:

  (i) Sump leads, or normally dry stormwater laterals 300 mm in diameter or less, may enter above the benching as a cascade.

(b) Haunched drops are not to exceed 500 mm. Consideration shall be given to the hydraulic grade line and surcharging where super-critical flows transition to tranquil sub-critical flows.

(c) For wastewater pipes, drops greater than 500 mm may be made using an internal drop structure.

4.4.7.9 Internal drop structures

The following applies to drop structures:

(a) External drop structures are not permitted within either the stormwater or wastewater network.

(b) Internal drop structures will not normally be considered for stormwater applications but are acceptable within wastewater systems.

(c) Drop structures shall be avoided where possible, by laying the approaching drain at a shallow grade, then descending to the manhole invert through a steep section of pipe at the final approach and:

  (i) A manhole is required at either end of the steep approaching inlet drain.

(d) For wastewater systems (see **Standard Detail DR02 – Internal Drop Details** in the *Regional Specification for Water Services*):

  (i) Internal drop structures are required where the approaching inlet grade is greater than 45 degrees.

  (ii) Internal drop pipework shall be designed to be clear of the design flow and the discharge shall be to a haunched channel.

  (iii) Internal drop pipes shall not be larger than 225 mm nominal diameter.

  (iv) The minimum size for a manhole with an internal drop structure is the nominal manhole diameter plus the drop pipe outside diameter.

4.4.7.10 Spacing

Manholes shall be spaced at intervals of:

(a) Not more than 90 m in road reserve for pipe less than 1050 mm in diameter.

(b) 90 times the pipe diameter for pipes 1050 mm in diameter or greater.

(c) 60 m in private property.

4.4.7.11 Changes in grade

Notwithstanding the provisions in **Section 4.4.7.2 Maintenance shafts** regarding manholes at the top of steep banks, changes of grade shall be made at a manhole.

4.4.7.12 Changes in direction

Any change in direction or bend shall be completely contained within the interior of the manhole. The maximum change of direction shall be 90 degrees.

An exception to this may be made where a manufactured mitred bend is required, generally on large pipes, typically 750 mm in diameter or larger, provided:

(a) There is a compelling reason not to form the bend within a manhole.

(b) There is a downstream manhole within 5 m of the bend.

(c) There are no proposed or potential connections to the bend.

(d) The location of the bend is shown, accurate to ±100 mm in the required co-ordinate system, on the drain's as-built plan.

Maintenance structures shall not be used for changes in direction.

4.4.8 Stormwater pipe intakes

The following applies to stormwater pipe intakes:

(a) Intakes shall be designed to accept the design flow without scour or erosion of the pipe surrounds. Wing walls are a minimum requirement for stormwater intakes directly into a pipe.

(b) Suitable barriers/fences shall be required above an intake where a fall of 1 m or greater is possible from above the intake headwall, and where public access is possible.

(c) An all-weather access track must be provided to the entrance of all intakes, as follows:

   (i) The access shall be at least 4 m wide and no steeper than 1:5 (v:h) and suitable for use by trucks.

   (ii) There must also be room for machinery to work at the intake.

   (iii) The access shall be in public land or protected by an easement.

   (iv) Provision shall be made so that no water can bypass the inlet structure and flow into compacted fill or areas where damage may occur. See also **Section 4.3.2.3 Pipe inlets** for hydraulic design requirements.

4.4.8.1 Stormwater intake grilles

The following applies to stormwater intake grilles:

(a) For culverts:

(i) Grilles are not typically required unless a specific safety risk is identified.

(ii) Wellington Water may request an intake grille to be installed in some locations.

(iii) Culverts are required to have access provisions for clearing similar to those of pipe intakes (see **Section 4.4.8 Stormwater pipe intakes**), and debris arrestors may be required as noted in **Section 4.4.8.2 Debris traps.**

(iv) Provisions to protect the structure against scour and erosion at the inlet and outlet shall be provided and supported by calculations where requested.

(b) For stormwater pipe intakes:

(i) A grille is to be installed unless it can be demonstrated through the Safety in Design process that the potential for pipe or valve blockage due to debris accumulation is low and there is no risk to safety (for people, especially children entering the intake).

(c) To determine the appropriate grille, the designer shall consider:

(i) The potential effects of seawater on the durability of the grille.

(ii) The public use of the area surrounding the intake.

(iii) The diameter of the intake.

(iv) The likelihood of people (especially children) entering the water course upstream of the intake.

(v) The accessibility of the water course (extent of vegetation, fencing and ground slopes).

(vi) The quantity and type of debris.

(vii) Maintenance requirements.

(viii) The consequences of blockage (safety and economic).

(ix) The use of a grille with a top-hinge for ease of maintenance (where practical).

(d) Stormwater intake grilles shall (see **Figure 4-2**):

(i) Consist of a vertical front face of a height at least equal to the pipe diameter, and a sloping top.

1. The angle of the top shall be greater than 1 to 4 (v:h).
2. The total open area of the grille shall be no less than two times the cross-sectional area of the intake pipe.
3. An alternative acceptable design would be to exclude the vertical front face and have a uniform slope surface with the angle greater than 1 to 4 (v:h).

(ii) Be made of galvanised steel flat bars and follow the below guidelines:
   1. The length of the bars shall run top to bottom (as opposed to across the intake).
   2. Each flat bar shall be positioned on its edge so that the thickness of the bar forms the face of the grille, with the flat side of the bar standing vertical.
   3. The minimum bar thickness shall be 10 mm, and the depth of bars (flat side) to be determined by the designer.
   4. The bars shall be spaced to maintain 140 mm clear opening (i.e., bars at 150 mm centres where bar thickness is 10 mm). Larger (even) bar spacing may be considered on a case-by-case basis.
   5. The edges of the bars are to be bevelled prior to galvanising

(iii) Be bolted to the wall with either hot dipped galvanised or stainless steel bolts in a fashion that will allow the grille to be readily replaced;

(iv) Be sufficiently strong to resist the impact of any debris that may come down the watercourse.

(v) Be sufficiently designed to withstand cleaning with an excavator bucket (where appropriate).

(vi) Not allow the top grille to protrude beyond the vertical grille (to avoid excavator buckets from catching on the top grille).

(vii) Be shaped and located to make clearing as easy as practical prior to or following storm events.

(viii) Maintain fish passage.

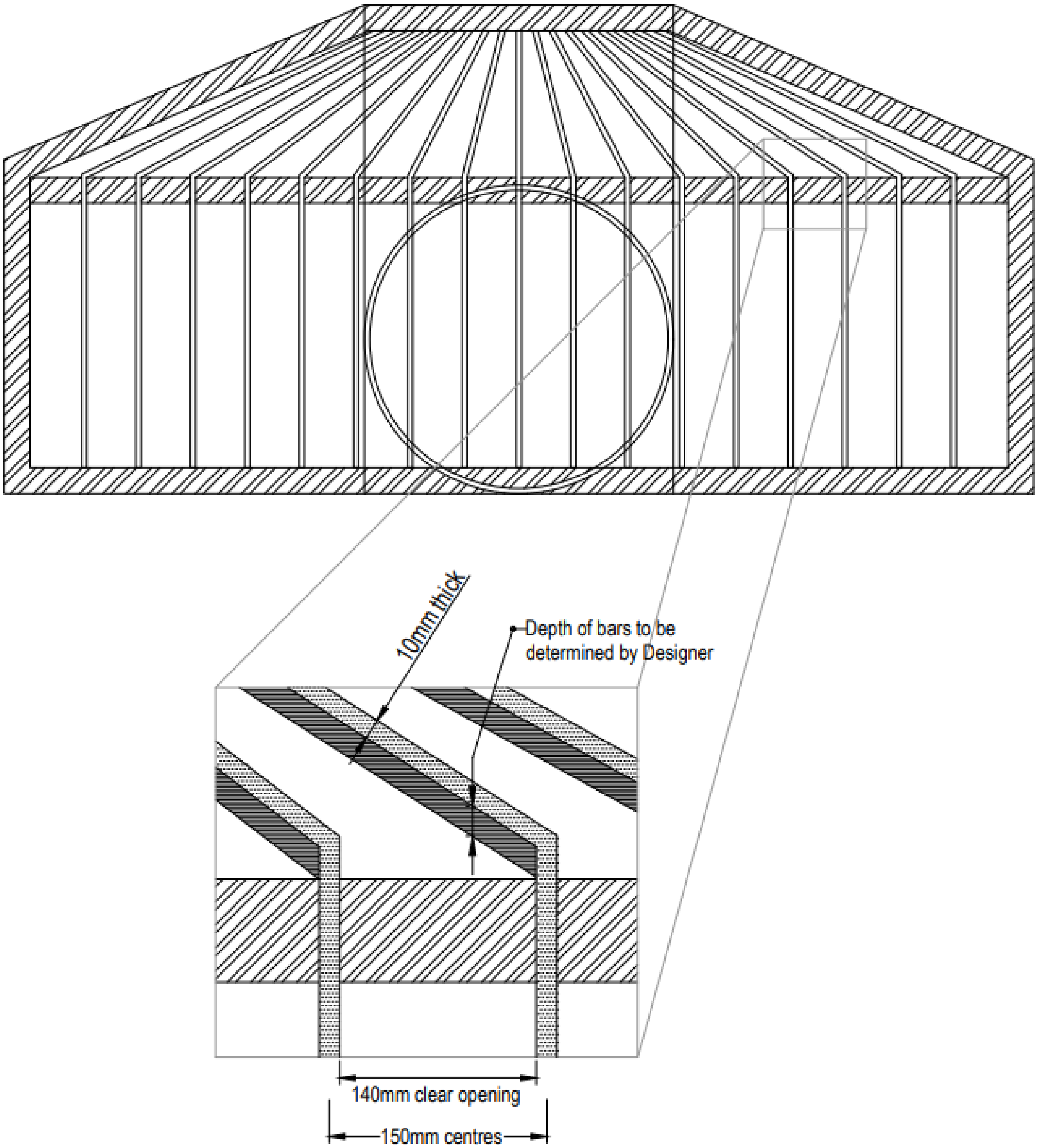


Figure 4-2 – Stormwater intake grille

4.4.8.2 Debris traps

Debris traps (or arrestors) may be required upstream of the intake at the request of Wellington Water. The debris trap shall:

(a) Be a coarse screen designed to restrict the entry of large objects into the intake structure.

(b) Typically be constructed from vertically set steel railway sections or similar, with bars spaced approximately 0.75 times the diameter of the intake pipe.

(c) Have a catch-pit immediately upstream of the debris arrestor to arrest sediments and heavier debris, if required. The dimensions of this trench or pit shall be based on catchment characteristics, approaching flow velocity and maintenance restrictions.

4.4.8.3 Secondary intakes/paths

The following applies to secondary intakes and secondary (overland) flow paths:

(a) Secondary intakes shall be considered in all cases where there is serious consequence of damage should the primary intake be overtopped.

(b) The preferred form of a secondary intake in a confined ponding area is a mushroom intake where entry of floating debris into the intake is minimised.

(c) The design of the secondary intake should be based around the assumption that the primary intake is blocked.

(d) Provision shall be made for flows greater than the design capacity of the intake and pipe to overflow to an secondary flow path that meets the minimum AEP, as described in **Section 4.2.7 Secondary system level of service**.

4.4.9 Outlets

The outlet or outfall from a public or private drain shall be to the public stormwater network or an approved alternative[15]:

(a) Discharging to land sloping down to receiving waters is to be avoided where possible. It may be considered where the designer can demonstrate that the flows can be controlled, there are no adverse environmental effects, and secondary (overland) flow is contained to within the developer's property before reaching a receiving body of water.

(b) Discharging to land shall not be considered where scouring is likely.

(c) Where significant turbulence is likely, such as at a large change in cross-sectional area, specific measures shall be taken to eliminate scour and erosion of the receiving drain and surrounds:

  (i) This may take the form of protective aprons and linings of the receiving channel or flow calming or energy dissipating structures.

  (ii) As a general rule, exit velocities in drains of up to 1.8 m/s may be tolerated without specific energy dissipation structures.

  (iii) Short duration flows up to 3 m/s may be tolerated if it can be shown that the channel is in stable and strong ground, potential maintenance has been considered and addressed and the consequences of erosion are small.

(d) Where the outlet discharges to a natural stream or channel, the outlet shall, as a minimum, be protected by a proprietary wing wall structure, concrete apron and concrete embedded downstream riprap with the intention of reducing scouring velocities.

(e) Any structure should be designed to minimise the collection of debris. Where collection of debris is likely, access considerations equivalent to those of an intake

[15] *See Auckland Council Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices July 2013 Tech Report 2013/018 for assessing outlet structures.*

(see **Section 4.4.8 Stormwater pipe intakes**) shall be incorporated into the design to allow for removal of the debris.

(f) Direct outfall to specific rivers, streams or the sea may require permission from Greater Wellington Regional Council.

4.4.10 Sumps

High-capacity sumps may be required in some instances. The intake capacity of these sumps shall be determined from first principles and in consultation with the manufacturer.

(a) Specific approval should be obtained from the roading authority if the sumps are not compliant with the relevant code of practice.

Sumps shall:

(b) Connect to a manhole, or to an open watercourse where no stormwater reticulation is available.

(c) Use a rear entry and cycle friendly grate on the road surface.

(d) Be double sumps at the end of cul-de-sacs, at low points in the road or where slopes are steeper than 5%.

(e) Be clear of vehicle crossings and access ways.

(f) Be placed where there is the potential for water to leave the road and enter a private property, typically upstream from vehicle crossings, or sudden changes in grade or direction.

(g) Be placed in areas where ponding of water is possible.

(h) Be spaced no greater than 90 m apart, but close enough to adequately accept the contributing flows.

(i) Have a flexible connection within 300 mm of the sump.

(j) Standard single sumps shall be serviced by a 225 mm nominal diameter lead, while double sumps shall be serviced by a single 300 mm nominal diameter lead.

(k) Sump leads shall be specifically designed where a lead is proposed to discharge to a pipe running full to ensure the sump lead is of a suitable size.

(l) Have a baffle on all sump outlets to mitigate the conveyance of litter and gross pollutants (see **Standard Detail DR04 – Baffled Sump Plan and Sections** in the *Regional Specification for Water Services*).

4.4.11 Stormwater pumping stations

The following applies to stormwater pumping stations:

(a) Publicly owned stormwater pumping stations will be considered only at the discretion of Wellington Water and only where, in the opinion of Wellington Water, there are no practicable alternatives.

(b) Wellington Water shall be contacted prior to design to establish any materials or design conventions that have been established in addition to those outlined in the *Regional Specification for Water Services*.

(c) Pumping systems shall be designed using a multi-pump system to best balance the need for regular pump operation against the relative infrequency of major storm events.

(d) The peak storm frequency (AEP) shall be set to match the upstream and downstream stormwater system, but shall be not less than:

   (i) The AEP specified in the Performance Criteria (see **Section 4.2.7.1 Secondary flow path**) when an overland secondary flow path can be identified that will ensure the minimum level of service is achieved

   (ii) 1% AEP when no overland secondary flow path is available.

(e) If the pumping station building covers less than two thirds of the lot, the lot shall have permanent fencing or other methods to prevent access by the public and livestock.

4.4.12 Easements

(This section also applies to wastewater design.)

The following applies to easements:

(a) Where a drainage easement is required, the easement shall be a minimum 3 m wide or the outside diameter of the pipe plus 2 times the depth to invert, whichever is greater.

(b) Drainage easements for stormwater are also required to provide for the unobstructed passage of secondary flow paths (refer to **Section 4.2.7.1 Secondary flow path** and removal of materials that may result in blockages downstream.

(c) Where the drainage easement is for the underground pipe and the secondary overland flow path, the easement shall be the width required to cater for clause (a) or (b) above, whichever is greater.

(d) Where more than one public main is laid in an easement, the easement shall extend 1.35 m from the outside edge of each outside drain.

(e) The cross section of the drainage easement shall, wherever possible, be designed and constructed as an access for maintenance (including mowing if appropriate). The easement may also be used for secondary overland stormwater flow if required.

(f) Unless otherwise approved, easements shall be within one lot and shall not straddle a boundary line. The pipe centreline shall not be laid less than 1.0 m from the boundary.

(g) The council will at all times retain a 24-hour access right to all services contained within the easement without impediment, and without prior notice to the property owner.

(h) No building works or obstruction to access shall be constructed within a drainage easement without written approval from Wellington Water (refer to **Section 3.8 Building in close proximity to public pipelines**).

(i) The easement shall be secured over all public services crossing private property at development stage whether services are existing or new.

4.4.13 Testing

(This section also applies to wastewater design.)

The following applies to testing:

(a) Unless otherwise stated, if records of testing and inspections are required, these records shall be provided to Wellington Water as part of the project completion and as-built documentation.

(b) For subdivisions all wastewater and stormwater drains will be tested upon completion of construction at the developer's expense and as part of the council's approval process.

(c) Wellington Water shall be present during the test and will sign the appropriate documentation provided by the council to verify the test if successful.

(d) A minimum of 48 hours of notice is required to be given to Wellington Water prior to the test being carried out.

(e) The developer shall provide all fittings and materials to carry out the test.

(f) For subdivisions, the developer is required to have met the following requirements prior to pipe testing and Wellington Water arriving on site:

   (i) Trenched and pipes laid.

   (ii) Bedding and surround material, top and bottom shall have been laid over the pipe. Minimum 100mm top and bottom of pipe.

   (iii) All pipe junctions exposed including laterals and inspection eyes.

   (iv) Lines flushed and all residual debris cleaned out.

   (v) All fittings and connection to have been installed prior to pressure test.

   (vi) Lines to have been pressurised overnight to the required pressure prior to the test commencing.

(g) All mains and branch pipelines, including manholes and connections shall be tested after backfilling. The test shall be either the Water Test or Low Pressure Air Test as outlined in the *Regional Specification for Water Services*.

4.4.13.1 CCTV inspection

Wellington Water may require the drain to be inspected with a colour CCTV camera.

(a) This inspection shall be additional to the water or air test.

(b) Any defects detected by the camera inspection shall be made good and the relevant section of pipeline tested again.

(c) Contractors are advised to carry out their own test before backfilling the trench.

(d) Acceptance of the drain will not be given until it has passed the water or air test and any CCTV inspection required.

5 WASTEWATER

5.1 Objectives

To provide a system for the safe treatment and disposal of wastewater that safeguards people and communities from injury or illness caused by infection or contamination resulting from exposure to wastewater; while at all times avoiding, remedying or mitigating adverse effects on the environment.

5.2 Performance criteria

Any scheme must demonstrate consideration and compliance with the criteria listed below.

5.2.1 Durability

The wastewater network shall:

(a) Be designed and constructed with materials suitable for the intended use, with a proven performance record, and commensurate with a nominal structural and operational life of 100 years; notwithstanding that:

   (i) Items with a lesser expected operational life, such as mechanical and electrical equipment, shall be selected and installed with consideration to maximising longevity, compatibility with existing systems and economic replacement.

(b) Be designed in a way that minimises the overall renewal and maintenance life-cycle costs. For the purposes of calculation, the lifecycle costs shall be determined using a life of no less than 100 years.

5.2.2 Climate change

Please see **Section 4.2.5 Climate change**.

5.2.3 Maintenance and operation

The wastewater network shall:

(a) Minimise the risk of flood water ingress without unduly restricting maintenance access.

(b) Be compatible with the existing wastewater drainage network.

(c) Be laid out in such a way as to minimise the potential for blockage and facilitate on-going maintenance or development.

(d) Minimise the likelihood of leakage, inflow and infiltration and the penetration of tree roots.

(e) Minimise the likelihood of blockage.

(f) Withstand all anticipated superimposed loads.

5.2.4 Level of service

The wastewater network shall:

(a) Minimise adverse environmental effects and comply with all consent conditions set under the Resource Management Act 1991.

(b) Adequately service the catchment including all current and future lots ultimately possible under the operative district plan. This includes potential expansion of the network beyond the developer's initial development.

(c) Consist of an underground piped reticulation system where an adjacent public reticulation is available.

(d) Be of capacity suitable for carrying peak flows anticipated during the lifetime, without surcharge and with due allowance for ground and surface water infiltration and inflow.

(e) Be designed to minimise blockage and sediment deposition.

(f) Maintain adequate self-cleansing velocities to ensure a daily flush at dry weather flow at both existing and fully developed stages, and:

    (i) Where inadequate flows are expected, such as within some industrial areas, or during initial stages of development, special flushing facilities shall be required at the discretion of Wellington Water.

(g) Adequately convey wastewater to an approved discharge point.

(h) Use gravity drainage wherever practicable. Where gravity drainage is not practicable, smart pressure sewer systems should be considered (see **Section 5.4.9 Pressure sewer systems**).

(i) Where using mechanical or electrical equipment, have adequate emergency provisions and alarm systems to minimise the possibility of discharge to land or water.

(j) Be adequately vented to reduce the build-up of hazardous gases and prevent siphoning of private drainage or gully traps. Ventilation should be provided in such a manner that it does not cause a hazard to property owners or members of the public.

(k) Provide alarm and telemetry systems that are compatible with those being used by Wellington Water at the time of project implementation.

(l) Not be connected to the stormwater network. Wastewater systems shall be designed and constructed to minimise the risk and extent of stormwater inflow and infiltration.

(m) Be designed to prevent floodwaters entering the network where the wastewater network is within a flood plain, or secondary flow path.

(n) Gully traps should be installed at a level that:

    (i) prevents unwanted wastewater discharge by being a minimum of 150 mm above the nearest opening (e.g. manhole) in the wastewater network

    (ii) prevents stormwater inflow by being above the 1% AEP flood event level, or at the minimum clearance allowable by the NZBC based on the overflow level of the lowest plumbing fixture.

(o) Ensure maintenance storage is provided at pumping stations (see **Section 5.4.8 Wastewater pumping stations**) to provide overflow protection in case of pumping failure.

    (i) For new build public systems, 8 hours ADWF maintenance storage volume, and if required an additional 12 hours detention volume (see clause (q) below) shall be the target level of service where it can be achieved cost effectively and particularly where traffic management is required to access the station, as shown in **Table 5-5**.

(ii) Emergency relief overflows and venting shall be provided for extreme events in addition to any maintenance storage provisions.

Where the existing network is affected by development, system upgrades shall meet the following minimum standards (which may need to be assessed in the hydraulic wastewater model):

(p) Overflows at unconstructed locations shall not be made worse (volume or frequency).

(q) Detention, if required by Wellington Water, should provide storage for 12 hours average dry weather flow (ADWF) in addition to storage volume requirements for maintenance purposes, as shown in **Table 5-5**. In general, gravity detention systems will not be accepted unless the design can clearly provide for effective avoidance of blockages and flushing of settle material. For private pumping stations, also see **Section 5.4.8.1 Private wastewater pumping stations**.

5.2.5 Access

The wastewater network shall:

(a) Be located within the road reserve except where special difficulties preclude this.

(b) Be protected by easement where special difficulties necessitate the placing of reticulation pipes on private property.

(c) Not unduly restrict the location of any future buildings or development.

(d) Be located and designed to provide reasonable access for maintenance without significant damage or disruption to other network utility services, land use activities and landscape values.

(e) Covers, barricades, fences and sign-posting shall be provided as appropriate to provide for public safety and prevent public access to hazardous areas.

5.2.6 Environmental quality

The developer shall ensure that environmental quality is considered in the location, design and construction of all components of wastewater systems. The following should be considered for environmental quality:

(a) Avoid adverse effects on cultural and heritage sites and respect cultural values, particularly the cultural values of tangata whenua relating to wastewater treatment and disposal.

(b) Preserve or protect areas of ecological significance, areas of significant habitat for indigenous flora and fauna and outstanding natural features.

(c) Avoid, remedy, or mitigate adverse effects on freshwater ecosystems, watercourse margins, esplanade strips, harbours and the coastal marine area.

(d) Avoid, remedy, or mitigate adverse effects on visual amenity.

(e) Provide for on-site silt and sediment management, erosion control and dust control during construction.

5.2.7 On-site disposal of grey water and wastewater

The following applies to on-site disposal:

(a) Grey-water reuse schemes in urban areas are considered an alternative solution and will be considered under special application (refer to **Section 3.3 Alternative solutions and dispensation**).

(b) On-site disposal of wastewater by surface or subsurface land disposal must not result in adverse environmental impact outside the bounds of the lot.

(c) A resource consent for on-site disposal of grey water or wastewater may be required under the regional plan.

5.3 Design methods

The design methods presented here are acceptable for the purposes of developing solutions compliant with the objectives and performance criteria of this standard. Deviation from these methods will be considered with suitable evidence that the method is equivalent in function and outcome to the standard solutions presented in this document.

Wastewater design is presented in two parts in this document:

- Wastewater design flows – determining the hypothetical design parameters for the collection system.
- Hydraulic design – calculating the behaviour of the flow within the system.

Certified calculations shall be made available to Wellington Water as part of any application.

5.3.1 Wastewater design flow

The design flows determined in this section are to be used in the hydraulic design of the wastewater collection network. Reference to the council's current district plan will be required to ensure all potential development upstream, downstream and within the development is accommodated in any proposed works.

5.3.1.1 Wastewater catchment

The following applies to the wastewater catchment:

(a) The catchment used for all wastewater design calculations shall be all the area that drains/discharges wastewater or could physically and legally drain/discharge wastewater to the point under consideration.

(b) When determining the design flow, the catchment shall be, as a minimum, considered to be developed to the full extent permitted by the district plan.

(c) Where future development is possible (i.e., if a district plan change is pending, or flows are possible from an adjacent development), the potential for additional wastewater flow shall be accommodated.

(d) Sewer catchment areas will usually need to be calculated manhole to manhole, so the network pipelines are not unnecessarily oversized.

5.3.1.2 Population

The following applies to the population for wastewater design:

(a) The population to be used for wastewater design in typical residential developments shall be based on a people per dwelling basis.

(b) Where the proposed number of dwellings cannot be determined, the minimum density per hectare (ha), outlined in **Table 5-1**, shall be adopted.

(c) Alternative means of estimating occupation and/or flows will be considered and may be discussed with Wellington Water.

Table 5-1 – Residential development population density

Council	Population per dwelling	Min. density people per ha*
HCC	3.5	60
PCC	3.5	50
UHCC	3.5	45
WCC	3.1	Residential – 140 Inner city – 400 Suburban centre - 1200
WCC CBD	3.1	400/ha of floor area**

* Gross area including streets but excluding reserves.

** Assuming 3 m between floor levels and maximum building height and coverage as per district plan. Ninth floors and above can assume 50% occupancy.

5.3.1.3 Residential design flows

The following design methodology has been adopted to provide realistic estimates for new and upgraded networks and may under-estimate flows in existing catchments with high infiltration and inflow. Designers should follow the additional steps in **Section 5.3.1.5 Application to existing network** where applicable.

For the design of residential wastewater pipelines, the peak wet weather flow (PWWF) shall be determined by:

PWWF = PDWF + Direct Inflow + Infiltration

Where:

PDWF	=	ADWF x PF
ADWF	=	0.0023 L/s/person (L/s) (equivalent to 200 L/person/day)
Peaking factor PF	=	7.23 x $\text{Area}^{-0.2}$ (area in ha)
Direct inflow	=	0.55 L/s/km of pipeline.
Infiltration (per km pipe length)	=	0.06 L/s/km (low groundwater table)
	=	0.43 L/s/km (high groundwater table)
	=	0.25 L/s/km (unknown groundwater table)

(a) The pipe length for inflow and infiltration rates is the length of pipeline in the catchment upstream of the point of analysis, excluding laterals.

(b) Where the pipe length within a collection area is unknown and in a proposed greenfield development, assume 0.8 km of pipeline per hectare of developed land.

(c) Typically, pipes in rock or clay slopes are anticipated to have low groundwater tables.

(d) Pipes in flat, valley floors or in coastal areas with an invert below 3 m MSL are anticipated to have a high groundwater table.

5.3.1.4 High density / industrial / commercial design flows

The following applies to high density, industrial or commercial design flows:

(a) Flow from large industrial or institutional complexes, wet industries, large residential buildings or commercial developments shall be by specific design and pertinent to the activity. The basis of design for this shall be submitted for approval to Wellington Water and prior to final design.

(b) Consultation with Wellington Water is required when designing flows for the following areas:

   (i) Hospitals and nursing homes

   (ii) Abattoirs or significant wet industries

   (iii) Institutional complexes such as universities

   (iv) Commercial port areas

   (v) Central business districts.

(c) Where specific activities are *not* known, the following factors from **Table 5-2** may be used:

Table 5-2 – Industrial and commercial design flows

Council		ADWF (L/ha/s)	PDWF (L/ha/s)	PWWF (L/ha/s)
HCC	Industrial/commercial	0.52	1.56	1.56
PCC	Heavy			1.3
	Medium			0.7
	Light			0.4
UHCC	Industrial	1.0		3.0
	Light industrial	0.08		0.23
	Commercial	0.25		1.0
WCC	Apply WCC residential method as outlined in **Section 5.3.1.3 Residential design flows** to obtain ADWF and PWWF.			

5.3.1.5 Application to existing network

Many existing areas have levels of inflow and infiltration that exceed the estimation method in **Section 5.3.1.3 Residential design flows.**

Conservative estimates of existing inflow and infiltration rates can be obtained by adopting a figure of 0.8 km of pipeline per hectare of catchment, irrespective of the actual pipeline length. Estimates should then be compared to Wellington Water calibrated model results (where available) and adjusted if appropriate.

Designers should consider scenarios to ensure:

(a) The sewer network has adequate capacity for the current population and high inflow/infiltration rates.

(b) The sewer network has adequate capacity for the future population and an upgraded network with inflow/infiltration as estimated in **Section 5.3.1.3 Residential design flows**.

5.3.2 Hydraulic design

The following applies to hydraulic design:

(a) Manning's Formula shall be used in the hydraulic design of sanitary sewers.

(b) The method outlined in **Appendix 1** shall be used with the following amendments:

 (i) Backflow effects for wastewater pipes should assume downstream pumping station wet well levels are at normal operational maximum (duty pump start level) (see **Section 4.3.2.5 Backflow effects and downstream level conditions**).

(c) Gravity wastewater pipelines shall not be designed to operate at pipe full capacity and pipes shall allow for a 15% air space in the design.

$$\frac{\text{Area of sewage}}{\text{Area of pipe}} = 0.85$$

 (i) For circular pipes, this is equivalent to a pipe flowing at a depth of 80% of the pipe diameter.

 (ii) This air gap is required to maintain airflow through the sewers and eliminate the discharge of odours at manholes.

(d) Additional design considerations are provided in **Section 4.3.2 Hydraulic design**.

5.3.2.1 Downstream water level

For wastewater design, the terminal downstream level for network design shall be taken as the pumping station's wet well maximum 'duty pump start' level.

5.3.2.2 Self-cleansing velocities

Notice should be taken of the requirement for new sewers to maintain self-cleansing velocities during subdivision staging. The design shall:

(a) Allow for interim measures for self-cleansing where these cannot be achieved during the initial stages of the development.

(b) Provide self-cleansing velocities demonstrated by either:

(i) Calculating the expected peak dry weather flow (PDWF) for the proposed pipe section and ensuring flow velocity exceeds the minimum requirement of 0.75 m/s, ***or***

(ii) Adopting the minimum pipe grades in **Table 5-3**.

Table 5-3 – Minimum grades for wastewater pipes

Pipe DN	Minimum grade	
150	1.11 %	1/90
225	0.69 %	1/145
300	0.44 %	1/230

Note: These values are based on pipes flowing at 52% depth (PDWF) and assuming a peaking factor of 2. Steeper grades may be required for areas with greater peaking factors.

(c) Permit shallower grades at the discretion of Wellington Water provided the applicant can demonstrate cleansing velocities can be achieved or the effects mitigated.

5.3.2.3 Maximum velocity

Maximum velocity guidelines include:

(a) Velocities during PWWF should not exceed 3 m/s.

(b) Where velocities exceed 3 m/s, either:

(i) Special provisions shall be made to reduce the velocity, such as:

1. Drop manholes (see **Section 4.4.7.8 Drops at manholes** and **Section 4.4.7.9 Internal drop structures**) to flatten the approaching grade, ***or***
2. Increasing pipe diameter.

(ii) Analysis shall be undertaken to demonstrate that there will be no adverse effects from the high velocity.

5.4 General specifications for wastewater

5.4.1 Information to be provided

In addition to the council's normal requirements for subdivision application, the developer shall, as a minimum, provide the following information with any wastewater design:

(a) Drawings and calculations as outlined below.

(b) Operations and maintenance guidelines for any pressure sewer system, pumping station, odour treatment or effluent treatment facility to be vested to the council.

5.4.1.1 Calculations

Calculations shall be prepared and presented as follows:

(a) The design details and calculations shall be prepared by a person qualified in wastewater design and demonstrate that required levels of service will be maintained.

(b) Calculations presented as part of any application shall include, but are not limited to:

(i) Peak and daily flows

(ii) Structure losses

(iii) Pipe losses

(iv) Backwater calculations.

(c) All assumptions regarding the design shall be clearly listed. Any deviation should be documented and Wellington Water's written approval for the deviation attached.

(d) Analyses, results, reports and calculations prepared by a suitably qualified person shall be submitted to Wellington Water for approval for pumping stations and on-site disposal fields proposed.

(e) Structural calculations shall be provided to support the proposed pipe class based on:

(i) Min/max cover

(ii) Traffic/construction loadings

(iii) Surcharge conditions

(iv) Bedding and surrounds.

5.4.1.2 Design and construction drawings

Design and construction drawings shall include:

(a) Details of all structures, including energy dissipating structures, internal/external drops, and typical trench cross sections.

(b) A legend.

(c) The level datum.

(d) Long-sections showing:

(i) Levels, grades, and material of proposed pipelines in terms of datum.

(ii) Material, depth and diameter of manholes and maintenance structures.

(iii) Chainage starting at the downstream end of the drain and with the upstream point of the drain on the right of the drawing, representing the way the drain would normally be constructed.

(e) The long-sections and plan drawings shall show proximity to any other existing or proposed services.

(f) Where on-site treatment is proposed, drawings are required outlining:

(i) Effluent treatment areas proposed

(ii) Flood levels in design event

(iii) Proximity of any natural body of water

(iv) Method and layout of irrigation.

Proposed works shall not begin until construction drawings have been approved by Wellington Water.

5.4.1.3 Asset operations and maintenance plan

New assets, such as those listed in **Section 5.4.1(b) Information to be provided,** will be accompanied by an asset operations and maintenance plan, as part of the completion documentation, which shall detail how the asset is to be operated and maintained over the life of the asset. A replacement schedule should also be included to show what works needs to be carried to ensure the asset is operable in perpetuity. The plan shall include as a minimum:

(a) Required inspection and condition assessment schedule.
(b) Required maintenance, both regular and occasional, to ensure continued operation.
(c) Required replacement schedule for components with a limited lifespan, or life span shorter than the nominal life expectancy of the asset as a whole.
(d) How the asset is to be operated or is intended to work, including:
    (i) Stages where operator input is required should be highlighted.
(e) Health and safety and operational risks intrinsic to the asset, operators and public and either:
    (i) How they have been mitigated (through design), ***or***
    (ii) How they should be mitigated (through operation).
(f) Compliance, auditing requirements and a renewal schedule for any regulatory permissions.

5.4.2 Lateral connections to the wastewater network

The following applies to lateral connections to the wastewater network:

(a) Each proposed dwelling on a lot shall be serviced by a separate connection to the public main at a location approved by Wellington Water, with the exception of:
    (i) Unit titled developments are exempt from this criterion and may be serviced by a single, suitably sized connection.
(b) Connections provided to lots must be at sufficient depth that they can be extended to the building platform in a manner compliant with the NZBC.
(c) Minimum grades for private connections up to the property boundary shall be as outlined in Clause G13 of the NZBC, but with a minimum grade of 1:60 unless otherwise justified.
(d) Connection to the public network shall be carried out by a contractor approved by Wellington Water as specified on the connection application form.
(e) Connection of the private drainage to the lateral (livening) shall require testing (dye testing or similar) to avoid the potential for cross-connections between the stormwater and wastewater systems.
(f) A minimum nominal diameter for a lateral connection shall be 100 mm.
(g) An inspection eye shall be installed at the property boundary, comprised of:
    (i) Proprietary inspection chamber with minimum 150 mm riser and screw-cap fitting within:
        1. Surface box with red lid marked 'SS' in non-trafficable areas, or
        2. Ductile iron lamp-hole frame and cover on a concrete footing
    (ii) On steep property boundaries with an exposed lateral pipe, the inspection eye may be replaced with a sealed inspection junction point.
(h) Connections shall be made at a manhole in the following situations:

(i) Where the lateral connection is 225 mm or greater.

(ii) Where the public main is identified as a trunk main, either on existing GIS network plans or as required by Wellington Water.

(i) Where the connection is not to a manhole, acceptable methods for lateral connections are listed in **Table 5-4.**

Table 5-4 – Acceptable methods for lateral connection to public wastewater main

Public main material	Acceptable method
PVC	PVC Y-junction with rubber ring joint slip couplers
PE100	Electrofusion PE100 Y-saddle or Y-junction
Earthenware or concrete (See **Section 4.4.4.2 Earthenware saddle connections to earthenware or concrete mains**)	1. Proprietary Y-junction with mechanical elastomeric metal banded couplers 2. Earthenware saddle installed in accordance with **Section 4.4.4.2 Earthenware saddle connections to earthenware or concrete mains**
AC and other pipe materials	Proprietary Y-junction with mechanical elastomeric metal banded couplers

(j) The minimum length of a connection shall be 1 m.

(k) Connections, in general, shall not be made to a sewer pipe deeper than 3.5 m to the crown, and instead:

(i) A shallower public branch sewer shall be provided to collect private connections before joining the deeper main at a manhole.

(l) Where the connection is to an empty lot (see **Standard Detail DR07 – Lateral Connections to Public Stormwater or Wastewater Mains** in the *Regional Specification for Water Services*), the terminal connection shall be:

(i) Laid at least 1 m inside and within the boundary of the property.

(ii) End in a method that can accept an approved spigot.

(iii) Pipe colour-coded red, ensuring that if paint is used any rubber ring gap is taped over to protect it from the paint.

(iv) Be blanked off or sealed with a proprietary removable cap colour-coded red.

(v) Be marked with a securely embedded H4 treated timber post, with at least 600 mm protruding above ground, and the top 100 mm painted red.

(m) A private connection cannot cross an adjacent property without the permission of Wellington Water and the adjacent property owner. Where permission is obtained, in writing, an easement shall be obtained in favour of the connection's lot.

5.4.2.1 Decommissioning and reuse of existing laterals

Where an existing building is demolished or replaced:

(a) The end of the lateral is to be capped at the main, relined or re-laid for future use.

(b) Wellington Water shall be advised of the final treatment.

(c) The reuse, without relining, of an existing lateral is not permitted, unless the lateral (from the building to the public main) is free from cracks and other defects as verified with the use of CCTV and is made of a resilient pipe material such as PVC, concrete or PE.

(d) The reuse of laterals made of earthenware or AC pipe is never permitted without lining.

5.4.2.2 Earthenware saddle connections to earthenware or concrete mains

See **Section 4.4.4.2 Earthenware saddle connections to earthenware or concrete mains.**

5.4.3 Public wastewater pipes

The wastewater system shall be designed as a separate system with no cross-connections to the stormwater system and in accordance with the following clauses.

5.4.3.1 Minimum size

The minimum nominal diameter for a public wastewater gravity pipe is 150 mm.

5.4.3.2 Minimum cover

The following applies to the minimum cover of wastewater pipes:

(a) Main wastewater pipes shall generally be laid with a minimum cover of 900 mm where practicable.

(b) The designer shall take into consideration traffic loading and structural design when asking Wellington Water for a reduction in minimum cover.

(c) Customer laterals shall be no shallower than 600 mm at the boundary.

(d) Where dispensation is granted for a wastewater lateral laid up a legal road bank steeper than 45 degrees (1 vertical to 1 horizontal), the lateral shall be pinned to the bank and suitably protected from damage.

5.4.3.3 Pipe materials

The permitted materials for use in the wastewater network are detailed in the *Regional Specification for Water Services*.

Materials for stream crossings, elevated pipelines and pumping station pipework shall be discussed and approved by Wellington Water prior to detail design.

5.4.3.4 Cathodic protection for steel pipes

Refer to **Section 6.4.11 Cathodic protection for steel pipes**.

5.4.3.5 Location

See **Section 4.4.5.4 Location**.

5.4.3.6 Pipeline design

The following sections are to be applied to both wastewater and stormwater designs:

- **Section 4.4.5.5 Changes in pipe diameter**
- **Section 4.4.5.6 Pipes at steep grade**
- **Section 4.4.5.7 Water stops**

- **Section 4.4.5.8 Pipe junctions**

5.4.4 Manholes

See **Section 4.4.7.1 Manholes**.

5.4.5 Easements

See **Section 4.4.12 Easements**.

5.4.6 Testing

See **Section 4.4.13 Testing**.

5.4.7 Venting

Venting of structures is required to eliminate the collection of noxious gases and corrosive conditions within the structure's air space. The following guidelines apply:

(a) The venting structure must be constructed on public land.

(b) The location must be approved by the relevant council.

(c) Venting shall be required at all:

- (i) Pumping station wet wells.
- (ii) Manholes that receive a rising main discharge.
- (iii) Manholes where inverted siphons enter or discharge.
- (iv) Terminal upstream manholes on any branch line (this is deemed satisfied for pipes in subdivisions if at least one property is connected to the most upstream manhole in the branch).

(d) Odour treatment will be required where vents discharge to urban areas. Odour treatment can be in the form of activated carbon filters or odour beds. Solutions for odour treatment shall be discussed with, and approved by, Wellington Water prior to detailed design.

5.4.8 Wastewater pumping stations

The following applies to wastewater pumping stations:

(a) Pumping stations will only be considered for approval by Wellington Water where gravity drainage is not feasible. Pumping stations serving more than 10 urban lots may be vested to the council.

(b) The Design shall be approved by Wellington Water before construction begins. The designer shall liaise with Wellington Water pumping station engineer prior to detail design to establish acceptable methods and materials.

(c) The developer shall bear all costs of design, construction and commissioning of pumping station, including supervisory control and data acquisition (SCADA), controls, flow metering, power supply and integration of the station into the wastewater network.

(d) Refer to **Section 5.2.4 Level of service** and **Table 5-5** regarding storage and overflow protection.

(e) Wastewater pumping stations shall be wet well or dry well pump installations depending on merit and site-specific conditions. Generally, wastewater pump stations shall be dry-well pump installations:

  (i) In the CBD, wastewater pump stations shall be dry well pump stations due to access and noise constraints.

  (ii) Wet-well pump installations will be acceptable where individual pumps are less than 10 kW in size.

(f) The station site shall be on a separately titled lot on the subdivision with a sealed vehicle access to a formed road. The lot shall be vested to the council. The site shall have permanent fencing or other methods to prevent access by the public and livestock as outlined by Wellington Water.

(g) If the pumping station building covers less than two thirds of the lot, the lot shall have permanent fencing or other methods to prevent access by the public and livestock.

Table 5-5 – Detention, maintenance and total storage volume for wastewater pumping stations

Storage volume	Public	Private
Detention volume	12 hours ADWF	12 hours ADWF
Maintenance volume	8 hours ADWF	24 hours ADWF
Total volume (above highest pump start level)	20 hours ADWF	36 hours ADWF

5.4.8.1 Private wastewater pumping stations

Where connection to Wellington Water network is not possible, and where Wellington Water has given written permission, private wastewater pumping stations may be considered provided they comply with the minimum criteria as set out here, and in the *Regional Specification for Water Services:*

(a) Wellington Water requires that the design of the station is to be carried out by a suitable professional and be submitted to Wellington Water for approval.

(b) To allow adequate time for maintenance, the wet-well shall be of a size to hold 24 hours of ADWF plus the volume of the rising main, above the pump start level. Where detention is required (see **Section 5.2.4 Level of service**), an additional 12 hours storage for a total of 36 hours is required.

(c) Non-return valves shall not be installed on the private discharge main in a way that prevents the un-discharged effluent to return to the wet well when pumping stops. This avoids septic conditions in the rising main. Notwithstanding this, the rising main discharge shall be placed and designed to eliminate the potential for sewage from the main pipeline to surcharge and backflow down the rising main and overflow the wet well.

(d) The rising main shall discharge to a private manhole, and then discharge to a public manhole by gravity.

(e) The resource consent may require additional emergency storage (over and above that required by **Section 5.2.4 Level of service** and the *Regional Specification for Water Services*) or an emergency disposal field depending on the surrounding environs and scope of the development.

(f) The developer shall take the responsibility to alert any future owners of the site and the station that:

   (i) The site is serviced by a private pumping station.

   (ii) The owners are fully responsible for the maintenance and operation of the station.

   (iii) The owners are responsible for any fines or consequences from a failure to adequately maintain the station.

   (iv) A 24-hour message service, including a high wet level alarm, overflow alarm, and on-going maintenance contract, must be acquired for the station.

   (v) The station must be kept to a standard acceptable to Wellington Water, including not causing a nuisance to other property owners or adverse effects to the surrounding environment.

   (vi) The pumping station must not discharge any material that may damage or cause negative effects to the Wellington Water sewer network or the environment.

(g) Notices shall be placed on the resource consent outlining the maintenance obligations of the private owner, and equivalent notices shall be placed on the Certificate of Title for the serviced properties.

5.4.9 Pressure sewer systems

Pressure sewer systems may be accepted by Wellington Water where gravity networks are not practicable due to high groundwater tables, flat topography, or areas with a high liquefaction potential. The design of the sewer system shall be carried out by a suitable professional and be submitted to Wellington Water for approval.

Pressure sewer systems shall be designed in conjunction with this document and Water Services Association of Australia WSA 07[16].

The following considerations need to be fully evaluated and presented in any situation where pressure systems are being proposed:

(a) Ownership

(b) Maintenance

(c) Operational

(d) Life-cycle cost.

[16] *Water Services Association of Australia (WSA) WSA 07 – Pressure Sewerage Code of Australia*

6 WATER SUPPLY

6.1 Objectives

To safely and reliably collect and adequately distribute water for domestic, commercial, industrial, and firefighting purposes in a manner that protects public health, promotes sustainability, and complies with the performance criteria outlined in this document.

6.2 Performance criteria

Any scheme must demonstrate consideration and compliance with the criteria listed below.

6.2.1 Durability

The following applies to the durability of the water supply system:

(a) The water supply network shall be designed and constructed with materials suitable for the intended use, with a proven performance record, and commensurate with a nominal structural and operational life of 100 years.

(b) Notwithstanding the nominal operational network life, items with a lesser expected operational life, such as mechanical components, pumps, control valves and electrical equipment, shall be selected and installed with consideration to longevity, compatibility with existing systems, technological and operational upgrading, and economic replacement.

(c) Consideration of the operating conditions shall include, but not be limited to:

(i) Ground conditions

(ii) Corrosion conditions

(iii) Pressure

(iv) Fatigue.

(d) Operating conditions shall be considered during selection of pipeline materials to provide the specified levels of service required by this standard.

(e) The water supply network and its components shall be designed in a way that minimises the overall life-cycle costs. For the purposes of calculation, the life-cycle costs shall be determined using a life of no less than 100 years.

(f) Designs shall accommodate anticipated demand growth and network expansion ultimately possible under the council's current district plan. This includes potential expansion of the network beyond the developer's initial development.

6.2.2 Climate change

Please see **Section 4.2.5 Climate change**.

6.2.3 Maintenance and operation

The following applies to maintenance and operation of the water supply network:

(a) The water supply network shall be designed to be watertight to the required test pressures set out in the *Regional Specification for Water Services*, which includes allowances for surge and fatigue.

(b) Components shall be compatible with the existing network.

(c) Pipework shall be laid underground at the depths set out in the *Regional Specification for Water Services*.

(d) The network shall be designed to minimise the extent of water supply outage required for any planned or unplanned maintenance activities.

(e) Pumping facilities shall have adequate standby pumping and emergency provisions to mitigate the consequences of pump or power failure, and:

  (i) All pump stations shall have 100% standby capacity.

(f) Drinking water systems shall be designed and equipped to prevent backflow into the pipeline during operation or maintenance.

6.2.4 Functionality

The functionality of the water supply system shall achieve the following:

(a) The system shall at all times comply with the provisions of the Water Services Act 2021.

(b) Wellington Water will not provide an on-demand supply from the reticulated water supply system in residential areas unless a reticulated wastewater system of suitable capacity is available.

(c) In any development, the reticulated supply shall be capable of providing uninterrupted flow and pressure to all existing and potential lots allowed for within the council's current district plan, and as measured at the downstream outlet of the service valve (refer to **Section 6.2.8 Levels of service**).

(d) Any shared, or private, reticulated water supply system shall:

  (i) Comply with the objectives and performance criteria of the *Regional Standard for Water Services*.

  (ii) Have sufficient capacity to supply simultaneously to all properties, the flows and pressures set out in the *Regional Standard for Water Services*.

(e) The network shall provide firefighting flows and pressures in compliance with SNZ PAS 4509, and the following clauses:

  (i) During firefighting scenarios, the pipeline pressure in elevated areas of water distribution zone shall remain positive.

  (ii) Any private firefighting mains shall be constructed to the performance requirements of the *Regional Standard for Water Services*.

(f) Trunk mains shall not have customer connections directly from the main.

  (i) All customer connections shall be from reticulation mains, which may in turn be connected to trunk mains.

(g) Pressure to all customer points of supply, in a reticulated network, shall be provided by gravity from a public storage reservoir, and:
   (i) Alternatives such as pressure boosting stations will not typically be considered.

(h) Pressure surges from demand or mechanical facilities shall be minimised through suitable design and provision.

(i) The network shall be designed so that no more than 50 lots will be isolated when isolating any reticulation pipe section for the purposes of maintenance.

6.2.5 Access

The following applies to access requirements for water supply assets:

(a) Provisions shall be made to allow suitable access for firefighting appliances and equipment to the firefighting water supply.

(b) Public pipelines shall be placed in the road reserve wherever possible, with suitable access for maintenance and operation. Where this is not possible, the pipe shall be placed on publicly owned land or land that is protected by an easement in favour of the council (refer to **Section 6.4.4 Easements**).

(c) Provisions shall be made so that that all facilities, such as reservoirs, flow/pressure monitoring stations, treatment facilities or pumping stations, are on publicly owned land, and accessible by vehicle during all weather conditions (refer also to **Section 6.4.17 Water supply pumping stations** and **Section 6.4.18 Reservoirs**). Such land shall:
   (i) Not be land-locked
   (ii) Have a corridor of publicly owned land so that suitable vehicle access and pipeline access to the facility can be developed that does not cross private land.

(d) The access performance criteria in this document applies to any existing, private water main that is proposed to be vested to council.

6.2.6 Environmental quality

The developer shall ensure that environmental quality is considered in the location, design and construction of all components of water systems. The following should be considered for environmental quality:

(a) Avoid adverse effects on cultural and heritage sites and respect cultural values, particularly the cultural values of tangata whenua.

(b) Preserve or protect areas of ecological significance, areas of significant habitat for indigenous flora and fauna, and outstanding natural features.

(c) Avoid, remedy, or mitigate adverse effects on freshwater ecosystems, watercourse margins, esplanade strips, harbours, and the coastal marine area.

(d) Avoid, remedy, or mitigate adverse effects on visual amenity.

(e) Provide for on-site silt and sediment management, erosion control and dust control during construction.

6.2.7 Contamination of the network

The network and its components shall be designed to reduce any risks of contamination of the water supply as required by Taumata Arowai and the Water Services Act 2021.

6.2.8 Levels of service

6.2.8.1 Network pressure

Pressures in the network shall comply with the following clauses:

(a) The maximum pressure in any part of the water supply network shall not exceed 90 m head of pressure.

(b) The minimum pressure available at the downstream outlet of the point of supply shall not be less than those set out in **Table 6-1**.

(c) The minimum pressure shall be the pressure available immediately downstream of the point of supply when the property is continuously drawing water.

(d) The water supply network shall be capable of providing the minimum levels of service at peak demand, as calculated in **Section 6.3.1.1 Peak demand**.

(e) Where the water pressure is less than 10 m head of water at the final level on the building platform, a private boosting pump station may be permitted provided pressures compliant with **Table 6-1** can be achieved at the point of supply.

   (i) Such pump stations shall be sized so that they cannot deliver flows and pressures greater than the specified minimum levels of service at the final level of the building platform.

   (ii) The pump station shall be fitted with an approved double-check valve to prevent backflow from the property into the water supply.

   (iii) A private booster station serving multiple lots shall have the facility to connect a standby generator.

(f) Fire suppression sprinkler systems (whether commercial or residential) may have a flow and pressure requirement greater than Wellington Water's minimum standards.

(g) It is the designer's responsibility to demonstrate that the public network can supply the sprinkler system's flow and comply with all relevant standards.

Table 6-1 – Mandated levels of service for pressure at point of supply

Maximum pressure*	Minimum pressure**	Comment
90 m	25 m	10 m min. pressure may be accepted for highest properties adjacent to reservoir

* Gauge pressure as measured at any point in the public network.

** As measured during peak demand flow assuming reservoir level is at the reservoir floor (bottom water level)

6.2.8.2 Reservoir volume

Reservoirs shall be designed to accommodate the storage volume outlined in **Table 6-2**.

Table 6-2 – Mandated levels of service for storage volumes

Method	Storage (L/person)	Scenario
1	700	Where actual consumption is not known such as new developments
2	2 x Average Day Demand	Used when demand statistics are available from Wellington Water. The designer to target the greater of the volume determined by each method. Consult with Wellington Water to determine critical users and their consumption.
3	Maximum Day Demand + 20% + SNZ PAS 4509 firefighting requirements	
4	(20 L/person/day for 23 days + critical users allowance) x 1.43	

6.2.8.3 Hydraulic capacity of pipelines supplying a reservoir

Gravity water supply pipelines supplying water to a reservoir shall be designed to:

(a) Have sufficient hydraulic capacity to supply within a 24-hour period, the volume of water used on the forecast peak day (excluding fire demand or pipeline failure).

(b) Maintain reservoir volume at or above 70% full under normal (excluding fire demand or pipeline failure) operating conditions.

6.2.9 Point of supply

The following applies to the point of supply for a drinking water supply (see also **Section 6.4.13 Residential service connections**):

(a) The point of supply for a drinking water connection is the boundary where the council responsibility ceases and private ownership begins.

(b) The legal definition is detailed in each council's by-laws. The by-law definition takes precedence over the descriptions given here.

(c) The point of supply, or the boundary between public and private responsibility, is typically the customer side of the service valve (toby) unless otherwise specified.

(d) The council shall own and maintain all pipework and fittings up to and including the point of supply.

(e) The point of supply shall be located in the road reserve 500 mm from the boundary, or in accordance with the following:

  (i) Where site constraints or other services prevent placing the point of supply in this location, the point of supply shall be located in the public road at a greater off-set from the road boundary.

  (ii) Where neither of these options are practicable for reasons of maintenance, access or boundary anomalies, alternative locations shall be discussed with Wellington Water.

(f) Service valves (or meters) must be installed within a surface box that can accommodate and allow the safe operation of the required service (i.e. service valves, manifolds, meters and associated fittings) and meet the minimum traffic loading requirements.

(g) Service valves (or meters) should not be located in driveways or areas where vehicle traffic is likely without consideration of traffic loading.

(h) If the service valve (or meter) will be located in a driveway or where vehicle traffic is likely, approval from Wellington Water is required and traffic loading must be considered.

6.3 Design methods

The design methods presented here are considered to be acceptable for the purposes of developing solutions compliant with the objectives and performance criteria of this standard. Deviation from these methods will be considered with suitable evidence that the method is equivalent in function and outcome to the standard solutions presented in this document.

As a minimum, the designer shall:

(a) Conduct flow and pressure tests on the public main. Test results shall be submitted to Wellington Water as part of any application.

(b) Have calculations prepared by an appropriately qualified engineer to demonstrate the proposed scheme will comply with the requirements of both SNZ PAS 4509 and the *Regional Standard for Water Services*. Certified calculations shall be submitted to Wellington Water as part of any application.

(c) For larger subdivisions, or those that may have a significant impact on the existing network, Wellington Water may also require that numerical network modelling is used to determine the scheme's compliance with the performance criteria of this document.

6.3.1 Hydraulic design

6.3.1.1 Peak demand

The following applies to the calculation of peak demand figures:

(a) The peak demand is based on the ultimate population or number of dwellings expected in the development/area. The ultimate population for a development can be determined from **Section 5.3.1.2 Population**.

(b) The peak instantaneous residential demand Q_{peak} shall be determined using:

Equation 2 $$\mathbf{Q_{peak} = 0.0162\ L/s \times Population}$$

(c) Peak day demand volume per person shall be assumed to be the litres per head figures presented in **Table 6-2**. Firefighting volumes are not included in the estimate of peak day demand.

(d) Where an area has predominantly industrial demand, and the demand is unknown, the designer may use the ADWF calculated in **Section 5.3.1.4 High density / industrial / commercial design flows** multiplied by a factor of 8, as the design demand for the water supply analysis.

(e) The peak demand shall be used to calculate minimum peak demand pressures within the network, and firefighting pressures.

6.3.1.2 Operating pressure

The following applies to the design of water supply operating pressure:

(a) The maximum operating pressure for any reticulation pipeline delivering drinking water to domestic or commercial properties shall be 90 m.

(b) Any new pipeline required to operate at greater than 90 m to supply drinking water to elevated areas remote from the supply reservoir, shall be constructed as dedicated high pressure trunk mains, and:

  (i) There shall be no service connections to private or commercial properties from these trunk mains, except as agreed in writing with Wellington Water and where there is no practical alternative connection.

(c) Subdivisions shall be designed so that the maximum mains pressure in any part of the new subdivision does not exceed 90 m.

(d) Where an existing main exceeds an operating pressure of 90 m, preference shall be given to designs that result in the new main being parallel to the high-pressure mains and operating at pressures less than 90 m.

  (i) In the renewal section all service connections shall be disconnected from the high pressure main and re-connected to the new main.

  (ii) The new main shall be retained to supply elevated areas downstream or shall be replaced with a dedicated new high-pressure trunk main.

(e) During design, consideration shall be given to inter-connection of subsequent renewals to create well networked pressure zones around high pressure trunk mains.

(f) All fittings and pipelines shall comply with the minimum pressure class specified in the *Regional Specification for Water Services*.

(g) An allowance for surge shall be made where the main is subjected to automated closing valves or the influence of pumps. The design operating pressure for any point in the system shall be calculated as:

  (i) Maximum possible static pressure + allowance for surge (See **Appendix 3**).

6.3.1.3 Firefighting flows

Firefighting flows shall be as outlined in the latest revision of SNZ PAS 4509. Compliant pressures shall be calculated with the firefighting flows being delivered simultaneously during a two thirds (2/3) peak demand period on a maximum demand day.

6.3.1.4 Domestic sprinkler systems

Domestic sprinkler systems:

(a) May be proposed for situations where the existing reticulation cannot meet the requirements of the FW2 water supply classification of SNZ PAS 4509.

(b) Shall be recorded as a requirement on a consent notice provided the reticulation can meet the FW1 requirements of SNZ PAS 4509.

(c) Are to be privately owned, operated and maintained.

The designer shall:

(d) Conduct tests on the public main; test results shall be provided by the applicant to Wellington Water.

(e) Have calculations prepared by an appropriately qualified engineer to demonstrate the proposed scheme will comply with the requirements of SNZ PAS 4509 and requirements of the proposed sprinkler system.

6.3.1.5 Allowable pipeline losses

The allowable head losses for a pipeline due to friction and turbulence, including fittings are as follows:

(a) At design peak demand, losses shall be:
   - (i) ≤ 50 m/km for rider mains (typically 50 mm)
   - (ii) ≤ 5 m/km for principal mains (100, 150, 200 mm)
   - (iii) ≤ 3 m/km for trunk mains (≥ 300 mm).

(b) Higher pipeline losses may be considered at the discretion of Wellington Water where it can be demonstrated that there are no detrimental pressure or surge effects.

(c) Higher pipeline losses are permitted during firefighting scenarios.

(d) Losses shall be calculated using the Darcy-Weisbach method outlined in **Appendix 1**.

(e) For pump station fed systems, designers shall consider the hydraulic effects of new, clean pipe, as well as mature pipe on the operation of the pump station.

6.3.2 Re-rating of PVC and PE pipelines

The pressure rating of PVC and PE pipelines shall be determined in accordance with the operating conditions:

(a) Where PVC or PE pipelines are pressurised by pump, the pressure rating of the pipe shall be increased so that the re-rated pipe is suitable for the design operating conditions, as specified in the *Regional Specification for Water Services*.

(b) Where PVC or PE pipelines installed above ground or are subject to operating temperatures greater than 25°C, the pressure rating of the pipe shall be increased so that the re-rated pipe is suitable for the expected operating conditions, as specified in the *Regional Specification for Water Services*.

(c) Designers shall note that black PE pipe exposed to solar loading can have a wall temperature exceeding 55°C.

(d) Designers shall note that re-rating for temperature and for fatigue are cumulative.

6.3.3 Pipe surge

The effects of surge shall be accounted for in the design as follows:

(a) A surge analysis shall be carried out for any areas where a surge within the network is possible due to an automated valve, pump, or other proposed facility capable of inducing surge. Where a surge is identified, the effect of the surge shall be mitigated.

(b) For metallic pipes, surge analysis shall be carried out as described in **Section 6.4.9 Rising mains.**

(c) Where plastic pipes are proposed in a cyclic environment, such as rising mains or direct-on-line pumping into the reticulation, provisions for a potential increase in pipe class shall be made due to fatigue and/or surge. **Appendix 3 o**utlines an acceptable method for determining the effects of surge and fatigue on plastic pipes.

6.3.4 Network modelling

Network modelling shall be completed in accordance with the following:

(a) Network modelling shall typically use the values in **Appendix 1 Table A1-3** for pipe roughness, except where modifications are made for other pipe types such as unlined cast iron or asbestos cement.

(b) Wellington Water may request the modelling to be carried out using particular software or format. Additionally:

(i) Wellington Water may be able to provide modelling services to the developer or wish to conduct the modelling in-house.

(ii) The developer is to discuss requirements with Wellington Water prior to carrying out any modelling to confirm process and requirements.

(c) Where the model incorporates existing infrastructure, the model shall be calibrated against recent data:

(i) Wellington Water may be able to provide some network data for this purpose.

(ii) The WaterNZ Modelling Special Interest Group has published the *National Modelling Guidelines for Water Distribution Network Modelling*. Models shall be developed and calibrated in accordance with these guidelines.

(d) The developer shall submit a modelling report outlining the scenarios, assumptions, verification and results from the modelling activities.

(e) Wellington Water may require a peer review of the model to be carried out at the developer's expense.

6.3.5 Hydraulic report

All scheme designs shall be accompanied by a hydraulic report. The hydraulic report shall demonstrate how the proposed scheme complies with the performance criteria of this document and shall include, but not be limited to:

(a) Demonstration of compliance with minimum pressures at points of supply during peak demand.

(b) Demonstration of compliance with minimum pressures during firefighting scenarios, including multiple scenarios as necessary to demonstrate suitable coverage of all proposed lots, and noting that:

(i) Minimum pressures in the network shall not fall below 10 m during firefighting scenarios and shall be compliant with the requirements of SNZ PAS 4509.

(c) The maximum pressures achieved in the network (including any allowances for surge where relevant).

(d) Life-cycle costs analyses (especially for pump selection and rising main sizing etc.).
(e) Head losses per kilometre for each pipe during peak demand flow.
(f) Hydraulic calculations.
(g) Fatigue and pipe de-rating calculations.
(h) Reservoir sizing report.
(i) Modelling report where numerical network modelling has been carried out.
(j) Results of any surge/transient analyses.
(k) All assumptions made regarding the scheme.

6.4 General specifications for water supply

6.4.1 Information to be provided

In addition to the council's normal requirements for subdivision application, the developer shall, as a minimum, provide the following information with any water supply design:

(a) Evidence that the performance criteria outlined in this document can be met with the proposed design.
(b) Calculations and drawings as outlined below.
(c) Operations and maintenance guidelines for any reservoir, pumping station or any other mechanical facility to be vested to the council.

Any developer considering an extension or modification to the existing network should arrange a meeting with Wellington Water prior to concept design to determine the scheme's water supply needs.

6.4.1.1 Calculations

Calculations shall be prepared and presented as follows:

(a) The design details and calculations shall be prepared by a professional, qualified to a tertiary level and experienced in water supply design.
(b) Calculations shall demonstrate that required levels of service will be maintained.
(c) Calculations presented as part of any application shall include, but not be limited to:
    (i) Demand calculations (both staged and projected ultimate demands)
    (ii) Hydraulic calculations
    (iii) Network modelling reports
    (iv) Structural calculations for reservoirs and pumping stations
    (v) Pump curves and duty points
    (vi) Economic evaluations
    (vii) Structural trench design.
(d) All assumptions regarding the design shall be clearly listed.
(e) Hydrant testing shall be mandatory for the design of any firefighting supply, whether private or public, except where:
    (i) Wellington Water may waiver this requirement if existing information is held demonstrating the network has adequate capacity.

6.4.1.2 Design and construction drawings

The following applies to water supply design and construction drawings:

(a) Any building consents shall be sought under the council's building compliance regulatory role.

(b) Proposed works shall not begin until construction plans have been approved.

(c) Drawings shall show:

   (i) The layout of the proposed reticulation including a legend, service connections, valves, hydrants, air valves, scour points, easements, stage termination points and any pertinent topographical features that may impact on the operation or future expansion of the network.

   (ii) Proposed materials, sizes and pressure class of all pipes.

   (iii) Typical and specifically engineered trench and installation details.

   (iv) Typical and specifically engineered thrust block details.

   (v) Junction and jointing details.

   (vi) Where any anchor blocks, bulk heads, water stops, above ground pipelines, steep pipelines, or where any non-standard installation is required.

(d) Specific construction drawings for specific facilities such as reservoirs, pressure reducing valves (PRVs), water meters or pumping stations will also be required.

6.4.1.3 Asset operations and maintenance plan

All new assets will be accompanied by an asset operations and maintenance plan, as part of the completion documentation, which shall detail how the asset is to be operated and maintained over the life of the asset. A replacement schedule should also be included to show what works needs to be carried to ensure the asset is operable in perpetuity. The plan shall include as a minimum:

(a) Required inspection and condition assessment schedule.

(b) Required maintenance, both regular and occasional, to ensure continued operation.

(c) Required replacement schedule for components with a limited lifespan, or life span shorter than the nominal life expectancy of the asset as a whole.

(d) How the asset is to be operated or is intended to work including:

   (i) Stages where operator input is required should be highlighted.

(e) Health and safety and operational risks intrinsic to the asset, operators and public and either:

   (i) How they have been mitigated (through design), ***or***

   (ii) How they should be mitigated (through operation).

(f) How the asset can be taken offline for maintenance or repair, outlined in detail, including any requirements to maintain continuity of supply.

6.4.2 Network layout

The following applies to the drinking water network layout (see **Standard Detail WS01 – Typical Water Reticulation Layout** in the *Regional Specification for Water Services*):

(a) Public mains should, as far as practicable, be laid in the road reserve and be arranged to:

  (i) Avoid dead ends and minimise friction losses, tendencies for surge and zones of stagnant water.

  (ii) Allow easy access for repairs and maintenance.

  (iii) Typically be parallel with property boundaries or road kerb lines.

  (iv) Maintain adequate clearance from buildings, structures and other infrastructure to avoid collateral damage from failures (see **Section 3.8 Building in close proximity to public pipelines**).

  (v) Cross other services as close to perpendicular as practicable and not place undue load on adjacent services (refer to additional requirements for adjacent services in the *Regional Specification for Water Services*).

  (vi) Take into consideration flexibility of distribution zone boundary changes and potential outage areas.

  (vii) Where practicable, limit the number of affected residents from any valve closures to 50 lots.

  (viii) Minimise the length of service connections and ensure that they do not cross carriageways where possible (see **Section 6.4.7 Rider mains**).

  (ix) Provide a fully networked system to minimise disruption when any section is shut down for maintenance.

(b) Principal mains shall be provided on both sides of the road in:

  (i) Major roads and dual carriageway roads

  (ii) Split level roads

  (iii) State highways and motorways

  (iv) Roads with railway lines

  (v) CBD and suburban centres

  (vi) Roads with a central dividing island

  (vii) Industrial/commercial areas.

(c) Where practicable, for ease of maintenance, reticulation mains with service connections shall be laid in the berm as opposed to the footpath or carriageway.

  (i) Mains shall not be laid under commercial verandas.

  (ii) New mains shall not be placed near mature trees, or proposed tree planting locations.

(d) Where a hydrant on a principal main is required in a private right-of-way in order to comply with SNZ PAS 4509, the main shall be a public main. The main shall be placed in an easement in favour of the council, clear of wheel tracks and constructed to the same standard as if laid in the public carriageway.

(e) Where a main is required to be laid in private land, the main shall have an easement (refer to **Section 6.4.4 Easements**) in favour of council registered over it on the property title.

6.4.2.1 Loops

Loops in the watermain network shall be used as follows:

(a) The network layout shall be designed to avoid dead ends as far as practicable to minimise water age and prevent the deterioration of water quality.

(b) Where a road or cul-de-sac terminates at a dead-end, and an access way or road reserve carries through to an adjacent street, the principal main shall be carried through to connect to the main in the adjacent street. The through-main shall be a minimum nominal diameter of 100 mm.

(c) Alternatively, Wellington Water may accept a looped rider main at the end of a short cul-de-sac.

6.4.2.2 Maximum branch main length

The following applies to the maximum length of branch mains:

(a) The maximum length of a branch, single-end fed reticulation main is 135 m long for a 100 mm pipeline, or 450 m long for a 150 mm diameter or larger pipeline.

(b) Dispensation for this clause may be applied for on a case-by-case basis taking into consideration minimum firefighting pressures, allowable pipeline losses and minimum peak pressures.

(c) Coastal roads where network loops are not practical are an example where dispensation may be considered.

6.4.2.3 Mains with no through flow (dead ends)

A pipe may be supplied by two water supply zones; one from each end. In normal operation, a normally shut valve shall separate the supply zones, resulting in a length of main that has no flow, but is under full operating pressure. The following applies to mains with no flow / dead ends:

(a) The shut valve and adjacent pipe forms a dead-end.

(b) Hydrants shall be placed either side of the shut valve to facilitate scouring of stale water either side of the shut valve.

(c) The maximum length of a dead end shall not exceed 10 m, except:

  (i) Where, for operational reasons, a dead end longer than 10 m is formed, a second shut valve shall be installed such that the section of “dead” pipe shall have a valve at both ends fully isolating the dead pipe.

  (ii) Hydrants shall be placed on the upstream side of each shut valve.

6.4.2.4 Rail / motorway / stream crossings

The following applies to watermains that cross beneath railways, streets, and streams:

(a) A water main, as far as is practical and where necessary, shall cross streets, railway lines, streams and underground services at right angles.

(b) Mains shall be installed within a steel encasement pipe when crossing beneath railway lines, motorways, or beneath structures such as embankments or monuments.
   (i) The steel encasement pipe shall be designed to the requirements of the latest revision of the Specification for the Installation of Utility Structures on Railway Land (C-SP-AE-64322).
   (ii) When installed in an encasement pipe, the water main shall be constructed in such a way that the main can be withdrawn and replaced without excavation of the road corridor, carriageway, or railway.
   (iii) The steel ducting shall be epoxy or concrete lined for protection against corrosion.

(c) Specification C-SP-AE-64322 shall be complied with for pipes in railway land.

(d) Special design, in consultation with Wellington Water, is required where a pipeline crosses above or beneath a stream and resource consent may be required.

6.4.3 Manholes

Manholes shall:

(a) Allow physical entry of a person and equipment to the pipe for purposes of maintenance, investigation or connection.

(b) Be constructed in pre-cast reinforced concrete with minimum number of risers to minimise risk of infiltration. Other materials may be accepted by Wellington Water upon application and with suitable reason.

(c) Be designed with a drainage discharge point into the bedding metal of the pipe.

6.4.3.1 Design to prevent floatation

See **Section 4.4.7.3 Design to prevent floatation.**

6.4.3.2 Deep manholes

See **Section 4.4.7.6 Deep manholes.**

6.4.4 Easements

Public water pipes should not be laid in private property. Easements in favour of the council are required for:

(a) Any public water supply assets proposed to be laid in private land, right-of-way, or private road (see **Section 6.2.5 Access**):
   (i) This includes any mains, service valves, service connections, chambers, or facilities.
   (ii) The pipe shall be laid along the centre of the easement such that it can be practically accessed, serviced, and replaced at any time in the future.

The width of easements shall be as follows:

(b) Council owned service pipes in private property shall have an easement width of 1 m.

(c) Rider mains shall have a minimum easement width of 1.8 m.

(d) For principal pipelines up to and including 150 mm diameter, easements shall be the greater of 3 m or the pipe outside diameter plus 2 x the depth to invert.

(e) For principal pipelines larger than 150 mm diameter, easements shall be the greater of 4m or the pipe outside diameter plus 0.5 m plus 2 x the depth to invert.

(f) Bulk and trunk mains shall be assessed on a case–by-case basis to ensure provisions for future access, maintenance and renewal are accommodated.

6.4.5 Distribution zones

The following applies to distribution zones:

(a) Distribution zones are discrete water networks, typically supplied from a common source, that occupy separate topographical areas with different operating elevations.

(b) They have a discrete boundary that is generally denoted by shut (boundary) valves and/or PRVs.

(c) Moving a distribution zone boundary is not permitted without written dispensation, as it affects water quality compliance, existing customers and may increase the risk of failure of existing pipes.

(d) Creation of a distribution zone supplied through a PRV is at the discretion of Wellington Water.

6.4.6 Water mains

The following applies to water mains:

(a) New water supply networks for new subdivisions, or renewal of the existing water supply network, shall only be constructed using pipe sizes, materials and fittings and construction methods complying with the requirements of the *Regional Specification for Water Services.*

(b) If non-complaint sizes and/or materials, or construction methodology are proposed, written application shall be made to Wellington Water. Acceptance of non-complying sizes or materials or construction methodology shall be at the sole discretion of Wellington Water.

6.4.6.1 Materials

The permitted pipe materials for use in the water supply network are detailed in the *Regional Specification for Water Services*.

Other items to note when considering pipe materials are:

(a) Pipe bridges and above ground pipes shall be concrete lined steel (STCL) or concrete lined ductile iron (DICL).

(b) Pipes on banks with a slope greater than 1:5 (v:h) shall be laid in STCL or axially restrained DICL. These pipes shall also be anchored using anchor blocks (see **Section 6.4.21 Thrust and anchor blocks**).

(c) PE or PVC pipes shall not be used in areas that are contaminated, or may be potentially contaminated, with hydrocarbons.

6.4.6.2 Location

See **Section 4.4.5.4 Location**.

6.4.6.3 Pipe sizes

Regardless of the minimum hydraulic requirements for providing adequate firefighting and peak demand flows and pressures, the **minimum** nominal internal diameter of pipes shall be:

(a) 20 mm for customer service connections.
(b) 50 mm for rider mains.
(c) 100 mm for principal mains in residential areas.
(d) 150 mm for principal mains in industrial/commercial and CBD areas.

In addition to the minimum diameters above, the allowable nominal pipe sizes permitted for use in the network are detailed in **Table 6-3**.

Table 6-3 – Allowable nominal pipe diameters

Type	Permitted nominal internal diameter (mm)	Allowable pipe material
Customer services	20, 25, 32, 40, 50	PE100 SDR11
	100, 150	PVC, STCL, DICL
Rider mains	50	PE100 SDR11
Principal mains (with customer connections)	100, 150, 200	PE100 SDR11, PVC, DICL, STCL
Trunk mains (no customer connections)	300, 400, 450, 500$^+$, 600$^+$, 750$^+$	PE100 SDR11, STCL, DICL
Trunk mains greater than 750 mm nominal diameter	Sized in agreement with Wellington Water	STCL or DICL

$^+$ StCL and DICL preferred for large diameters due to difficulty ensuring high quality jointing on large diameter PE100 pipes. However, pipes may be PE100 if these materials are not suitable for specific technical reasons only.

6.4.6.4 Minimum cover

The following applies to the minimum depth of watermain installation:

(a) No water main shall be laid at a depth of cover less than the minimum scheduled in the *Regional Specification for Water Services*.
(b) New water mains shall be designed to cross under existing services where possible.
(c) Where it can be shown that it is not possible cross under other services, Wellington Water may agree to reduce the depth of cover to the minimum special case stated in the *Regional Specification for Water Services*.

(d) If the minimum special case depth of cover cannot be achieved, a specific design shall be prepared for consideration by Wellington Water. This design shall consider pipe material and class, ground conditions, external loadings and connections to the pipeline either side of the crossing to maintain pipeline resiliency.

(e) If crossing under existing services requires the new water main be laid at a depth exceeding the maximum cover allowed by the *Regional Specification for Water Services*, options to reduce depth of cover to less than those specified may be considered and approved by Wellington Water.

  (i) The reduced depth of cover shall not be less than 300 mm below the listed minimum cover.

6.4.6.5 Maximum cover

The acceptable depth of cover shall, to some extent, be determined by method of installation and the health and safety risks that result from installation method.

Generally, the maximum depth of cover to water mains shall not exceed those specified in the *Regional Specification for Water Services*.

6.4.6.6 Terminal mains

The following applies to terminal mains that terminate at the end of a cul-de-sac or similar (see **Standard Detail WS01 – Typical Water Reticulation Layout** in the *Regional Specification for Water Services*):

(a) Terminal mains shall end at a hydrant, preferably situated in the carriageway.

(b) Any customer or rider main connections shall be positioned upstream of the terminal hydrant so the entire length of the principal main can be flushed through the hydrant.

(c) The length of pipe between the last service connection, or rider main connection, and the terminal hydrant flange/socket shall be between 500 mm and 1000 mm.

6.4.6.7 Bends and curves

The following applies to bends and curves:

(a) Pipes shall, wherever possible, be laid parallel to the kerb or carriageway centreline.

(b) To achieve small angles of deflection, rubber-ring jointed pipe may be laid with deflections at the joint up to the manufacturer’s recommended safe deflection.

(c) Curvature using the pipe barrel will not be tolerated except in PE pipes.

(d) Where deflections greater than those obtainable on rubber ring joints (RRJs) are required, they shall be achieved using pipe fittings as specified in the *Regional Specification for Water Services*.

6.4.7 Rider mains

Rider mains are required to service groups of adjoining properties that do not have road frontage adjacent to a principal main. Individual services that cross the carriageway centreline are not preferred.

Rider mains shall:

(a) Be 50 mm nominal diameter (see **Section 6.4.6.3 Pipe sizes**).

(b) Be supplied from a principal main at both ends, except for private roads or right-of-ways.

(c) Have intermediate connections for rider mains longer than 100 m.

(d) Have at least one flushing point.

(e) Have a valve installed at all connections to principal mains.

6.4.8 Above ground mains

Any above ground mains must be approved by the Wellington Water in principle and design. Reticulation mains shall not typically be laid above ground, except where the main:

(a) Crosses over a stream.

(b) Crosses over a railway or vehicle lane via a pipe bridge or attached to the deck of another bridge.

(c) Is built within a tunnel.

(d) Is attached to the face of a retaining wall or steep bank.

The following applies to materials for above ground mains:

(e) PVC shall not be used to construct any above ground water main.

(f) Although suitable for use above ground, PE shall not be used to construct water mains above ground except where specifically approved by Wellington Water.

  (i) PE water mains shall not be attached to steel or concrete bridges.

(g) STCL may be used to construct any above ground water main. STCL above ground pipelines shall be protected from atmospheric corrosion by application of 150 microns (minimum) of zinc metal spray with a sealer coat applied over the sacrificial corrosion protection.

(h) DICL may be used to construct any above ground water main. DICL above ground pipelines shall be protected against atmospheric corrosion as recommended by the manufacturer.

The following applies to jointing methods and allowances for movement in above ground pipelines:

(i) Pipes installed in the vertical axis (or on a grade exceeding 50%) shall be flange jointed and be suitably restrained to walls or structures to withstand seismic loading plus normal service loads.

(j) Pipes installed on flatter grades may be RRJ. All RRJs shall be tied and capable of rotation, extension, and contraction.

(k) Where pipes cross a bridge abutment, they shall be able to accommodate movement that results in both longitudinal and vertical or lateral offset. This shall be achieved using a mechanical joint and not a rubber bellow.

(l) Where pipes cross an expansion joint interface, suitable means shall be provided to allow for longitudinal movement. This may be a sliding expansion joint or bellows.

(m) Provision must be made to allow for protection, maintenance and replacement.

6.4.9 Rising mains

The following applies to rising main design:

(a) Rising mains shall be designed in consideration with the design duty of existing or proposed pump sets.

(b) The length, material, and diameter of the rising main have a significant influence on the dynamic head on the pumps.

(c) The pumps and/or rising main shall be selected to enable the pumps to operate as close as possible to the best efficiency point.

(d) Rising mains and materials shall be designed to accommodate anticipated surges and test pressures.

   (i) A transient analysis may be required by Wellington Water for:

      1. Rising mains longer than 300 m

      2. With a flow greater than 30 L/s and a dynamic head greater than 14 m

      3. A high lift (~50 m or greater) system with a check valve.

   (ii) Surge scenarios shall include sudden loss of electricity (sudden stop) and direct-on-line starting (sudden start).

   (iii) Surge protection devices will be considered to mitigate the effects of surge.

   (iv) Variable frequency drives may be considered to mitigate the surge effects of sudden start, but not for sudden stop surges as power failure is still a credible risk.

(e) Due to the cyclical loading nature of rising mains, the main shall generally be of STCL or DICL.

   (i) Butt fusion welded PE100 pipe may be considered for pumped mains 100 mm to 300 mm diameter, and shall be used for pumped mains less than 100 mm nominal diameter.

   (ii) PE pumped mains shall be re-rated to allow for fatigue and, where appropriate, temperature (see **Appendix 3**).

(f) The proposed rising main option shall be shown to be the most economical through a net present value analysis (NPV) comparing capital and operating costs over a 50-year period.

   (i) A sensitivity analysis on the interest rate used shall also be shown. This may simply be varying the rate by 1% to 2% either side of the interest rate to demonstrate the effect this has on the preferred economic option. The interest rate used should be the average long-term lending rates published by the Reserve Bank of New Zealand unless otherwise specified by Wellington Water.

(g) Rising mains shall be designed as normal buried water supply pipelines allowing for anchor and thrust blocks, trench stops, bulkheads and suitable jointing.

6.4.10 Suction mains

Suction mains are the pipes that are laid continuous between the upstream network and the pumpset inlet. These pipes shall be designed to the same standard as rising mains.

An analysis of the upstream network is required to ensure:

(a) The pumping station's operation does not create detrimental or nuisance surges within the upstream network.

(b) That satisfactory suction pressures can be maintained at the pump inlet under all design scenarios.

6.4.11 Cathodic protection for steel pipes

Cathodic protection shall be provided as follows:

(a) All steel pipelines shall be designed to accommodate the potential application of an impressed current cathodic protection system.

  (i) The design shall include bond cables across mechanical couplings, flange joints and valves to maintain electrical continuity.

  (ii) The pipe steel wall shall be insulated from concrete components (chambers and thrust blocks).

  (iii) Insulated joints shall be installed at branches on the pipeline and at both ends of the pipeline.

(b) For steel pipelines larger than 600 mm nominal diameter and longer than 1000 m, an impressed current cathodic protection system, including monitoring points, shall be installed that complies with AS 2832.1:2015.

6.4.12 Commercial service connections

Each commercial property on a lot, proposed, anticipated or otherwise, shall:

(a) Require a separate, single drinking water service connection from the public main up to and including the agreed point of supply (refer to **Section 6.2.9 Point of supply**).

(b) Have the size, depth of cover and material of the service pipe and the connection comply with the requirements of *Regional Specification for Water Services*.

6.4.12.1 Commercial water meters

A meter may be required to be installed as part of the connection (see **Section 6.4.23 Water meters**).

Water meters shall comply with the requirements of the *Regional Specification for Water Services.*

6.4.13 Residential service connections

The following applies to residential service connections:

(a) Each residential dwelling on a lot, proposed, anticipated or otherwise, shall require a separate, single potable service connection from the public main up to and including the agreed point of supply (refer to **Section 6.2.9 Point of supply**).

(b) Front sections (or dwelling units with individual street frontage) shall have the point of supply located adjacent to the street boundary, as outlined in **Section 6.2.9 Point of supply**.

(c) For properties supplied from a public main in a right-of-way or private land, the service valves shall be located in a shared property.

(d) The location of all service valves and service pipes shall be shown on the construction drawings for approval.

(e) Service valves should not be placed in driveways without special consideration of traffic loading.

(f) The size, depth of cover and material of the service pipe and the connection shall comply with the requirements of *Regional Specification for Water Services*.

(g) Where dispensation is granted for a service pipe laid up a legal road bank steeper than 45 degrees (1 vertical to 1 horizontal), the pipe shall be pinned to the bank and suitably protected from damage.

(h) Unit titled developments may be serviced by a single suitably sized service connection.

6.4.13.1 Residential water meters

A meter may be required to be installed as part of the connection (see **Section 6.4.23 Water meters**).

Water meters shall comply with the requirements of the *Regional Specification for Water Services*.

6.4.13.2 Connection to rural properties

Water supply connections from the reticulated water supply to rural or rural residential will be considered as follows:

(a) Connections will not be approved if the property is not connected to a reticulated public wastewater system. This is to limit the potential for an on-site wastewater system to be hydraulically overloaded.

(b) Connections may be considered by Wellington Water if the supply is a restricted flow supply and is metered.

6.4.14 Backflow prevention

The following applies to backflow prevention:

(a) The council’s policy and bylaw on backflow prevention shall be complied with at all times.

(b) Backflow preventers must be appropriate to the hazard classification.

(c) The backflow prevention device shall comply with NZBC and AS/NZS 2845.1.

(d) All commercial and industrial services shall require a testable backflow prevention device installed downstream of the service valve and meter and as close as practicable to the point of supply.

(i) A second shut-off valve shall be installed on the downstream side of the back-flow preventer and meter to allow the backflow prevention device to be isolated for maintenance purposes.

(e) All fire service connections require a double check detector check backflow prevention device, including specific backflow prevention requirements in compliance with NZBC, and NZS 4541 or NZS 4517, as appropriate.

(f) Requirements for access and easements must be considered.

(g) Wellington Water, at its discretion, may also request additional backflow prevention to meet their obligations under the Water Services Act 2021 and Taumata Arowai requirements.

(h) Refer to the standard details in Appendix 1 of the *Regional Specification for Water Services*, and the Approved Products Register.

6.4.15 Fire services

The following applies to fire services:

(a) Fire services for firefighting networks and automatic fire suppression sprinkler systems require specific consideration and design, and must comply with the NZBC and relevant fire standards.

(b) Notwithstanding this, if a standard 20 mm nominal diameter domestic customer connection is inadequate to provide both the demand requirements of this standard, and those of NZS 4517, a separate metered connection to the public main shall be designed and applied for to supply the sprinkler system and a single water closet. The size of the connection shall be sufficient to meet the requirements of NZS 4517.

6.4.16 Secure connections

A customer, such as a hospital or commercial development, may require a secure supply which will reduce the potential for water outages due to maintenance activities. The following applies to secure water supply connections:

(a) Secure connections may be in the form of:

(i) A dual connection from the same main, separated by a line valve and a minimum horizontal separation of 1 m, unless the connections have lateral restraint (flanged or welded connections), in which case they can be laid closer together (as per the minimum clearances between adjacent/parallel utilities as specified in the *Regional Specification for Water Services*. Both lines require backflow prevention to ensure continuity of service and backflow protection during testing and maintenance of one line.

(ii) Connections to two separate individual principal mains. Both lines require backflow prevention to ensure continuity of service and backflow protection during testing and maintenance of one line, and to avoid cross-connection.

(b) The form of the secure connection shall be discussed and approved at the discretion of Wellington Water.

(c) It is up to the designer to ascertain the design’s compliance with NZS 4541 if the connection is provided for the purpose of firefighting.

6.4.17 Water supply pumping stations

The following applies to water supply pumping stations:

(a) Pumping stations shall be provided by the developer to supply water to a reservoir at a higher hydraulic elevation than the sourced distribution zone.

(b) The designer shall discuss standard pumping station requirements with Wellington Water prior to preliminary design and shall comply with any Wellington Water technical specifications. Pumping station design shall, as a minimum, include:

(i) Consideration of rising main design (see **Section 6.4.9 Rising mains),** pressure surge potential and mitigation.

(ii) Consideration of available suction pressures and the detrimental effects the station may have on suction pressures when running.

(iii) Electrical supply including protection measures and terminals for emergency generator connection.

(iv) Variable speed drive (VSD) pump control unless agreed otherwise with Wellington Water.

(v) Pumpset selection and installation, including efficiency at operating flow rates.

(vi) Magnetic flow metering.

(vii) Manual and electronic pressure monitoring.

(viii) Seismic restraint systems for all equipment.

(ix) Bellows on inlet and outlet to reduce vibration and noise though the pipework unless agreed otherwise with Wellington Water.

(x) Anti-vibration base and mounts for pump and motor sets.

(xi) Consideration of practical maintenance of all equipment and pipe work.

(xii) SCADA (using Wellington Water-specified equipment and I/O conventions) with viable radio link.

(xiii) Permanent station building with suitable security, access, ventilation, acoustic dampening, lifting provisions (overhead gantry), drainage, parking and external visual mitigation.

(c) The design specifications shall be approved by Wellington Water along with acceptable pump makes.

(d) The developer shall provide all electrical connections and electricity accounts for the station. Switchboards will require terminals to allow the station to be powered by a mobile stand-by generator.

(e) Pipework within the station shall generally be flange jointed of either DICL or STCL.

(f) The pump station and access shall be placed completely within a separately titled lot or within road reserve (refer to **Section 6.2.5 Access**):

(i) A sealed access road of not less than 3.5 m width shall be provided to the nearest public street.

(ii) The immediate area around the station’s titled lot (if applicable) shall be fenced and provided with a locked gate.

(iii) The station shall be designed such that it complements the surroundings through the use of architectural featuring and/or landscaping and planting.

(iv) The final design shall be approved by Wellington Water.

(g) Operation and maintenance manuals will be required for all pumping stations as part of the completion documentation.

(h) Liaison with Wellington Water is required if the station is to be connected to part of the wholesale water supply network.

(i) If the pumping station building covers less than two thirds of the lot, the lot shall have permanent fencing or other methods to prevent access by the public and livestock.

6.4.17.1 Pumping stations serving a reservoir

The following applies to pumping stations that serve reservoirs:

(a) Pumping stations shall be designed with a minimum of two pumps in a duty/standby arrangement (100% standby capacity).

(b) Three pumps may be allowed in larger stations with Wellington Water approval. Where three pumps are installed, they shall be in a duty/assist/standby arrangement (with 50% standby capacity).

(c) The pumps shall be sized to pump the greater of the full reservoir storage volume over a 24-hour period or the peak day volume over an 18-hour period, without using the standby unit.

(d) Small stations (daily pumping volume less than 2500 m^3/day) shall be sized to pump the greater of the full reservoir storage volume over an 18-hour period or the peak day volume over a 15-hour period, without using the standby unit.

6.4.17.2 Booster pumping stations

Booster pumping stations:

(a) Will not typically be permitted for developments.

(b) Require special permission from the Wellington Water to be considered as an option.

(c) If permitted, shall be designed to provide, as a minimum, 1.5 times peak consumer demand using variable frequency drives and compatible pumpsets.

(d) Shall not be used for firefighting supply.

(e) All fire hydrants shall be supplied by gravity from reservoirs.

6.4.18 Reservoirs

The following applies to reservoir:

(a) Reservoirs shall, as a minimum, retain the volume outlined in **Table 6-2**, including firefighting volume and storage volume determined from the ultimate development population outlined in **Section 5.3.1.2 Population**.

(b) Council reserves the right to refuse developments that are proposed to be served by a small reservoir, typically those serving less than 100 sections and/or smaller than 250 m3 in size.

(c) Only designers that have been approved by Wellington Water are permitted to design reservoirs. The designer shall approach Wellington Water prior to preliminary design to ascertain the current Wellington Water specifications for reservoirs, which will supersede any requirements outlined in the *Regional Specification for Water Services*. Wellington Water will approve designers for a typical reservoir who are Chartered Professional (CPEng) Civil or Structural Engineers as appropriate with a minimum of 5 years relevant experience and with a minimum of 3 specific, seismically resilient, water retaining structures in their project history. Proposed peer reviewers shall be a Structural Engineer with a CPEng qualification, a minimum of 7 years relevant experience and with a minimum of 4 specific, comparable jobs in their project history.

(d) Reservoirs shall be funded and constructed by the developer to the above specifications.

(e) The council reserves the right to construct the reservoir at the council's expense, with a contribution from the developer, if there is an additional purpose for the reservoir.

(f) The council may contribute to any reservoir being constructed by a developer if that reservoir is suitably sized to supply an area outside the proposed development.

(g) Reservoirs shall be sited on a separately titled and fenced lot and with a minimum 3.5 m wide gated and sealed vehicle access road (refer to **Section 6.2.5 Access**).

    (i) The separately titled lot and reservoir shall be vested to council.

    (ii) Security to the site and structures shall be to current Wellington Water standards. The site shall be secured to reduce unrestricted public access and prevent access by livestock.

    (iii) Vehicle access to the reservoir shall be no steeper than 1 to 6 (v:h).

    (iv) The reservoir shall be suitably screened and visually mitigated to complement the surrounding environment, including any security fencing or gates required.

(h) Operational and maintenance manuals are required as part of the completion documentation.

6.4.19 Water fittings

6.4.19.1 Fire hydrants

Fire hydrants shall:

(a) Comply with the requirements of the *Regional Specification for Water Services*.

(b) Only be placed on mains 100 mm nominal diameter or greater and may be used for:

    (i) Providing water for firefighting.

    (ii) Flushing water from terminal mains.

    (iii) Allowing air to enter, and discharge from, the main during mains filling or draining.

(iv) Scouring.

(v) Introducing water to the mains from adjacent zones or for disinfection or pressure testing.

(vi) Introducing chlorine disinfection solution to the mains.

The following applies to the placement of fire hydrants:

(c) Maximum spacing shall be as per SNZ PAS 4509 and suitable for the highest risk fire hazard class in the vicinity.

(d) Special note shall be made of SNZ PAS 4509 requirements for hydrant spacing with regards to distance lines and access to buildings set back from the carriageway.

(e) Notwithstanding the requirements of SNZ PAS 4509, hydrants shall be:

(i) Spaced at intervals not exceeding 90 m in commercial and industrial areas, and 135 m in residential areas.

(ii) Placed at intersections and adjacent to special fire risks.

(iii) In front of long right-of-ways.

(iv) At high points in the reticulation for release of air.

(v) At low points in the reticulation for emptying and re-filling the pipeline.

(vi) Placed adjacent to all line and network valves.

(vii) Placed with due consideration to the safe operation of the hydrant.

(viii) Placed at the end of terminal mains and at reticulation low points to allow for scouring.

(ix) Placed either side of a distribution zone boundary valve.

(f) Terminal hydrants shall be placed in the carriageway unless discharge can be made to a suitable sump or drain without flowing over unsealed public land and without nuisance. The terminal hydrant shall be mounted on a hydrant bend.

(g) Hydrants shall not typically be placed on rising mains or trunk mains where these mains are without services and there are adequate parallel principal mains available.

6.4.20 Valves

Only valves complying with the *Regional Specification for Water Services* and listed in the Approved Products Register shall be installed within the drinking water supply network:

(a) Butterfly valves shall not be used in the water supply network except where approved by the *Regional Specification for Water Supply*.

(b) Where butterfly valves are approved for use, valves shall comply with all specified requirements.

(c) Valves are used to isolate sections of the network for operational or maintenance purposes. They shall be located:

(i) In a manner that minimises the number of properties affected by a mains closure.

(ii) At the beginning of any branch or rider main.

(iii) In locations that enable safe operation, taking into account traffic and access considerations.

(iv) In a manner that minimises the number of valves or hydrants required at intersections, whilst still achieving operational objectives.

(v) Either side of above ground pipelines and other pipeline structures that require separate maintenance or are expected to require inspection and/or repair following a seismic event.

(vi) At distribution zone boundaries.

(d) All buried valves shall be housed in a surface box in a manner approved by Wellington Water.

(e) At intersections, valves shall be placed on all branch pipelines and at least one placed on the through pipeline to maintain operational flexibility and limit potential customer disruption.

6.4.20.1 Gate valves 100 mm diameter or greater (sluice valves)

Gate valves 100 mm and greater shall comply with the requirements of the *Regional Specification for Water Services.*

Because of the height of the valve bonnet on gate valves, typically butterfly valves would be used in preference to gate valves on pipelines exceeding 500 mm diameter.

6.4.20.2 Gate valves 80 mm diameter

The following applies to 80 mm gate (sluice) valves:

(a) 80 mm pipelines do not comply with the size requirements of the *Regional Specification for Water Services*.

(b) Except in exceptional circumstances, new 80 mm diameter pipelines shall not be constructed. This shall not apply to renewal of existing 80 mm rising main where the pump station is sensitive to pipe DN.

(c) 80 mm gate valves shall only be used for repair and maintenance of existing 80 mm mains or on 80 mm service valves.

6.4.20.3 Gate valves 50 mm diameter or less

Gate valves 50 mm or less shall comply with the requirements of the *Regional Specification for Water Services*.

6.4.20.4 Zone boundary valves

Where a closed valve (100 mm diameter or greater) is used as a boundary between two distribution zones, a hydrant shall be installed either side of the valve to permit the scouring of stale water and use of a mobile PRV installation if required.

The surface box of the boundary valve shall be painted red.

6.4.20.5 Air valves

Generally, air valves shall not be installed on reticulation mains that are not trunk mains, or bulk mains. Hydrants and scour valves may be used to manually introduce or release air in these cases.

6.4.20.6 Pressure reducing valves

The use of PRVs shall:

(a) Be avoided if at all practicable.

(b) Only be used with the approval of Wellington Water. Reduced capital costs shall not be the sole justification for their use.

(c) Where PRVs are approved, they shall comply with the requirements of the *Regional Specification for Water Services.*

6.4.20.7 Scour valves

Scour valves are generally required to drain the pipe for maintenance purposes, release air from pipes or to flush potentially stagnant water from 'dead end' mains.

(a) Backflow prevention is required at all scour valves.

(b) Written approval from Wellington Water is required for design details of scours larger than 50 mm in diameter and for scours on rider mains that cannot comply with **Standard Detail WS06 Rider main scour detail** in the *Regional Specification for Water Services*.

(c) Scour valves are required at:

   (i) The end of all public and private rider mains.

   (ii) For rider mains, scour valves are required at the highest point of the rider main where there is more than 20m change in elevation. This is to facilitate the release of air during recharge operations.

   (iii) The end of all terminal reticulation mains (hydrants are acceptable) (see **Section 6.4.2.3 Mains with no through flow (dead ends)**.

   (iv) The low point between line valves of all mains with a nominal diameter greater than 200 mm.

(d) Scour pipes must not discharge to a kerb, open channel, or a closed stormwater structure such as a stormwater pipe.

(e) Scour valves on reticulation larger than 50 mm shall include a chamber downstream of the scour valve for the pressure pipe to transition to gravity and to facilitate de-chlorination, before the water is discharged.

   (i) The chamber must not discharge to a closed stormwater structure such as a stormwater pipe.

   (ii) The chamber must discharge to an approved outlet and facility shall be provided to prevent damage, channel scour or flooding due to operation of the scour valve.

   (iii) If discharge is to a stream or other water body, then potential impacts on water quality must be addressed.

(f) Valves shall be sized to drain the main by gravity over a period not greater than 1 hour. Minimum scour sizes shall follow **Table 6-4**.

Table 6-4 – Minimum scour sizes

Main size	Scour size
50 mm	50 mm
100 to 200 mm	100 mm
250 to 300 mm	150 mm
350 to 375 mm	200 mm

6.4.21 Thrust and anchor blocks

All concrete for thrust or anchor blocks shall be minimum strength 20 MPa at 28 days.

6.4.21.1 Thrust blocks

The following applies to thrust blocks (see **Standard Detail WS03 – Typical Thrust Block Details** in the *Regional Specification for Water Services*):

(a) Thrust blocks shall be designed to resist the total unbalanced thrust and transmit all load to the adjacent ground. Calculation of the unbalanced thrust shall be based on the pressures experienced during pressure testing.

(b) Where the thrust block will not experience loads due to pressure testing, calculation of the unbalanced thrust shall be based on the design pressure.

(c) For PE water mains, calculation of the unbalanced thrust shall be the thrust due to Poisson's Response less the thrust due to hydraulic pressure.

(d) Calculation of unbalanced thrust shall include a factor of safety of 1.5.

(e) Thrust blocks are required regardless of any joint restraints employed in the pipework, with the exception that thrust blocks shall not be required on changes of direction on PE water mains.

(f) Special engineering design is required for thrust blocks on nominal pipe sizes greater than 300 mm. The design shall consider in-situ soil properties when designing the thrust blocks.

6.4.21.2 Anchor blocks

Anchor blocks are designed to prevent the movement of pipe bends in a vertical direction. See **Standard Detail WS04 – Typical Anchor Block Details** in the *Regional Specification for Water Services.*

(a) Anchor blocks are typically installed on vertical bends on banks and employ the weight of mass concrete to restrain the pipework.

(b) Where possible vertical changes in direction shall be designed so that anchor blocks are not required.

6.4.22 Water stops (bulkheads)

Water stops, also known as bulkheads, are required where:

(a) The potential for trench scour is high.

(b) The surrounding natural ground prevents sufficient natural drainage of the trench (if the trench is susceptible to water infiltration).

The bulkheads shall:

(c) Be keyed into the adjacent, natural ground by a minimum of 150 mm.

(d) Be spaced as per the requirements of **Section 4.4.5.7 Water stops**.

6.4.23 Water meters

Where a meter cannot be accessed safely, either a remote display shall be installed in a location that is safe and has ready access for meter readers and is either on the boundary or public land or be set up to be read remotely on the council system.

6.4.23.1 Commercial meters

The following applies to commercial water metering:

(a) A single revenue meter shall be installed at the council side of the point of supply.

(b) For existing commercial service connections, where the meter is inside private property, the meter shall be relocated to the council side of the boundary during renewal of the meter.

6.4.23.2 Customer meters

The following applies to customer meters:

(a) All non-residential properties, or mixed residential and non-residential properties, extraordinary users as defined in the council's bylaws or charter, may be required to be metered at the point of supply.

(b) Developers should check the current metering policy with the council before submitting designs.

(c) Meters shall be installed to Wellington Water specifications.

(d) The meter and surface box shall be of a type approved by Wellington Water.

6.4.23.3 District area meters

District area meters are non-revenue meters designed to measure the gross community consumption. The following guidelines apply:

(a) District area meters are typically designed and installed by Wellington Water, but Wellington Water or council policy[17] may require the developer to install an area meter as part of any large multiple lot development.

(b) The area meter shall be an approved magnetic flow meter which shall be connected to Wellington Water's SCADA system.

[17] *For example, please see the Upper Hutt City Manual of Polices 2020, 3.13 Water conservation policy Manual of policies (upperhuttcity.com)*

(c) The arrangement of the meter installation shall be discussed with Wellington Water prior to detail design, but it shall typically include:
   (i) A pressure tapping with ball valve and, potentially, a pressure transducer.
   (ii) A suitably large chamber, preferably outside traffic lanes.
   (iii) Suitable operator access provisions.
   (iv) Suitable chamber drainage.
   (v) Upstream and downstream valves within a suitable vicinity.
   (vi) Suitable roadside control cabinet.
(d) The developer shall arrange the power supply for the meter operation.

6.4.24 Testing and commissioning

The following applies to testing and commissioning of the water supply:

(a) Unless otherwise stated, if records of testing and inspections are required, these records shall be provided to Wellington Water as part of the project completion and as-built documentation.
(b) For subdivisions, all water supply pipes, pumping stations, reservoirs and any relevant appurtenant structures and fittings will be tested upon completion of construction at the developer’s expense, and as part of the council’s approval process, prior to the issue of any S.224c certificate.
(c) Wellington Water shall be present during the tests and will sign the appropriate documentation to verify the test if successful.
(d) A minimum of 48 hours of notice is required to be given to the council prior to the test being carried out.
(e) The developer shall provide all labour, fittings and materials to carry out the test.

6.4.24.1 Pipes

The following applies to testing and commissioning of pipes and water mains:

(a) All water mains shall be tested in accordance with the requirements of *Regional Specification for Water Services* before commissioning.
(b) Before commissioning, the following shall be shown by testing to have been achieved:
   (i) All welds on PE pressure mains shall comply with the performance requirements for PE welds set out in the *Regional Specification for Water Services*.
   (ii) The water main, including all connections and fittings, is drip tight at the specified test pressure.
   (iii) All internal surfaces of the water main, including connections and fittings, has been exposed to sterilising water. The concentration of free, available chlorine, and the contact time shall be as specified in the *Regional Specification for Water Services*.
   (iv) Drinking water is compliant with the Water Services (Drinking Water Standards for New Zealand) Regulations 2022.

(c) Connecting to a public water main shall be carried out by a contractor approved by Wellington Water.

(d) The developer is not permitted to operate any public network valves without approval from Wellington Water.

6.4.24.2 Pumping stations

The following applies to testing and commissioning pumping stations:

(a) All pump stations shall be tested and certified in accordance with the *Regional Specification for Water Services* before being commissioned.

(b) A commissioning plan for pumping stations shall be submitted to, and approved by, Wellington Water prior to completion.

(c) All building and electrical work shall be tested and provided with a code of compliance certificate to the satisfaction of the council in its building regulatory role.

(d) Wellington Water will only accept the station once the station has satisfactorily met all the requirements of the commissioning plan and any relevant building and resource consents.

(e) Submission, in hard copy and electronic form, of operational and maintenance manuals comprise part of the commissioning requirements.

6.4.24.3 Reservoirs

All water reservoirs shall be tested, disinfected and certified in accordance with the *Regional Specification for Water Services*, and drinking water is compliant with the Water Services (Drinking Water Standards for New Zealand) Regulations 2022 before being commissioned.

7 APPENDICES

Appendix 1 Hydraulic design for drainage pipes

The following provides technical accompaniment to **Section 4.3.2 Hydraulic design** and **Section 5.3.2 Hydraulic design** These pages relate specifically to stormwater and wastewater design.

Manning's Formula

Manning's Formula (**Equation 3**) can be used to estimate the capacity of the drain being designed.

$$Q = \frac{1}{n} A R^{\frac{2}{3}} \sqrt{S}$$

Equation 3

Where: Q = flow m^3/s

n = roughness coefficient (see

Table A1-1)

A = cross-sectional area of water in pipe (m^2)

R = Hydraulic radius (A / wetted perimeter) m

S = decimal slope (m/m)

For circular pipes running partially full, the roughness coefficient Manning's n should be modified for pipes using the following:

$$n' = n\left(\frac{\left(1-\frac{d}{D}\right)-\left(1-\frac{d}{D}\right)^{7}}{2}+1\right)$$

Equation 4

Where: n' = modified Manning's n

n = Manning's n (from

Table A1-1)

d = depth of water in pipe

D = diameter of pipe

See **Appendix 2** for graphical representations of pipe capacities for pipes running 80% and 100% full including an allowance for air entrainment.

Table A1-1 – Hydraulic roughness factors for Manning's Formula

Pipe material	Manning's n
Vitreous Clay	0.013
Precast Concrete Pipe	0.013
Cast in situ Concrete	0.015
PVC/PE	0.011
Corrugated Aluminium, PE or PP	0.025
Open channel	
Straight uniform channel in earth and gravel in good condition	0.0225
Unlined channel in earth and gravel with some bends and in fair condition	0.025
Channel with rough stony bed or with weeds on earth bank and natural streams with clean straight banks	0.03
Winding natural streams with generally clean bed but with some pools and shoals	0.035
Winding natural streams with irregular cross sections and some obstruction with vegetation and debris	0.045
Irregular natural stream with some obstruction with vegetation and debris	0.060
Very irregular winding stream obstructed with significant overgrown vegetation and debris	0.100

Air entrainment

Where the pipe exceeds grades of 10%, allowances shall be made for bulking of the flow due to air entrainment, and special precautions made to release the air and surplus energy.

The air to water ratio may be calculated from the following:

Equation 5
$$\frac{air}{water} = \frac{kV^2}{gR}$$

Where: k = coefficient of air entrainment:

= 0.004 for smooth concrete pipes

= 0.008 for cast in-situ concrete pipes

g = gravity (9.81 m/s^2)

R = hydraulic radius

V = velocity

Losses through structures

Losses through a structure shall be compensated for through a drop in the invert level through the manhole. The drop shall be additional to the entry and exit slopes and shall be introduced gradually across the manhole.

The losses to be accounted for are:

- h_d Head loss due to change in direction
- h_j Head loss due to junction (if applicable)
- h_n Nominal headloss across structure

Therefore, the total drop (h_f) through the manhole to be accommodated shall be from:

Equation 6
$$h_f = h_d + h_j + h_n \quad \textbf{(m)}$$

Head losses due to a change in direction (h_d) shall be determined using the below equation where the loss coefficient (K_d) shall be determined from the figure presented in **Appendix 6**.

Equation 7
$$h_d = K_d \frac{V_i^2}{2g}$$

Alternatively, the loss coefficients in **Table A1-2** can be used (conservative).

Table A1-2 – Bend loss coefficient

Angle	K_d
22.5°	0.25
45°	0.60
90°	0.90

Pipe junctions and laterals joining the main flow increase turbulence in the manhole and the change in flow volume changes the flow momentum. Losses due to a junction shall be described by the following:

Equation 8
$$h_j = \left(\frac{D_L}{D_i}\right)^2 \frac{V_i^2}{2g}$$

Where D_i and V_i is the incoming pipe diameter and velocity and D_L is joining lateral diameter. ***Alternatively,*** the momentum equation, shown in the equation below and **Figure A1-1** may be used to determine h_j.

Equation 9
$$h_j = \frac{Q_1V_1 - Q_2V_2 - Q_3V_3\cos\theta_3 - Q_4V_4\cos\theta_4}{0.5(A_1 + A_2)g}$$

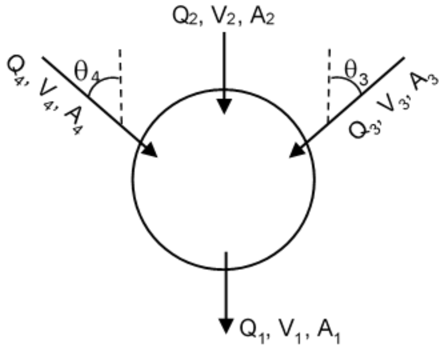


Figure A1-1 – Variables for use with Equation 10

The nominal loss h_n across the structure accounts for the changes in cross-section area as the pipe transitions from circular to open channel and back again as well as discontinuities and increased roughness of the haunching.

Equation 10 $$h_n = 0.1\frac{V_i^2}{2g}$$

Darcy-Weisbach Calculation (pressure pipes)

Pipeline losses shall be calculated using the Darcy-Weisbach Equation (**Equation 11**) where the Moody friction factor f can be determined using the Moody diagram or calculated using the Colebrook-White or Swamee-Jain method. The Swamee-Jain method is non-iterative and simpler to solve and differs from the iterative Colebrook-White method by less than 1% for turbulent flow. These methods should not be used where the Reynolds number exceeds 10^8 or pipe roughness is greater than 5% of the diameter.

Appendix 7 provides head loss charts for standard PVC pipes using the Swamee-Jain method and the roughness coefficients in **Table A1-3**.

Equation 11 $$h_f = f\frac{L}{D}\frac{V^2}{2g}$$ **(Darcy-Weisbach Equation)**

Where:

h_f	= headloss
f	= friction factor determined by **Equation 12** or **Equation 13**
L	= length of pipe (m)
D	= internal diameter of pipe (m)
V	= fluid velocity (m/s)
g	= gravity (9.81 m/s^2)

The friction factor f can be determined using either the Colebrook-White method (**Equation 12**) or the Swamee-Jain Equation (**Equation 13**). **Table A1-3** provides the roughness factors ε to be used in either the Colebrook-White or Swamee-Jain equations. The roughness factors allow for fittings and ageing of a typical reticulation or trunk pipeline. Calculations for pump stations or areas with a large number of fittings may require special consideration.

Equation 12 $$\frac{1}{\sqrt{f}} = -2\log_{10}\left(\frac{\varepsilon / D}{3.7} + \frac{2.51}{R\sqrt{f}}\right)$$ ***(Colebrook-White Method)***

Equation 13 $$f = \frac{0.25}{\left[\log_{10}\left(\frac{\varepsilon / D}{3.7} + \frac{5.74}{R^{0.9}}\right)\right]^2}$$ ***(Swamee-Jain Method)***

Where: ε = pipe roughness (mm) from **Table A1-3**

D = internal pipe diameter (mm)

R = Reynolds number = (V x D)/10^{-6} for water (D in metres)

Table A1-3 – Colebrook-White pipe roughness

Material	**Age of pipe (see notes below)**		
	< 10 years⁺ (mm)	**10-25 years⁺ (mm)**	**> 25 years* (mm)**
Asbestos Cement (AC)	0.03	0.06	0.5
PVC / PE	0.06	0.06	0.15
Clay/earthenware	0.06	0.15	0.15
Cast iron	0.3	0.6	3
Concrete lined ductile iron (DICL)	0.06	0.15	0.15
Concrete lined steel (STCL)	0.06	0.15	0.15
Copper (Cu)	0.03	0.06	0.5
Ductile iron (unlined)	0.045	0.06	3
Galvanised iron (GI)	0.3	0.6	3.0
Steel (unlined)	0.03	0.06	3
Reinforced concrete (RC)	0.15	0.6	3
Unknown	0.03	0.06	0.5

⁺ These factors should only be used for the simulation and calibration of existing networks and pipelines. They shall NOT be used for the design of new pipelines.

* For the design of new/replacement pipelines, roughness factors for pipes >25 years shall be used to ensure network performance can be maintained throughout the lifespan of the pipeline/network.

Appendix 2 Nomographs for drainage pipes

The following charts are a graphical representation of the calculations from **Appendix 1** for Manning's Formula and air entrainment for Class 2 pre-cast concrete pipes.

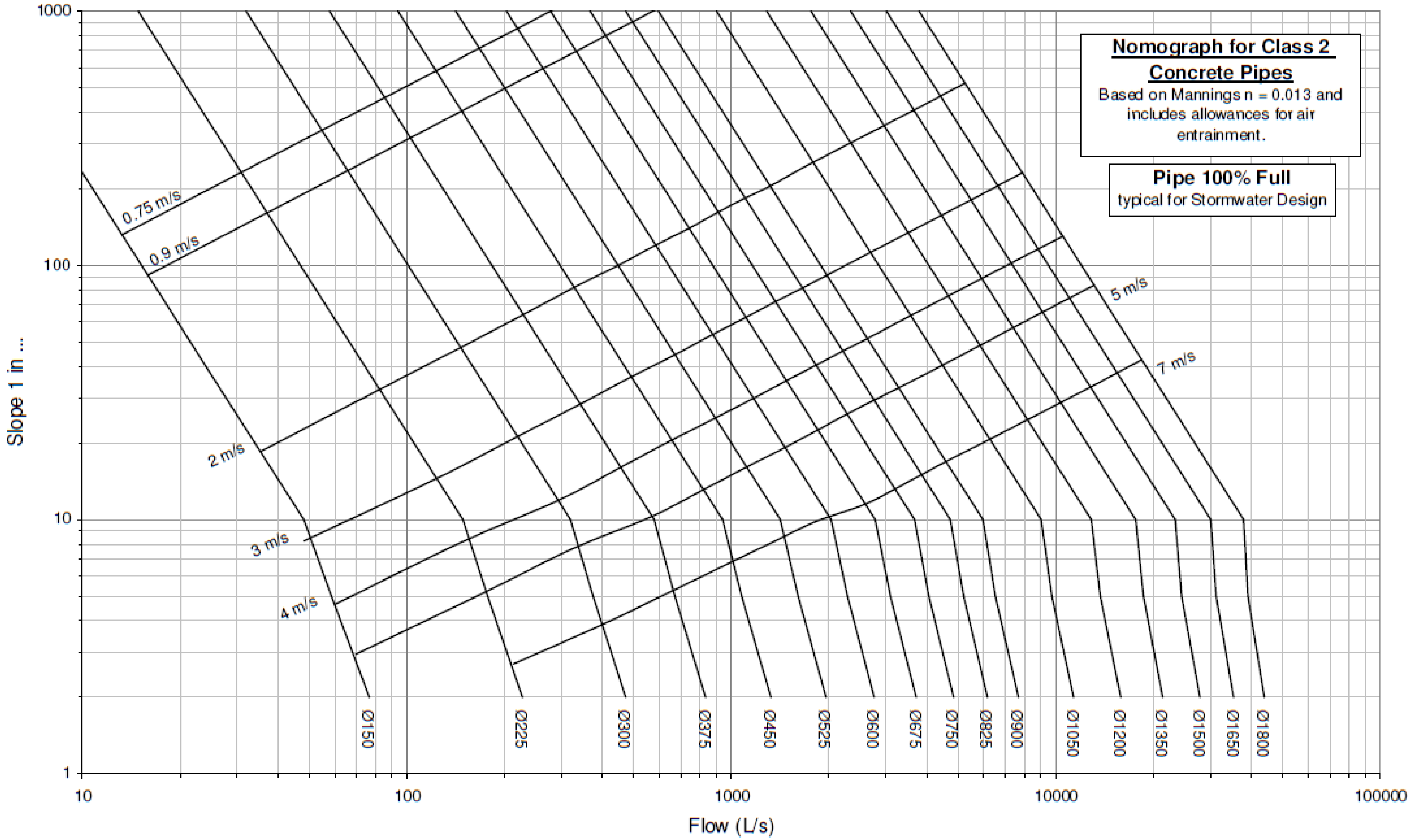


Figure A3-1 – Nomograph for Class 2 concrete pipes 100% full

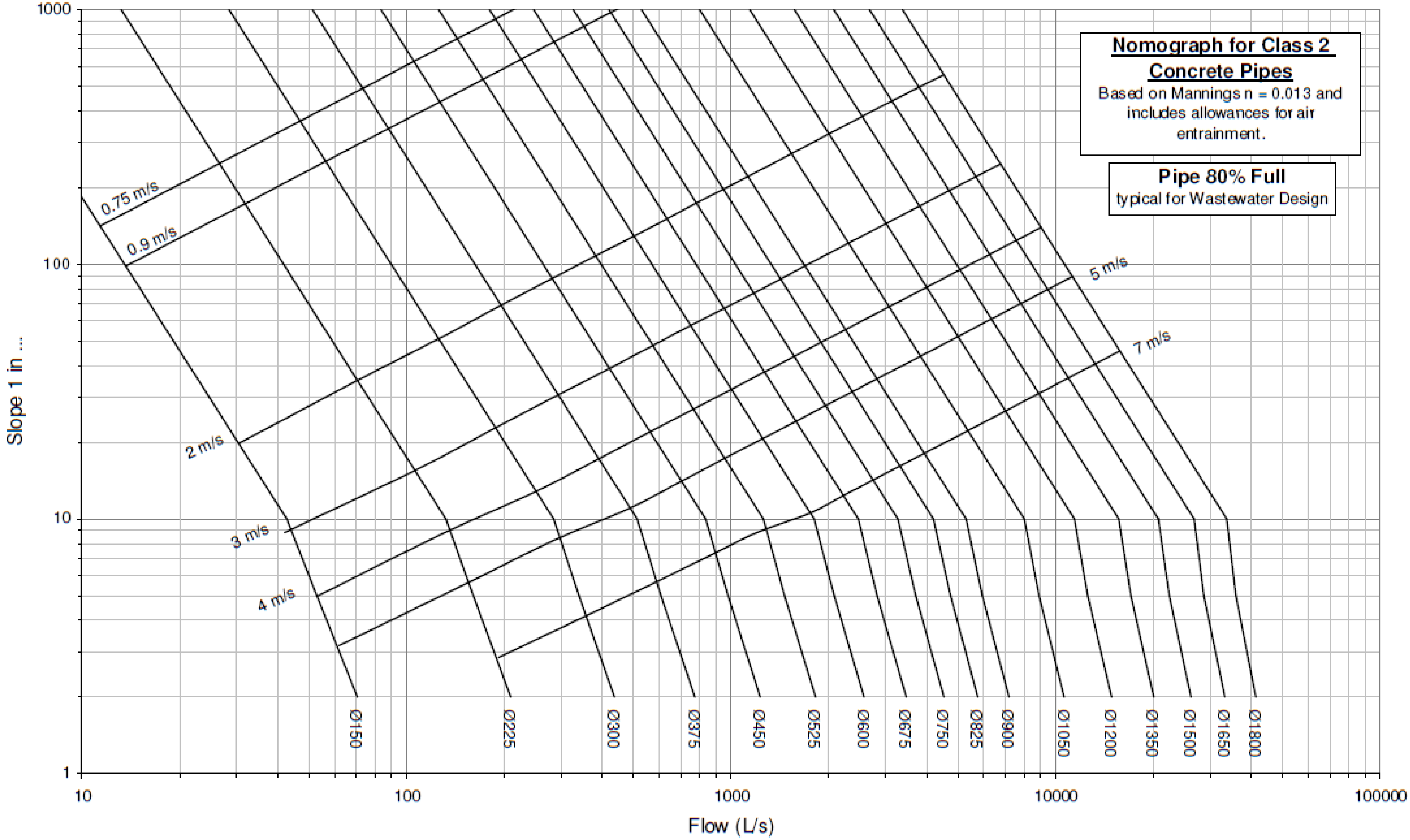


Figure A3-2 – Nomograph for Class 2 concrete pipes 80% full

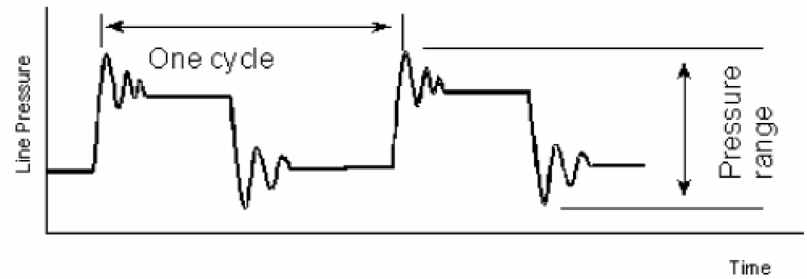
Appendix 3 Surge and fatigue calculations

Where plastic pipes are proposed in a cyclic environment, such as rising mains or direct-on-line pumping into the reticulation, provisions for a potential increase in pipe class shall be made due to fatigue and/or surge.

Surge is the sudden change in pressure caused by sudden changes in fluid velocity; for example, an unanticipated power failure resulting in the pumps shutting down and uncontrolled pressure transients (water hammer) in the pipeline. A transient analysis shall be carried out on all rising mains to ensure transients do not exceed the working pressure of the pipeline and fittings. Where transients are excessive, measures such as soft-starters or variable frequency drives on the pumps, surge control valves or increased pipe classes shall be considered.

Fatigue is a result of a large number of repetitive surge events. Generally, a larger number of smaller events can be tolerated than a lesser number of large surges.

Gradual diurnal changes in pressure due to normal consumer demand, as typically experienced by most reticulations, generally do not require specific fatigue design.



(from PIPA publication POP101[18])

Figure A4-1 – Definition of a pressure cycle and surge range

Where plastic pipes are used, and fatigue is expected, **Equation 14** and **Equation 15** should be used to determine equivalent operating pressures. Note that these can be used for water or wastewater pumping applications.

Equation 14
$$Cycles_{100} = Cycles_{day} \times CF \times 36500$$
(kPa)

Where: $Cycles_{100}$ = equivalent cycles over 100 years

$Cycles_{day}$ = expected number of cycles per day

CF = 2 for pumped systems,

= 1 for non-pumped systems

$Cycles_{100}$ is to be used to determine the Fatigue Cycle Factor (F) from **Table A4-1.**

[18] *Plastic Pipe Industry of Australia Ltd (PIPA) Guidelines POP101 – PVC Pressure Pipes Design for Dynamic Stresses*

$$OP_{equiv} = \frac{\Delta P}{F}$$

Equation 15

Where:

OP_{equiv} = equivalent Operating Pressure (kPa)

ΔP = Max surge pressure – Min surge pressure (kPa)

F = Fatigue Cycle Factor from **Table A4-1**

The pipe class shall be based on the greater of the nominal working pressure or the OP_{equiv}.

Table A4-1 – Fatigue cycle factors[19]

Total cycles over 100 year pipe life ($cycles_{100}$)	PE80b PE100	PVC-U	PVC-M	PVC-O
26,400	1	1	1	1
100,000	1	1	0.67	0.75
200,000	1	0.81	0.54	0.66
500,000	0.95	0.62	0.41	0.56
1,000,000	0.88	0.50	0.33	0.49
2,500,000	0.80	0.38	0.25	0.41
5,000,000	0.74	0.38	0.25	0.41

PE80b - medium density PE; PE100 - high performance PE; PVCU-U - unplasticised polyvinyl chloride; PVC-M - modified polyvinyl chloride; PVC-O - molecularly oriented polyvinyl chloride

Alternative specific design is required for more complex situations, such as common rising mains or temperatures greater than 20 degrees.

Example fatigue calculation

The pressure in a pumped rising main surges to 950 kPa when started, to gradually stabilise at 400 kPa. When the pumps stop, the pressure in the pipe drops to a minimum of 100 kPa. The nominal working pressure in the pipe is 950 kPa and theoretically requires a minimum modified polyvinyl chloride (PVC-M) pipe class of nominal pressure 12 (PN12).

The pump is expected to start 8 times a day ($Cycles_{day}$) which is equivalent to 292,000 over 100 years. As it is a pumped system, $Cycles_{day}$ is multiplied by 2 which provides a $Cycles_{100}$ of 584,000. This translates into a Fatigue Cycle Factor of around 0.40 from the table above.

The surge pressure ΔP = 950 kPa – 100 kPa = 850 kPa. This means the equivalent operating pressure, as shown in **Equation 16**, is:

Equation 16 $\boldsymbol{OP_{equiv}} = \frac{\mathbf{850}}{\mathbf{0.40}}$ **which = 2,125 kPa**

This suggests a minimum PN25 pipe is more appropriate as the OP_{equiv} of 2,125 kPa is greater than the original PN12 working pressure.

[19] *From Plastic Pipe Industry of Australia Ltd (PIPA) Guidelines available from www.pipa.com.au: POP010A and POP101 – PVC Pressure Pipes Design for Dynamic Stresses*

Appendix 4 Pre-construction testing and assessment of load bearing capacity

A robust trench foundation with sufficient allowable bearing capacity is required to resist loading from the bulk trench backfill and dynamic surcharge loads (typically traffic) at surface level.

A poorly compacted foundation level can lead to settlement of the pipe trench, which can lead to potholes (or other carriageway defects), loss of grade on gravity mains and additional stresses in the pipeline itself.

In situ material should be tested at least 500 mm below the pipe foundation level prior to bulk excavation works or pipeline construction.

Information from preliminary testing (typically DCP) can be used to assess the allowable bearing capacity of the existing material at the pipe trench foundation level. Pre-construction testing at this level should be completed after initial preparation (surface trimming and light compaction) of the disturbed in situ ground.

Calculation of applied loading at the trench foundation level should follow AS/NZS 2566 and typically completed at the detailed design stage.

The following bearing capacity check can be made at the foundation level:

Equation 17 $$\boldsymbol{Total\ Factored\ Load^{\dagger} \leq Allowable\ Bearing\ Pressure}$$

† Including impact factors where appropriate

If the applied loads at the foundation level result in an applied soil stress that is less than the allowable bearing capacity, the in situ material will provide a suitable trench foundation. The in situ test data should be used to produce an allowable bearing capacity, rather than the ultimate bearing capacity of the material.

The appropriate technical resources, as approved by Wellington Water, should be consulted when estimating the allowable bearing capacity of soils. This generally requires geotechnical engineering input, but is at the discretion of Wellington Water.

Appendix 5 Migration of fines

Where groundwater is present above the trench foundation level in fine grained soils, granular bedding material will typically provide a path for water movement, with the risk that fines are washed out of the surrounding ground causing a loss of support to the embedment and pipeline.

The limit for migration of fines, as outlined in AS/NZS 2566.1, is as follows:

Migration of fines will occur if:

Equation 18 $$D_{85,fine} \leq 0.2 \cdot D_{15,coarse}$$

Where:

$D_{85,fine}$ = particle size at which 85% pass occurs for the fine-grained material (typically the surrounding in situ soil)

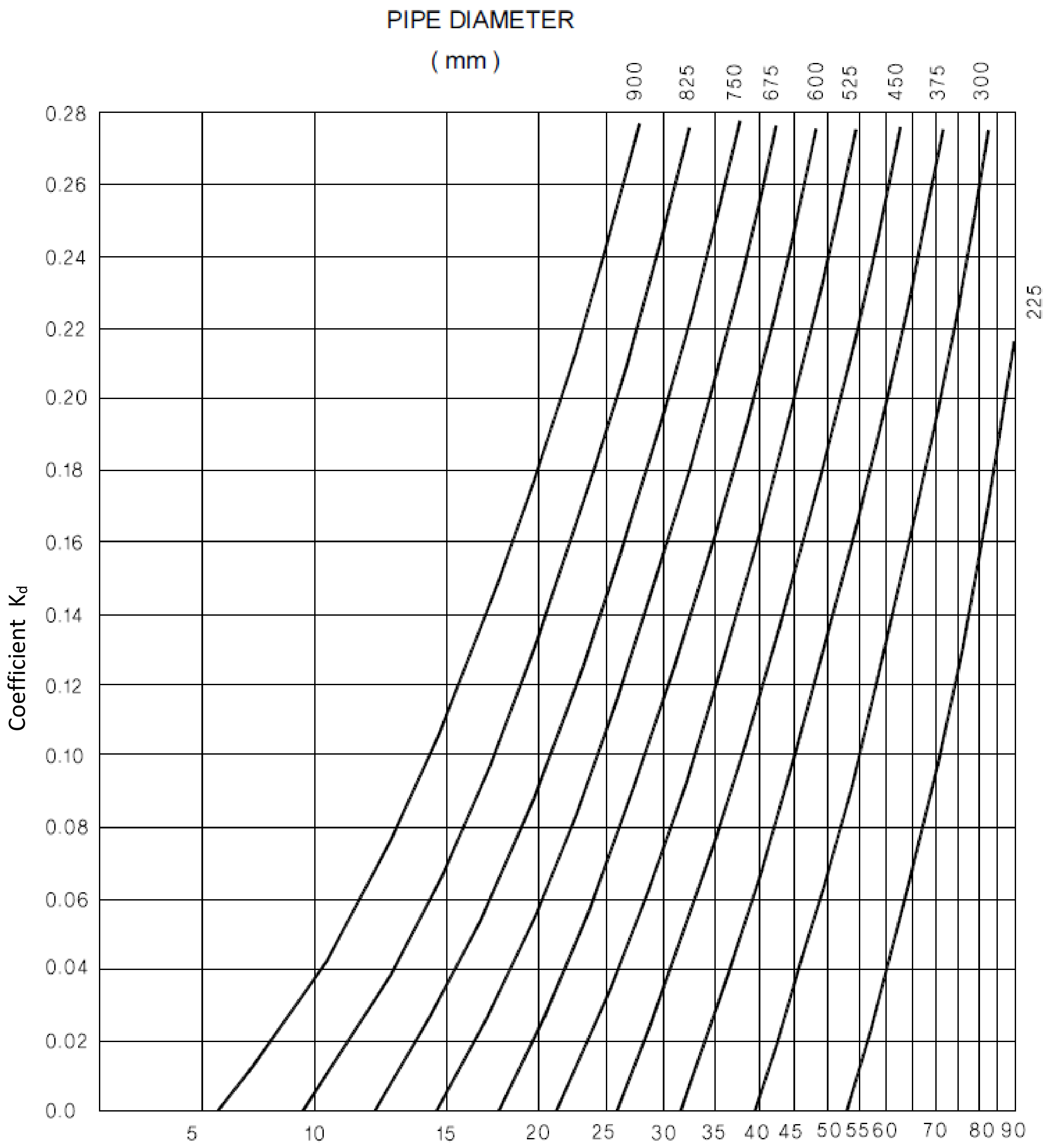
$D_{15,coarse}$ = particle size at which 15% pass occurs for the coarse-grained material (typically the pipe embedment)

As part of the pipe laying, grading curves for in situ soils shall be acquired via pre-construction testing; grading curves for embedment material and bulk backfill shall be provided by the developer from the supplier.

The standard mitigation for migration of fines is installation of filter fabric in accordance with the requirements of the *Regional Specification for Water Services* around the pipeline embedment, which allows groundwater movement and prevents the unwanted transportation of fine-grained components.

Appendix 6 Losses through 1050 manhole

(Chart adopted from NZBC)



Change in direction (degrees)

Figure A7-1 – Losses through 1050 manhole

Appendix 7 Standard PVC water pipe head losses

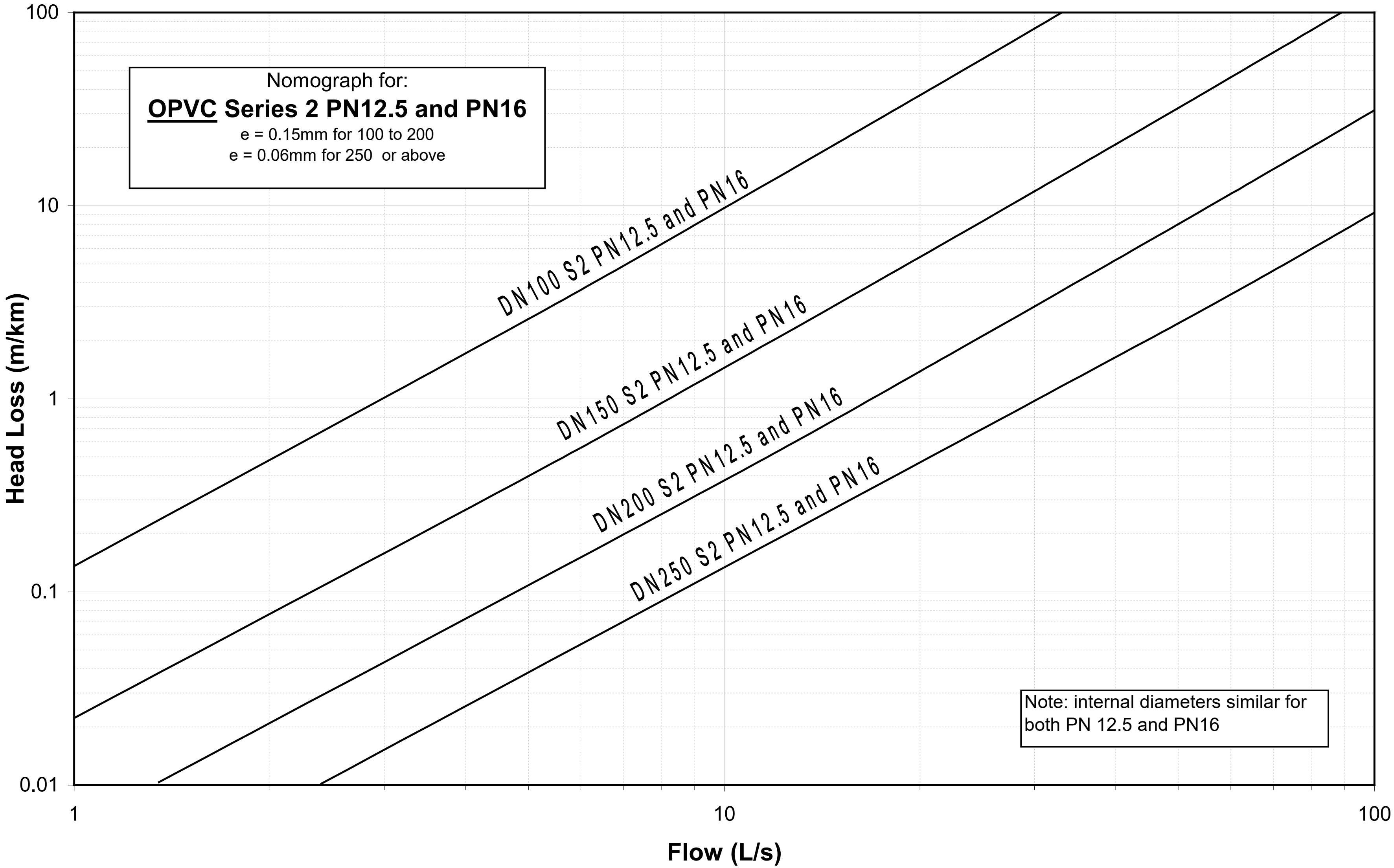


Figure A8-1 – PVC water pipe head loss PN12.5 and PN16

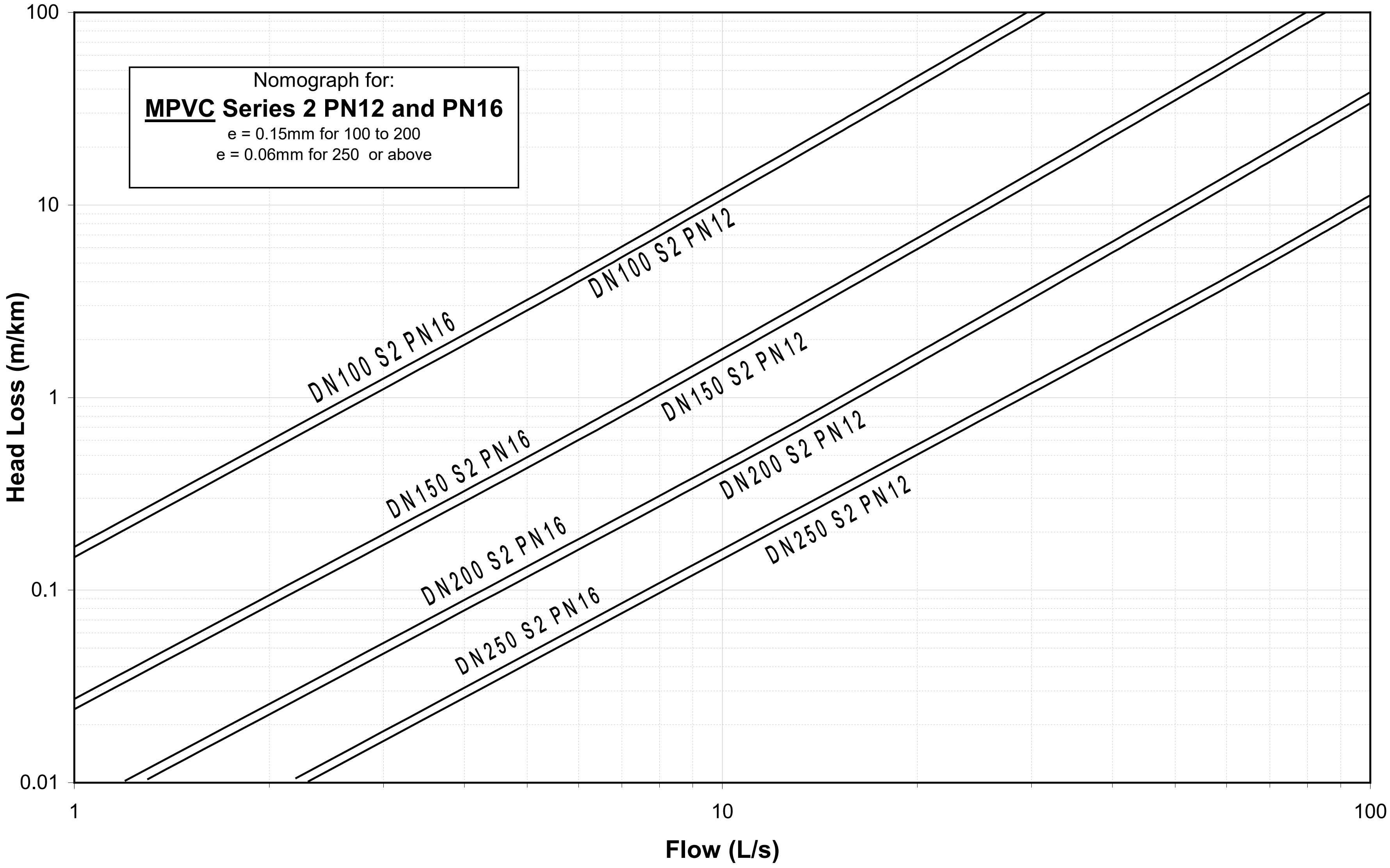


Figure A8-2 – PVC water pipe head loss PN12 and PN16

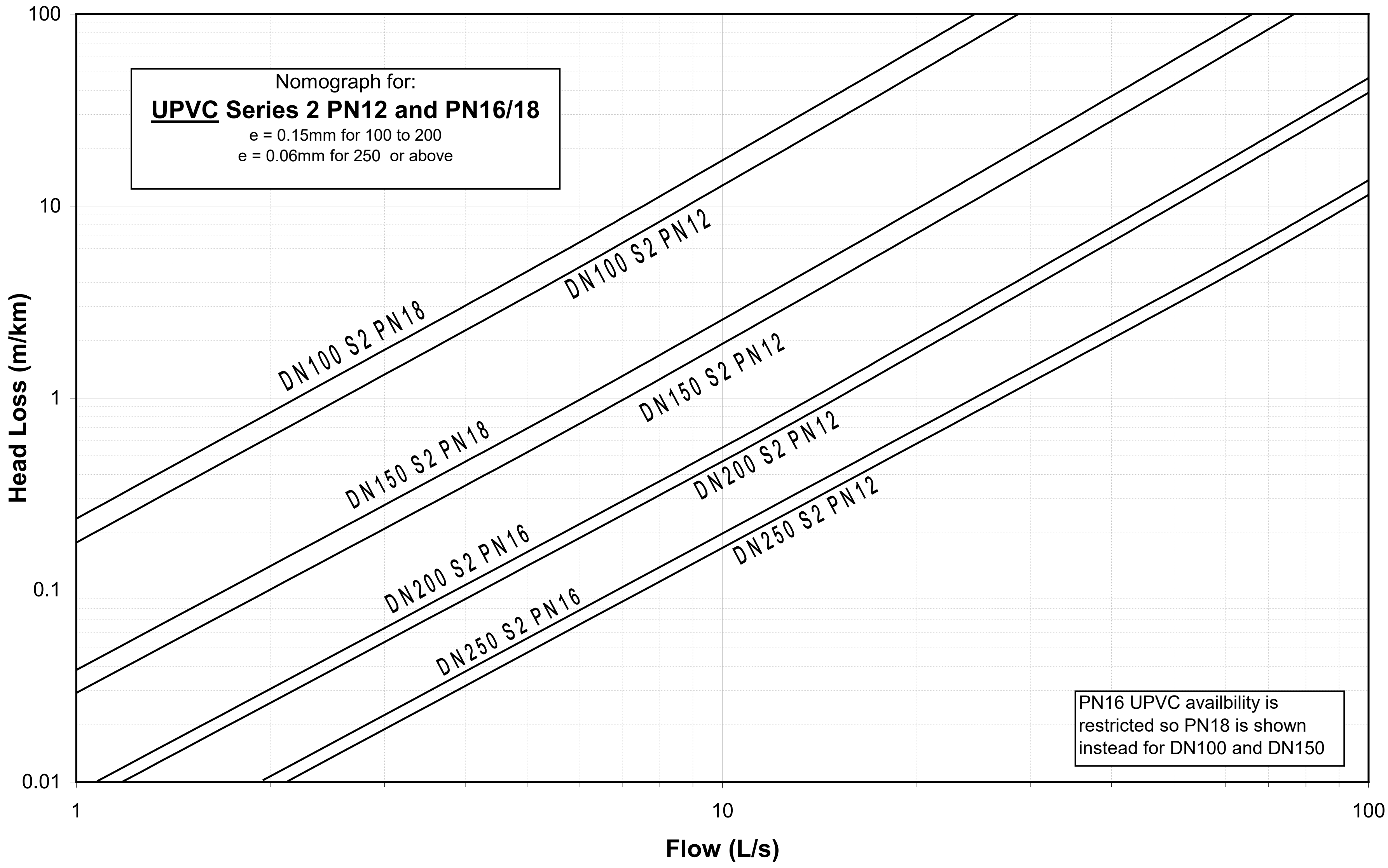


Figure A8-3 – PVC water pipe head loss PN12.5 and PN16/18

Appendix 8 Standard Details

Standard network layouts and engineering details are included in the *Regional Specification for Water Services* which is available on the Wellington Water website.