Wellington Water

Regional Specification for Water Services

December 2021 Version 3.0

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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0	Final	December 2015
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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.

~~In July 2020, the Government launched the Three Waters Reform Programme – a three-year programme to reform local government three waters service delivery arrangements. The intention is to reform local government's three waters services into a small number of multi-regional entities with a bottom line of public ownership. The implications of the reform on the size, shape and design of these entities is still being worked through. Ongoing engagement is expected throughout 2021 as councils and their communities make decisions on remaining in or opting out of the reform programme.~~

The Regional Specification for Water Services, and its parent document, the Regional Standard for Water Services (~~June 2021,~~ version 3.0), serve as updated versions of three waters infrastructure standards, and specifications 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.

In July 2020, the Government launched the Three Waters Reform Programme – a three-year programme to reform local government three waters service delivery arrangements. From July 2024, New Zealand's three waters services will be managed by four, publicly-owned water service entities. After water reform it is expected that a new Regional Standard and Specifications will be produced, reflective of geographic arrangements.

The Regional Specification for Water Services (R.Spec) contains the minimum technical specifications for the materials, construction, installation, testing and commissioning of the stormwater, wastewater and water supply networks. It is the detail around how the Regional Standard is to be enacted.

The document is to be used in conjunction with the Regional Standard for Water Services (RSWS)~~, which promotes consistency within the local industry for the benefit of developers, designers, suppliers and councils the Regional Specification is~~ available at www.wellingtonwater.co.nz.

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

1.1 Review of specification

The specification will be reviewed and revised as needed as policy and technology evolves. Users of this document should ensure that the latest published version is used. Feedback on the specifications can be made to:

Wellington Water Limited
Private Bag 39-804
Wellington Mail Centre 5045x, Lower Hutt

c/- Standards

Alternatively, feedback can be sent to the following email: standards@wellingtonwater.co.nz.

~~To request a change to a standard, click on the link below and complete the request form: https://www.wellingtonwater.co.nz/contractors/technical-information/ [hyperlink disabled for this draft version].~~

2 USING THE REGIONAL SPECIFICATION FOR WATER SERVICES

The Regional Specification for Water Services lists the technical requirements for materials and methods used in the construction of the three waters network infrastructure. The specification details the requirements for a specific product, process or activity. It is to be read in conjunction with the Regional Standard for Water Services~~RSWS~~, the Regional As-built Specification, Regional Draughting Manual and the Approved Products Register. The Regional Standard for Water Services~~RSWS~~ outlines the network objectives, performance criteria for minimum operational and functional levels of service, design methodology and general specifications. The Approved Product Register lists products that comply with the requirements of the Regional Specification~~s~~ for Water Services.

This specification supersedes the Regional Specification for Water Services, May 2019.

2.1 Departures from this specification

Departures from this specification require the written permission of Wellington Water.

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 ~~(IDs)~~, unless specifically noted otherwise. Only polyethylene pipes (PE) are denoted with a nominal outside diameter and should be post-fixed with the letters OD. For example:

63 OD	is 63 mm nominal outside diameter for PE pipes
100 mm	is 100 mm nominal internal diameter for other types of pipes

2.2.2 Definitions

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

Table 2-1 – Definitions

Term	Description
Building Line Restriction (BLR)	An angled line projecting up to the surface from ~~a point 300 mm~~ below the ~~invert of the~~ pipeline ~~and offset 0.5 x pipe OD from the pipe centreline~~. ~~The angle of the BLR is typically 45 degrees (1 horizontal:1 vertical) for cohesive soils and 2 horizontal:1 vertical for non- cohesive soils, or as determined through geotechnical testing.~~
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.

Term	Description
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 300 mm below the pipe invert.
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.
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 375mm and can be as large as 1400 mm in diameter. Also referred to as "bulk main".
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).
Developer	An individual or organisation having the financial responsibility for the ~~development~~ project and includes the owner, contractor and constructor.
Drainage	Wastewater or stormwater pipework, channel or stream, and drain has the same meaning.
Network	All pipes, fittings, pumping stations, reservoirs, structures, treatment facilities and any other appurtenant components or facilities directly associated with water supply, wastewater or stormwater.
Overland flow	See 'secondary flow".
Potable water	Drinking water as defined in the Health (Drinking Water Amendment) Act 2007.
Principal main	A water main, typically 100 to 200 mm in diameter, that provides the firefighting and majority of water 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 trunk main.
Pumping station (in stormwater)	Similar to pumping station (wastewater) but designed to convey the stormwater to a safe discharge point.

Term	Description
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.
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.
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.
Service valve	An isolation (water shut off) valve where a potable water connection is made between the public water supply (in the street) and the private dwelling or commercial building. Sometimes referred to as a "toby".
Sewer	A pipe that conveys wastewater/sewage, typically using gravity. Could also be called a sewer drain.
~~**Sewerage**~~	~~The collective term for a network of wastewater/sewer pipes.~~
Stormwater	Rainwater that does not percolate 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.
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.
Trunk main (in water supply)	A water main typically 300mm or greater in diameter designed to transport water between reservoirs, distribution zones, source waters and reticulation mains. Sometimes called a transmission main~~, bulk main~~ or primary main.
Trunk main (in wastewater)	A large sewer that collects tributary flow from adjacent catchments and/or pumping stations.
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
ABS	Acrylonitrile butadiene styrene	
AC	Asbestos cement	
AS	Australian Standard Specification	
ASME	American Society of Mechanical Engineers	
ASTM	American Society for Testing and Materials	
AWWA	American Water Works Association	
BLR	Building Line Restriction	
BS	British Standard Specification	
BSP	British standard pipe	
CAR	Corridor access request	
CCTV	Closed-circuit television (video)	
dB(A)	Decibel A-weighted	dB(A)
DI	Ductile iron	
DN	Nominal diameter	mm
DWI	Drinking Water Inspectorate (UK)	
EF	Electrofusion	
EPDM	Ethylene-propylene diene monomer, a synthetic rubber	
GRP	Glass reinforced plastic	
GTAW	Gas tungsten arc welding	
GWRC	Greater Wellington Regional Council	
hr	Hour	hour
H	Head (water column measured in metres)	m
ha	Hectare	ha
~~**ID**~~	~~Internal diameter~~	~~mm~~

Abbreviation	Description	Unit
ISO	International standards	
kPa	Kilopascal	10^3Pa
L	Litre	L
m	Metre	m
MPa	Megapascal (e.g. 10^6Pa)	MPa
m/s	Metres per second (e.g. ms^{-1})	m/s
m^3/s	Cubic metres per second (e.g. m^3s^{-1})	m^3/s
mg/L	Milligrams per litre and it can also be expressed as parts per million (ppm)	mg/L
mm	Millimetres	mm
MMAW	Manual metal arc welding	
MSL	Mean sea level (1953 Wellington Vertical Datum)*	m
N	Newton (1N = 1 kg m/s^2)	N
NBR	Nitrile	
NZBC	New Zealand Building Code	
NZS	New Zealand Standard Specification	
NCD	WCC New City Datum (same datum as MSL)	m
NCOPUATTC	National Code of Practice for Utility Operators' Access to Transport Corridors~~[1]~~	
NSF	National Sanitation Foundation	
NZECP	New Zealand Electrical Code of Practice	
NZTA	NZ Transport Agency	
~~**NZVD2009**~~	~~NZ vertical datum (0.44 m above MSL)~~	~~m~~
N/m/m	Newtons per meter per meter, used as a measure of the ring stiffness for a pipe.	
OD	Outside diameter	mm
PE	Polyethylene (generic)	
PE80b	Medium density PE (MDPE)	
PE80c	High density PE (HDPE)	
PE100	High performance PE (HPPE)	
PIPA	Plastics Industry Pipe Association of Australia Limited	

~~[1] National Code of Practice for Utility Operators' Access to Transport Corridors. NZ Utilities Advisory Group (Inc). 2019~~

Abbreviation	Description	Unit
PN	Nominal pressure	bar
PP	Polypropylene	
PPE	Personal protective equipment	
ppm	Parts per million and it also can be expressed as milligrams per litre (mg/L)	ppm
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
RCA	Road Controlling Authority	
RMA	Resource Management Act 1991	
RTU	Remote telemetry unit	
RPZ	Reduced pressure zone	
R.Spec	Regional Specification for Water Services	
RSWS	Regional Standard for Water Services	
s	second	s
SCADA	Supervisory control and data acquisition	
SDR	Standard dimension ratio	
SN	Stiffness number	
STCL	Concrete lined steel	
STP	Specified test pressure	
TNZ	Transit New Zealand	
WMS	Work Method Statement	
WPS	Welding Procedure Specification	
WRAS	Water Regulation Advisory Scheme (UK)	
WWL	Wellington Water Ltd.	

*Note: Tide levels listed in Tide Tables published by Land Information New Zealand 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 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
50%	1 in 2

2.3 ~~Referenced standards~~References

New Zealand (NZS), Australian (AS) and joint (AS/NZS) standards are referenced throughout this document, as well as British (BS, BS EN), American Society of Mechanical Engineers (ASME), American Society for Testing and Materials (ASTM) and international (ISO) standards. 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.

Where it is stated that a product must comply with a nominated standard, third party certification demonstrating compliance with the standard shall be made available from the manufacturer. The certifying agency shall be National Association of Testing Authorities approved and shall be acceptable to Wellington Water. Standards and documents referenced in this document are listed in **Table 2-4**.

Table 2-4 – Referenced documents and standards

Reference	Title
Regional Standard for Water Services (RSWS)	Wellington Water's Regional Standard for Water Services [IMMP47]
As-Built Specification	Wellington Water's As-Built Specification [IMMP48]
Draughting Manual	Wellington Water's Draughting Manual [IMMP49]
NCOPUATTC	National Code of Practice for Utility Operators' Access to Transport Corridors
NZBC	New Zealand Building Code
NZTA M/07	Specification for roadmarking paints
TNZ M/4	Specification for basecourse aggregate
SNZ PAS 4509	New Zealand Fire Service firefighting water supplies code of practice
New Zealand standards	
NZS 3101.1 & 2	Concrete structures standard

Reference	Title
NZS 3104	Specification for concrete production
NZS 3106	Design of concrete structures for the storage of liquids
NZS 3109	Concrete construction
NZS 3501	Specification for copper tubes for water, gas and sanitation
NZS 4219	Seismic performance of engineering systems in buildings
~~NZS 4402~~	~~Methods of testing soils for civil engineering purposes~~
NZS 4442	Welded steel pipes and fittings for water, sewage and medium pressure gas
NZS 4517	Fire sprinkler systems for houses
NZS 4522	Underground fire hydrants
NZS 4541	Automatic fire sprinkler systems
~~NZS 4781~~	~~Code of practice for safety in welding and cutting~~
~~NZBC E1/VM1~~	~~New Zealand Building Code, Clause E1, Verification Method 1 (Schedule 1 of the Building Regulations 1992)~~
~~NZTA M/07~~	~~Specification for roadmarking paints~~
~~SNZ PAS 4509~~	~~New Zealand Fire Service firefighting water supplies code of practice~~
~~TNZ M/4~~	~~Specification for basecourse aggregate~~
Joint Australian and New Zealand standards	
AS/NZS 1170.0	Structural design actions – Part 0: General principles
AS/NZS 1260	PVC-U pipes and fittings for drain, waste and vent applications
AS/NZS 1477	PVC pipes and fittings for pressure applications
AS 2129	Flanges for pipes, valves and fittings
AS/NZS 2280:2014	Ductile iron pipes and fittings
AS/NZS 2566.2	Buried flexible pipelines – Part 2: Installation
AS/NZS 2638.2	Gate valves for waterworks purposes – Part 2: Resilient seated
AS/NZS 2845.1	Water supply – Backflow prevention devices – Part 1: Materials, design and performance requirements
AS/NZS 2865	Safe working in a confined space
AS/NZS 2980:2007	Qualification of welders for fusion welding of steels
AS/NZS 3500.1	Plumbing and drainage – Part 1: Water services
AS/NZS 3518	Acrylonitrile butadine styrene (ABS) compounds, pipes and fittings for pressure applications
AS/NZS 3725	Design for installation of buried concrete pipes
AS/NZS 3862	External fusion-bonded epoxy coating for steel pipes
AS/NZS 4020	Testing of products for use in contact with drinking water

Reference	Title
AS/NZS 4058	Precast concrete pipe (pressure and non-pressure)
AS/NZS 4087	Metallic flanges for waterworks purposes
AS/NZS 4129:2008	Fittings for polyethylene (PE) pipes for pressure applications
AS/NZS 4130	Polyethylene (PE) pipes for pressure applications
AS/NZS 4131	Polyethylene (PE) compounds for pressure pipes and fittings
AS/NZS 4158	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS/NZS 4331.1	Metallic flanges – Part 1: Steel flanges
AS/NZS 4331.2	Metallic flanges – Part 2: Cast iron flanges
AS/NZS 4671	Steel reinforcing materials
AS/NZS 4765	Modified PVC (PVC-M) pipes for pressure applications
AS/NZS 4998	Bolted unrestrained mechanical couplings for waterworks purposes
AS/NZS 5065	Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications
Australian standards	
AS 1579	Arc-welded steel pipes and fittings for water and wastewater
AS 1646	Elastomeric seals for waterworks purposes
AS 1741	Vitrified clay pipes and fittings
AS 1199.1	Sampling procedures for inspection by attributes – Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection
AS 2129	Flanges for pipes, valves and fittings
AS 2439.1:2007	Perforated plastics drainage and effluent pipe and fittings – Part 1: Perforated drainage pipe and associated fittings
AS 3996	Access covers and grates
AS 4794	Non-return valves for waterworks purposes – Swing check and tilting disc
AS 4795.1	Butterfly valves for waterworks purposes – Wafer and lugged
AS 4795.2	Butterfly valves for waterworks purposes – Double flanged
AS 4956	Air valves for water supply
International standards	
ANSI/NSF 61	Drinking water system components – Health effects
ANSI/AWWA C219/06	Bolted, sleeve-type couplings for plain-end pipe
ASME B31.4	Pipeline transportation systems for liquids and slurries
ASTM A312	Standard specification for seamless and welded austenitic stainless steel pipes

Reference	Title
BS EN 1092	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated, Steel flanges
BS 534	Specification for steel pipes, joints and specials for water and sewage
BS 2971	Specification for class II arc welding of carbon steel pipework for carrying fluids
BS 5163.1	Valves for waterworks purposes. Predominantly key-operated cast iron gate valves. Code of practice
BS 6920	Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water
ISO 2531	Ductile iron pipes, fittings, accessories and their joints for water applications
ISO 5752	Metal valves for use in flanged pipe systems – Face-to-face and centre-to-face dimensions
ISO 13953	Polyethylene (PE) pipes and fittings -- Determination of the tensile strength and failure mode of test pieces from a butt-fused joint
ISO 13954	Plastics pipes and fittings -- Peel decohesion test for polyethylene (PE) electrofusion assemblies of nominal outside diameter greater than or equal to 90 mm
ISO 13955	Plastics pipes and fittings -- Crushing decohesion test for polyethylene (PE) electrofusion assemblies
ISO 13956	Plastics pipes and fittings -- Decohesion test of polyethylene (PE) saddle fusion joints -- Evaluation of ductility of fusion joint interface by tear test
ISO 21307:2011	Plastics pipes and fittings -- Butt fusion jointing procedures for polyethylene (PE) pipes and fittings used in the construction of gas and water distribution systems

3 GENERAL REQUIREMENTS

This document provides the minimum technical and construction specifications for the three waters network and constitutes the minimum requirements of Council as a utility owner under the Local Government Act. Reference shall be made to this document when planning and designing new stormwater, wastewater and water supply infrastructure (the three waters) and for the renewal, upgrade or decommissioning of existing infrastructure.

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 Specification for Water Services (R.Spec) 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 1992, and New Zealand Building Code (NZBC)

(b) Civil Defence Emergency Management Act 2002

(c) Energy Efficiency and Conservation Act 2000

(d) Fire and Emergency New Zealand Act 2017

(e) Health (Drinking Water Amendment) Act 2007

~~(e)~~(f) Health and Safety at Work Act 2015 and related regulations

~~(f)~~(g) Land Drainage Act 1908

~~(g)~~(h) Local Government Act 1974 and Local Government Act 2002, and related council by-laws and policies

~~(h)~~(i) Resource Management Act 1991, including all applicable National Environmental Standards, regulations and regional and territorial planning documents

~~(i)~~(j) Utilities Access Act 2010, National Code of Practice for Utility Operators' Access to Transport Corridor and the Installation of Utility Structures on Railway Land

~~(j)~~(k) Electricity Act 1992, Electricity (Hazards from Trees) Regulations 2003

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

3.3 Testing and inspection records

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.

4 GENERAL SPECIFICATIONS

The following specifications shall be read in conjunction with the drainage and water supply specifications. They contain items that are relevant to both activities and are presented here to avoid duplication.

4.1 Health and safety obligations

The requirements of the Health and Safety at Work Act 2015 and the Health and Safety at Work Regulations 2016 shall be observed at all times.

In particular, under Section 43 of the Health and Safety at Work Act all developers must, so far as is reasonably practicable, ensure that the way all plant or structure is installed, constructed, or commissioned is done so without the risk to the health and safety of persons who:

(a) Construct or install the plant or structure.

(b) Use the plant or structure at a workplace for the purpose it was installed, constructed or installed.

(c) Carries out any reasonably foreseeable activity for the proper use, decommissioning, or dismantling of plant, or demolition or disposal of the structure.

(d) Are in the vicinity of the workplace and whose health and safety may be affected by a use of an activity referred to in paragraphs a) to c above.

Contractors and construction staff must meet their obligations under the Health and Safety at Work Act. For Wellington Water projects, this means complying with any minimum ~~PPE~~ personal protective equipment requirements and mandated work practices, as well as any contractual obligations.

Designers, contractors and construction staff working for Wellington Water ~~or~~ on assets under Wellington Water's control must comply with ~~specifications for immunisation (see **Section 4.1.1 Immunisations**) and all of~~ Wellington Water's minimum health and safety standards, which are available online~~. These are available from Wellington Water's Health & Safety Manager~~.

4.1.1 Immunisations

All staff physically working on the wastewater or water supply networks must comply with the immunisations in **Table 4-1**.

Table 4-1 – Required immunisations

Network type	Immunisation	Frequency
Water supply	Hepatitis A	If no antibodies present[1]
	Hepatitis B	If no antibodies present[1]
	Polio	Every 10 years
	Typhoid	Every 3 years
	Tetanus	If not up to date[2]
Wastewater	Hepatitis A	If no antibodies present[1]

Network type	Immunisation	Frequency
	Hepatitis B	If no antibodies present[1]
	Tetanus	If not up to date[2]
	Measles, Mumps and Rubella	If not up to date[2]
	Polio	Every 10 years
Stormwater	No specific requirements	

1 Refer to **Section 4.1.1**(a) **Immunisations**

2 Based on Ministry of Health guidelines.

(a) The following testing treatment and immunisation regime shall be adhered to:

(i) **Hepatitis A.** If a blood test proves the presence of antibodies, no vaccination is required. If no antibodies are detected, immunisation using appropriate vaccine shall be carried out.

(ii) **Hepatitis B.** If a blood test proves the presence of antibodies, no vaccination is required. If no antibodies are detected, three consecutive vaccinations at monthly intervals shall be administered, followed by a blood test after one month.

(b) No contractor's staff employed on other sites involving work in or on any river, drain, or sewer, shall be allowed to carry out work on the water supply network unless permanently transferred and undergoing the above tests and vaccinations.

(c) Clearance Certificates, signed by a registered medical practitioner, shall be sent to Wellington Water at the first opportunity.

(d) Where the contractor's employees have already been certified, the contractor shall submit a list of names of such persons for checking. If new persons are engaged during the progress of the work, the contractor shall seek Wellington Water's direction as to what work they may be engaged upon pending production of a certificate.

(e) No person will be employed in making connections to existing water mains unless that person has clearance. Wellington Water reserves the right to order from the Site, at any time, any person for whom a satisfactory clearance has not been obtained.

(f) Workers are to immediately report the onset of any gastrointestinal illness. Such a worker is to be placed immediately on work not involving the handling of distribution components until free from diarrhoea for 48 hours, and with specific conditions (including Hepatitis A, Shigella, Typhoid and Cholera), a medical certificate of clearance is to be obtained.

4.2 Environmental management

Where construction work is being carried out on behalf of Wellington Water, environmental management plans are required, and the following considerations are required as a minimum.

The three waters network shall be designed so that no harm shall occur to the environment during construction, operation, maintenance, or demolition of the network.

4.2.1 Water ponding/stormwater management

The following applies to water ponding and stormwater management:

(a) Water ponding in the trench shall be prevented by means such as pumping and fluming.

(b) Discharge of sediment laden water ~~shall be to a location approved by Wellington Water~~ where it may enter water may need approval from GWRC or Wellington Water.

(i) ~~This may be to the sewer network, or other approved location only~~Refer to the regional plan for rules regarding discharges to land where it cannot enter water (including groundwater in an aquifer protection area), or to water, or to the stormwater network. Discharges may require a resource consent from GWRC or written approval from Wellington Water.

(ii) ~~Under no circumstances shall sewage be diverted to the stormwater system or be in a water supply trench~~Discharge to the wastewater network needs written approval from Wellington Water and may also need a trade waste consent.

(c) When working in the road reserve:

(i) The stormwater network shall be maintained and operated in accordance with the requirements of the ~~National Code of Practice for Utility Operators' Access to Transport Corridors (~~NCOPUATTC~~)~~.

(ii) The requirements ~~under Section 5.3.2, *Pollution Control*,~~ of the NCOPUATTC shall be complied with at all times.

4.2.2 Noise control

The following applies to noise control:

(a) Compliance is required at all times with standards for noise for the proposed activity and zone as defined in the District Plan, otherwise consent will be required under the Resource Management Act 1991~~The Resource Management Act 1991 shall be complied with at all times~~.

(b) The best practical means of reducing the noise of continuous use equipment to affected people shall be employed at all times.

(c) The continuous noise level at residential and commercial property boundaries shall not exceed the ambient level by more than 10 dB(A).

(d) Any directions from the Council's environmental noise control unit shall be complied with.

(e) The requirements under Section 5.3.5, *Noise and Vibration Management*, of the NCOPUATTC and the Corridor Manager's Work Access Permit and Local and Special Conditions shall be complied with at all times.

4.2.3 Odour control

The following applies to odour control:

(a) Foul or offensive odours emitting from the works or other sources as a result of any construction work shall be minimised at all times.

(b) No foul or offensive odours shall be emitted from the works or other sources as a result of the work outside normal working hours or at other times when the site is not occupied.

(c) Potential odour situations (from or adjacent to the works site) shall be immediately reported to the "On-call Officer, Pollution Response" GWRC at 0800 496 734.

4.3 Working near trees

Where work is:

(a) In the road reserve, all work and activities must comply with the requirements of the NCOPUATTC.

(b) On private property, the works must comply with the agreement of the landowner, as well as:

(i) Comply with the rules in the relevant district plan related to the affected trees.

(ii) Comply with the Electricity (Hazards from Trees) Regulations 2003, where applicable, when working within the canopy of trees.

(iii) Comply with the requirements of NZECP 34[2] when using machinery close to overhead conductors (refer also to the Approved Code of Practice for Safety and Health in Tree Work: Part 1 Arboriculture[3] and Part 2: Maintenance of Trees Around Power Lines[4]).

Before any tree is affected by an excavation, the council arborist and private property owner, if relevant, must be contacted to liaise on the extent and nature of the work. Where the tree is to be kept, the following shall apply:

(c) Where the branches or roots of any tree may be harmed by the proposed activities, these shall only be trimmed by the council arborist or at their approval. Generally, roots shall first be exposed by hand digging, or hydro jetting.

(d) A tree-protection zone (as a guide, this is the area under the drip line of a tree or within a radius of half the height of the tree, whichever is greater) must be established by a qualified and experienced arborist (refer to **Standard Detail DR08 – Tree Dripline**).

(e) A temporary fence must be erected for the duration of the works.

(f) No materials, equipment, liquids or vehicles are to be positioned, and no work is to be carried out within the tree-protection zone without the prior approval of a qualified and experienced arborist.

(g) All care should be taken to minimise run-off from chemical / material storage sites.

[2] *New Zealand Electrical code of practice for electrical safe distances. NZECP 34:2001. Manager, Standards and Safety, Ministry of Consumer Affairs.*

[3] *Approved Code of Practice for Safety and Health in Tree Work: Part 1 Arboriculture. WorkSafe New Zealand. 2012*

[4] *Approved Code of Practice for Safety and Health in Tree Work: Part 2: Maintenance of Trees Around Power Lines. Department of Labour. 1996*

4.4 Working with asbestos cement pipes

4.4.1 Design for replacement of asbestos cement pipes

The following applies to the design for replacement of asbestos cement (AC) pipes:

(a) So far as reasonably practicable, the designer shall not design for the on-line replacement of the AC pipe unless the AC is to be removed from the ground. Methods that are considered unacceptable include, but are not limited to, pipe ~~cracking~~ bursting ~~or slip-lining~~ of AC pipes ~~(see **Section 4.12 Slip-lining**)~~.

(b) Any excavation, removal, and disposal of the AC pipe shall be carried out in accordance with the approved code of practice for the Management and Removal of Asbestos[5], and the Health and Safety at Work (Asbestos) Regulations 2016.

(c) Where an AC pipeline remains on site~~is decommissioned in situ~~, the pipe's Asset ID, location and alignment shall be included within the supplied as-built drawings to allow ~~identified in~~ Wellington Water's asset database to identify the pipeline ~~(GIS)~~ as including a hazardous material.

(i) The AC pipe's physical condition shall be noted, as well as other details, such as whether it was capped, grouted, re-purposed or has experienced any other modification or treatment.

4.4.2 Working with AC pipes

The following applies to working with AC pipes:

(a) The approved code of practice for the Management and Removal of Asbestos[6] and the Health and Safety at Work (Asbestos) Regulations 2016 shall be complied with when working with or coming in contact with AC pipes and fittings.

(b) Personnel, when working with AC pipes and fittings, shall take all reasonable steps to prevent asbestos fibres from becoming airborne.

(c) When dealing with ~~non-friable~~ asbestos materials, the contractor is advised to follow the instructions given below (as a minimum requirement):

(i) Health and Safety at Work (Asbestos) Regulations 2016 and

(ii) Approved Code of Practice: Management and Removal of Asbestos.

~~(d) New Zealand Demolition and Asbestos Association (NZDAA) publication, Asbestos – New Zealand guidelines for the management and removal of asbestos (3rd Edition)~~

~~(e) Interim Guidance for Work Involving Asbestos~~

~~(f) Information Sheet 5 – Personal Protective Equipment to use when Working with Asbestos[7].~~

~~(g)~~(d) ~~These best practice documents are available from the WorkSafe website.~~Cutting of AC pipe in a dry condition using a hand or power saw is not permitted.

~~(h)~~(e) Hydro-excavation near AC pipe is not permitted.

[5] *Approved code of practice: Management and removal of asbestos. WorkSafe New Zealand. 2016*

[6] *Approved code of practice: Management and removal of asbestos. WorkSafe New Zealand. 2016*

~~[7] Information Sheet 5 – Personal Protective Equipment to use when Working with Asbestos. WorkSafe New Zealand. 2016~~

~~(i)~~(f) Personnel working with asbestos shall provide the necessary safety instructions to personnel, issue personal protection and equip personnel to safely work with material.

~~(j)~~(g) All AC pipe shall be placed in a suitable bag and disposed of at a landfill registered to accept asbestos products.

~~4.5 Excavation~~

~~The following applies to excavation and trenching:~~

~~(a) Excavation shall only begin after all permissions and pre-possession documentation has been submitted and approved in writing by Wellington Water.~~

~~(b) Excavation for all manholes and other structures shall be such as to leave adequate space for bracing, compaction of backfill and extraction of timber and shoring. On completion, this space shall be thoroughly compacted with approved materials.~~

~~(c) Excavated topsoil that is to be reused, be separately stacked and measures taken to ensure that topsoil remains unmixed with clay or other deleterious matter. Similarly, turf that is to be reused shall be cut and safeguarded for later placement.~~

~~(d) Trenches shall be of sufficient width and depth to permit dewatering, bedding and pipe jointing to be carried out with adequate working room and in a safe manner.~~

~~(e) Trenches in stable country may be opened a maximum of 25 m in advance of pipe laying, but this allowable advance distance may be reduced at the discretion of Wellington Water or conditions outlined by the Road Controlling Authority (RCA).~~

~~(f) The 25 m maximum may be increased where a case can be suitably justified to Wellington Water and the RCA, and where it can be demonstrated that the open excavation can be managed in a safe manner.~~

~~4.5.1 Definition of hard rock~~

~~For the purposes of contractual definition, hard rock shall be considered to be ground that cannot be removed in-situ using a 10 tonne excavator fitted with a rock bucket and requires other means of removal.~~

~~4.5.2 Trenching near other underground services~~

~~The following applies to trenching near other underground services:~~

~~(a) All underground services in and adjacent to the construction site shall be marked out on site prior to construction.~~

~~(i) Where this marking out cannot be carried out by the Utility Operator, a mark out shall be arranged to be carried out by a competent person using reliable equipment where applicable.~~

~~(ii) Marked out services shall be exposed to confirm their as-built location and depth before excavation of the trench.~~

~~(b) Measures shall be taken to ensure existing underground utility structures are not damaged during excavation, and that the works are carried out in a manner that protects the separation requirements of other Utility Operators as provided for in relevant codes and the NCOPUATTC.~~

~~(c) Minimum utility structure clearances shall be maintained.~~

(d) The respective Utility Operators instructions shall be adhered to when excavating near the existing services. These instructions may include that a representative of the authority is on site while excavations are undertaken and that machinery shall not be used for excavation within a defined distance of the service.

(e) The instructions given in the following WorkSafe NZ publications are advised as a minimum requirement:

(i) Excavation Safety Good Practice Guidelines[8] and

(ii) Guide for Safety with Underground Services[9].

4.5.3 Excavation side supports

The following guidelines apply to excavation side supports:

(a) Excavation work shall comply with the relevant sections of:

(i) Excavation Safety Good Practice Guidelines[10]

(ii) Guidelines for the Provision of Facilities and General Safety in the Construction Industry[11] and

(iii) Requirements of the Utility Operator under Section 5.5, Trenching Procedures, of the NCOPUATTC.

(b) Trench side supports shall be used as necessary to fully support the trench side and to meet the requirements of:

(i) The Health and Safety in Employment Act 1992 and all Health and Safety in Employment Regulations under this Act and

(ii) The Excavation Safety Good Practice Guidelines.

(c) In addition to the requirements of the Excavation Safety Good Practice Guidelines, all excavations (irrespective of depth or ground conditions), where it is necessary for a worker to perform tasks within the excavation with their head and shoulders below ground level (for example at all water main cut-in locations, lateral service connections made within the trench etc), must be shored unless:

(i) The face is cut back to a safe slope (as defined in the Excavation Safety Good Practice Guidelines) and the material in the face will remain stable under all anticipated conditions of work and weather.

(ii) Shoring is impracticable or unreasonable and safety precautions certified by a Chartered Professional Engineer (CPEng) to be adequate have been taken.

[8] Excavation safety: Good practice guidelines. WorkSafe New Zealand. 2016

[9] Guide for Safety with Underground Services. Occupational Safety and Health Service, Department of Labour. 2002

[10] Excavation safety: Good practice guidelines. WorkSafe New Zealand. 2016

[11] Guidelines for the Provision of Facilities and General Safety in the Construction Industry. Occupational Safety and Health Service, Department of Labour. 1995

4.6 Bedding, haunching and surrounds

The following applies to bedding, haunching and surrounds:

(a) The foundation of the trench is to be checked for stability of the soil. If required by Wellington Water, it must be either strengthened, excavated and removed or compacted to an acceptable standard.

(b) Generally, a plate compactor is to be run over the trench floor to bind the surface and identify any obvious weak spots.

(c) The foundation shall be tested with a Scala penetrometer and must return a result of at least 4 blows per 50 mm of penetration.

(i) Scala testing shall be carried out at 10 m intervals along the trench invert, or

(ii) At any apparent change in ground conditions.

(d) Any weak spots shall be removed, until a foundation of stable strength has been achieved, and replaced with suitable backfill material compacted to at least 4 blows per 50 mm compaction or more as may be required.

4.6.1 Bedding, haunching and surrounds for flexible pipes

A flexible pipe is a pipe that relies primarily upon side support to resist vertical loads without excessive deformation. This includes PVC, PP, PE, and metallic pipes such as steel and ductile iron.

The following applies to flexible pipes:

(a) Bedding, haunching and surround material for flexible pipes shall be a selected cohesionless material that complies with the grading curves of Appendix G of AS/NZS 2566.2. Typical compliance is outlined in **Table 4-2**.

(b) The material shall be free of organics and of sharp, angular aggregates.

(c) There shall be a minimum of 100 mm of bedding material below the pipe.

(d) The bedding and surround material shall be placed and compacted to a level above the pipe as outlined below:

(i) 100 mm cover for pipes up to and including DN 150 mm

(ii) 150 mm cover for pipes greater than DN 150 and up to DN 900

(iii) 200 mm cover for pipes greater than DN 900 and up to DN 1,500

(iv) 300 mm cover for pipes greater than DN 1,500

(e) Careful placement and layered compaction of pipe bedding and surround material is required, particularly to provide full side and lower arc support. Minimum relative compaction for cohesionless soils shall be as outlined in AS/NZS 2566.2, which states:

(i) Relative Dry Density index of 70% in trafficable areas or

(ii) Relative Dry Density index of 60% in non-trafficable areas.

Table 4-2 – Bedding, haunching and surrounds material for flexible pipes

In-situ soil environment	Approved Material
In a sand environment	Sand native to in-situ
	Imported sand (**Table 4-3**)
In all other environments	AP20* for > DN 150
	AP10* for DN 63 to DN 150
	AP5* for < DN 63

* Pea-metal and single graded equivalents are acceptable

Table 4-3 – Imported sand

Sieve size (mm)	Weight passing (%)
4.75	100
2.36	90-100
1.18	85-100
0.60	70-100
0.30	50-100
0.15	0-40
0.075	0-5

Source: AS/NZS 2566.2, Table G3

4.6.2 Bedding, haunching and surrounds for rigid pipes

A rigid pipe is a pipe that supports vertical loads primarily by virtue of its resistance to bending or deformation as a ring. This includes concrete and vitreous clay pipes.

The following applies to rigid pipes:

(a) Design shall require HS (haunch and side) support design as per AS/NZS 3725 where the pipe is designed to be supported by the bedding, haunching and side zone material within a trench. Alternative bedding and support design shall only be considered by Wellington Water where HS design is not practical.

(b) The material to be used for bedding, haunching and side zone material shall comply with **Table 4-4**.

(c) Compaction shall be as outlined in **Section 4.8 Compaction**.

Table 4-4 – Bedding, haunching and side zone material for rigid pipes

In-situ soil environment	Pipes up to and incl. 450 mm internal dia.	Pipes greater than 450 mm internal dia.
In **sand**: • Bedding and haunching • Side zone	 Sand native to in-situ Sand native to in-situ	 Sand native to in-situ Sand native to in-situ
In **all other environments**: • Bedding and haunching • Side zone	 5-20 mm drainage* 5-20 mm drainage*	 5-40 mm drainage* 5-40 mm drainage*

* Complying with Table 4-5.

(d) There shall be a minimum of 100 mm of bedding material below the pipe for pipes ≤ 1500 mm and a minimum of 150 mm of bedding material for pipes > 1500 mm.

(e) A rebate shall be formed in the bedding below any collars such that the pipe is supported on the full length of the barrel as opposed to the collar.

(i) A minimum of 50 mm of bedding material is required below any pipe collars.

Table 4-5 – Drainage bedding and haunching

Sieve size (mm)	5-20 mm drainage dry mass passing (%)	5-40 mm drainage dry mass passing (%)
53.0	-	100
37.5	-	98-100
26.5	100	-
19.0	98-100	27-45
13.2	-	-
9.5	12-30	5-22
4.75	0-5	0-5
0.15	0-3	0-3

(f) Acceptable material within the grading limits would result in material that is well graded and free draining. Granular material that complies with the above, but that would break down when wetted, such as shale or conglomerates, are not suitable materials and shall not be used.

4.6.2.1 Pipe surround for rigid pipes

Rigid pipes shall be surrounded from the top of the bedding, haunching and side zone material to 200 mm above the top of the pipe with either bedding material or trench backfill material, provided that the maximum size of the material does not exceed:

(a) For vitreous clay pipes: 5-20 mm drainage (see **Table 4-5**).

(b) For reinforced concrete pipes 450 mm diameter or less: 5-20 mm drainage (see **Table 4-5**).

(c) For reinforced concrete pipes greater than 450 mm: 5-40 mm drainage (see).

The pipe surround material shall:

(d) Not contain any organic material.

(e) Be compacted by hand tamping in layers no more than 150 mm thick.

(f) Include the use of bedding and haunching material as acceptable for pipe surround.

4.6.3 Filter fabric

Filter fabric shall:

(a) Be used in all trenches unless otherwise specified in writing by Wellington Water.

(b) Be placed as a barrier between bedding, pipe surround or backfill and native materials[12] to prevent the migration of fines.

(c) Be selected to match the material grading. Typically, filter fabric with the following properties will be suitable:

(i) Pore size of 75 microns

(ii) Permeability 90 L/m^2/s

(iii) CBR (California Bearing Ratio) puncture resistance 1500 N and

(iv) Terram 1000 or Bidim A29 would typically be acceptable filter fabrics.

4.6.4 Concrete bedding

The following applies to concrete bedding:

(a) Pipes with collars shall be supported at their collar by a 20 mm thick H4 treated softwood block[13] and the lower 90-degree arc of the pipe barrel hand packed with concrete.

(b) Flush jointed pipes shall be supported at the joint by a 50 mm thick H4 treated softwood block and the lower 90-degree arc of the pipe barrel hand packed with concrete to ensure joints remain aligned during laying and backfilling.

(c) The surface of any concrete already hardened shall be chipped, washed and brushed clean, and shall have a layer of cement grout brushed in before new concrete is placed upon it.

(d) In wet trenches, the concrete bed shall be supported on each side by firmly fixed timber shutters, and a drainage channel shall be formed outside these. Water shall be kept below the bottom of the bedding by pumping from sumps or by other approved means.

(e) No concrete shall be placed into running water. Concrete may be placed to displace still water if permitted in writing from Wellington Water.

(f) All concrete shall be allowed to set for at least 24 hours before any loads from pipelaying, backfilling, etc are applied.

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[12] In practice, bedding material would normally be required to be enveloped in filter fabric. This filter fabric may also be required to enclose the pipe.

[13] This is to ensure that the pipe is not supported on a hard object (which will cause the pipe to break). If the pipe is supported on a softwood block, then when loaded, the block should crush and transfer the loading to the bedding via the pipe barrel.

(g) Concrete used for pipe bedding shall have a minimum compressive strength of 20 MPa after 28 days.

(h) H4 treated softwood blocks and wedges only shall be used to support the pipe during laying and shall be removed when completed.

4.6.5 Concrete surround and cradle

Concrete surrounding of unplasticised polyvinyl chloride (PVC-U) and PE pipes will not be permitted except when laid on the face of a bank to prevent mechanical damage. Concrete surrounding of concrete and earthenware drains will not normally be permitted.

The following applies to concrete surround and cradle:

(a) Where concrete surrounding is specified, then, except where the pipe is under a building, there shall be a physical break in the surround at each pipe joint to maintain pipe flexibility. This shall be created by the insertion of a ply-wood spacer shaped to the pipe barrel and placed on the pipe barrel immediately adjacent to the collar of the connecting pipe.

(b) Pipes laid on a concrete cradle or concrete surrounded shall be supported at the collar on H5 treated softwood blocks (for flush jointed concrete pipes, the blocks shall be placed at the joint).

(i) There shall be a minimum thickness of concrete of 0.25 x pipe outside diameter (OD) under the pipe barrel, but no less than 100 mm.

(ii) Concrete cradles shall extend a minimum of 0.25 x pipe OD above the bottom of the pipe barrel.

(c) Concrete used for pipe cradles and surrounds shall have a minimum compressive strength of 20 MPa after 28 days.

4.7 Backfilling

The following general guidelines apply to backfilling of an excavation over and above the bedding, haunching and surrounds:

(a) No backfilling shall be carried out until the laying and jointing of the lines have been approved in writing by Wellington Water or their representative.

(b) Vibrating rollers shall not be used within 500 mm of the top of concrete, earthenware or plastic pipes.

(c) When backfilling on a live sewer or stormwater trench, at no time shall water be allowed to escape from the pipe into the trench.

4.7.1 Road reserve and private drives

The following applies to backfilling in the road reserve and on private drives:

(a) Any trench in the road corridor up to 1 m depth to invert shall be backfilled using imported AP40 granular material complying with the requirements of TNZ M/4.

(b) Where a trench in the road corridor has a depth to invert greater than 1 m, and depth to the top of the bedding greater than 0.8 m, imported AP65 granular material complying with the requirements of TNZ M/4 may be used as bulk backfill between the top of the bedding and a depth 0.5 m below the surface level.

(c) Suitable in-situ material shall not be used as bulk backfill in trenches in the road corridor except:

(i) Where pipelines are laid in the carriageway and the in-situ material is sand, and the in-situ material can be compacted to the requirements of **Section 4.8.4 Compaction requirements for in-situ material**.

(ii) In the berm where the in-situ material is not plastic and can be compacted to the requirements of **Section 4.8.4 Compaction requirements for in-situ material**.

(d) Trench sides shall be supported so that there is no damage caused to adjacent assets by the trench excavation and pipe-laying backfilling operations. Excavated material may be reused where it can achieve the required compaction requirements and does not contravene the aforementioned requirements.

4.7.2 Compaction and testing

Compaction and testing shall comply with this specification.

4.7.3 Private property

The following applies to backfilling in private property (excluding private drives and paved areas), unless otherwise specified in the approved drawings:

(a) General backfill material (see **Table 4-6**) shall be:

(i) Dry and free of rocks and organic and deleterious material.

(ii) Placed uniformly and not dropped from a height of more than 500 mm. Layers shall be compacted in 150 mm thick lifts.

(iii) For non-cohesive material, compacted as outlined in **Section 4.8 Compaction**.

(b) When backfilling settles below the level of the adjacent ground, the level shall be raised with additional topsoil and grass seed.

Table 4-6 – Backfill material for private properties

In-situ soil environment	Backfill material
Sand	Sand
Other – non-trafficked	GAP 40 or selected fill

4.8 Compaction

A consistent level of compaction shall be achieved throughout the backfill, sub base and basecourse. The following general guidelines apply to compaction:

(a) Compaction levels shall not vary by more than 20% within each backfill layer. The depth of lifts shall be managed to achieve this.

(b) The contractor may use a Clegg impact tester (Clegg hammer) to monitor compaction on site.

(c) When the contractor believes the backfill compaction is satisfactory, compaction records shall be measured using a SCALA penetrometer. Compaction measurements shall:

(i) Be at 5 m intervals along the trench length

(ii) Not be taken in the outside edge of the trench and

(iii) Be taken in the middle 50% of the trench width.

(d) SCALA penetrometer blow counts shall be recorded through all layers down to the top of the bedding which should be no closer than 200 mm above the pipe. Care shall be taken not to damage the pipe with the penetrometer. Site compaction test records shall include the following:

(i) Site name

(ii) Contract number (where applicable)

(iii) Contractor's name (where applicable)

(iv) Location along trench as a Chainage from a known point and

(v) Number of blows per 50 mm penetration from surface to top of bedding.

4.8.1 Compaction of trench invert

The following applies to the compaction of trench inverts:

(a) Compaction testing of the excavated trench invert shall be conducted before the invert is prepped for laying and compacting the pipe bedding.

(b) SCALA penetrometer measurements shall:

(i) Be carried out at 5 m intervals along the trench length.

(ii) Be taken to a depth of 300 mm below the excavated trench invert. No measurement is to be recorded for the top 50 mm.

(c) The interval between penetrometer measurements shall be reduced so that testing will occur where there is a noticeable change in:

(i) Soil type

(ii) Soil density

(iii) Soil plasticity and

(iv) Soil water content.

(d) To be acceptable, **Table 4-7** provides the blow counts per 50 mm penetration to be measured.

(e) Where blow counts in the trench invert are less than those specified in **Table 4-7**, the soft material shall be replaced with compacted basecourse to a depth where compliant blow counts can be met, or as agreed in writing by Wellington Water. The basecourse shall be compacted to return 6 blows per 50 mm penetration when tested with a SCALA penetrometer.

Table 4-7 SCALA penetrometer – un-compacted trench invert

Ground conditions	Blows per 50 mm penetration
Sands	4
Stiff clays	4
Stiff silts	3
Weathered yellow-brown greywackes	5
Weathered but hard greywackes	Testing not required

Ground conditions	Blows per 50 mm penetration
Blue hard rock	Testing not required

4.8.2 Compaction of pipe bedding

The following applies to the compaction of pipe bedding:

(a) Pipe bedding shall have a grading that, when compacted, shall not be free-flowing when a free face is excavated in the bedding zone.

(b) The side support (haunching) and bedding overlay shall be placed in a manner so that:

(i) Uniform distribution and compaction of bedding is achieved, especially under the haunches of the pipeline.

(ii) The pipeline position in the trench is maintained.

(iii) The pipeline level and grade is maintained.

(iv) The pipe and any pipe coatings are not damaged.

(c) The contractor shall ensure that bedding along the trench edges is well compacted.

(d) Heavy machine compaction may be used to compact bedding below the pipeline.

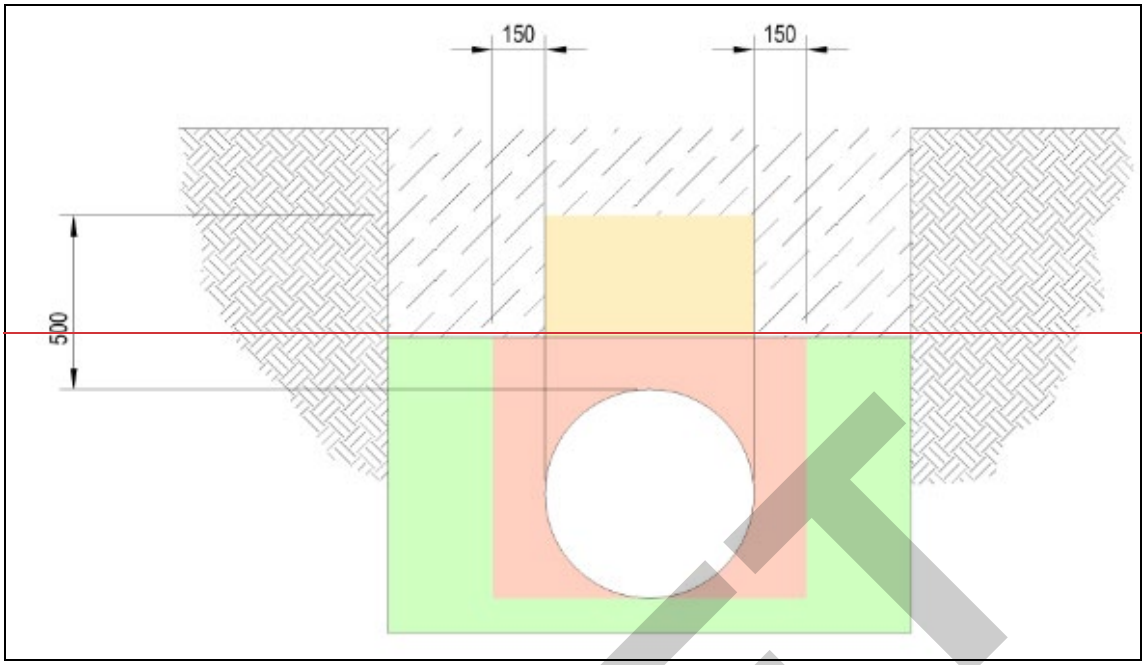
(e) Hand compaction, or light machine compaction, shall be used to compact bedding in the overlay or around the haunches and the spring-line of the pipe, except that:

(i) Heavier machine compaction may be used when compacting bedding that is more than 150 mm clear of the spring-line of the pipe barrel as shown in **Figure 4-1 .**

(f) It is recognised that penetrometer testing may not be practical because of the relatively shallow layers of bedding in a typical small pipe trench.

(g) A Clegg impact tester (Clegg hammer) may be used to monitor compaction on site. Clegg testing shall be undertaken on the bedding below the pipe, in the bedding at the spring-line of the pipe and above the pipe's spring-line when testing the bedding overlay.

(h) The Clegg CIV value corresponding to 70% relative compaction shall be determined as outlined in **Section 4.8.2.1 Compaction requirements**.



~~Note: Area in red is where heavy machine compaction shall not be used~~

~~**Figure 4-1 – Heavy machine compaction**~~

~~4.8.2.1 Compaction requirements~~

~~Bedding shall be compacted to a relative density of 70%. The following methods may be used to develop an indirect method to measure 70% relative density on-site.~~

~~(a) Laboratory testing~~

~~(i) Laboratory testing shall be used to establish the minimum dry density for the bedding material and maximum dry density for the bedding material, as per NZS 4402.~~

~~(ii) The maximum dry density for the bedding material, determined in the laboratory, is then be entered into a nuclear densometer as 100% relative density.~~

~~(b) On-site compaction testing~~

~~(i) Bedding shall be placed in a test trench on-site and compacted to relative density of 70%.~~

~~(ii) The test trench shall have the same width dimension as the pipeline trench.~~

~~(iii) The depth of the test trench shall be a nominal 600 mm, and the test bedding shall have a compacted depth of 300 mm.~~

~~(iv) A pipe shall not be laid in the test trench.~~

~~(v) The relative density of the compacted bedding shall be measured by nuclear densometer.~~

~~(c) Correlation of Clegg Hammer to 70% relative density~~

~~(i) Once a relative density of 70% is achieved in the test bedding, three Clegg hammer readings shall be taken.~~

~~(ii) The average of the Clegg hammer readings shall be recorded and used for monitoring bedding compaction.~~

4.8.3 Compaction of trench backfill

This section applies to compaction of backfill placed above the bedding (for buried flexible pipelines), or above the surround (for buried rigid pipelines) and:

(a) Up to the sub base for trenches in the carriageway.

(b) Up to the basecourse layer for trenches in the carriageway where a sub base is not required.

(c) Up to the basecourse layer for trenches in the footpath or other paved area.

(d) Up to the top soil layer for trenches in the berm.

4.8.3.1 Compaction requirements for imported backfill

Trench backfill shall be measured using a SCALA penetrometer. A Clegg Hammer may be used as a cursory test, but SCALA penetrometer results are required as evidence of suitable compaction.

The number of blows per 50 mm penetration shall not be less than the values in **Table 4-8**.

Table 4-8 SCALA penetrometer blows – imported backfill

Location of Backfill	Blows per 50 mm penetration	Indicative Clegg Hammer
In carriageway	7	CIV 35
In footpath	4	CIV 25
In berm	2	CIV 10

4.8.4 Compaction requirements for in-situ material

Where the requirements of this specification can be met, it shall be acceptable to use in-situ sand as bedding and backfill material.

The Council specified SCALA penetrometer requirements, in some cases, may not be able to be achieved when using in-situ material as backfill and/or as bedding.

When it is intended to re-use in-situ material as backfill and/or bedding and pipe surround, Trench Compaction Testing shall be carried out. This testing shall follow the process set out below.

(a) Laboratory Testing

(i) Laboratory testing, using the standard Proctor test, shall be undertaken on the in-situ material to determine the Maximum Dry Density (MDD) possible for the in-situ material. The laboratory shall also measure the density of the in-situ material.

(ii) The density of the undisturbed in-situ material shall be expressed as the percentage MDD.

(iii) Where the density of the undisturbed in-situ material exceeds 95% MDD, the in-situ material shall be deemed unsuitable for use as backfill and the trench shall be backfilled with imported basecourse.

(b) On-site Backfill Testing

(i) An excavation shall be opened on-site and backfilled with selected in-situ material.

(ii) The trench shall be backfilled and compacted using the moisture level which provided the highest MDD in the Proctor testing and the compaction plant proposed to be used.

(iii) Samples of the compacted backfill shall be taken for standard Proctor testing to measure the compacted density achieved.

(iv) The density of the site compacted material shall be recorded as the percentage MDD.

(v) To be acceptable, the percentage MDD achieved on-site shall not be less than 95% MDD. (The percentage MDD achieved on-site may exceed 100% MDD.)

(vi) Where, after changes to the compaction method, 95% MDD or better cannot be achieved, the in-situ material shall be deemed unsuitable for use and the trench shall be backfilled with imported basecourse.

(c) Correlation of Proctor Results to Nuclear Densometer and SCALA Penetrometer

(i) Nuclear Densometer

1. Nuclear densometer measurements shall be taken on the compacted backfill and on the undisturbed in-situ material.
2. This is required to check the correlation of the nuclear densometer measured density to the laboratory measured density. The two densities shall correlate to within +/- 2%.

(ii) SCALA Penetrometer

1. SCALA penetrometer measurements shall be taken on the compacted backfill.
2. This is required to determine the number of blows per 50 mm penetration that correlates to the percentage MDD achieved during successful site backfill.
3. Where the site backfill test achieved a density greater than 95% MDD the trench backfill shall be scarified and re-compacted to a density of 95% MDD measured by ND.
4. SCALA penetrometer measurements shall be taken on the compacted fill to determine the number of blows per 50 mm penetration that correlates to 95% MDD.

4.8.5 Compaction of sub base

The following applies to compaction of the sub base, above the trench backfill and below the basecourse layer:

(a) Placement and compaction shall be as per the NCOPUATTC and any Council local supplement.

(b) Compaction shall be measured by SCALA penetrometer.

(c) For imported sub base material, it shall be compacted to comply with the requirements for the carriageway in **Table 4-8**.

~~(d) Compaction of in-situ materials shall be measured as described in **Section 4.8.4 Compaction requirements for in-situ material** and compaction shall be to be 95% MDD.~~

~~4.8.6 Compaction of road basecourse~~

~~The following applies to compaction of the road basecourse, above the sub base and below the seal layer:~~

~~(a) Placement and compaction shall be as per the NCOPUATTC and any Council local supplement.~~

~~(b) Compaction shall be measured by Scala penetrometer.~~

~~(c) For imported sub base material, it shall be compacted to comply with the requirements for the carriageway in **Table 4-8**.~~

~~4.9 Reinstatement~~

~~The resurfacing of the trench shall, as a minimum, comply with the NCOPUATTC and relevant council's local conditions. The same standards required for trafficable and non-trafficable in the road reserve shall apply to private property also, unless otherwise agreed in writing with the property owner.~~

~~From May to August inclusive, grassed areas shall be reinstated with imported turf or by reinstating the existing excavated turf.~~

4.5 Excavation

4.5.1 General

The following applies to excavation:

(a) Excavation shall only begin after all permissions and pre-possession documentation has been submitted and approved in writing by Wellington Water.

(b) Excavation work shall comply with the relevant legislation and regulatory documents outlined in **Section 3 General Requirements**, as well as relevant sections of the most current version of the Excavation Safety Good Practice Guidelines.

(c) Excavation risk assessments / planning must:

(i) Address:

1. the risk of excavation collapse, including at any depth where it is necessary for a worker to perform tasks within the excavation with their head and shoulders below ground level,
2. fall from heights (e.g. personnel/equipment/loads),
3. (iii) edge protection

(ii) Be in accordance with the requirements set out in (b) above.

Trenches:

(d) Shall be of sufficient width and depth to permit dewatering, bedding, and pipe jointing to be carried out with adequate working room and in a safe manner. Minimum clearance between the pipe wall and the side of the trench shall be as

detailed in Table 4.2 of AS/NZS 2566.2:2002 or Figure 4 of AS/NZS 3725:2007, or superseding documentation, as appropriate.

(e) May be subject to conditions outlined by the Road Controlling Authority (RCA).

4.5.2 Definition of hard rock

Where the definition of hard rock is not specified in the contract, the default definition shall be taken as:

(a) Hard rock is considered to be ground that cannot be removed in-situ using a 10 tonne excavator fitted with a rock bucket and requires other means of removal.

4.5.3 Excavated material

The following applies to the stockpiling and disposal of excavated material:

(a) When dealing with excavated topsoil that is to be reused, it must be separately stacked, and measures must be taken to ensure that topsoil remains unmixed with clay or other deleterious matter. Similarly, turf that is to be reused shall be cut and safeguarded for later placement.

(b) Stockpiling of excavated material alongside the trench must be at a distance in accordance with Excavation Safety Good Practice Guidelines.

(c) Disposal of excavated material may require resource consent.

4.5.4 Trench dewatering

The following applies to trench dewatering:

(a) Trench dewatering may require resource consent.

(b) Where dewatering is required, the developer shall provide dewatering facilities so that pipe bedding, pipe laying, inspection of the pipe joints and backfilling can be carried out in a trench free of water before and after pipe installation. Where dewatering is not feasible, please refer to **Section 4.7.3 High groundwater environment**.

(c) Groundwater and foreign material shall not be allowed to enter the new pipe at any stage.

(d) If the developer wants to use the new stormwater or wastewater pipeline for dewatering, and this is compliant with the applicable consents, then the developer should propose this as part of their dewatering plan.

(e) Pump hoses, power cords, etc., used for dewatering shall not be run across the surface of any section of the roadway in use without adequate controls. Any slot or ditch required to carry these shall be constructed in accordance with the traffic control requirements and sealed, to provide a smooth surface for traffic, and be watertight. After the service is removed, the road surface shall be reinstated.

4.6 Typical trench arrangement

A typical trench arrangement is provided in **Figure 4-1** below.

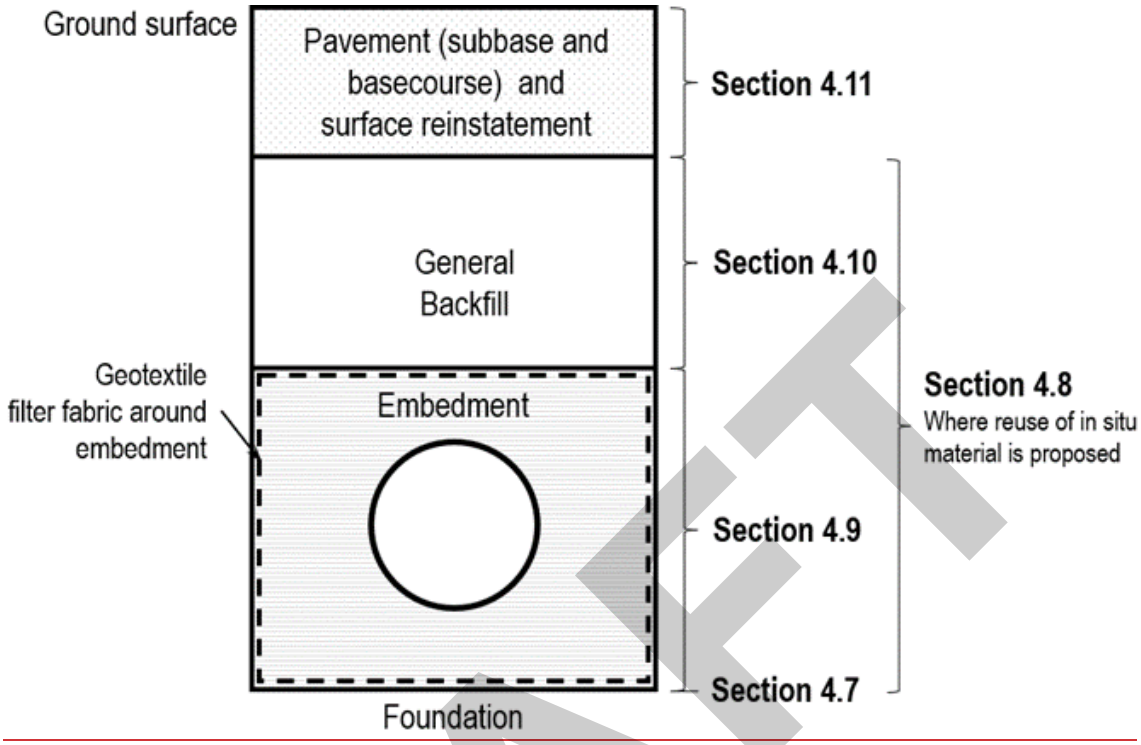


Figure 4-1 – Typical pipe trench arrangement

4.7 Trench foundation

4.7.1 Standard preparation of pipe trench foundation

The following applies to trench foundations for all pipes:

(a) The foundation of the trench is to be checked for stability of the soil.

(b) 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.

(c) A plate compactor is first run over the trench foundation to bind the surface and identify any obvious weak spots.

(d) The in situ trench foundation shall be tested with a Scala penetrometer and must return a result of at least 4 blows per 50 mm of penetration. Where this cannot be achieved, an alternative requirement for the site-specific ground conditions may be approved. This must be verified using the method in **Appendix 5** of the Regional Standard for Water Services.

(e) Scala testing shall be carried out at 10 m intervals along the trench invert, or at any apparent change in ground condition.

(f) Soft, weak soil must be either strengthened, excavated and removed, or compacted to an acceptable standard (see **Section 4.7.2 Remedial measures for insufficient bearing capacity**).

4.7.2 Remedial measures for insufficient bearing capacity

Where the trench foundation level tested with a Scala penetrometer cannot achieve 4 blows per 50 mm of penetration, the following applies:

(a) If the applied loads at the trench foundation level results in soil stresses greater than the allowable bearing capacity, the in situ material will not provide a suitable trench foundation.

(b) Following failure to achieve the required compaction, the trench foundation should be further compacted with a plate compactor and retested with Scala penetrometer. If the required blows per 50 mm still cannot be achieved, Wellington Water may approve a lower minimum requirement.

(c) Where the trench foundation must be remedied, the trench must be over excavated and poor material removed. Imported, compacted fill will be installed in a raft below the trench foundation level to provide the required support, as shown in the figure below. The depth of this raft will be determined by the depth at which the in situ ground has suitable bearing capacity (at least equal to the applied soil stress at that level). Wellington Water will provide further direction if this depth exceeds 300 mm below the foundation level.

(d) Imported fill for the raft will generally be AP65 (graded material) compacted after placement to 6 blows per 50 mm.

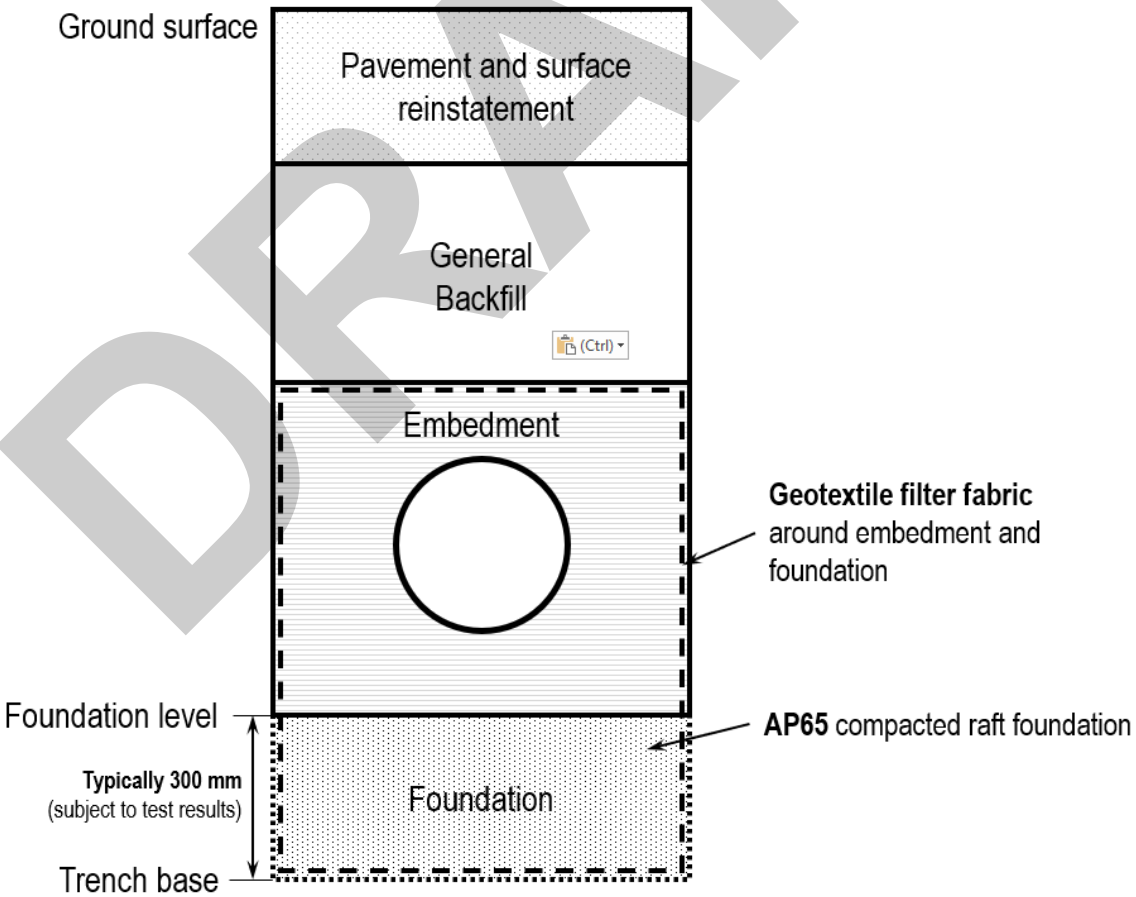


Figure 4-2 – Typical trench arrangement with a raft foundation constructed of imported fill

4.7.3 High groundwater environment

The following applies to loads in a high groundwater environment:

(a) Compaction of AP65 (or other basecourse) can be difficult below the water table due to the fines content of the material. The trench should be dewatered to install the raft arrangement as shown in **Figure 4-2** in accordance with the requirements of **Section 4.5.4 Trench dewatering**.

(b) Where dewatering is not feasible on site, it is acceptable to install single size drainage material in the submerged portion of an increased thickness raft, provided the groundwater level is below the original trench foundation.

(c) The soil stress from the applied loads acting on the in situ material beneath the base of the raft (including any drainage material) should be checked by Wellington Water to ensure it is less than the allowable bearing capacity for these soils. This will be determined by Wellington Water using the procedure outlined in **Appendix 5** of the Regional Standard for Water Services.

(d) If AP65 is being used above 10 mm drainage material with a typical grading curve, no fabric or other separation is required between these materials. Geotextile filter fabric requirements for other material combinations are to be checked using the procedure outlined in **Appendix 6** of the Regional Standard for Water Services. The minimum standard of fabric for this application is Bidim A29 or equivalent.

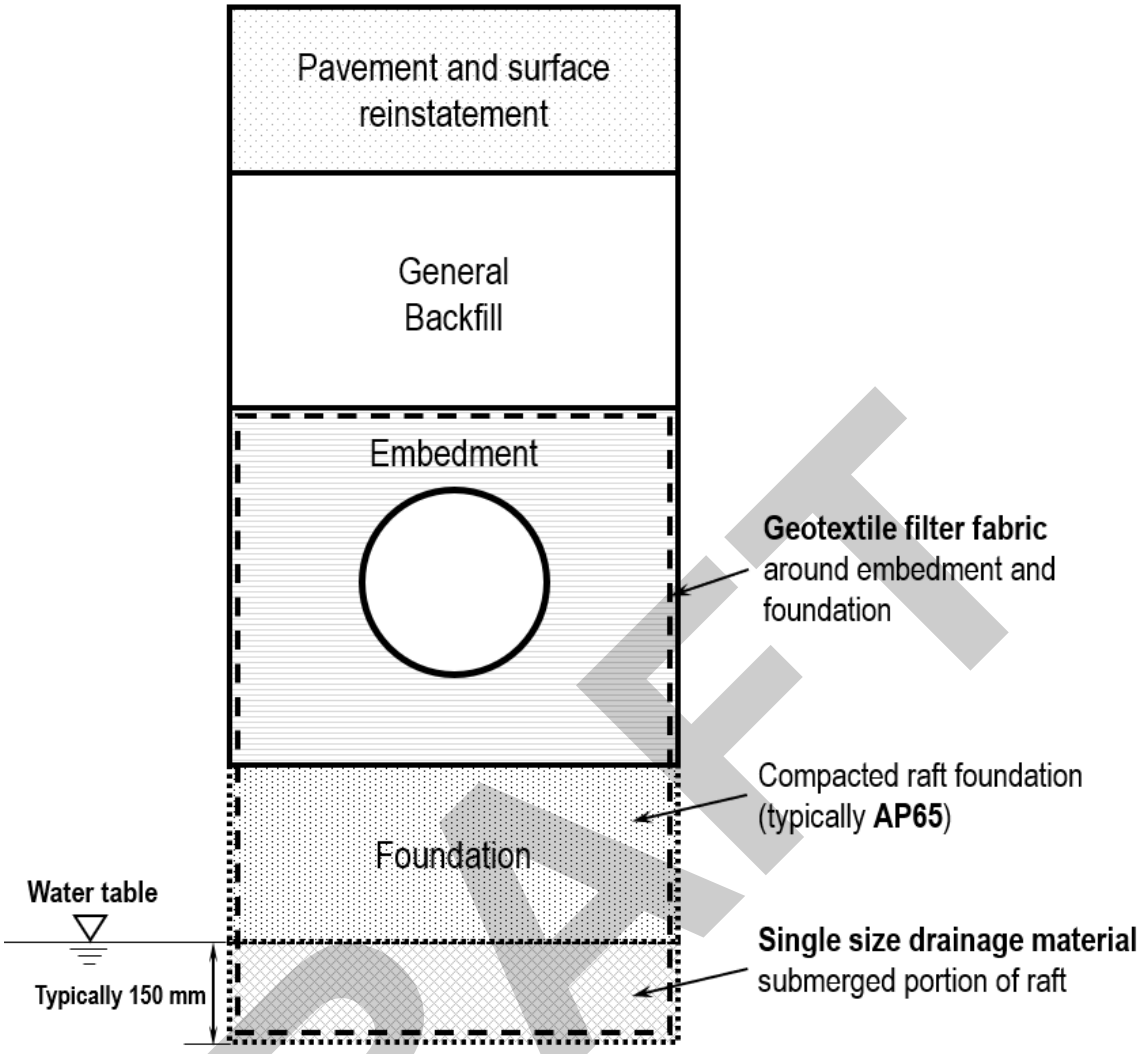


Figure 4-3 – Typical trench arrangement where the site has a high groundwater table

4.7.4 Extremely poor ground

The following applies to loads in poor ground conditions:

(a) If the in situ ground at the trench base is particularly poor (i.e. very soft, puggy clay), then AP65 will not be suitable as the raft construction material, as the compaction effort will press the raft material into the soft pug rather than compact it.

(b) In this instance, the trench must be over excavated and the poor ground removed. Refer to **Figure 4-4** for a typical detail of this arrangement. The additional depth of excavation shall be reinstated as follows:

(i) The raft shall be constructed from well-graded quarry forkings or river run gravel with a large maximum stone size (typically all passing 100 mm sieve, 1% max. passing 0.5 mm) or equivalent material, as agreed with Wellington Water.

1. This material is used as it can be compacted to form a bridging arrangement (raft) over poor ground.
2. Due to the larger particle size components, quarry forkings and river run material requires significantly more compactive effort compared to AP65 or other general graded backfill. This will require heavy duty shoring or trench boxes to be installed with wider trench widths.

(ii) The raft will typically be installed with a depth of 300-400 mm, depending on the maximum stone size.

(iii) A blinding layer of graded material of a depth appropriate to the material is to be placed over the raft and compacted for the purpose of achieving a Clegg reading (e.g. 150 mm for AP65 or 100mm for AP40).

(iv) Due to the low fines content of the quarry forkings and river run material, geotextile filter fabric will be required between the binding layer and the pipe embedment to mitigate against particle migration into the embedment materials.

1. The minimum standard of fabric for this application is Bidim A29 or equivalent.
2. If the contractor would prefer to delete the geotextile filter fabric, this would need to be verified using the procedure outlined in **Appendix 6** of the Regional Standard for Water Services.

(c) Post-construction Clegg Hammer testing is required to demonstrate the quarry forkings or river run material has achieved compaction. The target test reading should be determined using the procedure outlined in **Appendix 5** of the Regional Standard for Water Services.

(i) Clegg Hammer testing is to be undertaken only where a blinding layer has been installed on top of the quarry forkings or river run material. Avoid taking readings directly on a stone or boulder.

(ii) The contractor shall obtain approval from Wellington Water that the post-construction testing is being undertaken at appropriate locations; multiple readings will generally give a reliable result with outliers discarded.

(iii) Clegg Hammer readings are only representative for the most recent compacted layer.

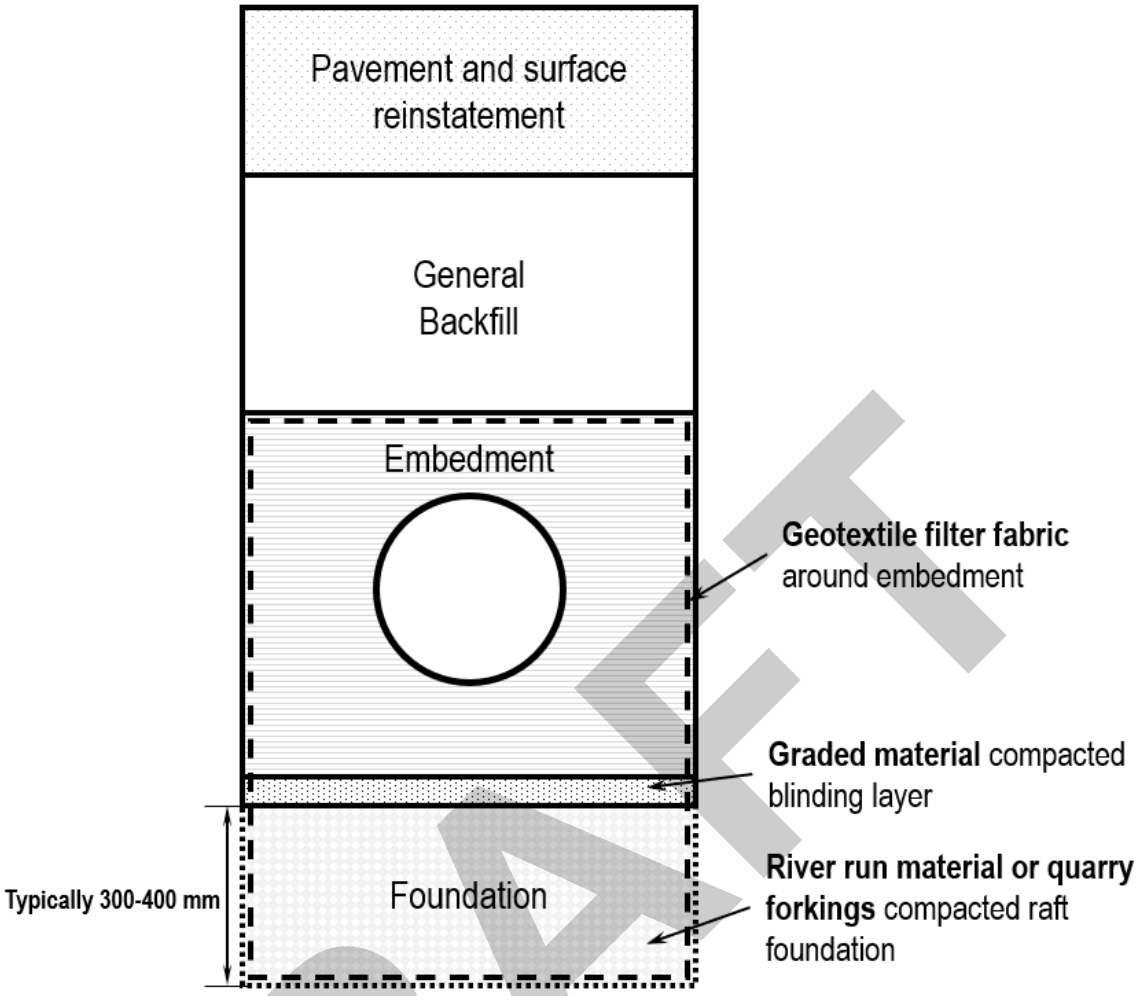


Figure 4-4 – Typical trench arrangement where the in situ ground is extremely poor

4.7.5 Post-construction testing

The following applies to testing of the pipe foundation:

(a) Compaction testing (typically Scala for basecourse materials or Clegg Hammer for quarry forkings or river run with large stones) should be recorded at regular intervals (typically 10 m) at the foundation level along the full pipeline alignment.

(b) See **Section 4.7.1**(f) **Standard preparation of pipe trench foundation** regarding locations of soft, weak soil.

(c) Compaction testing shall be conducted after compaction of the trench foundation and before preparation for laying and compacting the pipe embedment.

(d) Scala measurements shall be taken to depth of 300 mm below the trench foundation level. No measurement shall be recorded for the top 50 mm.

(e) Wellington Water or their representative shall witness a sufficient number of tests to confirm the necessary compaction is being achieved.

(f) Site compaction test records shall include (this applies for all compaction testing throughout trench depth):

(i) Site name

(ii) Contract number (where applicable)

(iii) Contractor's name (where applicable)

(iv) Location along trench as a chainage from a known point

(v) Test depth and trench level being tested

4.8 Reuse of in situ material

4.8.1 Compaction and testing for pipe embedment

The following applies to the reuse of in situ material for embedment. See **Section 4.9 Pipeline embedment** for general requirements for embedment material.

(a) Typically embedment is imported. There are opportunities to re-use excavated material as pipeline embedment in sand environments only.

(b) Wellington Water must approve the reuse of excavated material for pipe embedment.

(c) The compaction and testing requirements for native sand embedment material are outlined in **Section 4.9.4.3 Graded embedment material testing.**

(d) If the in situ material changes, the material parameters and compaction requirements must be re-evaluated.

4.8.2 Compaction and testing for general backfill

The following applies to the reuse of in situ material for general backfill. See **Section 4.10 General backfill** for general requirements for backfill material.

(a) Where reuse of material is proposed for backfill in a trafficable area, placement and compaction must be in accordance with the NCOPUATTC and NCOPUATTC local conditions.

(b) The level of compaction testing and minimum compaction targets to be achieved in a non-trafficable area will be determined by Wellington Water. The compaction achieved must be at least equal to that recorded in the adjacent in situ ground, tested by a Scala penetrometer.

4.9 Pipeline embedment

4.9.1 Flexible pipe embedment

The following applies to embedment of flexible pipes:

(a) The structural and embedment installation for flexible pipes should be in accordance with AS/NZS 2566.2.

(b) A standard embedment drawing for flexible pipes can be found in **Standard Detail DR03 – Typical Trench and Waterstop Details**.

(c) Flexible pipe materials (e.g. PE, PVC, steel, ductile-iron) deflect to an elliptical shape when put under applied loads, and in doing so, mobilise sufficient lateral earth pressures in the adjacent ground to resist the applied loads and control the cross-sectional deflection.

(d) The embedment zone for flexible pipes can be subdivided into the subzones shown in **Figure 4-5**.

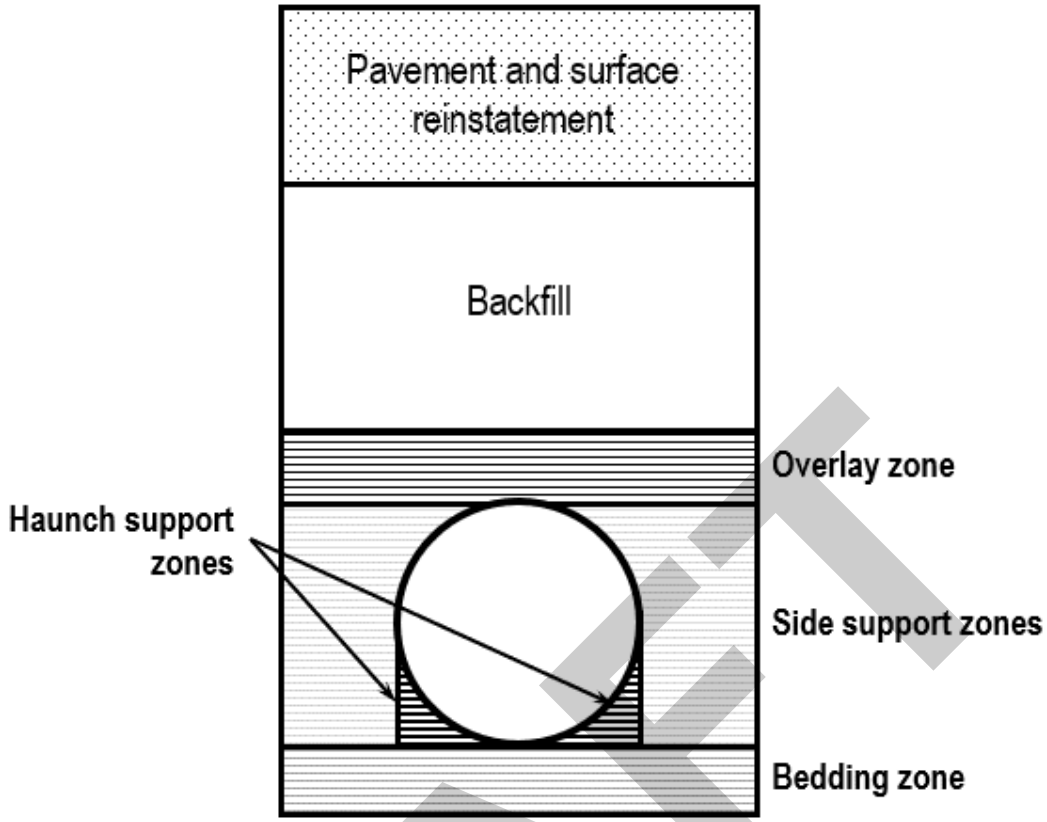


Figure 4-5 – Embedment for flexible pipes

4.9.1.1 Bedding, haunching and side zone material for flexible pipes

The following applies to embedment material for flexible pipes:

(a) Bedding, haunching and surround material for flexible pipes shall be a selected cohesionless material that complies with the grading curves of AS/NZS 2566.2. Typical material compliance with this specification is outlined in **Table 4-2** to **Table 4-6**.

(b) The material for all pipes shall be free of organics and sharp, angular aggregates.

Table 4-2 – Bedding, haunching and surrounds material for flexible pipes

In situ soil environment	Material
In a sand environment	Native Sand Imported sand (**Table 4-3**)
In all other environments	AP20* for > DN 150 AP10* for DN 63 to DN 150 AP5* for < DN 63 20 mm down, well graded gravel (**Table 4-6**)

* Single-size aggregate should be used where strict control of grading is essential. Pea-metal and single graded equivalents are acceptable; examples are given in **Table 4-4** and **Table 4-5**.

Table 4-3 – Imported sand material grading limits

Sieve size (mm)	Weight passing (%)
4.75	100
2.36	90-100
1.18	85-100
0.60	70-100
0.30	50-100
0.15	0-40
0.075	0-5

Source: Table G3 AS/NZS 2566.2

Table 4-4 – 5 to 14 mm drainage chip grading

Sieve size (mm)	Weight passing (%)
13.2	98-100
9.5	24-42
4.75	0-3
0.15	0-2

Source: Drainage General Conditions of Specification, WCC (2006)

Table 4-5 – Asphalt aggregate 8mm down grit typical grading

Sieve size (mm)	Weight passing (%)
6.7	100
4.75	92
2.36	29
1.18	12
0.075	12

Source: Horokiwi Quarries (2015)

Table 4-6 – Grading limits for bedding/surround material (typically used for bulk water pipes)

Sieve size (mm)	Weight passing (%)
6.7	100
4.75	92
2.36	29
1.18	12
0.075	12

Source: Table 6 AS/NZS 3725:2007 and Table G1 AS/NZS 2566.2:2002

4.9.1.2 Pipe surround for flexible pipes

The following applies to the pipe surround for flexible pipes:

(a) The minimum embedment zone dimensions for flexible pipes are given in AS/NZS 2566.2 Table 4.2.

(b) Careful placement and compaction of pipe embedment material to the specified embedment geometry is necessary to ensure the pipe is adequately supported. See **Section 4.9.4 Compaction and post-construction testing** for compaction requirements)

4.9.2 Rigid pipe embedment

The following applies to embedment of rigid pipes:

(a) The structural and embedment design for rigid pipes should be in accordance with AS/NZS 3725.

(b) A standard embedment drawing for rigid pipes can be found in **Standard Detail DR03 – Typical Trench and Waterstop Details**.

(c) Rigid pipe materials (e.g. concrete, vitreous clay) have inherent structural strength with applied loads taken by the pipeline itself. The embedment for rigid pipes is designed to distribute loads evenly around the pipe and provide sufficient support beneath the pipe to resist the total vertical loads and prevent excessive settlement.

(d) Because of this, pipe bedding, haunch and side zones are particularly important for rigid pipelines. These embedment subzones for rigid pipes are shown in **Figure 4-6**.

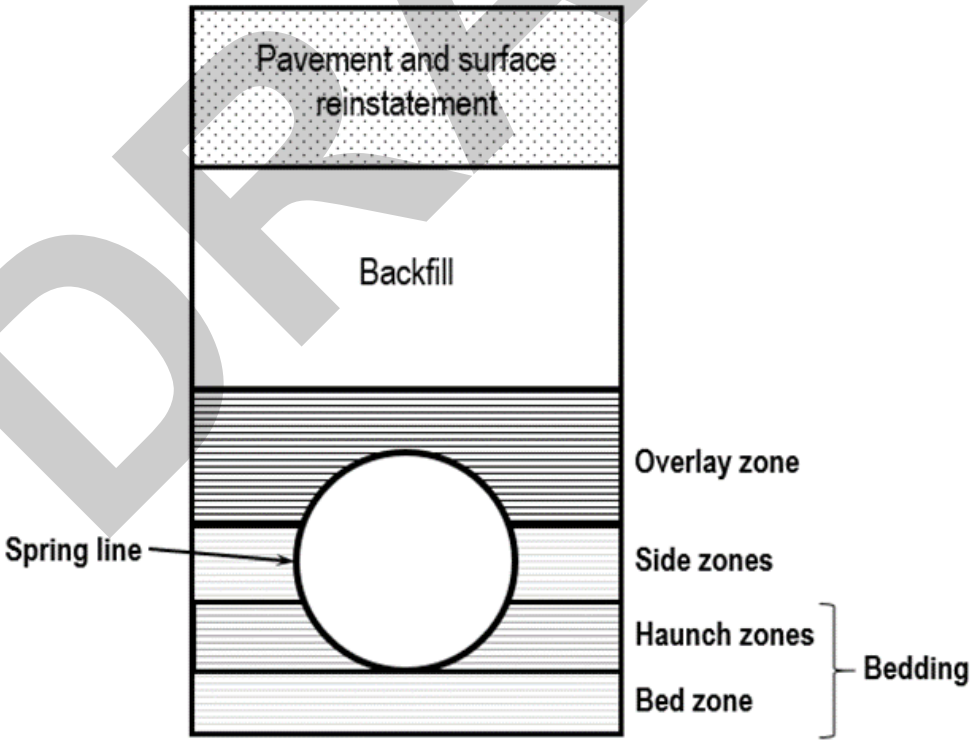


Figure 4-6 – Embedment for rigid pipes

4.9.2.1 Bedding, haunching and side zone material for rigid pipes

The following applies to material for rigid pipes:

(a) The material to be used for bedding, haunching and side zone material shall comply with **Table 4-6**, or **Table 4-7** and **Table 4-8**. Suitability shall be verified using the procedures outlined in AS/NZS 3725.

(b) Acceptable material within the grading limits will result in material that is well graded and free draining. Granular material that complies with this section, but that would break down when wetted, such as shale or conglomerates, are not suitable materials and shall not be used.

(c) The pipe embedment material shall not contain any organic material.

Table 4-7 – Bedding, haunching and side zone material for rigid pipes

In situ soil environment	All rigid pipes	Reinforced concrete pipes greater than 450 mm internal dia. only
In sand:		
• Bedding and haunching	Native Sand	Native Sand
• Side zone	Native Sand	Native Sand
In all other environments:		
• Bedding and haunching	5-20 mm drainage*	5-40 mm drainage*
• Side zone	5-20 mm drainage*	5-40 mm drainage*

* Complying with **Table 4-8**.

Table 4-8 – Drainage bedding, haunching and side zone

Sieve size (mm)	5-20 mm drainage dry mass passing (%)	5-40 mm drainage dry mass passing (%)
53.0	-	100
37.5	-	98-100
26.5	100	-
19.0	98-100	27-45
13.2	-	-
9.5	12-30	5-22
4.75	0-5	0-5
0.15	0-3	0-3

4.9.2.2 Pipe surround for rigid pipes

The following applies to pipe surround for rigid pipes:

(a) The minimum embedment zone dimensions for rigid pipes are given in AS/NZS 3725 Table 5.

(b) A rebate shall be formed in the bedding below any collars such that the pipe is supported on the full length of the barrel as opposed to only the collar.

(i) A minimum of 50 mm of bedding material is required below any pipe collars.

4.9.3 Geotextile filter fabric and migration of fines

The use of geotextile filter fabric around pipeline embedment is the default arrangement in all cases (also note the requirements of **Section 4.7.2 Remedial measures for insufficient bearing capacity).** However, it can be deleted from surrounding the pipeline embedment if:

(a) The bedding and surround material meets the grading limits given in **Table 4-6**.

(b) It can be shown that migration of fines will not occur. The limit of migration of fines can be determined using information provided by the quarry and the method outlined in the **Appendix 6** of the Regional Standard for Water Services.

4.9.4 Compaction and post-construction testing

The following applies to the compaction of pipe embedment:

(a) The bed, haunch, side support and overlay shall be placed in a manner so that:

(i) Uniform distribution and compaction of bedding is achieved, especially under the haunches of the pipeline.

(ii) The pipeline position in the trench is maintained.

(iii) The pipeline level and grade are maintained.

(iv) The pipe and any pipe coatings are not damaged.

4.9.4.1 Graded material placement and compaction

The following applies to graded material placement and compaction:

(a) The contractor shall ensure that bedding along the trench edges is well compacted.

(b) The material shall be compacted in layers.

(c) Heavy machine compaction may be used to compact bedding below the pipeline.

(d) Light machine compaction, achieved only by hand operated machinery, shall be used to compact bedding in the overlay or around the haunches and the spring-line of the pipe.

(i) Except that heavier machine compaction may be used when compacting bedding that is more than 150 mm clear of the spring-line of the pipe, as shown in **Figure 4-7**.

(e) The contractor is to ensure the compaction effort (and plant) applied will not cause damage to the pipe.

(g) → No construction equipment or plant to be used directly over the pipe until it is adequately covered.

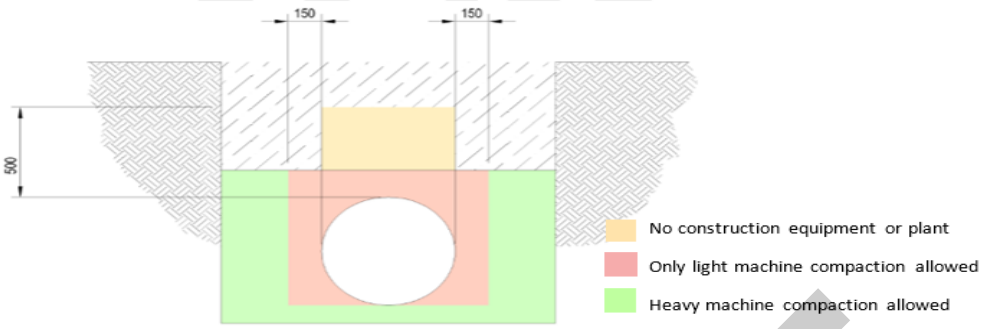


Figure 7 – Areas where heavy machine compaction shall not be used (red area)

Figure 4-7 – Restrictions on use of heavy machine compaction

4.9.4.2 Single size gravel placement and compaction

The following applies to post-construction testing for single size gravel, which is drainage metal, processed aggregate or similar product. Grading limits for these materials are shown **Table 4-3** to **Table 4-5**:

(a) This material is often referred to as 'self-compacting' fill. This is a misleading phrase and implies that no additional compaction is required at installation stage. In fact, the material must be installed in discrete layers (of approximately 150 mm) and hand-tamped to ensure it is worked into all voids present below and around the pipeline, particularly in the haunch zones.

(b) Proper placement is critical for a single size embedment.

(c) No suitable field test for compaction is available.

(d) The following is critical for quality assurance:

(i) Correct placement and workmanship as per the specification.

(ii) Monitored by the Contractor's supervising engineer, recorded on daily inspection sheets and in site photographs showing correct methodology has been used for each pipe.

(iii) Adequate material crushing strength to resist applied loads, durability (wetting and drying) and other material requirements as specified in the relevant design codes (such as AS/NZS 2566.2 or AS/NZS 3725).

(iv) Quarry to provide the supporting evidence for (iii).

4.9.4.3 Graded embedment material testing

The following applies to post-construction testing for graded embedment materials (**Table 4-6**), which are graded gravels, sands, and other material:

(a) Graded embedment shall be compacted to achieve the mechanical properties required under AS/NZS 3725 and AS/NZS 2566.

(b) An acceptable compaction is to achieve a minimum of 4 blows per 50 mm with a Scala penetrometer.

(c) Where this cannot be achieved, a suitable test for compaction is to achieve at least 95% MDD of a lab based modified Proctor test (the percentage of MDD achieved on-site may exceed 100% MDD).

(i) The field test readings need to be calibrated to the MDD for the proposed embedment material prior to installation for in situ soils, and discuss with the supplier for imported fill.

(ii) To reduce the cost of field testing, it is acceptable to use a Scala penetrometer calibrated to the required percentage of MDD.

(d) Compaction testing should be executed and recorded at 10 m intervals for the full embedment depth, along the full pipeline alignment. Wellington Water may approve an increased interval length if representative tests at greater intervals are providing consistent results.

(e) It is preferable that compaction testing be completed for the full embedment depth.

(f) Where there are concerns about striking the pipe during testing, it will be acceptable to test to the top of the embedment provided that:

(i) The embedment material is the same as the general backfill material (e.g., native sand in sand environments)

(ii) The Developer has demonstrated a satisfactory technique for installation of embedment material as observed by Wellington Water on site during construction monitoring.

(iii) The Developer can demonstrate adequate compaction throughout the backfill for the full pipeline alignment at intervals as per **Section 4.9.4.3**(d) **Graded embedment material testing**.

(iv) The Developer accepts the additional risk associated with not testing the embedment compaction.

(g) Wellington Water or their representative shall witness in person a sufficient number of tests to be satisfied that the necessary compaction has been achieved.

4.9.5 Concrete bedding

4.9.5.1 Application

The following applies to the application of concrete bedding (cradle):

(a) Concrete bedding shall not be used for flexible pipeline materials.

(b) Concrete bedding is not typically specified for concrete pipe embedment under AS/NZS 3725; however, it may be necessary where a particularly high bedding factor is required.

(c) Graded material is preferable for all rigid pipe applications (see **Section 4.9.2 Rigid pipe embedment**); special allowance should be sought from Wellington Water prior to specifying concrete bedding.

(d) Pipe bedding performs a different function to the pipe trench foundation and is not interchangeable.

4.9.5.2 Requirements

The following applies to concrete bedding requirements:

(a) Effective performance of concrete bedding is reliant on a sound trench foundation. This can be achieved through the methodology outlined in **Section 4.7 Trench foundation** or by using a blinding layer of weak concrete at the trench foundation level.

(b) Concrete bedding shall extend at least 150 mm either side of the pipe and shall have a thickness no less than 100 mm or 0.25 x pipe OD (whichever is greater).

(c) Pipes with collars shall be supported at their collar by a 20 mm thick H4 treated softwood block and the lower 90-degree arc of the barrel hand packed with concrete.

(d) Flush jointed pipes shall be supported at the joint by a 50 mm thick H4 treated softwood block and the lower 90-degree arc of the pipe barrel hand packed with concrete to ensure joints remain aligned during laying and backfilling.

(e) The surface of any concrete already hardened shall be chipped, washed and brushed clean, and shall have a layer of cement grout brushed before new concrete is placed on it.

(f) In wet trenches, the concrete bed shall be supported on each side by firmly fixed timber shutters, and a drainage channel shall be formed outside these. Water shall be kept below the bottom of the bedding by pumping from sumps or by other approved means.

(g) No concrete shall be placed into running water. Concrete may be placed to displace still water if permitted in writing from Wellington Water.

(h) Concrete used for pipe bedding shall have a minimum compressive strength of 20 MPa after 28 days.

(i) All concrete shall be allowed to set for at least 24 hours before any loads from pipelaying, backfilling, etc are applied.

4.9.6 Concrete surround

4.9.6.1 Application

The following applies to the application of concrete surround:

(a) Concrete surround is not typically required (or permitted) for flexible pipe materials. Project-specific approval should be sought from Wellington Water prior to specification.

(b) Concrete surrounding of concrete and earthenware drains will not normally be permitted.

4.9.6.2 Requirements

The following applies to concrete surround requirements:

(a) Where concrete surrounding is specified, then, except where the pipe is under a building, there shall be a physical break in the surround at each pipe joint to maintain pipe flexibility. This shall be created by the insertion of a plywood spacer

(typically 18 mm thick) shaped to the pipe barrel and placed on the pipe barrel immediately adjacent to the collar of the connecting pipe.

(b) Pipes laid on a concrete cradle or concrete surrounded shall be supported at the collar on H4 treated softwood blocks (for flush jointed concrete pipes, the blocks shall be placed at the joint).

(c) Concrete used for pipe cradles and surrounds shall have a minimum compressive strength of 20 MPa after 28 days.

(d) Where concrete surrounding is specific for flexible pipeline materials, the pipe shall be wrapped in a soft, compressible material to provide a transition to the rigid concrete surround.

(e) For plastic pipe materials operating under pressure, steel reinforcement will be required in the concrete surround to carry the forces transferred from the pipeline.

4.10 General backfill

4.10.1 General

The following general guidelines apply to backfilling of an excavation above the embedment:

(a) No backfilling shall be carried out until the laying and jointing of the lines have been approved in writing by Wellington Water or their representative.

(b) Large vibrating rollers shall not be used within 500 mm of the top of pipes.

(c) At all times during backfilling, the contractor must ensure that the pipe coating and protective wrapping are not damaged in any way.

4.10.2 Backfill material

4.10.2.1 Road reserve and private drives

The following applies to backfilling road reserves and private drives (including trafficable paved areas):

(a) Any trench shall be backfilled in accordance with NCOPUATTC and NCOPUATTC local conditions.

4.10.2.2 Private property

Where backfilling is in private property (excluding private drives and paved areas), and unless otherwise specified in the approved drawings, general backfill material (see **Table 4-9**) shall be:

(a) Dry and free of rocks and organic and deleterious material.

(b) Placed uniformly and compacted to the specified relative compaction for the material.

(c) For non-cohesive material, compacted as outlined in **Section 4.10.3 Compaction and post-construction testing**.

(d) Where the finished trench surface settles below the level of the adjacent ground, the level shall be raised with additional material consistent with that used in the initial reinstatement, and surface made good.

Table 4-9 – Backfill material for private properties

In situ soil environment	Backfill material
Sand	Sand
Other – non-trafficked	GAP 40 or GAP 65 or suitable excavated material

4.10.3 Compaction and post-construction testing

The following applies to backfill placed above the embedment material (for buried flexible pipelines) or above the surround (for buried rigid pipelines):

(a) Placement and compaction shall be as per the NCOPUATTC and NCOPUATTC local conditions.

(b) A consistent level of compaction shall be achieved across each layer of backfill.

(c) Compaction measurements shall not be taken in the outside edge of the trench but taken in the middle 50% of the trench width.

(d) Compaction shall be measured by Scala penetrometer.

(e) A Clegg Hammer may be used as a cursory test, but Scala results are required as evidence of suitable compaction. The conversion of number of blows per 50 mm penetration to Clegg Hammer results is given in **Table 4-10**.

(f) Wellington Water or their representative shall witness in person a sufficient number of tests to be satisfied that the necessary compaction has been achieved, but not closer than 200 mm above the pipe.

(g) Ideally, to avoid the formation of voids, trench shoring should be raised above the layer that is about to be compacted before compaction is undertaken. However, it is acceptable to lift trench plates and sheet piles after compaction provided all voids have been filled on both sides of the plates and sheet piles.

Table 4-10 – Conversion between Scala penetrometer blows and Clegg Hammer results

Blows per 50 mm penetration	Indicative Clegg Hammer
7	CIV 35
4	CIV 25
3	CIV 15
2	CIV 10

4.11 Reinstatement

4.11.1 Pavement and surface reinstatement

The pavement layers and resurfacing of the trench shall, as a minimum, comply with the NCOPUATTC and NCOPUATTC local conditions or the appropriate subdivision code of practice. All compaction and post-construction testing for pavement layers shall also be in accordance with **Section 4.10.3 Compaction and post-construction testing**. The same standards required for trafficable and non-trafficable in the road reserve shall apply to private property also, unless otherwise agreed in writing with the property owner.

From May to August inclusive, grassed areas shall be reinstated with imported turf or by reinstating the existing excavated turf or as required by subdivision consent conditions.

~~4.9.1~~4.11.2 Marking of hydrants, valves, service valves and pavement

Any street markings disturbed by construction works shall be remarked as per the NCOPUATTC and the relevant council's Code of Practice.

~~4.9.1.1~~4.11.2.1 Hydrants

Marking of hydrants shall (see also **Section 6.2.11.4 Hydrant valves**):

(a) Comply with SNZ PAS 4509.

(b) Be carried out within 24 hours of the pipeline being commissioned.

(c) Include the hydrant box lid and any concrete surround, the triangle near the carriageway centreline pointing at the hydrant and a circle if required.

(d) Include reflective blue pavement markers to be installed on the centreline as per the standard.

~~4.9.1.2~~4.11.2.2 Gate (sluice) ~~Sluice~~ valves

The following applies to marking of gate ~~sluice~~ valves:

(a) Normally shut valves and fire service valves shall be marked with a non-slip reflective paint that complies with NZTA M/07 excepting colour.

(b) "Normally Shut" valves shall be painted red.

(c) "Fire Service" valves shall be painted green.

(d) Scour valves shall be painted blue.

(e) Gate ~~Sluice~~ valves shall be painted within 24 hours of commissioning of the pipeline.

~~4.9.1.3~~4.11.2.3 Service valves

The following applies to the marking of service valves (see also **Section 6.2.11.5 Service valves**):

(a) Marking of the location of services valves shall be carried out within 2 weeks of commissioning of the pipeline or prior to vesting of the asset.

(b) Service valve locations shall be marked on the point of the adjacent kerb closest to the valve.

(c) They shall be identified by a "V" cut into the top of the kerb with the point of the "V" pointing towards the valve location.

(d) The "V" shall be a minimum of 100 mm long and be cut a minimum of 5 mm deep into the kerb.

~~4.9.1.4~~4.11.2.4 Obsolete markings, service covers and blocks

Obsolete markings, service covers and blocks shall be removed within 24 hours of the pipeline being taken out of service.

4.12 Building in close proximity to ~~over or near~~ public pipelines

The following applies to building in close proximity to ~~works over or near~~ public pipelines as defined in **Section 2.2.2 Definitions**~~, and laying new or upgraded pipelines near existing structures and retaining walls~~. This section should be read in conjunction with **Standard Detail DR09 – Building in Close Proximity ~~over and near pipe~~** and the design standards in the Regional Standard for Water Services.

(a) All load bearing foundations and piles should terminate below the building line restriction (BLR) and not within any prohibited zones for the type of foundations or piles (refer to **Standard Detail DR09 – Building in Close Proximity~~over and near pipe~~**).

(b) All new or upgraded pipelines should be laid so that none of the existing foundations terminate above the BLR or within an applicable prohibited zone (refer to **Standard Detail DR09 – Building in Close Proximity~~over and near pipe~~**).

(c) Where a pipeline is relocated around building works, a cut-off wall shall be constructed in the old trench to prevent ground water flow through the trench beneath the building works. A collection and diversion system may also be required at the discretion of Wellington Water if the ground water flow is significant.

(d) Where building ~~works over~~in close proximity to an existing public pipeline cannot be avoided, then the existing pipe should be ~~re-laid along the same alignment~~ replaced with a new pipe and "sleeved" at the developer's expense (see **Section 4.12.1 Sleeving an existing pipe**)

(i) Sleeving is required primarily to preserve access for maintenance and ~~protection~~future renewal of the ~~sleeved~~ pipe.~~, including allowing for potential increased load bearing capacity.~~

(ii) The sleeve ~~should be sized considering the maximum possible required future capacity but~~ is not intended to function as a future standalone pipe.

(iii) The sleeve or "host pipe" must comply with **Section 4.12.1 Sleeving an existing pipe**.

(e) As sleeving is not always practicable for large pipes, building directly over a larger pipe (≥600 mm) without sleeving may be considered if:

(i) The BLR requirements are still met (i.e., piles and building inner-edge points are below the BLR).

(ii) It is demonstrated that there are no increased loads on the existing pipeline from the proposed building works, including no disturbance to the pipeline from piling or other construction activities.

(iii) The building works are fully self-supporting and an excavation could be made to maintain or replace the pipe without undermining the foundations of any building works.

~~(i)~~(iv) The applicant provides Wellington Water with a PS2 producer statement from a Chartered (Structural) Engineer stating that the structure has been designed to meet the above conditions.

4.12.1 Sleeving an existing pipe

Sleeving consists of ~~relaying~~replacing an existing pipe with a new pipe that is housed within a new host pipe or "sleeve" that is laid at the same time.

The following applies to sleeving of pipes:

(a) The replaced pipe to be sleeved ~~pipe~~ shall be:

(i) Sized to accommodate the expected future capacity for the upstream catchment, regardless of the size of the existing pipe.

(ii) Able to be removed and replaced without excavation of the host pipe (notwithstanding launch/receiving pits).

(iii) Held concentrically centrally within the host pipe using polyethylene (PE) spacers, or similar purpose-designed spacers, with a minimum durability of the sleeved pipe.

(iv) Not connected to any laterals or junctions.

(v) Constructed from PE or other approved materials.

(b) The sleeve must be laid in accordance with the following requirements (see **Figure 4-8** for a diagram):

(i) The sleeve shall be laid with sufficient working space, within the same lot, or within adjacent public land with prior written approval from the landowner, to allow for maintenance and removal of the pipe as follows:

1. The launching end of the sleeve shall have a minimum length of clear working space adjacent to the building along the pipe alignment compliant with the requirements in **Table 4-11.**

Table 4-11 – Minimum clear space requirements for launch end of sleeve

~~Pipe Depth~~Depth to sleeve invert	Minimum length of clear space
1.0 – 2.0m	4.0m
2.0 – 3.0m	6.0m
3.0 – 4.0m	8.0m

2. The receiving end of the sleeve shall have a minimum 2 m length of clear working space adjacent to the building along the pipe alignment.

3. The width of the clear working space shall comply with the easements widths detailed in the relevant section(s) of the Regional Standard for Water Services.

(ii) The sleeve should extend a minimum of 1.0 m and not less than half the sleeve invert depth outside of the building foundation. Greater clearances may be required at the discretion of Wellington Water.

(iii) The top of the sleeve must be a minimum of 600 mm depth below the underside of any slab / floor beams.

(iv) If sleeving is a condition of resource consent, an easement will be required to protect access to the working space.

(c) ~~A host pipe is required as a mitigation against increased load and/or to preserve access for maintenance and future renewal.~~ The host pipe shall be:

(i) Designed and constructed ~~as a drainage pipe that can~~to accommodate the proposed loading.

(ii) Sealed against ingress of groundwater at both ends.

(iii) Large enough to accommodate the ~~existing~~ replaced pipe ~~replacement~~, including any collars or joints on the pipe (such as electrofusion (EF) couplers).

~~Sized such that it may admit a pipe large enough to accommodate the expected future capacity for the upstream catchment, regardless of the size of the existing pipe.~~

(iv) Constructed from approved materials compliant with this specification.

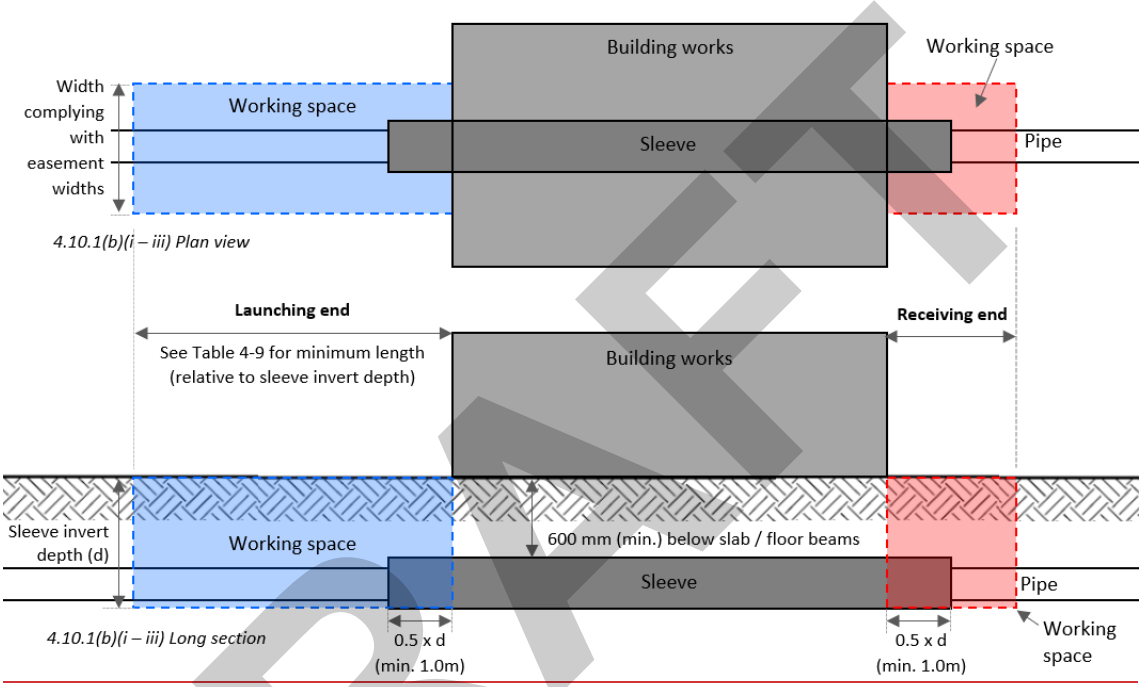


Figure 4-8 – Clearance and working space requirements for sleeved pipes

~~4.10~~4.13 As-builts

As a minimum, as-builts shall comply with the Regional As-built Specification and Regional Draughting Manual which are ~~is~~ separate to this document. As-builts shall also comply with any requirements individual councils may impose as part of any subdivision application.

~~4.11~~4.14 Slip-lining

Slip-lining is where a new pipeline is inserted inside an existing pipeline. The following applies to the slip-lining of pipes:

~~(a) Pipes that may be slip-lined are cast iron pressure pipe, PVC pressure pipe, concrete lined steel (STCL) pressure pipe, reinforced concrete pipe and PE pipe.~~

(a) ~~Pipes that shall NOT be slip-lined are AC water mains and AC rising sewers. AC pipelines shall not be slip-lined~~ Slip-lining AC pipes should be considered only if there is no other practicable alternative because the AC pipe surrounding the new pipeline constitutes a hazard that places those working on the new pipeline at risk (see **Section 4.4.1 Design for replacement of asbestos cement pipes**).

(b) Although it is possible to install rubber ring jointed pipe such as PVC by slip-lining, unrestrained pipe shall not be used for slip-lining. Restraint joint PVC, restraint

jointed ductile iron (DI) pipe, butt fusion welded PE pipe (that is externally de-beaded where needed) or butt-welded steel pipe may be used to slip-line deleted pipelines.

(c) ~~Gravity pipelines shall not be slip-lined because it will result in an unacceptable reduction on ID and grade may not be maintained.~~For gravity pipelines, slip-lining shall be assessed on a case-by-case basis and approval of slip-lining as the preferred methodology must be obtained from Wellington Water in the design phase. Assessments shall include:

(i) An options analysis (i.e., comparing risks and benefits of slip-lining to other methods such as open trench pipe replacement)

(ii) Comment on the effect on grade and

(iii) Calculations proving the network will continue to meet hydraulic design requirements.

~~(c)~~(d) The new pipeline must be smaller than the existing pipeline resulting in an annular gap between the new pipe and the host pipe. The annular gap may, or may not, be filled by flowable grout or a similar material.

~~(d) Slip lining is considered to provide a new pipeline that is seismically resilient (see **Section 4.16.1 Butt fusion welding**).~~

~~4.11.1~~4.14.1 Slip lining installation

The following applies to the installation of pipes by slip lining:

(a) The host pipe shall be cut back a distance “d” either side of any connections to the inserted pipe, where “d” is 1.5 times the expected differential movement between the host pipe and the inserted pipe during a seismic event. This is required to prevent the connection to the inserted pipe being broken by impact with the host pipe.

(b) A proposed methodology shall be submitted to Wellington Water or their representative and shall include the location of launching and receiving pits, slip-lining methodology, maximum allowable pulling force as recommended by the pipe manufacturer and equipment to be used.

(c) Launching and receiving pits shall be excavated based on the proposed methodology. The location of the pits shall take into account traffic, hazards and the impact on the operation of the piped infrastructure.

(d) A section of the existing host pipe shall be removed to enable slip-lining activities. Any pipe cuts, especially on the pipe which will remain in service, shall be neat and square and made such that splitting or stressing of the existing pipe is avoided.

(e) The existing pipeline shall be cleared of any obstructions that will prevent the insertion of the liner. If inspection reveals an obstruction that is not at the location of the entry shaft and cannot be removed by cleaning and descaling, the pipe shall be exposed by excavation and the obstruction removed. Such excavation shall be approved in writing by Wellington Water prior to the commencement of the work.

(f) The cleaned pipe shall be proofed to ensure no further obstructions exist. The proover shall be:

(i) Equivalent in diameter to the pipe to be pulled plus proposed skids and

(ii) Pulled in the same direction that the proposed slip-lining will be carried out.

(g) PE100 pipe joints shall be ~~fusion~~ butt fusion welded (see **Section 5.4.5.1 Butt fusion jointing**).

(h) Polythene coated 4 mm^2 copper tracer wire as per **Section 6.3.8 Warning tape / tracer wire**, shall be inserted along with the slip-lined pipe.

(i) The ~~PE100~~ pipe shall be inserted into the existing main with a power winch and a steel cable connected to the end of the pipe by the use of an appropriate pulling head. The load on the pulling cable shall be monitored at all times to ensure the pipe's allowable pulling force is not exceeded. The inserted pipe shall:

(i) Be guided into the host pipe using rollers and

(ii) Not be bent beyond the allowable bending radius (see **Section 5.2.1 Drains laid on a curve**).

(j) During insertion of PE100 pipe, precautions should be taken to protect the new pipe to prevent any ragged edges of the existing main from scoring the outside of the new pipe as it is being pulled into the existing main.

(i) Pipe scored greater than 10% of the pipes wall thickness shall not be permitted to be used or accepted for installation.

(ii) This may be achieved using skids firmly attached to the pipe.

(iii) Once the insertion is initiated, the pipe shall be continued to be pulled at a steady and uninterrupted rate to completion.

(k) The inserted PE100 pipe shall be pulled a minimum of 1 m beyond the end of the host pipe and allowed to relax after pulling for a minimum time of 24 hours before the annular gap is sealed. This is to allow for the pipe to shrink after relaxing. The time may be reduced for shorter pipe lengths at the discretion of Wellington Water ~~or their representative~~.

~~4.12~~4.15 Pipe-bursting

Pipe bursting, or pipe cracking, is the term used to describe a renewal method where a tapered cone is forced through the bore of the pipe which is to be renewed. The forcing cone, which is larger than ~~the ID of~~ the pipe being renewed, shatters and displaces the existing pipe. A new pipeline is then drawn-in behind the forcing cone.

The following applies to pipe-bursting:

(a) Pipes that shall NOT be pipe-burst are AC pipe~~, gravity pipe affected by dips~~ and gravity pipe that is concrete haunched.

~~(b) Pipes that may be pipe-burst are cast iron (CI) pipe, PVC pipe, STCL pipe, reinforced concrete pipe and PE pipe.~~

(b) Dips in gravity pipe need to be rectified or assessed to Wellington Water's approval prior to pipe bursting.

(c) Pipe ~~cracking~~ bursting is typically used to renew a pipe with a new pipe of equivalent diameter. It is possible to renew the pipe with a larger pipe.

(d) The suitability of pipe bursting ~~cracking~~ to renew any pipe is restricted by the depth of cover to the existing pipe and the ~~amount of~~potential for ground-heave ~~experienced at the ground surface~~ and the proximity of other services.

(i) Typically, where the difference in OD of the existing pipe and the OD of the forcing cone is greater than ~~10~~ 0.1 times the depth of cover, pipe bursting would not be suitable.

~~(e) Pipe bursting cracking is considered to result in a seismically resilient pipe.~~

~~(f)~~(e) Pipe bursting ~~cracking~~ shall not be used to renew AC pipelines because it leaves shattered asbestos fragments in the ground, which constitutes a hazard that places those working on the new pipeline at risk.

~~(g)~~(f) Pipe bursting ~~cracking~~ is achieved by:

(i) A ~~pneumatic~~ dynamic (typically pneumatic or hydraulic) impact tool, which forces the cone through the existing pipe. ~~Pneumatic~~ Dynamic bursting ~~cracking~~ is not suitable for pulling-in new PVC pipelines.

(ii) A static ~~hydraulic ram~~ pulling of the forcing cone through the existing pipe. Static ~~hydraulic~~ bursting ~~cracking~~ is suitable for pulling-in PE and threaded PVC pipes.

~~(h)~~(g) The existing pipeline shall be cleared of obstructions that will prevent the progress of the pipe bursting equipment.

~~(i)~~(h) If inspection reveals an obstruction that is not at the location of the entry shaft and cannot be removed by cleaning and descaling, the pipe shall be exposed by excavation and the obstruction repaired or removed. Such excavation shall be approved in writing by Wellington Water prior to the commencement of the work.

~~(j)~~(i) Where it is apparent from inspection that a repair has been made that has used ductile iron or steel couplings, the repair shall be excavated and the repair coupling removed.

~~(k)~~(j) PE pipe shall be butt fusion welded ~~and externally de-beaded~~.

~~4.12.1~~4.15.1 Pipe bursting of pressure pipelines

The following additional points apply to the pipe bursting of pressure pipelines:

(a) Because PVC approved pressure pipes are rubber ring jointed, pipe bursting ~~cracking~~ is not suitable for installing new PVC pressure mains.

(b) If the new PE pipe is scored to a depth exceeding 10% of the pipe wall thickness, the pipe shall be cut off to where the depth of scoring is less than 10% and a new section of pipe drawn-in.

(c) If the new PE pipe is scored to a depth exceeding 0.2 mm (or the minimum depth of peel), it shall not be welded using electrofusion couplers. A short length of new pipe may be butt fusion welded to the scored pipe, which can then be electrofusion welded together.

~~4.12.2~~4.15.2 Pipe bursting of gravity pipelines

The following additional points apply to the pipe bursting of gravity pipelines:

~~(a) Pipe bursting is not suitable to renew gravity pipelines that are affected by dips.~~

~~(b)~~(a) Where the existing pipe to be renewed is a gravity sewer and the grade less than 1%, it shall not be renewed using PE pipe. In such cases it shall be renewed using threaded PVC pipe.

~~(c)~~(b) A ~~hydraulic~~ pipe bursting machine shall be used that is suitable for the conditions anticipated with the existing pipeline.

~~4.12.3~~4.15.3 Underground services near pipe bursting

Underground services shall be marked out prior to any pipe bursting, and the following approaches followed:

(a) Where pipe bursting is employed, a minimum clearance of 750 mm to other services (between barrels) is required where the proposed pipe is the same nominal internal diameter as the existing pipe.

(b) If a pipe with a larger internal diameter is to be pulled through the existing pipe, the minimum clearance to other services (between barrels) shall be 1000 mm.

(c) If the pipe crosses another utility, the junction shall be excavated prior to bursting such that earth pressures on the adjacent utility are not increased when the pipe is pulled past the junction.

~~4.12.4~~4.15.4 Pipe bursting installation

The following applies to the installation of pipes by pipe bursting:

(a) The manufacturer of the pipe shall be consulted as to the safe pulling force to be used on the proposed pipe.

(b) Monitoring of the pulling force shall be maintained during installation.

(c) The safe pulling force shall not be exceeded at any time.

(d) A copy of the manufacturer's recommendations and the installation methodology shall be presented to Wellington Water or their representative prior to installation.

(e) Where the pulling force is exceeded, the installer may be required to replace the pipe at their expense.

(f) Prior to installation, the existing pipe shall be inspected and all bends, tees, fittings and steel and ductile iron couplings shall be removed.

~~(g) Concrete encased pipe shall not be replaced by pipe-bursting.~~

~~(h)~~(g) Tracer wire, as per **Section 6.3.8 Warning tape / tracer wire**, shall be used with all pipe bursting activity.

~~4.12.5~~4.15.5 Pipeline recovery

Pipes installed by pipe bursting shall be:

(a) Pulled a minimum of 1 m beyond the end of the host pipe.

(b) Given suitable time to recover from thermal expansion and stretching before connecting to a rigid connection.

(c) Given a minimum period of 24 hours before connecting the pipeline to any valves, manholes, bends or other rigid connection.

~~4.13~~4.16 Impact moling

The following applies to installation by impact moling:

~~(a) Pipes DN 50 and smaller~~or less ~~may be installed by impact moling (i.e., Grundomat). An impact mole with radio sonde fitted in the front end is preferred.~~

(a) All the underground services shall be marked with depths prior to any impact moling operation. It is recommended that adequate target points are excavated to monitor this operation.

(b) Due to the inaccurate nature of impact moling, a clearance of 1000 mm is required between the proposed alignment and other parallel services.

(c) Tracer wire as per **Section 6.3.8 Warning tape / tracer** wire shall be used with all impact moling activity.

(d) Where an impact mole bore is forced off-line or prevented from advancing along the proposed alignment, the bore shall be stopped. The impact mole shall be excavated and exposed, the alignment corrected and the unit re-launched.

(e) To avoid the pipeline being contaminated with lubricating oil, either a front vented impact mole shall be used, or alternatively, a liner film within the pipe shall be installed. On completion of the bore the liner shall be removed, leaving a clean inner surface.

(f) Adequate time shall be allowed for the installed pipe to relax prior to any connections or fittings being made.

~~4.14~~4.17 Directional drilling

The following applies to directional drilling:

(a) The objective is the installation of polyethylene pipelines on a proposed alignment by:

(i) Creating a clean hole through which the new pipe is drawn-in.

(ii) Creating a fluidised column of soil and mud through which the new pipe can be drawn-in and displace the fluidised ground.

(b) When complete, the polyethylene pipe should extend between the launch pit and drill pit, or new manholes in continuous, watertight lengths.

~~4.14.1~~4.17.1 Underground services near directional drilling

The following applies to underground services near directional drilling:

(a) All underground services shall be located prior to the drilling operation.

(b) The drilling operator shall be liable for damages to any underground services despite any approval given by the Wellington Water or their representative.

(c) The proposed alignment of the pipe shall have a clearance of 1000 m from other parallel services, buildings or ground surface.

(d) A tolerance of ±100 mm will be permitted between the proposed and as-built alignment.

~~4.14.2~~4.17.2 Directional drilling pipe installation

The following applies to directional drilling pipe installation:

(a) Directional drilling is suitable for installing:

(i) New sewer pipes at grade

(ii) Pressure pipelines and

(iii) ~~Small S~~stormwater pipelines typically less than 450 mm, although larger sizes are possible with appropriate rig and space for establishment.

(b) Voids greater than 50 mm around the proposed alignment shall be backfilled and sealed with bentonite grout (or similar approved material).

(c) No drilling fluid or waste material shall be discharged into the sewer or stormwater system. All waste material shall be disposed to an approved site. Spillage of any drilling fluid shall be cleaned immediately.

(d) It should be ensured that the pipes are not subjected to pulling loads in excess of the pipe manufacturer's recommended tensile loads. Pipes shall not be subjected to excessive bending stresses during pullback operations.

(e) All precautions shall be made to ensure that the end of the pipe to be passed through the bore is sealed to prevent the ingress of earth or other foreign matter.

(f) Tracer wire as per **Section 6.3.8 Warning tape / tracer wire**, shall be drawn through the bore with the pipe.

(g) The pipe shall be pulled a minimum of 1 m beyond the end of the host pipe and provided suitable time to recover from and stretching before connecting to a rigid connection.

(h) A minimum period of 24 hours shall pass before connecting the pipeline to any valves, manholes, bends or other rigid connection.

(i) Sewer pipelines at grades of 1% or flatter shall not be installed using directional drilling.

(j) Frac-outs are the loss of drilling mud to the environment either through ground surface, into streams or other structures:

  (i) To ensure frac-outs do not occur, the length of the drill-shot, ground conditions and mud pressures shall be considered.

  (ii) Before drilling commences, the contractor shall provide for approval a procedure for the containment and clean-up where frac-outs could occur.

(k) A directional drilling machine shall be used that is suitable for the conditions anticipated. The size and capacity of the drilling equipment must be compatible with the torque and pull back required to perform the drilling, reaming and pipe pullback installation. It shall also be capable of installing a pipeline to the required tolerances.

(l) Directional drilling shall be carried out with either a "pit-launched" or "surface launched" machine. Appropriate drilling fluid or "mud" shall be used to facilitate the boring.

  (i) Adequate sample pits shall be excavated to evaluate what type of bore head and "mud" to use for the operation.

  (ii) A sonde or beacon shall be built into the head or fixed close to the head to monitor the progress of the drilling head.

  (iii) A hard-wire guidance system and adequate target points is recommended to accurately monitor the progress of the drilling head while drilling.

(m) A 1:100 scale site plan shall be forwarded to Wellington Water and written approval obtained prior to drilling. The plan shall show all the underground services, buildings and proposed alignment of the pipe.

(n) PE100 pipe joints shall be ~~fusion~~ butt fusion welded (see **Section 4.19.1 Butt fusion welding**).

(i) Where the depth of scoring on the pipe, for an area extending 50 mm all-round the contact area of the saddle, exceeds the depth of peel for electrofusion saddles the depth of peel may be increased so that.

1. The OD of the peeled pipe is not smaller than the minimum OD recommended by the manufacturer of the saddle.
2. The OD of the peeled pipe is not smaller than the minimum requirements of PIPA POP001.

~~1.~~3. Where this cannot be achieved the pipe shall be rejected. ~~Where thepipe is scored, and the depth of scoring is greater than the peeling depth for the electrofusion saddle, the pipe shall be rejected.~~

(ii) Where the depth of scoring on PE100 pipe exceeds the depth of peel for electrofusion sockets~~, the pipe shall be cut off and a short section butt fusion welded on before an electrofusion socket is used.~~:

1. The pipe ends shall be cut off.
2. Short sections of undamaged pipe shall be butt-welded to the end of each drill shot.
3. The drill shots shall be joined using an electrofusion socket fitting (coupler) installed on the new, undamaged pipe ends.

(iii) Where the ends of the drill-shot(s) need to be replaced with undamaged new pipe, the new pipe shall be butt-welded to the drill-shot(s), except where **Section 4.19.5**(g) **Welding PE pressure pipe** applies, in which case the following applies:

1. The drill-shots can be cut-back to a section of pipe where the depth of scoring is less than the peel depth for electrofusion sockets.
2. The undamaged new pipe is installed as a single length of pipe (a closing piece) between the end of each drill-shot.
3. No more than two electrofusion couplers are used to connect the closing piece to the two drill-shots.

(o) The alignment of the grade of the pilot hole shall be checked after drilling and compared against allowable tolerances. Where deviations are outside the allowable tolerances, a new pilot hole shall be drilled.

4.18 Lining as pipe rehabilitation

At this time, the Regional Specification for Water Services does not contain specifications for pipe rehabilitation using cured in place pipe (CIPP) lining, spiral wound lining, and fold and form lining. Please contact Wellington Water for the latest guidelines on these trenchless technologies.

~~4.15 Seismic resilience~~

~~Seismic resilience:~~

~~(o) Shall be considered for all installations.~~

~~(p) Extends to pipelines, facilities and any fixtures and fittings within the facilities.~~

~~(q) Level of resilience shall depend on the criticality of the asset. A more critical asset is afforded greater resilience in design.~~

4.15.1 Critical structures

The following applies to seismic resilience of critical structures:

(r) All new critical structures are to be designed as an Importance Level 4 (IL4), as determined in AS/NZS 1170.0.

(s) Critical structures include pumping stations, reservoirs, telemetry buildings, treatment plants and emergency stores.

(t) The retrospective strengthening of existing critical structures to IL4 as per AS/NZS 1170.0 will be subject to a value assessment. The criteria maybe relaxed on a case by case basis.

(u) The structure shall be designed with a 100 year life expectancy.

(v) The design shall comply with contemporary design codes which shall include, but not limited to, the NZBC, NZS 3106 and AS/NZS 1170.0.

4.15.2 Serviceability limit state

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

An SLS of 1000 years is the minimum load case.

4.15.3 Ultimate limit state

The ultimate limit state (ULS) of a reservoir shall be defined as the reservoir generally holding its contents with only limited cracking and leakage that requires only minor repairs to remedy, and the structure's stability is not compromised by the damage. This includes the reservoir's roof which shall remain serviceable under dead load conditions.

A ULS of 2500 years is the minimum load case.

4.15.4 Pipe-work

Where pipes enter structures such as pumping stations and reservoirs:

(w) Suitable flexibility shall be incorporated to minimise the risk of failure at the structure interface.

(x) Couplings such as "Flex-tend" or "GeoFlex" flexible joints shall be used to provide flexibility whilst maintaining the best probability of operation after a seismic event.

(y) Care shall be provided where cable ducts enter buildings to ensure ducting is not at risk of shear due to differential movement between the structure and surrounding soils.

4.15.5 Pipelines

Designers shall consider ground conditions when designing new pipelines and choose a seismically resilient solution appropriate to the ground conditions.

4.15.5.1 General

The following applies to seismic resilience of pipelines in general:

(z) Pipelines shall be designed to resist the effects of:

(i) Liquefaction,

(ii) Lateral spreading,

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

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

(aa) Trunk pipelines and reservoirs shall be designed for anIL4 as determined in AS/NZS 1170.0. Trunk gravity sewers, trunk rising sewers and wastewater pump stations shall be designated IL 4.

(bb) Pipelines connected to structures such as valve chambers, scour chambers, pump stations and reservoirs shall be able to accommodate differential settlement and differential lateral movement without failing at the connection point.

(cc) Mechanisms allowing the pipeline to accommodate significant differential lateral movement, or differential settlement, shall be considered on pipelines greater than 300 mm nominal bore. Where the magnitude of the expected movement results in such mechanisms being impractical, the risk of failure shall be mitigated by other means so that breaks in the main can be easily isolated and repaired.

(dd) GWRC publishes seismic hazard maps highlighting the areas at risk.

4.15.5.2 Definition of pressure pipeline seismic resilience

A "seismically resilient pressure pipeline" refers to an underground pipeline that can:

(ee) Reasonably be expected to remain in operation following a severe movement of the Wellington Fault without significant deformation or leakage.

(i) Where a severe movement of the Wellington Fault is defined as: An event where ground displacements up to 4-5 m in the horizontal direction and 1 m in the vertical direction occur at one or more location along the Wellington Fault.

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

(gg) Be easily maintained during the normal operation life of the pipeline.

This definition:

(hh) Excludes the pipelines, or sections of pipeline, that are:

(i) Immediately adjacent to any fault (which is considered to be within 50 m)[14].

(ii) Laid across any active fault [16].

(iii) Laid along any active fault [16].

(iv) Installed on a structure such as a bridge.

(v) Installed inside host, encasement or carrier pipes [15].

(ii) 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.

(jj) Applies to the pipelines rather than ancillary structures such as pump stations and large valve chambers, which constitute transitions between mobile and fixed

[14] *These pipelines are expected to experience ground shear, and shall be assessed individually.*

[15] *The shear conditions entering and exiting are uncontrolled. These pipelines must be assessed individually.*

elements. Bedding types also result in specific vulnerabilities. These must be assessed individually.

4.15.5.3 Definition of gravity sewer pipeline seismic resilience

A "seismically resilient pipeline" refers to an underground pipeline that can:

(kk) Reasonably be expected to remain in partial operation following a severe movement of the Wellington Fault and be resilient to significant infiltration.

(i) Where a severe movement of the Wellington Fault is defined as: An event where ground displacements up to 4-5 m in the horizontal direction and 1 m in the vertical direction occur at one or more location along the Wellington Fault.

(ii) 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 operating but will contribute to the removal of sewage flows from over-land flow paths.

(iii) Where resilient to significant infiltration is defined as: The pipe is constructed from continuous pipe, so that every joint is not expected to open and allow groundwater to infiltrate. And when constructed in liquefiable ground the pipe is protected from inflow of liquefied soils which may temporarily, or permanently block the pipeline.

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

(mm) Be easily maintained during the normal operation life of the pipeline.

(nn) Have manholes that can resist floatation in fluids with a density up to 1.8 tonne per m^3 when that manhole is located in liquefiable soils.

This definition excludes the pipelines, or sections of pipeline, that are:

(oo) Immediately adjacent to any fault (which is considered to be within 50 m of the fault).

(pp) Laid across any active fault.

(qq) Laid along any active fault.

(rr) Installed on a structure such as a bridge.

4.15.6 Critical mains

Critical mains are pipelines with a high consequence of failure and are crucial in any post natural disaster recovery.

(ss) These are typically:

(i) Water mains with a diameter of DN 200 or greater.

(ii) Wastewater pipes with a DN 225 or greater.

(iii) Wellington Water shall identify which pipelines are critical for any given application based on the consequence of failure or ancillary function.

(tt) Pipelines identified as being critical shall be designed such that:

(i) There is minimal requirement to take the pipe out of service; that is no service connections or firefighting fittings to maintain.

(ii) They have the best practicable chance of surviving a natural event such as an earthquake or tsunami.

(uu) Each design should be considered on its merits.

4.15.6.1 Potential for liquefaction or ground movement

The following applies to critical pipelines in areas with a potential for liquefaction or ground movement:

(vv) Critical mains laid in areas with a potential for liquefaction shall be designed to mitigate the damage from lateral spread, damage from P-Waves, and damage from floating. This will include:

(i) Use of continuous pipe such as welded steel and welded PE.

(ii) Use of restrained joint systems as restrained DI.

(iii) Flexibility.

(ww) Resilient ductile iron pipe systems shall typically demonstrate compliance with ISO 16134 and the class of pull-out resistance, rotation and elongation identified.

(xx) Critical mains in areas with a high potential for liquefaction should typically be able to meet the highest classification of ISO 16134 at Class S 1 for expansion/contraction performance, Class A for pull out resistance, and minimum of 3-degree joint deflection.

(yy) Drainage pipes shall be wrapped with filter fabric to prevent the ingress of liquefied material due to joint separation.

4.15.6.2 Critical mains in all other areas

The following applies to critical mains in all other areas:

(zz) Critical mains in areas that do not have potential for liquefaction or ground movement may be constructed using rubber ring jointed DI and PVC pipe as well as pipes specified in **Section 4.15.2.5**.

(aaa) Drainage pipes shall be wrapped with filter fabric to prevent the ingress of material due to joint separation.

4.15.7 Non-critical mains

The following applies to seismic resilience of non-critical mains:

(bbb) Non-critical mains in areas with low shaking and no liquefaction potential may be designed with a lower level of seismic resilience.

(ccc) Mains in hill suburbs that are founded in non-liquefiable, firm, native ground and that are not trunk/critical mains, may be constructed using pipes with standard rubber ring joints as permitted within the Approved Products Register.

(ddd) Stormwater pipelines may be constructed of reinforced concrete.

(eee) All drainage pipes shall be installed with filter fabric wrapping to prevent the ingress of material due to joint separation.

~~**4.15.7.1 Potential for liquefaction**~~

~~Non-critical water supply and wastewater pipelines in areas with a potential for liquefaction shall be pipes laid with a minimum Class C pull out resistance as defined in ISO 16134. This includes polyethylene pipes as well as steel and ductile iron pipes using restraining gaskets.~~

~~4.16~~4.19 Polyethylene welding

It is critical for PE pressure pipelines that butt fusion welds exhibit ductile yield, and electrofusion welds exhibit ductile decohesion.

Welding shall generally follow the requirements of PIPA ~~POP002~~POP001[16] and PIPA POP003[17], except where amended by this specification.

~~4.16.1~~4.19.1 Butt fusion welding

The following applies to butt fusion welding (see also **Section 6.4.3 Polyethylene butt fusion and electrofusion welding**):

(a) Generally, butt fusion welding shall only be carried out on pipes that are of the same outside diameter, standard dimension ratio (SDR) and material (i.e., both pipes are PE100 or PE80b).

(b) Petrol powered chainsaws shall **NOT** be used to cut PE pipe.

(c) Fully automatic butt fusion welding machines shall **NOT** be used. A fully automatic machine completes a weld without prompting the operator to carry out checks.

(d) Pipes of the same OD, but a different wall thickness, shall be joined using an electrofusion coupler, or the wall of the pipe with the smaller SDR (that is the thicker wall) shall be machined to match the wall thickness of the pipe it is to be welded to.

(e) Only hydraulic butt fusion welding machines shall be used.

(f) Semi-automatic welding machines are approved for use. A semi-automatic machine cannot complete the weld without the operator checking, measuring and inputting a prompt for the machine to continue at critical stages (weld alignment, for example).

(g) All equipment used for butt fusion welding shall be maintained as per manufacturer's specifications and in good working order.

(h) Pressure gauges shall be calibrated within the last six months and in readable increments of at least 10 kPa.

(i) The welding site shall be fully enclosed to protect it from environmental conditions such as wind, windblown dust, rain, dirt and bright sun.

(j) Gravity PE100 pipes less than or equal to 160 OD and that are laid at a grade less than 2% shall be internally de-beaded.

[16] *Industry guidelines. Electrofusion jointing of PE pipes and fittings for pressure applications. Issue 8.0. POP001. Plastics Industry Pipe Association of Australia Limited (PIPA). 2019.~~Industry guidelines Polyethylene (PE) pipes and fittings for compressed air. POP002. Plastics Industry Pipe Association of Australia Limited (PIPA). 2014.~~*

[17] *Industry guidelines Butt fusion jointing of PE pipes and fittings – recommended parameters. POP003. Plastics Industry Pipe Association of Australia Limited (PIPA). 2018.*

~~4.16.2~~4.19.2 Electrofusion welding

The following applies to electrofusion welding (see also **Section 6.4.3 Polyethylene butt fusion and electrofusion welding**):

(a) Petrol powered chainsaws shall **NOT** be used to cut PE pipe.

(b) The contractor shall not commence electrofusion welding unless they have on-site all necessary plant to carry out electrofusion welding. This shall include effective alignment clamps, ~~and~~ re-rounding clamps and PI tape suitable for the size of the pipe being welded.

(c) Electrofusion jointing shall be carried out using an automatic electrofusion control box designed for the fittings proposed to be used. The control box shall have a barcode reader and electronic data logging, which shall be downloaded daily and delivered to Wellington Water.

(d) Before preparing the pipe end, visible reversion shall be cut off so that the pipe end has a constant OD.

~~(d)~~(e) Hand scrapers shall **NOT** be used, except where required to dress pipe ends.

~~(e)~~(f) Witness marks should be scored on the pipe with a hand scraper in preference to using a non-depositing pen.

~~(f)~~(g) The welding site shall be fully enclosed to protect it from environmental conditions such as wind, windblown dust, rain, dirt and bright sun.

~~4.16.3~~4.19.3 Site QA forms

A welding log sheet shall be maintained by the operator as part of the quality documentation. The log sheet shall record the information shown in **Table 4-12**, as a minimum:

Table 4-12 – Minimum information required on welding log sheets

Weld type	Category	Information required and details	
All welds	General weld information	Weld number	
		Date and time weld was made	
		Weld location *(accurate to +/- 1 m when installed)*	
	Welder information	Welders name	
		Certification details including currency	
	Pipe details	PE material classification	
		DN	
		SDR	
		PN	
		Pipe manufacturer	Name
			Code for date and place of manufacture
Butt fusion welds	General	Welding parameter used, including revision no / date	
		Operators observations	
	Machine	Make	

Weld type	Category	Information required and details		
	details	Model		
	Pipe details	Measured OR calculated mean pipe wall thickness		
	Heater plate	Condition		
		Cleaned?		*Y / N / NA*
		Average temperature at 4 points – recorded for 2 sides		
	Alignment	Misalignment	Is misalignment visible?	*Y / N / NA*
			Record maximum misalignment	
		End-gap	Is end-gap visible?	*Y / N / NA*
			Record maximum end-gap (if present)	
	Cool time	Was cool time out of the clamps observed?		*Y / N / NA*
	External weld bead inspection	Width	Minimum and maximum	
		Height	Minimum and maximum	
		Bead fully rolled-over and round?		*Y / N / NA*
		Bead symmetrical on both sides?		*Y / N / NA*
		Bead uniform around weld circumference?		*Y / N / NA*
		Pitting visible?		*Y / N / NA*
		Surface of bead appears glassy or satin?		*Y / N / NA*
		Bead discoloured?		*Y / N / NA*
	Miscellaneous	Operator's observations		
Electrofusion welds	Fitting details	Type	Electrofusion socket / electrofusion saddle / electrofusion transition	
		Size	Record DN if applicable	
		Manufacturer		
		Model or designation		
	Pipe details	Out of round	Record measured ovality before re-rounding / record corrected ovality if re-rounded	
		Reversion	Is it visible?	*Y / N / NA*
			What does it measure?	
			Was it cut-off?	*Y / N / NA*
		Pipe OD	Before peeling	
			After first peel	
			After second peel	
			After third or final peel	

Weld type	Category	Information required and details		
		Pipe ends	Pipe ends cut square?	*Y / N / NA*
			Record each pipe end max. out-of-square	
	Cleaning solvent	Type	Cloth and liquid / wipes	
		Manufacturer's name and branding		
		Solvent type	IPA or ethyl alcohol	
		Concentration on label		
	Electrofusion control box	Make		
		Model		
		Currency of certificate of calibration		
	Miscellaneous	Was alignment clamp used?		*Y / N / NA*
		Was re-rounding clamp used?		*Y / N / NA*
		Did witness marks align with fitting?		*Y / N / NA*

~~(g) Operator identification~~
~~(h) Weld number~~
~~(i) Weld location (accurate to +/- 1 m when installed)~~
~~(j) Date and time~~
~~(k) Welding equipment type and model~~
~~(l) Pipe details (PE material classification, SDR, DN)~~
~~(m) Pipe manufacturer and their code for date and place of manufacture~~
~~(n) Measured wall thickness~~
~~(o) Heater plate condition in terms of roughness and cleanliness~~
~~(p) Heater plate temperature~~
~~(q) Initial bead up stress~~
~~(r) Heat soak time~~
~~(s) Heat soak gauge pressure~~
~~(t) Heater plate removal time~~
~~(u) Bead roll-over stress~~
~~(v) Interface fusion stress~~
~~(w) Cooling time (in clamps)~~
~~(x) Final overall bead width and height and~~
~~(y) Operator confirmation that the weld appears good (visual inspection of bead etc).~~

The welding log sheet shall be submitted to Wellington Water as part of the project completion ~~and~~ alongside the as-built documentation.

~~4.16.4~~4.19.4 Pipeline testing and weld testing

Hydrostatic testing, or air testing, of the pipe to show that it is water tight shall not be accepted as evidence that the welds are full strength and ductile. Weld testing shall be as outlined in the following sections.

~~4.16.5~~4.19.5 Welding PE pressure pipe

The following applies to the welding of PE pressure pipe:

(a) PE pressure pipe shall comply with AS/NZS 4130.

(b) The high pressure-single pressure welding parameter specified in ISO 21307:2011 shall not be acceptable.

(c) Acceptable welding parameters include:

(i) The single pressure-low pressure parameter specified in ISO 21307:2011

(ii) DVS 2207.1[18] and

~~(iii) PIPA POP003[19] – the issue PRECEDING issue 6.1~~

~~(iv) LeHunt welding parameter~~

~~(v)~~(iii) Other welding parameters accepted in writing by Wellington Water.

(d) PE pressure pipes shall be welded by qualified PE welding operators, whose certification is current and has a good track record and experience welding pipe of an equivalent size and class as the pipeline to be constructed in the contract.

(i) Acceptable welding qualifications shall include certification under the existing New Zealand ITO framework, or certification under the proposed PIPA NZ qualification framework.

(ii) Where a welder is not certified, or their certification is lapsed and they can show good experience welding pipe of an equivalent size and class to Wellington Water, they may be acceptable at the written discretion of Wellington Water.

(iii) Where the welding operator is newly qualified and/or with limited experience, they shall weld under the supervision of a suitably qualified welding operator acceptable to Wellington Water.

(e) PE pressure pipe shall be welded **AND** destructively tested according to this specification.

(f) PE pressure pipe DN 125 and greater shall be butt fusion welded.

(g) Electrofusion socket couplers shall not be used to join PE pressure DN 125 and greater, except where welds must be completed in the trench (for example, to join pipe currently being laid to pipe that was previously laid during the contract).

(h) Welding of tapping saddles and tapping tees shall be by electrofusion saddle welding.

[18] DVS 2207.1 *Welding of thermoplastics - Heated element welding of pipes, piping parts and panels made out of polyethylene.*

~~4.16.6~~4.19.6 Welding PE gravity pipe

The following applies to the welding of PE gravity pipe:

(a) PE gravity pipe shall comply with AS/NZS 4130 or AS/NZS 5065.

(b) PE gravity pipes shall generally be welded by qualified welding operators, or welding operators with a good track record and experience welding pipe of an equivalent size and class to the pipeline to be constructed in the contract.

(c) PE gravity pipe shall be welded according to this specification.

(d) It shall not be necessary to destructively test welds according to this specification.

(e) The requirement for butt fusion welds shall generally be determined by the installation method.

(f) Electrofusion socket couplers shall be acceptable for the joining of PE gravity pipe.

(g) The contractor shall take care that the pipe ends are prepared correctly and bevelled so that the joint will not rag in operation.

~~4.16.7~~4.19.7 Work method statement

Before site welding or pre-qualification welding commences, the contractor shall submit a work method statement (WMS) for acceptance in writing by Wellington Water.

The WMS shall contain the following information, dependent on weld type~~contains~~:

Table 4-13 – Information required for WMS

Weld type	Category	Information required and details	
All welds	Compliance information for proposed:	Pipe to be used to construct the contract	
		Welding parameters to weld the pipe	
		Welding plant to be used to construct the contract	
		Welding operators to carry out the construction welding	
	Method	Detailed method information on how the contractor proposes to weld the pipe	
	Contract information	Contract title	
		Contract number	
	Introduction	e.g., "This Work Method Statement outlines the steps and calculations to [butt fusion / electrofusion] weld PE pipes for the above contract."	
	Referenced documents	Including relevant standards for pipe, relevant standards welding parameters, WSA documents, PIPA guidelines, welding machine operating manuals etc.	
	Pipe specific details including:	Resin	Base resin manufacturer
			Resin name
			Batch information
			Copies of conformance paperwork from resin manufacturer

Weld type	Category	Information required and details	
		Pipe	Pipe manufacturer
			Pipe batch information
	Welding machine details	Manufacturer	
		Model	
		Age and condition	
		Maintenance history	
		Copy of current certificate of calibration	
		Data logging and data logging output	
		Ancillary equipment	Pipe cutting equipment
			Generator to be used
			Pipe rollers
			Welding shelter
	Welding operator details including:	Copies of certification	
		Relevant experience (including track record from weld testing)	
	Proposed Welding Procedure Specification (WPS) including brief details on:	How pipe is cut	
		Handling of pipe	
		Pipe cleaning	Cleaning solvent proposed to be used
			Physically how the cleaning is carried out
		Alignment checking and how tolerances are measured	
		QA inspections and recording	
		Data log capture and delivery to Wellington Water	
Butt fusion welding	Additional welding machine details	Ram area	
		Ancillary equipment	Facing plate (does it have new cutters installed)
			Heater plate (is it skinned or bonded Teflon – condition of faces)
		Cleaning solvent	Brand
			Solvent used
			% Concentration of solvent and water
	Additional WPS details specific to weld type	Loading of pipe	
		Roller set-up and handling of weld during pull-off	
		Heater plate checking and recording	
		Control of the heat soak, weld, and cool times	

Weld type	Category	Information required and details	
	Welding parameters	Welding parameters proposed for the welding – including worked calculations for each pipe size and pipe class to be welded.	
Electrofusion welds	Details of the electrofusion fittings proposed to be used including:	Manufacturer	
		Type and model number	
		Size and pressure rating	
		Batch number(s)	
	Additional welding machine details	Ancillary equipment	Details of proposed alignment clamps for use, and if used
			Details of re-rounding clamps proposed for use
			Details of peeling tool proposed to be used, including condition of cutters and depth of cut
			Pipe cutting equipment
	Additional WPS details specific to weld type	How pipe is cut square	
		Pipe measurements	Mean OD
			Ovality
			Reversion
		Pipe peeling	Details on extent of peel
			How depth of cut is measured,
			Required depth of peel
		Witness marking	
		Use of re-rounding clamps	
		Control of the weld and cool times	
		Re-fusing fittings	

~~(a) Compliance information for the pipe proposed to be used to construct the contract.~~

~~(b) Compliance information for the welding parameters proposed to weld the pipe.~~

~~(c) Compliance information for the welding plant proposed to be used to construct the contract.~~

~~(d) Compliance information for the welding operators proposed to carry out the construction welding.~~

~~(e) Detailed method information on how the contractor proposes to weld the pipe.~~

~~The WMS for butt fusion welding shall contain the following information:~~

~~(f) The contract title~~

~~(g) The contract number~~

(h) Introduction – for example "This Work Method Statement outlines the steps and calculations to butt fusion weld PE pipes for the above contract."

(i) Referenced documents – this would include relevant standards for pipe, relevant standards welding parameters, WSA documents, PIPA guidelines, welding machine operating manuals etc.

(j) Pipe specific details including:

(i) The base resin manufacturer, resin name, batch information.

(ii) Copies of conformance paperwork from the resin manufacturer.

(iii) The pipe manufacturer

(iv) The pipe batch information

(k) Welding machine specific details including:

(i) Manufacturer

(ii) Model

(iii) Ram area

(iv) Age and condition

(v) Maintenance history

(vi) Copy of current certificate of calibration

(vii) Data logging and data logging output and

(viii) Details on ancillary equipment, such as:

1. Details of cleaning solvent proposed to be used (brand, solvent used, % concentration of solvent and water)
2. Facing plate (does it have new cutters installed)
3. Heater plate (is it skinned or bonded Teflon – condition of faces)
4. Generator to be used
5. Pipe rollers
6. Welding shelter and
7. Pipe cutting equipment.

(l) Welding operator details including copies of certification and relevant experience (including track record from weld testing).

(m) Proposed Welding Procedure Specification (WPS) including brief details on:

(i) How pipe is cut

(ii) Handling and loading of pipe

(iii) Roller set-up and handling of weld during pull-off

(iv) Pipe cleaning,

(v) Alignment checking and how tolerances are measured

(vi) Heater plate checking and recording

(vii) Control of the heat soak, weld and cool times

(viii) QA inspections and recording and

(ix) Data log capture and delivery to Wellington Water.

(n) Welding parameters proposed to be used for the welding – the WMS should show worked calculations for each pipe size and pipe class to be welded.

The WMS for electrofusion welding shall contain the following information:

(o) The contract title

(p) The contract number

(q) Introduction – for example "This Work Method Statement outlines the steps to electrofusion weld PE pipes for the above contract".

(r) Referenced documents – this would include relevant standards for pipe, WSA documents, PIPA guidelines, welding machine operating manuals etc.

(s) Pipe specific details including:

(i) The base resin manufacturer, resin name, batch information

(ii) Copies of conformance paperwork from the resin manufacturer

(iii) The pipe manufacturer and

(iv) The pipe batch information.

(t) Details of the electrofusion fittings proposed to be used including:

(i) Fitting manufacturer

(ii) Fitting type and model number

(iii) Fitting size and pressure rating and

(iv) Batch number/s.

(u) Welding machine specific details including:

(i) Manufacturer

(ii) Model

(iii) Age and condition

(iv) Maintenance history

(v) Copy of current certificate of calibration

(vi) Data logging and data logging output and

(vii) Details on ancillary equipment such as:

1. Details of alignment clamps proposed to be used
2. Details of re-rounding clamps proposed to be used
3. Details of peeling tool proposed to be used, including condition of cutters and depth of cut
4. Pipe cutting equipment
5. Generator to be used
6. Pipe rollers and
7. Welding shelter.

(v) Welding operator details including copies of certification and relevant experience (including track record from weld testing).

(w) Proposed WPS including brief details on:

(i) How pipe is cut – including how pipe is cut square

(ii) Handling of pipe

(iii) Pipe measurement including mean OD, ovality, reversion

~~(iv) Pipe cleaning including cleaning solvent proposed to be used and physically how the cleaning is carried out~~

~~(v) Pipe peeling including details on extent of peel, how depth of cut is measured, and required depth of peel~~

~~(vi) Witness marking~~

~~(vii) Alignment checking and how tolerances are measured and use of alignment clamps~~

~~(viii) Use of re-rounding clamps~~

~~(ix) Control of the weld and cool times~~

~~(x) Re-fusing fittings~~

~~(xi) QA inspections and recording and~~

~~(xii) Data log capture and delivery to Wellington Water.~~

~~4.16.8~~4.19.8 Butt fusion welding framework ~~Pre-qualification welding and weld testing~~

It is critical for PE pressure pipelines that butt fusion welds exhibit ductile yield, and electrofusion welds exhibit ductile decohesion.

To achieve this, welding operations carried out in these works shall follow the destructive testing process in **Figure 4-9.**

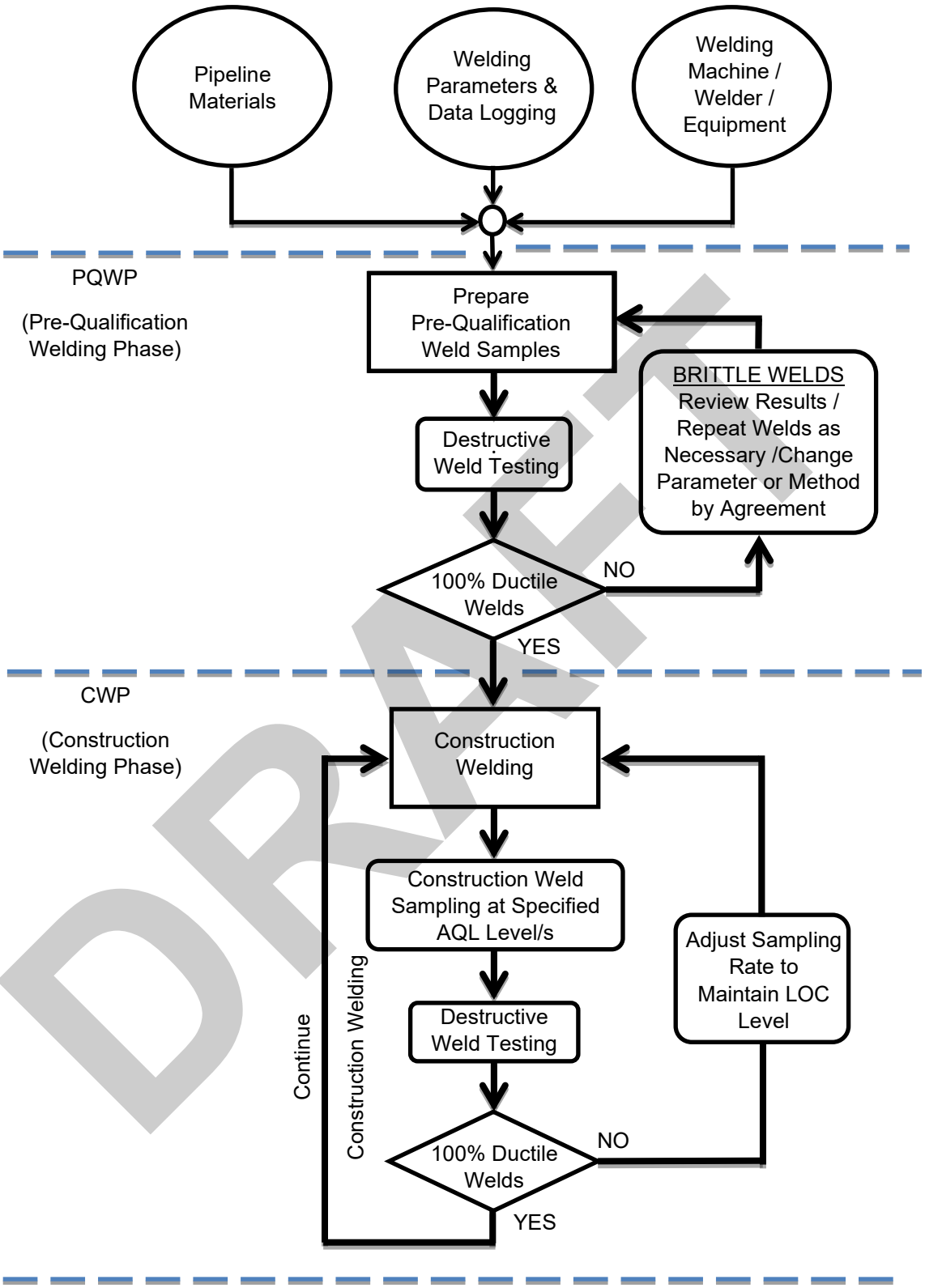


Figure 4-9 – Butt fusion welding framework

4.19.8.1 Pre-qualification welding and weld testing

The pre-qualification welding phase shall be carried out as follows:

(a) Before commencement of the PE welding portion of the contract works, the contractor shall:

(i) Weld three pre-qualifying butt fusion welds for each size and class of pipe for which butt fusion welding will be used in the contract works.

(ii) Weld three pre-qualifying electrofusion socket welds for each size of electrofusion coupler to be used in the contract works – except for electrofusion couplers smaller than 63 mm where prequalification welding shall not be required.

(iii) Weld three pre-qualifying electrofusion saddle welds for each size of pipe for which PE saddles will be used in the contract works (i.e. no EF (electrofusion) saddles used, no EF saddle test welds required).

(b) The pre-qualifying welds shall be made:

(i) Under site conditions

(ii) In the presence of Wellington Water

(iii) Using the plant and labour specified in the WMS and

(iv) In accordance with the approved WMS.

(c) Where the contractor proposes to pre-qualify more than one welding operator, then each welding operator shall prepare three weld specimens for each weld specified above.

(d) The welds shall be cut-out as specified and marked with:

(i) The Council and contract name.

(ii) Test weld number (each weld shall be sequentially numbered so it can be individually identified).

(iii) The welder's name and certification number.

(iv) Butt fusion welds shall be marked to show their orientation in the welding machine.

(e) The test welds shall be sent to ~~a testing laboratory acceptable to Wellington Water~~an IANZ registered laboratory for destructive testing.

(f) ~~The contractor shall be paid a Lump Sum rate to prepare and forward the test welds to the testing laboratory.~~ The welds shall be tested and the performance requirements of the welds shall conform with requirements outlined in **Table 4-14**. ~~The cost of testing shall be paid by Wellington Water.~~

(g) The welds shall be tested and the performance requirements of the welds shall conform with requirements outlined in **Table 4-14.**

(h) A pass result shall occur when all pre-qualifying welds are shown by destructive testing to meet or exceed the performance requirements specified.

(i) A failed result shall occur when any of the three welds, for any one type of weld, do not meet the performance requirements specified.

(j) Following a pass result, the contractor is required to complete the contract welding in an identical manner using the same welding operator, equipment, and WMS that was used to prepare the pre-qualifying weld.

Table 4-14 – Weld performance and test requirements

Weld	Testing requirement	Performance requirement
Butt fusion weld – DN125 and greater	ISO 13953	Tensile Strength of any test piece shall be greater than 90% of the tensile strength of unaffected pipe wall. All test pieces shall be fully ductile. The weld shows no visual defect.[4] All test pieces after sectioning show no visual defect.[4]
Electrofusion socket weld – DN63	ISO 13955	% brittle decohesion shall be ~~equal to or less than L/3~~ [1]0% The weld shows no visual defect.[4] All test pieces after sectioning show no visual defect. [4]
Electrofusion socket weld ≥DN125	ISO 13954	% brittle decohesion shall be equal to or less than L/3[1] The weld shows no visual defect.[4] All test pieces after sectioning show no visual defect. [4]
Electrofusion saddle weld	ISO 13956	Maximum brittle decohesion L_d =/< 50% [2] A_d =/< 25% [3] The weld shows no visual defect.[4]

1. Where L is the distance between the first and last element winding.
2. L_d = (L/y) x 100 (%)
   Where L is the greatest length of brittle decohesion and y is the distance between the first and last element winding in any radial direction from the centre of the fitting.
3. A_d = (A/A_{nom}) x 100 (%)
   Where A is the aggregate of all the areas where brittle decohesion has occurred and A_{nom} is the theoretical area of the total fusion zone, as declared by the manufacturer or measured on the fitting.
4. Visual defects shall include, but not limited to:
   (i) Butt Fusion Welds:
      a) Misalignment greater than 10%
      b) Beads that are not symmetrical, fully rolled-over and the correct size
      c) Pitting in the weld bead
      d) Discolouration or glassy appearance to a weld bead
   (ii) Electrofusion Welds:
      a) Hand scraped pipe
      b) Unevenly scraped pipe
      c) Insufficient peeled area
      d) Visible misalignment across an electrofusion coupler
      e) Melt-rise indicators uneven or not risen in an electrofusion fitting
      f) Loss of melt from the cold zone of an electrofusion weld

g) Witness marks not visible

(k) Normal construction welding shall not commence until the welding contractor has successfully completed a satisfactory pre-qualifying weld.

(l) The contractor shall note that the results of weld testing will not be available for a period of approximately one week. The contractor shall allow for this in the programming of their work.

(m) Where a failed result occurs, the contractor shall re-evaluate their WMS and propose changes to achieve a pass result. When the revised WMS is acceptable to Wellington Water, the contractor shall prepare three new weld specimens (of the weld/s that failed) for testing.

(n) The cost to repeat the pre-qualifying test welds shall be deemed to be included in the contractor's lump sum rate. The laboratory costs for repeat testing shall be paid by the contractor.

(o) The contractor shall note that, where a pass result is achieved for the pre-qualifying butt fusion welds, but not for one or more of the pre-qualifying electrofusion welds, it would be possible to mobilise on-site and undertake the construction butt fusion welding. However, the electrofusion fitting associated with the failed result cannot be installed on-site until the pre-qualifying electrofusion weld/s pass testing.

(p) When specifying the reporting of test results, Wellington Water shall require additional information to that specified by the standard. The test report shall detail the following information:

(i) Date of the test

(ii) Laboratory conducting the test

(iii) Full identification of the pipe, including the nominal size, SDR rating, material and manufacturer

(iv) Dimensions of the pipe before cutting the specimens, including diameter, ovality and wall thickness

(v) Weld beads are symmetrical

(vi) Identification of the sample by number or other

(vii) Number of specimens tested

(viii) Temperature of specimen at time of test

(ix) Cross head speed

(x) Maximum breaking load

(xi) Printout in graphical form of extension of the cross head versus load

(xii) Whether rupture occurred in the weld plane

(xiii) Nature of the rupture in the weld plane (ductile or brittle) and

(xiv) Any special observations made during or after the test.

~~4.16.8.14~~4.19.8.2 Construction welding

The construction welding phase shall be carried out as follows:

(a) Construction welding shall not commence until the contractor can achieve three consecutive passes for each type of pre-construction weld.

(b) Welds will be sampled and destructively tested to maintain the level of confidence as established in the preconstruction welding phase.

(c) Welds shall comply with the performance requirements set out in this document.

(d) The Sampling Plan shall be designed in accordance with AS 1199.1 "Sampling Procedures for inspection by Attributes".

(e) The Lot size shall not exceed 150 welds of the same type and size. Where the number of welds of the same type and size exceed 150 in number, the works shall be broken down into two or more smaller Lots of approximately the same size.

(f) The general inspection level shall be I.

(g) The Acceptance Quality Limit (AQL) shall be 2.5.

(h) To be acceptable, NO welds from the Lot shall fail (that is, not satisfy the performance requirements specified in this document). Where all welds pass, the Lot shall be acceptable and it shall not be subject to re-sampling.

(i) The contractor shall note the soonest time test results will be available is five working days after receipt of the welds by the testing Laboratory.

(j) Where the contractor chooses to continue welding they do so at their risk.

~~4.16.8.2~~4.19.8.3 In case of failure

In case of failure:

(a) Where a weld fails testing, the Lot may not necessarily be rejected.

(i) In the first instance a new Lot shall be created.

(ii) The new Lot shall be from the last passed weld (or last accepted Lot), to the failed weld.

(iii) The new Lot shall be sampled as follows:

General Inspection Level = I

AQL = 2.5

Acceptance Requirement = No weld fails

(b) Where all welds pass, the failed weld will be considered an aberration and the new lot shall be accepted.

(c) Where one or more welds fail, the new Lot will be rejected. In this the contractor shall replace that section of pipeline, or the welds in that section (as agreed with Wellington Water), at their cost.

(d) The contractor is required to investigate the reason for the weld failure. As appropriate they will make changes to their WMS, as agreed with Wellington Water, and re-commence welding.

5 DRAINAGE SPECIFICATIONS

The following specifications pertain to technical aspects of general drainage construction. These may be superseded by specific specifications issued by Wellington Water for Wellington Water construction contracts. All other construction must comply with the following specifications unless dispensation is given in writing by Wellington Water.

5.1 Safety

The following requirements are for personnel who have been employed to work on Wellington Water projects and the councils' assets. They are minimum requirements, but do not constitute full compliance with all legislative requirements. Reference should be made to Wellington Water's health and safety policy and any relevant procedures and policies by those responsible for carrying out the works.

5.1.1 Drainage hazards

All workers shall be instructed about the hazards of working in sanitary and stormwater sewers. These hazards include:

(a) Bacterial and viral danger to food and drink in the absence of high standards of hygiene.

(b) Infection danger to open cuts.

(c) Rat bites, flea infestation.

(d) Toxic wastes which may burn or poison.

(e) Poisonous or explosive gases.

Workers coming into contact with sewage shall be inoculated against Hepatitis (infectious and B as available) and Tetanus. Refer to **Section 4.1.1 Immunisations** for relevant information on immunisations and vaccinations. ~~Wellington Water's Safety in Design and Confined Space~~ Entry ~~process/policy is available by contacting the Health and Safety manager.~~

5.1.2 Drainage network underground entry

Entry to any parts of a live sanitary or stormwater sewer system is considered to be a confined space activity. Only personnel with third-party confined space entry certification shall enter a confined space.

All personnel shall comply with Wellington Water's Confined Space Entry process/policy which is available ~~by contacting the Health and Safety Manager~~online.

~~(a) Any personnel entering a live drainage manhole, or working on a broken out live sewer exposed by a confined excavation, shall carry out the following safety checks, as a minimum:~~

~~(i) Check the smell of the manhole/excavation. If gas is smelt, the system shall be ventilated by opening manholes upstream and downstream.~~

~~(ii) Use a gas detector (both before and during entry). The gas detector shall be capable of detecting explosives, low oxygen and hydrogen sulphide. If gas is detected, the system shall be ventilated by opening manholes upstream and downstream.~~

~~(iii) Ensure at least one person is available on the ground surface to check working conditions for manholes/excavations greater than 1.5m deep.~~

~~(iv) Ensure a ladder or similar is available to assist getting out of manholes/excavations greater than 1.5m deep.~~

~~(v) Ensure a safety harness is used where manholes/excavations are deeper than 3m or the outlet pipe is 450 mm or larger. In this case the surface workers and equipment shall be capable of pulling out workers below.~~

5.2 Setting out

The following applies to setting out drainage pipes and systems:

(a) All drainage works shall be set out under the direction of a registered drainlayer, person qualified to the National Certificate in Infrastructure Works (Infrastructure Pipelaying Technician) (Level 3) or New Zealand Certificate in Pipe Installations (Level 4), ~~or person qualified to the National Certificate in Infrastructure Works (Infrastructure Pipelaying Technician) (Level 3),~~ and to the position and levels detailed on the approved drawings.

(b) Where the alignment is related to the street boundary, drains shall be laid with reference to permanent land transfer boundary pegs or temporary boundary marks placed by a licensed cadastral or ~~the~~ registered professional surveyor responsible for the final land transfer pegging. Pipes *shall not* be laid by reference to the kerb line only.

(c) The deviation in level at any point from that specified or shown on the long section shall not be greater than 5 mm for grades flatter than 1%, or 10 mm for grades steeper than 1%.

(d) Where it is intended for the drain to be straight, the deviation from a perfectly straight line at any point shall not exceed the lesser of ¼ the internal diameter or 150 mm.

(e) The maximum joint displacement of flush jointed concrete pipes shall be 5 mm.

(f) Notwithstanding anything written in this specification, no change in direction at any point within the drain shall exceed the manufacturer's recommended maximum change.

5.2.1 Drains laid on a curve

The following applies to drains laid on a curve (PE only):

(a) PE drains laid with a curve between manholes shall be formed by bending the pipe. The tightest radius of curvature for bending shall be 50 x the OD of the pipe, but no ~~less than the manufacturers recommended maximum~~tighter than the manufacturer's recommendation.

(b) A twin 1.0 mm TPS (thermoplastic-sheathed cable) electrical locator cable shall be laid along the top of the curved drain:

(i) The ends of the cable shall be extended into the manholes and up to the lid so that locating instruments can be connected onto the cable.

(ii) Joints in the cable between manholes will not normally be permitted as the normally permitted maximum spacing of manholes is less than the supplied length of the cable.

(iii) If it is necessary to make joints in the cable, they are to be made with electrical connectors and shall be completely encased in a silicon rubber sealant to seal the joint against corrosion.

5.2.2 Drain invert at a manhole

For the purposes of measurement and setting out, the invert level of a drain at a manhole is:

(a) The level of a pipeline projected to the centre of the manhole. For example, the level the pipe invert would be if it was laid to the centre of the manhole. This excludes any change in grade or drop in the manhole.

(b) Not the level of the drain at the wall of the manhole.

(c) Not necessarily the actual finished level at the centre of the manhole.

5.2.3 Clearances from other utilities

The following applies to clearances from other utilities when setting out drainage pipes:

(a) Pipes shall be laid parallel to other services whenever practicable.

(b) Where a pipe crosses another utility, it shall be as close to perpendicular as practicable, and shall maintain minimum horizontal and vertical clearances as outlined by the other utility.

(c) Where these are not provided, the minimum clearances shown in **Table 5-1** shall be observed. The clearances are between utility pipe/conduit barrels.

Table 5-1 – Minimum clearances from drains as measured between barrels

Utility	Minimum horizontal clearance (mm)	Minimum vertical clearance (mm) when crossing
Gas Mains	300	150
Telecommunications conduits and cables	300	150
Electricity conduits and cables	500	225
Other drains	300	150
Water mains	1000*	200++

* or 1000 mm radial distance from watermain: i.e. horizontal can reduce when vertical increases.

++ Wastewater pipes ~~shall~~ should always be vertically lower than water supply mains to reduce the risk of cross contamination due to a water main failure.

5.3 Materials

The following applies to materials for the drainage network:

(a) All materials shall conform to the appropriate New Zealand Standard (NZS) . Where no appropriate NZS exists for a particular material, then the Australian Standard (AS) shall be used; or failing that, the British Standard Specification (BS) shall apply.

(b) All materials shall, at Wellington Water's discretion, be subject to test under the appropriate standard. Materials shall also be subject to Wellington Water's approval even though they conform to the appropriate standard specification.

(c) Current approved materials are listed in the Approved Products Register published on Wellington Water's website. Approvals are subject to change and care shall be taken that designers and specifiers are using the most current version.

(d) Materials that do not comply with the prescribed standards and/or specifications listed shall only be used with the written permission of Wellington Water and only after it has been demonstrated through third party certification that the item complies with the required standards.

(e) Materials used for construction and repairs shall be in a new condition and shall be suitable for the design life as required by the specification and associated standards.

5.3.1 Cement

The following applies to the use of cement ~~in drainage~~:

(a) General purpose Portland cement shall be used unless otherwise specified in the design.

(b) Only dry, fresh cement shall be permitted for use in the manufacture of concrete.

(c) Additives shall be used only where specified in the engineering drawings and only when permitted in writing by Wellington Water.

5.3.2 Sand

Sand shall be clean, sharp and free from dust, shell, soft particles, loam, vegetable and other debris. Sand shall be graded as specified in the design before it is incorporated into the works.

5.3.3 Reinforcing steel

Reinforcing steel shall comply with AS/NZS 4671. Reinforcing rods shall be free of scale rust and bent and placed in accordance with NZS 3109.

5.3.4 Mortar

Mortar shall consist of one part of cement to two parts of sand by volume, thoroughly mixed with water to form a paste of a consistency suitable for the particular purpose. No mortar shall be used when more than two hours old unless it has an appropriate retarder.

5.3.5 Non-structural concrete

The following applies to non-structural concrete ~~used for drainage~~:

(a) All non-structural concrete shall have a minimum 28-day crushing strength of 17 MPa unless specified otherwise.

(b) It is preferable that ready mix concrete be used, although concrete may be mixed on site using a concrete mixer.

(i) Hand mixing without the use of a concrete mixer will not be permitted.

(ii) Specified concrete with strengths greater than 25 MPa shall be supplied as ready mix and shall not be mixed on-site (see **Section 5.3.6 Structural concrete**).

(iii) Mixing shall be continued for at least two minutes and until the concrete is of an even colour and consistency throughout.

(c) The proportion of coarse aggregate to fine aggregate shall be between the limits of 1:1 and 2:1, so as to give the most desirable results for dense, strong concrete. The quantities of coarse and fine aggregate shall be separately determined by dry, loose volume, or by equivalent weight. The maximum aggregate size shall be 20 mm.

(d) The smallest quantity of water practicable shall be used to produce the desired workability and completion of the concrete.

(e) The slump shall not exceed 100 mm when measured in a standard cone. Wellington Water may, under exceptional circumstances, permit a greater slump.

(f) A minimum of 1 volume of cement to every 6 volumes of aggregate shall be used to give a minimum crushing strength at 28 days of 17 MPa. It should be noted when determining batch quantities that the crushing strength is dependent upon water content as well as cement content (i.e., the more water used, the weaker the concrete).

(g) If required by Wellington Water, standard test blocks shall be cast and cured.

5.3.6 Structural concrete

The following are the minimum standards for structural concrete and may be superseded by specific design.

(a) Measurements, mixing and delivery of materials shall be in accordance with NZS 3109 and NZS 3104, and the following conditions shall be observed:

(i) No addition of water to the concrete in the agitator or in the bin will be permitted.

(ii) No additives shall be used without the permission of Wellington Water.

(iii) Discharge of concrete from agitators and truck mixers shall be completed within one and a half hours after the introduction of mixing water to the cement or cement to the aggregates.

(b) All structural concrete for cast in-situ reinforced bases and walls shall comply with NZS 3109 and shall have a minimum crushing strength of 30Mpa at 28 days.

(c) The cover of concrete over reinforcement from any surface exposed to sewage or the atmosphere above sewage shall be at 75 mm. Notwithstanding this, cover to reinforcement shall be as per NZS 3101.1&2 for the relevant exposure classification.

(d) All bar intersections shall be tied with 16 gauge soft black iron wire and all ends of ties shall be bent into the body of the concrete away from the surface. No part of the wire ties shall protrude into the cover region.

(e) Secure formwork shall be erected to form the sides of all concrete slabs, headwalls and anchor blocks. Concrete bearing surfaces on headwalls and anchor blocks shall be cast against undisturbed ground. No concrete shall be placed until the formwork and reinforcement has been inspected and approved by Wellington Water.

(f) Wellington Water shall be given 24 hours' notice of any intention to place concrete and of the time the concrete has been ordered.

(g) A smooth face finish is required on all faces except those permanently buried.

(h) Surfaces shall be poured against clean plywood or steel faced shutters free from all blemishes and arranged to produce a smooth even and blemish free surface with no fins, offsets, air-holes or other disfigurements.

(i) Covers for protection from water, rain or frost shall be used as required. Concrete shall not be placed in ponded or running water. Running water over fresh concrete is not permitted.

~~(i)~~(j) Concrete testing shall be prepared to standard 300 mm x 150 mm test blocks, if required. Slump tests may be required to be carried out on site. The contractor shall provide all test cylinders, slump cones, plates, trowels etc required for the testing of concrete.

5.3.7 Pipes

5.3.7.1 Concrete pipes

All concrete pipes:

(a) Shall conform to AS/NZS 4058.

(b) Shall have reached the equivalent of 7 days maturity before delivery to the site.

(c) Shall be free from cracks, flaws and other defects. No reinforcing shall be visible nor any rust stains.

Where concrete pipes are to be:

(d) Used for sewer applications, they shall be lined with a proprietary PE lining system or manufactured with suitable additives and sacrificial layer to achieve the durability requirements.

(e) In contact with a marine environment, either internally or externally, they shall be designed and manufactured to comply with the requirements of AS/NZS 4058 for pipe suitable for a marine environment.

5.3.7.2 Vitrified clay pipes

Vitrified clay pipes, also known as earthenware or ceramic pipes, shall be Class 4 and manufactured to AS 1741. Rubber-ring jointed pipes only shall be used.

5.3.7.3 PE100 Pipes

PE100 pipe used for gravity drainage applications shall be:

(a) Black in colour.

(b) Certified as Series 1 pipe complying with AS/NZS 4130.

(c) Permitted pipes sizes (outside diameter) are: 110, 160, 250, 315, 400, 450, 500, 560, 630, 710, 800, 900, 1000 mm.

(d) Minimum wall thickness ~~of~~ equating to a maximum standard dimension ratio (SDR) of SDR17, which may require consideration of the installation methods and any anticipated pulling forces and shall be confirmed suitable or amended to a thicker wall by the designer.

5.3.7.4 Steel Pipes

Steel pipes shall:

(a) Be polyethylene tape coated and epoxy or concrete lined. Concrete linings shall have suitable additives and sufficient thickness to provide the required durability.

(b) Be manufactured to NZS 4442, AS 1579 or BS 534. Steel pipes used for rising mains and other pressure applications shall comply with the requirements of **Section 6.2.6 Steel pipes**.

(c) Be designed to ensure suitable provisions for flexibility have been accounted for to accommodate loading from seismic events, differential settlement or thermal expansion. This may be mechanical couplings, bellows or approved proprietary flexible joints.

(d) Steel pipes shall otherwise be welded. Tied couplings/axial restraint shall be considered for all situations.

5.3.7.5 Ductile iron pipes

Ductile iron pipes shall comply with AS/NZS 2280, be a minimum PN20 and concrete or epoxy lined. Concrete linings shall have suitable additives and sufficient thickness to provide the required durability.

5.3.7.6 Fastenings and gaskets

The following applies to fastenings and gaskets:

(a) All fastenings shall be selected to be compatible with the material to be fastened and to prevent galvanic corrosion.

~~(a)~~(b) Where fastenings such as nuts, bolts and washers are in a wet-well or in contact with sewage, 316 stainless fastenings shall be used. Anti-galling compounds shall be used on all stainless steel threads.

~~(b)~~(c) Where fastenings are:

(i) ~~buried or~~ Exposed to an above ground environment, hot dipped galvanised fixtures may be used provided they can be wrapped with the full Denso system (primer, mastic, petrolatum tape and PVC outer wrap). ~~316 Stainless Steel fixings shall be used in all other conditions.~~

(ii) Buried, they shall be either hot dip galvanised or 316 stainless steel fastenings. All buried fastenings shall be wrapped with the full Denso system (primer, mastic, petrolatum tape and PVC outer wrap).

~~(c)~~(d) All flanges and rubber ring joints shall use ethylene-propylene diene monomer (EPDM) gaskets. Nitrile (NBR) shall be used where long-term exposure to hydrocarbons is anticipated.

5.3.7.7 PVC-U Pipes

The following applies to PVC-U pipes:

(a) PVC-U pipes for non-pressure applications shall conform to AS/NZS 1260.

(b) Only plain walled pipes will be accepted.

(i) Solid walled sandwich construction pipes will be accepted where there is no difference in density between sandwich layers.

(ii) Foam sandwich pipes will not be accepted.

(c) Only rubber ring joints ~~only~~ shall be used with PVC-U pipes.

(i) Solvent jointed pipes shall not be considered for public assets.

(ii) Rubber rings shall comply with AS 1646.

(iii) NBR rings shall be used where long-term exposure to hydrocarbons is anticipated.

(d) Spigots and sockets of pipes shall be thoroughly cleaned immediately before jointing, and rubber rings shall be free from dust, dirt or grease.

(e) Witness marks shall be marked and used as per the manufacturer's recommendations.

(f) The rubber rings shall be mounted inside the socket and lubricated using a suitable lubricant (Medlube or other proprietary AS/NZS 4020 certified product).

(g) The pipe shall be lined up and supported so as to be concentric with the pipes already laid in the same line. Pressure shall be applied to the socket end of the pipe. The spigot end shall be pushed into the preceding socket until the witness mark is just visible. The pipe shall NOT be pushed hard up against the back of the socket.

5.3.8 Manhole covers

The following applies to manhole covers:

(a) Manhole covers shall be circular and of an approved type and shall be made from ductile iron. Cast iron lids may be used by special permission.

(b) Only approved manhole covers shall be used on public drains.

(c) All covers shall comply with a minimum load rating to AS 3996 Class D. Higher loadings may be required depending on the anticipated application (e.g., airports or loading yards).

(d) General cover specifications are as follows:

(i) Sewer covers are to have two closed keyways (or one if hinged).

(ii) Stormwater covers are to have two open keyways (or one if hinged).

(iii) All ~~centres~~ covers shall fit the proprietary frame in any position without rocking. If necessary, the seating surfaces shall be machined.

(iv) The top surface of the frame and ~~centre~~ cover shall be flush.

(v) The ~~cover~~ frame and cover shall allow a 600 mm diameter minimum clear opening.

(vi) The cover shall be marked with the manufacturers name and year of manufacture.

(e) Particular attention is drawn to the need to ensure that the covers shall not rock and that the gap between the manhole cover and the frame does not exceed 2 mm at any point.

5.3.8.1 Hinged covers

Hinged covers shall be:

(a) Designed such that they can be installed with or without a captive hinge.

(b) Designed such that they can open under surcharge between zero and 90 degrees without the hinge disengaging from the frame.

(c) Able to "lock" into position once opened, to avoid accidental closure due to wind or impact.

(d) Able to "unlock" from the upright position by manual means and without special equipment.

(e) Able to be easily removed from the installed frame without special tools or excavation (unless it has a captive hinge for a specific reason).

(f) Installed on existing manholes during renewals, upgrades or where new pipe connections are added, and as outlined in **Section 5.6.11.1 Hinged manhole covers.**

5.3.9 Maintenance shaft covers

Maintenance shaft, or cleaning eye/lamp hole, covers shall be:

(a) Grey cast iron or ductile iron and of a design approved in writing by Wellington Water.

(b) Designed to comply with ~~Class D loading of~~ a minimum load rating to AS 3996 Class D. Higher loadings may be required depending on the anticipated application (e.g., airports or loading yards).

~~5.5 Excavation~~

~~See **Section 4.5 Excavation**~~

~~5.6 Bedding~~

~~See **Section 4.8 Reuse of in situ material**~~

~~5.7 Backfilling~~

~~See **Section 4.10 General backfill**~~

~~5.8 Reinstatement~~

~~See **Section 4.11 Reinstatement**~~

5.4 Jointing and laying of pipes

5.4.1 General

The following applies to jointing and laying of drainage pipes:

(a) New pipes shall be connected to existing pipes, whether mains or private laterals as set out in this section.

(b) Where a new pipe is joined onto an existing rigid pipe, then:

(i) Only the minimum length of bedding shall be removed from beneath the existing pipe.

(ii) Where more than two pipe diameters of bedding is removed from beneath existing pipe, then the bedding shall be replaced with concrete to prevent the existing pipe end from shearing off at or near the joint. This is because it is not possible to adequately support this section of pipe by ramming bedding

material under the pipe, and as such, "concrete bedding" is used to support the pipe end.

(c) When connecting a new rigid pipe or PVC-U pipe to an existing pipe:

(i) The first preference always shall be for a rubber ring joint. New drains, including repairs consisting of more than one pipe, shall be joined using the manufacturers supplied joint. Rubber sleeve jointed earthenware drains and rubber sleeves with stainless steel wires are not permitted.

(d) When normal rubber ring joints cannot be used, a Fernco connector, Fernco sleeve with stainless steel band clips, or a Naylor Band Seal Coupler, shall be used or a similar flexible connector or coupler approved in writing by Wellington Water. The connector or coupler ~~nominal ID~~DN end sizes shall match within 5 mm of the OD of the actual pipe end making the respective joint.

5.4.1.1 Joints in a liquefiable/sand environment

Where a rubber-ring/sleeved or flush joint is made in ground that is comprised of silt/sand or areas with a potential for liquefaction, the pipe joint shall be wrapped in filter-fabric that extends beyond the joint by a minimum of 450 mm in order to prevent the ingress of silt or sand in the event of a joint separation.

5.4.2 Changes in grade or direction

Changes in grade or direction between manholes shall be made using factory made bends. In exceptional circumstances, such as large diameter drains, the fabrication of epoxy jointed bends may be permitted for concrete pipes.

5.4.3 Repairs

Generally, repairs to pipes are carried out with the same material as the parent pipe.

5.4.4 Flush jointed concrete pipes

Flush jointed concrete pipes shall not normally be used, unless specifically approved by Wellington Water for exceptional circumstances. They shall be sealed with an approved sealant and epoxy. The sealant shall be guaranteed to give a watertight seal for 50 years.

5.4.5 Polyethylene pipe joints

Polyethylene pipes shall be joined using butt fusion or electrofusion welded methods. Butt fusion shall be used for directional drilling, pipe-bursting or slip-lining activities.

Jointing new PE to existing PE shall be as set out in **Section 4.19 Polyethylene welding**.

5.4.5.1 Butt fusion jointing

See **Section 4.19.1 Butt fusion welding**

5.4.5.2 Electrofusion jointing

See **Section 4.19.2 Electrofusion welding**

5.4.6 Cathodic protection

See **Section 6.3.9 Cathodic protection**

5.5 Water stops

The following applies to water stops (refer to **Standard Detail DR03 – Typical Trench and Waterstop Details**):

(a) Water stops shall be constructed from 17 MPa concrete 150 mm thick, set a minimum of 150 mm into the sides and floor of the trench and shall extend 300 mm above the top of the pipe.

(b) Where concrete or earthenware pipes are used, the water stop shall be constructed immediately downhill of the collar of the pipe.

(c) If the drain is laid on metal (gravel) bedding and either subject to traffic loading or laid with more than 1.5 m of cover, then that portion of the pipe not encased by the water stop shall be supported on a concrete cradle along the full length of the pipe. This is to ensure the pipe is uniformly supported where subject to significant loading and the pipe is not subject to differential shear at the metal/concrete interface. The concrete bedding shall stop at the next pipe joint.

(d) Where PE pipes are used, then where the pipe passes through the water stop, it should be wrapped in an elastic material (e.g., a rubber sleeve secured with wire ties) to enable the pipe to deform inside the water stop.

5.6 Manholes

5.6.1 Manhole design

The following applies to manhole design (refer to **Standard Detail DR01 – Manhole Details**):

(a) Manholes shall be designed to withstand HN-HO-72 loadings as a minimum, or greater in areas where additional loading is anticipated, such as airports or loading yards. See **Section 5.6.10 Manhole lid construction** for loading requirements for manhole lids.

(b) Risers shall typically be precast reinforced concrete units complying with AS/NZS 4058 as a minimum for manufacturing. The manufacturer is to certify the riser design is suitable for the design loading.

(c) Specific internal linings may be specified depending on the potential effluent being transported, for example, sludge or centrate pipelines and manholes may require additional protection against corrosive gases and fluids.

5.6.1.1 Manhole design against liquefaction

Where new manholes are to be installed in areas identified with potential liquefaction, the following mitigations shall be employed:

(a) Manhole risers, lids and bases shall be fastened together using proprietary riser section joiners.

(b) Flanged precast concrete manhole bases shall be used.

(c) 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.

(d) The backfill shall be a compacted, non-cohesive, gap graded material (i.e., AP40 or similar).

5.6.2 Manhole construction

The following applies to manhole construction:

(a) The diameter of cast-in-situ bases of precast manholes shall be at least 300 mm plus the outside diameter of the manhole and shall be at least 150 mm thick.

(b) Manholes with a precast base shall be placed on a wet concrete bed or on 150 mm of bedding material.

(c) Precast manhole bases shall be used for all manholes constructed below the water-table or sea level.

(d) Manholes shall have the minimum practical number of risers. For the majority of manholes, only one riser will be necessary.

(i) If more than one riser is used, a layer of mortar or an appropriate epoxy shall be placed on the joint before positioning the next riser, or

(ii) Proprietary rubber rings or butyl mastic strips shall also be used to seal between riser sections. Rubber rings shall be appropriately lubed and set before jointing.

(iii) Similarly, a layer of mortar shall be placed on the top of the top riser before placing the manhole roof.

(iv) Epoxy ***shall not*** be used between the lid and the riser in case the lid needs to be removed in the future.

(e) For sewer manholes, all joints, except that between the top riser and the lid, shall be internally sealed with mortar, epoxy, butyl mastic strips or proprietary rubber rings. Joints between risers shall also be externally sealed with epoxy or other approved sealant. This external sealing is in addition to the internal sealing between risers.

(f) Where the manhole riser is the same diameter as, or smaller than the pipe diameter, then:

(i) **Either** the manhole shall be formed by pouring concrete around the pipe up to near the top of the pipe and sitting the riser on the concrete haunch so formed. The riser shall be supported by the concrete haunch and not by the pipe. The opening into the drain shall be formed by cutting the top of the drain off and the size of the opening shall approximate the diameter of the riser.

(ii) **Or** a precast manhole tee shall be used. Tee manholes in road reserve or any other location likely to receive traffic loading shall be designed and installed to take full HN-HO-72 loading or greater if additional loading is anticipated. A copy of the manufacturer's installation specification shall be given to Wellington Water. Alternatively, the lid can be isolated from the riser such that traffic loading is not transferred to the pipe. This may entail using an oversized lid supported by a ring-beam that is not structurally connected to the riser.

~~**5.11.2.1 Design against liquefaction**~~

~~The following applies to design against liquefaction:~~

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

~~Areas with potential for liquefaction are published by Greater Wellington. Reference to the latest hazard maps shall be made prior to design.~~

~~Where new manholes are to be installed in areas identified with potential liquefaction, the following mitigations shall be employed:~~

~~(a) Manhole risers, lids and bases shall be fastened together using proprietary riser section joiners.~~

~~(b) Flanged precast concrete manhole bases shall be used.~~

~~(c) 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.~~

~~(d) 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 of backfill – wet density of in-situ material) x volume x g and~~

~~(ii) The weight of the manhole.~~

~~(a) The backfill shall be a compacted, non-cohesive, gap graded material (i.e., AP40 or similar).~~

~~(b) 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.~~

~~(c) 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 5.11** still apply.~~

5.6.3 Manhole rungs

The following applies to manhole rungs:

(a) Rungs shall be installed in all manholes deeper than 1 m unless there is a specific dispensation approved by Wellington Water.

(b) Rungs shall be a “drop step” type and shall be constructed from 15 mm (minimum) 316 or 316L grade stainless steel.

(c) A 304 or 304L grade stainless steel may be used in stormwater environments. They shall have stainless steel nuts and washers and a rubber washer at the back of the manhole as a water seal.

(d) For drainage manholes, the alignment of the rungs shall be parallel to the flow as much as possible so as not to interfere with rodding activities.

(e) The manhole lid shall be oriented such that the entry hole is above the rungs.

(f) The first manhole rung shall be between 500 mm and 675 mm below the finished ground level.

5.6.4 Manhole safety grilles

~~Manholes safety grilles shall be fitted into manhole access lid frames for all new manholes deeper than 3 m. 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.~~

Manhole safety grilles shall meet the following requirements:

(a) Manhole safety grilles shall comply with AS3996 Class A.

(b) Grilles shall be constructed from stainless steel 316L grade or an approved alternative material with adequate strength and corrosion properties.

(c) The maximum opening size of any section of the grille fit and surface shall not be able to pass a sphere larger than 150mm diameter. All products shall be marked in accordance with the conformity assessment body's (e.g., AS/NZS) requirements.

(d) Manhole safety grilles product certification (ISO Type 5) to AS3996 Class A. This certification shall include the fit to the access lid frame design meeting the specified load requirements.

~~5.11.4 Manholes with false floors~~

~~Precast manholes with an invert below the pipe invert shall be:~~

~~(g) Filled with bedding material to 50 mm below the pipe invert.~~

~~(h) Covered with a layer of polythene. This is to enable the pipe to be broken out in the future without having to replace the manhole.~~

~~(i) A 50 mm layer of concrete shall then be placed over the polythene to create a false floor in the manhole. The polythene sheet prevents the concrete running into the bedding and preventing future breaking out.~~

~~5.6.4~~5.6.5 Connections to manholes

The following applies to manhole connections:

(a) On all earthenware and concrete pipes entering (and leaving) a manhole, a flexible joint shall be provided within 2.5 times the outside diameter of the pipe or 700 mm of the outside edge of the manhole base, whichever is the lesser.

(b) PVC-U and PE pipes shall not be fixed to manholes until the temperature of the main has returned to ambient ground temperature.

(c) PVC-U pipes entering and leaving a manhole shall be fixed to manholes using factory made fittings.

(d) PE pipes shall be fixed to manholes either by the use of a puddle flange or by strips welded onto the pipe.

(i) Only the outlet pipe is to be flanged to the manhole.

(ii) The inside face of this flange shall be flush with the inside of the manhole wall.

(iii) Inlet pipes shall extend no less than 60 mm and no more than 100 mm into the manhole and butt against the benching/tiling.

(iv) The inlet pipes shall be sealed against the manhole wall, but not anchored.

(e) All sewer leads shall enter through the benching.

(f) Sump leads and normally dry stormwater leads may enter the manhole over the benching.

~~5.6.5~~5.6.6 Expansion joints on PE pipes at manholes

The following applies to expansion joints on PE pipes at manholes:

(a) Normally the connection of PE to a manhole is 'fixed' into the manhole wall by use of a stub-flange anchoring the pipe into the manhole wall with epoxy-mortar and/or concrete.

(b) Where the incoming sewage is likely to have wide temperature fluctuations (e.g. due to significant volumes of process hot water), then suitable double rubber seal expansion joints fixed into the manhole wall may be necessary to accommodate the calculated longitudinal expansion and contraction of the PE pipe.

(c) Usually, an expansion joint is necessary at each end of the pipe, with an anchored sleeve at the centre of the pipe length to ensure ½ of the total movement takes place at each joint.

(d) The positioning of the pipe end within the expansion joint at construction shall be set according to the pipe ambient temperature, in relation to the expected temperature related movement.

(e) Specific design is required, as pipe movement is significantly reduced with increasing pipe depths.

(f) Laterals shall be connected at the manhole, or at the anchor sleeve.

~~5.6.6~~5.6.7 Benching of manholes

The following applies to the benching of manholes:

(a) Manholes shall have a formed invert from inlet to outlet. ~~The invert shall be formed using tiles.~~

(b) Earthenware tiles and half pipes shall be used on all sewer pipes.

(c) Stormwater pipes may have benching formed from concrete half-pipes, or from in-situ placed concrete with a minimum 25 MPa strength trowelled to produce a smooth finish.

(d) Above the tile level, the channel shall have vertical 25 MPa concrete walls formed to the level of the outlet pipe soffit to form a full pipe depth channel through the manhole.

(e) The tiles etc used to form the invert shall be cut neatly as appropriate to form an invert with minimum spacing between the tiles.

(f) The gap between the tiles shall be filled with epoxy mortar.

(g) Bends must be sufficiently gentle for the flow not to leave the channel and deposit debris on the benching. As a guide, 45-degree springs or less would normally be required.

(h) Manholes shall be constructed to allow all drains entering (and leaving) the manhole to be inspected by a closed-circuit television (CCTV) camera. The size of the camera shall be taken as 470 long x 130 wide x 85 high (with 130mm being the width to the outside of the wheels).

~~5.11.8 Deep manholes~~

~~The following applies to deep manholes:~~

~~Manholes deeper than 5m shall have platforms at equal spacings down the manhole at between 2.5 and 4.5m spacing. They shall be constructed from hot dipped galvanised webbed grates for stormwater manholes and stainless steel webbed grates for sewer manholes.~~

~~Landings shall be designed to withstand a live load of 1.5 kPa in addition to the weight of the landing itself.~~

~~Intermediate platform openings shall be aligned such that a person can be winched straight up or down past platforms without entanglement.~~

~~Energy dissipation structures are specifically excluded from this clause.~~

~~5.6.7~~5.6.8 Manholes on large pipelines

Where a manhole is required on a large pipeline, and where the manhole riser diameter is required to be smaller than the pipe it is connected to (an off-take riser), the installation shall be as follows:

(a) The manhole lid shall be isolated from the riser such that the traffic load is not transferred through riser to the connection with the pipe. This can be achieved by using an oversized lid which is resting on a suitably designed ring-beam surrounding, but not connected to the off-take riser.

(b) The top of the off-take riser shall be 150 mm below the underside of the lid.

(c) The gap between the off-take riser and the ring-beam shall be sealed with Sikaflex or similarly flexible sealant approved in writing by Wellington Water, at the top of the off-take riser.

~~5.6.8~~5.6.9 Drops at manholes

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

~~5.6.8.1~~5.6.9.1 Haunched internal ~~drops~~drop structures

The following applies to the construction of haunched internal drops:

(a) Normally dry stormwater drains DN 300 or smaller (e.g., sump leads) may enter on top of the benching, and do not require a haunched drop.

(b) A haunched internal drop in a manhole shall not exceed 500 mm from the inlet invert, to the receiving invert. Drops up to this height are to be benched in the manhole.

(c) Drops greater than 500 mm in wastewater manholes may be achieved through using an internal drop structure as described in **Section 5.6.9.2 Internal drop structures**.

(d) Haunched internal drops will not be permitted on sewer pipes greater than DN 225 (nominal bore) or DN 300 on stormwater pipes.

~~(e) Will not be permitted to be installed in an existing manhole, as there will be inadequate room in the manhole for the drop whilst retaining working room. Size requirements for manholes with internal drops structures are covered in the RSWS.~~

~~5.6.8.2~~5.6.9.2 Internal drop structures

Internal drop structures (see **Standard Detail DR02 – Internal Drop Details)**:

(a) Will not normally be considered for stormwater applications but are acceptable within wastewater systems.

(b) Will not be permitted to be installed in an existing manhole, as there will be inadequate room in the manhole for the drop whilst retaining working room.

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

~~(c)~~(d) Are required on wastewater systems where the approaching inlet grade is greater than 45 degrees. Internal drop pipework shall be designed to be clear of the design flow and the discharge shall be to a haunched channel. Internal drop pipes shall not be larger than ~~DN~~ 225 mm diameter (nominal bore). The minimum size for a manhole with an internal drop structure is the nominal manhole diameter plus the drop pipe outside diameter.

~~(d)~~(e) Shall be fabricated from PVC-U, ABS or stainless-steel pipe.

~~(e)~~(f) Shall ensure all discharge from the incoming pipe is collected by the drop structure and conveyed to the manhole floor without surcharge or “over-splashing”.

~~(f)~~(g) Shall be securely fastened to the wall with stainless steel fasteners.

~~(g)~~(h) Shall allow unobstructed access to the inlet of the incoming pipeline for the purposes of rodding and inspection.

~~(h)~~(i) Shall permit unobstructed access to the drop structure pipe, through the top, for rodding and inspection.

~~5.6.9~~5.6.10 Manhole lid construction

The following applies to manhole lids:

(a) Manholes in road reserves shall be designed to withstand HN-HO-72 loadings as a minimum.

(b) Manholes in areas where vehicles cannot access, such as hill sections, back sections or pedestrian access ways, may use lighter duty lids which shall have a minimum thickness of 150 mm for manholes up to and including 900 mm nominal internal diameter or 200 mm thick for manholes with a nominal diameter 1050 mm and larger.

(c) Manholes shall have the nominal 600 mm diameter or 1200 mm x 600 mm (for water supply) opening to the side which shall be placed above the manhole rungs. Rungs shall be aligned perpendicular to the main flow. The closest edge of the opening shall typically be between 100 mm and 200 mm from the inside wall of the manhole riser, or with up to 300 mm with written approval from Wellington Water.

(d) The finished ground level shall be a minimum of 150 mm above the top of the manhole lid, and no more than 300 mm. Where a distance of 300 mm is likely to be exceeded, a new manhole riser section shall be used to raise the lid to within acceptable tolerances.

~~5.6.9.1~~5.6.10.1 Adjustment rings

Adjustment rings shall:

(a) Be manufactured from 40 MPa concrete.

(b) Have minimum cover to reinforcement of 50 mm from the inside face and 40mm from the outside face.

(c) Be internally reinforced with a minimum of D12 reinforcement with the entire ring being suitable for HN-HO-72 loading when installed as designed. This will typically result in a ring with a top-face width of around 105 mm.

(d) Sit on a bed of mortar between the lid and the adjustment ring to ensure a non-rocking interface with the lid.

(i) Epoxy mortar is NOT to be used for this purpose to enable future removal of the ring if required.

(ii) Butyl mastic strips or sealants shall be used where the manhole is in the berm and surface water ingress is expected.

~~5.6.9.2~~5.6.10.2 Raising a manhole

Where a manhole frame and cover are to be raised, but the lid or slab remain at the same level, then the following approach shall be followed:

(a) Packing may be placed between the manhole slab/lid and frame, but this additional packing shall not exceed 100 mm.

(b) The packing shall be precast concrete adjustment rings. Bricks shall not be used for this purpose. Mortar may only be used to bed the adjustment ring and frame.

(c) The total packing (sum of packing between the frame and lid/slab) shall not exceed 300 mm. Where the required packing would exceed this amount, the manhole lid (or alternatively the manhole slab in recent WCC manholes) shall be raised instead by building up the supporting walls.

(d) Manhole walls shall be raised using the same construction technique as the existing walls. Precast manholes shall be raised using the minimum possible number of precast risers. Brick manholes shall be raised using a double row of bricks.

(e) In WCC, where a slab of an existing manhole (for drainage) needs to be raised, this shall be achieved using bricks, concrete paving stones or concrete adjustment blocks. The slab shall be raised no greater than 300 mm above the lid. Mortar shall be used to bed and seal the bricks, stones or blocks.

~~5.6.10~~5.6.11 Manhole frame and covers

The following applies to manhole frames and covers:

(a) Only approved manhole covers shall be used on public drains.

(b) All covers shall comply with a minimum load rating to AS 3996 Class D (see also **Section 5.3.8 Manhole covers**).

(c) Covers on wastewater manholes shall have factory fitted, water-tight gaskets to prevent against surface water ingress.

(d) The opening in the manhole lid shall be aligned above any manhole rungs which shall typically be aligned such that entry is perpendicular to the flow. The frame and cover shall be aligned over the lid's access opening.

(e) The cover shall be finished flush with final ground level and shall not rock. Particular care shall be taken in carriageways and footpaths, both public and private, to ensure that the cover is flush.

(f) Where the manhole cover is to be set at an angle, the frame level can be set using 25 mm wide timber shims or steel set screws through the frame flange. The frame shall be set in a bed of mortar in between the lid or adjustment ring. Any set screws shall be removed after setting of the frame on the mortar to ensure full load engagement between the frame and the mortar. Timber shims may remain as these will compress and transfer the load.

(g) On completion of the manhole, the keyways shall be left clean and free of any debris. There should be silicone placed in the key-way to prevent the key-way from filling with debris between construction and inspection.

(h) The frame and any adjustment rings shall be haunched with 20 MPa concrete up to 25 mm below the finished ground level. A gradually tapering rounded haunch profile is required from the manhole lid to the frame with minimum of 50 mm cover to embedded adjustment rings.

(i) A light duty frame shall only be used where there is no vehicular traffic or possibility of vehicular traffic in the future.

~~5.6.10.1~~5.6.11.1 Hinged manhole covers

Hinged covers shall be:

(a) Installed on existing manholes during renewals, upgrades or where new pipe connections are added.

~~(a)~~(b) ~~Where hinged manhole covers are installed in the carriageway, covers shall be~~ Oriented such that the hinge is oriented towards oncoming traffic, where installed in the carriageway. Should the lid pop open under surcharge, the cover will present a 'ramp' to oncoming traffic as opposed to a raised edge.

~~5.6.11~~5.6.12 Changes in grade and direction

All changes in grade and direction shall be made within the manholes unless specifically detailed on the approved plans. Changes in grade and direction outside of manhole, where permitted, shall be formed using factory formed, smooth radius bends or similar.

~~5.6.12~~5.6.13 Repairs to manholes

Minor repairs to manholes may be made by sealing leaks with Sikadur/Sikaflex, or a similar product approved in writing by Wellington Water, then making a more permanent repair by chemical or cement grouting.

~~5.6.13~~5.6.14 Terminal rising-main manholes

Terminal rising-main manholes shall be designed such that turbulence is minimised as the discharge transitions from pressure to gravity flow.

Manholes that receive a rising-main discharge shall be:

(a) Lined with a coating or protective layer resistant to protect the concrete from hydrogen sulphide attack (if the manhole is of concrete construction).

(b) Vented to the atmosphere. Odour treatment may be required if the manhole is located in a built-up area. Odour treatment may require the vent to be force ventilated.

(c) Designed to prevent turbulence where the rising-main discharge traverses any change in grade and where the discharge enters the main flow channel.

(d) The downstream pipeline may also need corrosion protection.

(e) The downstream capacity of the network shall also be taken into consideration during the design stage.

5.7 Field drains

The following applies to field drains:

(a) Field drains shall be constructed from standard drainage pipes slotted to admit water. The slots shall be restricted to the top half of the pipe. All conditions relating to laying of pipes would normally apply to field drains.

(b) Perforated coil drain shall be heavy walled, smooth bore polyethylene with a minimum ring stiffness of 500 N/m/m at 5% deflection and comply with AS 2439.1.

(c) Flexible field drains laid with a main to remove trench water should be laid above the main or if laid beside the main, laid sufficiently far from the main to enable both pipes to be adequately backfilled with compacted material.

(d) Field drains should preferably be connected into a street channel or manhole rather than direct into a stormwater main. Field drains connected into a stormwater manhole may join in above the benching.

5.8 Testing

The following applies to testing of drains:

(a) Testing of drains shall be by either the water test or low pressure air test as outlined in this section (based on tests prescribed in New Zealand Building Code E1/VM1).

(b) For subdivisions, the following requirements must be met:

(i) All sewer and stormwater pipes will be tested upon completion of construction at the applicant's expense and as part of Wellington Water's approval process.

(ii) Wellington Water's representative shall be present during the test and will sign any appropriate documentation to verify the test if successful.

(iii) A minimum of 24 hours of notice is required to be given to the Wellington Water prior to the test being carried out.

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

(v) The developer is required to have met the following requirements prior to pipe testing and Wellington Water arriving on site:

1. Trenched and pipes laid.

2. Bedding and surround material, top and bottom, shall have been laid over the pipe. Minimum 100 mm top and bottom of pipe.
3. All pipe junctions exposed, including laterals and inspection eyes.
4. Lines flushed and all residual debris cleaned out.
5. All fittings and connection to have been installed prior to pressure test.
6. Lines to have been pressurised overnight to the required pressure prior to the test commencing.

(c) For renewals, all mains and branch pipelines, including connections, may be tested after backfilling.

5.8.1 Water test

The following applies to water testing of drainage pipes:

(a) The upstream end of the section under test shall have a minimum head of 1.5 m above the pipe soffit. The maximum head at the lower end of the pipeline shall be 6 m.

(b) Concrete and earthenware pipes shall be soaked for 24 hours prior to the test.

(c) Care shall be taken to ensure that all air is expelled when filling the pipe with water.

(d) For concrete and ceramic pipes, the amount of leakage shall not exceed 0.5 mL water per mm pipe diameter per m pipe length per hour measured over a minimum period of 30 minutes. This is equivalent to 2.25 litres of leakage in 30 minutes for a 30 m long 300 mm diameter pipeline.

(e) For PVC-U and PE pipes, there shall be no leakage after 5 minutes.

5.8.2 Low pressure air test

The following applies to the low-pressure air test for drainage pipes:

(a) The low-pressure air test is applicable to pipelines only and should not be used where new manholes are required to be tested also.

(b) It is recommended concrete and earthenware pipes are soaked prior to the test being completed to ensure a positive test.

(c) Air is to be introduced into the pipeline until a pressure of 3 kPa is reached (300 mm water gauge pressure).

(d) Time is to be allowed for the air temperature to become uniform and pressure to stabilise, typically at least 3 minutes.

(e) The air supply is to be disconnected and the pressure drop measured after 5 minutes.

(f) The pipeline is acceptable if the pressure drop does not exceed 0.5 kPa (50 mm water gauge pressure).

(g) The low-pressure air test is highly susceptible to temperature fluctuations. A 1°C change in temperature can result in a 30 mm change in water gauge pressure. It is recommended to soak concrete and ceramic pipes prior to low-pressure air tests.

5.8.3 Testing of concrete manholes

The following applies to concrete manhole testing:

(a) Manholes ~~shall not typically~~may not be required to be tested, given that~~.~~ the allowable leakage (1 millilitre/millimetre diameter/meter length) over the typically short depth of the manhole is optically difficult to detect.

(i) Notwithstanding this, all manhole joints shall be sealed and any obvious sign of infiltration or exfiltration shall be remedied prior to commissioning.

5.8.4 CCTV inspection

Wellington Water shall require the drain to ~~also~~ be inspected with a colour CCTV camera as follows:

(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) Developers ~~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.

5.8.5 Pressure line testing

Any pipelines that are subject to pressure, such as pumped rising mains or high-pressure inverted siphons, shall be tested to the same requirements as a water supply pipeline of an equivalent material and pressure class.

5.9 Wastewater pumping stations

5.9.1 General

The following applies to wastewater pumping stations:

~~(a) Wastewater pump stations shall generally be dry-well pump installations.~~

~~(b) Wet-well pump installations will be acceptable where individual pumps are less than 10 kW in size.~~

(a) 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 be fenced and provided with a lockable gate as outlined by the council.~~

(i) Architectural featuring of any visible structures shall be within the context of the proposed subdivision and shall be subject to the approval of Wellington Water.

(ii) The minimum standard for fencing is a 1.8 m high, 50mm diamond, 2.5 wire diameter chain link fence with rails top and bottom. In residential areas, fence design shall be considered within the context of the neighbourhood and/or agreed with adjacent landowners.

(b) Wastewater pumping stations are required to:

(i) Pump 120% of the design peak wet weather flow (PWWF) in a duty, or duty assist arrangement with at least one other pump on standby. All pumps shall be of the same make and model.

(ii) The duty shall be interchangeable between pumps.

(iii) Have an operating wet-well storage sized to limit the maximum number of pump starts to 12 per hour, or per the manufacturer's recommendation, whichever is less ~~based on one pump at dry-weather flows~~.

(c) As the pumps will be operating at dry-weather flow conditions most of the time, the selected pump shall be suitable for operating for long durations at the dry weather duty. Efficiency can be sacrificed when the pumps are operating at their wet weather duty, although they shall still be suitable to operate at this higher duty.

(d) Wet-wells shall be vented to prevent the build-up of corrosive gases. Fan assisted activated carbon odour control shall be ~~considered~~ provided in all residential and commercial/retail areas, however consideration will be given to reducing this requirement depending on the environment and ~~the District Plan~~ any consents required under regional plan rules for discharges to air.

(e) Chamber lids and access covers shall be capable of withstanding HN-HO-72 loadings and ~~a minimum~~shall also comply with the requirements of AS 3996 Class D.

(f) For wet wells and dry wells, lids shall be constructed to provide a minimum 1200 x 600 mm clear opening to allow for access and the movement of parts and equipment.

~~(e)~~(g) All valves shall be operable either from the surface or from within a drywell/valve chamber. Valves, including isolation valves and non-return valves but excluding foot-valves, shall not be installed in the wet-well.

~~(f)~~(h) The internal walls, floor and ceiling of all wet-wells shall be protected from corrosion using sulphate resistant linings or construction materials. Internal walls and ceiling shall be coated with: Sikagard 62, or Mastermix Multi-cote, or an equivalent.

(i) The internal walls, floor and ceiling of all dry-wells shall be lined with a Wellington Water approved sealant to assist with cleaning and maintenance.

(j) Floors of all dry wells shall be slip resistant.

(k) Chambers shall be designed to prevent floatation (with consideration given to possible liquefaction) and chamber latches shall be designed to be impervious to inflow and infiltration.

~~(g)~~(l) Access hatches shall be large enough to easily remove equipment and light enough to be lifted safely by one person, gas assisted hatches may be necessary at larger installations; a hinged safety grill will be installed below each access hatch, however each installation will be considered separately.

5.9.2 Equipment requirements

Wastewater pumping stations are required to:

(a) Be metered using a full bore magnetic flow meter either each pump individually or on the common discharge.

(b) Have an approved non-return valve on each discharge pipe between the discharge isolation valve and the pump.

(c) Have ~~an~~ a resilient-seated isolation valve to isolate the pump from any common discharge. ~~All valves in ground are anti-clockwise closing. All valves within the building are clockwise closing.~~

(d) Have ~~an~~a resilient-seated isolation valve on the pump suction (if in a dry-well arrangement).

(e) All valves in ground and buildings, for both trunk main and reticulation mains, shall be clockwise closing. All valves shall include a tag or other means to clearly indicate closing direction.

(f) Have an approved pressure transducer on each wet-well recording the wet-well level accurate to +/- 10 mm.

(g) Have an approved pressure transducer on the discharge recording the pressure to +/- 1 kPa (100 mm H_2O).

(h) Have a dry-well sump pump that discharges back into the wet-well (if in a dry-well arrangement). The sump pump shall sit in a sump at least 300 mm deep and be controlled by floats that start prior to ~~when~~ the water level reaching~~exceeds~~ the top of the sump wall and stops when the water level recedes 50 mm above the pump volute~~below the top of the sump wall~~. The sump pump should be able to handle solids up to 30 mm diameter as a minimum.

(i) Have guide-rails and a self-seating discharge bend (if in a wet-well arrangement) to ensure the pump is lowered into place without fouling or requiring manual connection.

(j) Have a 316 stainless steel chain fixed to each pump to enable the lifting and lowering of any submersible pumps into position.

(k) Have an air-release mechanism between the pump and the non-return valve to promote self-priming in the event of an air-lock (if in a dry-well arrangement). The air discharge from the valve is to be piped back into the wet-well.

(l) Have a tapping on the common discharge with a 25 mm BSP male/female stainless steel ball valve fitted with lever handle with a manual safety release.

(m) Have single bellows mechanically isolating the pump from the suction and discharge pipe. Tie rods are not to be used with the bellows (dry-well installations).

(n) Have a metered water supply ~~provided to the station equipped~~ with ~~a~~ reduced pressure zone (RPZ) backflow ~~prevention device~~preventer installed to allow for wash-down and connection of the wet well and storage tank washer systems. The supply shall be fitted with a tap connection with 20 mm BSP (minimum) thread to allow fitting of a hose. The water service connection shall be minimum DN32 terminating in a stainless steel lockable cabinet adjacent to the wet well.

5.9.3 Pipework

The following applies to wastewater pumping station pipework:

(a) Pipework shall be ductile iron manufactured to AS/NZS 2280 and fusion epoxy bonded coated to AS/NZS 4158.

(b) Pipework shall have a minimum pressure rating of PN16 unless the design working pressure requires a higher pressure class.

(c) Flanged or spigoted bends, tees and "specials" fabricated from STCL may be permitted where ductile iron fittings are not practicable. These shall be manufactured to the requirements of NZS 4442 with the ~~and be~~ external surface either polyethylene tape wrapped ~~and concrete lined at the fabricators,~~ or epoxy coated to AS/NZS 3862. An epoxy coating is to be applied over the internal concrete lining.

(d) Special abrasion resistant linings may need to be considered where pipework has a history of high grit and flow velocities. A specialist abrasion resistant coating maybe required where velocities exceed 4 m/s.

(e) ABS pipework may be used provided the pipe is suitably isolated from vibration. Stub flanges shall be used with backing rings; plastic flanges will not be permitted under any circumstances. All fitting in ABS are to be fabricated by the supplier.

(f) Flanges shall comply with the following:

~~(i) be AS/NZS 4087 PN16 (Fig B5 ductile iron or Fig B7 steel). This drilling pattern is typically compatible with AS 2129 (BS10) Table D.~~

(i) Ductile iron flanges shall comply with the latest revision of AS/NZS 4087 Figure B5.

(ii) Carbon steel flanges shall comply with the latest revision of AS/NZS 4087 Figure B7.

(iii) No other flange materials shall be permissible.

(g) The inlet pipe from the network to the wet-well shall enter the wet-well above the all-pumps-start level such that the inlet flow is not affected by backflow from the station wet-well under normal PWWF operating conditions.

All pipework:

(h) Crossing a soil-structure interface shall be designed to withstand differential movement due to settlement or seismic movement.

(i) Shall be supported and designed to withstand seismic forces as per NZS 4219.

(j) In the wet-well shall be welded or flanged 316/316L stainless steel or ABS.

(k) Shall be arranged such that the rising main can drain directly into the wet-well.

5.9.4 Pumps

Pumps shall be:

(a) Of a non-clogging type with a minimum through-let of 75 mm where practicable. Hardened impellors shall be specified when ordering.

(b) Rated capable of a minimum ~~12~~ 8 starts per hour when started direct online.

(c) Operated using a variable speed drive if rated 5 kW or greater.

(d) Be selected to have its duty point within ±10% of the best efficiency point (BEP) unless otherwise approved by Wellington Water.

(e) The minimum pump efficiency at the duty point shall not be less than 50%. Lower efficiencies may be approved in cases where:

(i) the pumps are very small, or

(ii) the pump curve is very flat thus resulting in low energy use, or

(iii) meeting this specification would result in excessive clogging.

5.9.5 Dry-well installations

The following applies to dry-well installations:

(a) Concrete plinths shall be used for dry-well plinths.

(b) Steel pump supports may be considered with ductile iron and/or steel suction and discharge pipework, which are less susceptible to vibration.

(c) Steel plinths will not be considered where ABS pipe is used.

(d) Forced ~~negative pressure~~ positive ventilation ~~shall be provided~~ to the dry-well should be used, with a fan blowing air in at the top~~being drawn~~ and expelled ~~from the top of the dry-well, and fresh air being drawn into and piped to~~ from the pipe within 900 mm of the dry-well floor.

(i) The number of air-changes shall comply with the NZBC for an occupied space.

(ii) Prior to entry into the dry-well, operators are to have a clear line-of-site to the operating status of the ventilation system to confirm it is operational. This may require the installation of an additional alert system at the entry point.

~~(ii)~~(iii) Both the inlet pipe and the outlet ventilation pipes shall be to an external space with good natural ventilation and with both the inlet and outlet suitably separated to avoid mixing of the exhaust and incoming air.

(e) Dry-well hatches for below ground dry-wells shall be sealed against water ingress. They shall have a minimum load rating of AS 3996 Class D. ~~Multipart lids shall be constructed to provide a 1200 x 1200 mm clear opening to allow parts and equipment to be lowered into the dry well.~~ Access openings shall be fitted with a protective screen which will prevent accidental falls into the dry-well when the hatch is open.

(f) The dry-well is to include a gantry system (or similar) which will enable pumps to be lifted to a lay down area. There shall be provision for suitably sized lay down area as well as a mechanical system in place to lift pumps from the lay down area to outside the dry-well.

(g) For each pump the minimum working room around the pumps shall be 600 mm

(h) The minimum working room in front of the control switchboard shall be 1200 mm.

(i) Flow meters and the control switchboard are to be housed within the dry-well unless dispensation is granted by Wellington Water.

(j) Bellows shall be installed on the delivery side and considered on the suction side of the pump, unless agreed otherwise with Wellington Water, to manage vibration and noise through the pipework.

(k) Dry-well installations shall have smoke detectors and emergency lighting connected to SCADA for alarming.

5.9.6 Electrical specification

The electrical design shall take into account the following:

(a) The electrical and SCADA specification and standard design shall be obtained from Wellington Water prior to design.

(b) The control switchboard shall be provided with a plug and wiring capable of allowing an emergency generator of a suitable size to power the station to start and maintain the station's design duty point at design peak wet-weather flow.

~~(b)~~(c) The form of connection (plug or tails) must be approved by Wellington Water.

5.9.7 Private wastewater pumping stations

In addition to the above specification, the following shall be applied to private wastewater pumping stations that are not associated with a smart pressure sewer system:

(a) Pumps shall have an open multi-channelled impellor with a macerator/grinder on the intake (allowing maximum 8 mm free passing). Pumps shall also have thermal overload protection and a liquid temperature rating of 40°C.

(b) Materials and design shall have minimum 50 years durability.

(c) The rising main shall be a minimum of 63 mm OD high performance polyethylene (PE100) standard dimension ratio 11 (SDR11).

(d) 90-degree bends are not permitted on pipes less than 90mm OD. The preference is to use a long radius or swept bend constructed from a section of pipe. Two 45-degree bends may be used where required.

(e) All controls, electrical equipment and cables are to be provided with suitable weatherproof enclosures and sited above 1% AEP flood level.

(f) The station shall be fitted with an audible and visual alarm system indicating pump failure and overflow.

~~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.~~

(g) Additional emergency storage or an emergency disposal field may be required depending on the surrounding environs and scope of the development.

(h) For pumping stations associated with smart pressure sewer systems, please contact Wellington Water for the latest guidance.

5.10 Stormwater pumping stations

5.10.1 General

The following applies to stormwater pumping stations:

(a) Wet-well pumping arrangements are generally acceptable and considered practicable for large installations.

(b) Submersible pumps shall be installed on guides (centrifugal pumps) or in casings (axial flow pumps) and shall be provided with a means to remove them without draining of the wet-well or taking the station out of operation.

(c) Electrical equipment shall be housed in a cabinet or structure that can be suitably accessed during wet-weather without compromising operator safety or safe operation of the station.

(d) Stormwater pumping stations are required to:

(i) Pump the design flow in a duty, or duty-assist (or multiple assist) arrangement with one pump on standby.

(ii) Have an operating regime and system that limits the number of pump starts to 8 per hour.

(e) A metered water supply and tap outlet shall be provided to the immediate vicinity of the station and fitted with and approved RPZ backflow preventer.

(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.

(g) If required by council or Wellington Water, the site shall ~~be fenced and provided with a lockable gate~~be secured to prevent public access as outlined by ~~council~~Wellington Water.

(i) Architectural featuring of any visible structures shall be within the context of the proposed subdivision and shall be subject to the approval of Wellington Water.

(ii) The minimum standard for fencing is a 1.8 m high, 50 mm diamond, 2.5 mm wire diameter chain link fence with rails top and bottom. In residential areas, fence design shall be considered within the context of the neighbourhood and/or agreed with adjacent landowners.

(h) Chamber lids shall provide access openings centrally over each pump and shall be designed to withstand HN-HO-72 loadings ~~when in roads (including paths and berms)~~and rated to a minimum of AS 3996 Class D.

(i) Access openings shall be provided with protective screens to prevent people from falling into the chamber while maintenance is being carried out.

(j) The wet well shall be designed such that the wet well can be isolated from the reticulation and drained without compromising minor stormwater flows. Isolation can be via a penstock gate or stop-logs specifically stored on-site.

5.10.2 Equipment requirements

Stormwater pumping stations are required to:

(a) Have an appropriate means to stop recirculation of pumped water either by non-return gate or motorised penstock.

(b) Have an isolation valve to enable the isolation and inspection/removal or any pump.

(c) Have an approved pressure transducer/probe on the suction side of the pumps to record levels/pressure to +/- 10 mm H_2O (0.1kPa).

(d) Have an approved pressure transducer/probe on the discharge side of the station recording the pressure to +/- 10 mm H_2O (0.1kPa).

(e) Have bar screens or similar to prevent rubbish entering the pump volute. A means of accessing and cleaning the screens shall be included in the design.

~~(f) Have chamber lids and access covers capable of withstanding HN-HO-72 traffic loads and rated to a minimum of AS 3996 Class D.~~

5.10.3 Pumps

The following applies to stormwater pumps:

(a) All pumps in a station shall be of the same make and model.

(b) Pumps shall be submersible pumps with a non-clogging hardened impellor.

(c) Pumps shall be rated capable of a minimum 8 starts per hour when started direct online.

(d) Valves shall isolate all pumps and incorporate an easily dismantled pipe joint near the pump, which enables easy removal of the pump.

(e) Each duty pump shall be capable of passing all required flows up to and including the design flow without exceeding the restriction on the number of starts.

(f) Where practical, the pumps shall be installed in a duty-standby arrangement with each pump capable of accommodating the full flow. The duty shall be interchangeable between pumps.

(g) Where multiple pumps are used, only one pump is required to be on standby while the others are on duty or assist; for example, in a three-pump arrangement, the full design flow can be carried by only two pumps with one pump on standby.

5.10.4 Pipework

The following applies to stormwater pumping station pipework:

(a) Pipework shall be ductile iron manufactured to AS/NZS 2280 and fusion epoxy bonded coated to AS/NZS 4158.

(b) Pipework shall have a minimum pressure rating of PN16 unless the design working pressure requires a higher-pressure class.

(c) STCL shall also be permitted manufactured to NZS 4442 and either polyethylene tape wrapped and concrete lined at the fabricators, or epoxy coated to AS/NZS 3862. AWWA M11[20] may also be used for the design of steel pipes.

(d) Suitably rated concrete pressure pipes may also be used for low pressure scenarios (less than 10 metres pressure).

(e) Special abrasion resistant linings may need to be considered where pipework is expected to have high flow velocities. A specialist abrasion resistant coating maybe required where velocities exceed 4 m/s.

(f) Flanges shall ~~be AS/NZS 4087 PN16 (Fig B5 ductile iron or Fig B7 steel). This drilling pattern is typically compatible with AS 2129 (BS10) Table D~~ comply with the following:

(i) Ductile iron flanges shall comply with the latest revision of AS/NZS 4087 Figure B5.

(ii) Carbon steel flanges shall comply with the latest revision of AS/NZS 4087 Figure B7.

(iii) No other flange materials shall be permissible.

(g) All pipework shall be supported and designed to withstand seismic forces as per NZS 4219.

5.10.5 Dry-well installations

See **Section 5.9.5 Dry-well installations**.

[20] *M11 Steel pipe: A guide for design and installation.* American Water Works Association

5.10.6 Electrical specification

The electrical design shall take into account the following:

(a) The electrical and SCADA specification and standard design shall be obtained from Wellington Water prior to design.

(b) Pumps over 2 kW shall employ a minimum of a soft starter on each pump capable of handling 8 starts per hour. Variable speed drives are permitted.

(c) The control switchboard shall be provided with a plug and wiring capable of allowing an emergency generator of a suitable size to power the station to start and maintain the maximum design ~~wet weather~~ flow rate.

(d) The form of connection (plug or tails) must be approved by Wellington Water.

6 WATER SUPPLY SPECIFICATIONS

6.1 Hygienic practices and immunisations

Any person, plant or material ~~etc~~ on a work site will be required to leave the site until hygiene and immunisation requirements of this specification are met.

A high standard of hygiene is to be maintained by all personnel working on the water supply reticulation.

Refer to **Section 4.1.1 Immunisations** for relevant information on immunisations and vaccinations.

6.1.1 Cleanliness

(a) Measures must be taken to ensure all pipes are clean and to prevent material getting inside the pipe during laying operations.

(b) Pipes must be inspected immediately prior to laying to ensure cleanliness.

(c) Outside working hours, the end of the pipe must be kept tightly sealed to prevent ingress by water or trench materials.

(d) Particular care must be taken where the pipe end could be affected by stormwater flows or groundwater levels under all conditions.

(e) An antibacterial lubricant suitable for use with potable water must be used on all gaskets and rubber rings coming into contact with potable water (see **Section 6.2.1.1 Suitability for contact with drinking water**).

~~6.1.1 Immunisations~~

~~The following applies to immunisations:~~

~~(d) The following testing treatment and immunisation regime shall be adhered to:~~

~~(i) **Hepatitis A.** If a blood test proves the presence of antibodies, no vaccination is required. If no antibodies are detected, immunisation using appropriate vaccine shall be carried out.~~

~~(ii) **Hepatitis B.** If a blood test proves the presence of antibodies, no vaccination is required. If no antibodies are detected, three consecutive vaccinations at monthly intervals shall be administered, followed by a blood test after one further month.~~

~~(e) The following routine vaccination schedule shall be followed by all staff working on the reticulation:~~

~~(i) Polio – every 10 years~~

~~(ii) Typhoid – every 3 years~~

~~(iii) Tetanus – every 3 years~~

~~(f) No contractor's staff employed on other sites involving work in or on any river, drain, or sewer, shall be allowed to carry out work on the water supply network unless permanently transferred and undergoing the above tests and vaccinations.~~

~~(g) Clearance Certificates, signed by a registered medical practitioner, shall be sent to Wellington Water at the first opportunity.~~

~~(h) Where the contractor's employees have already been certified, the contractor shall submit a list of names of such persons for checking. If new persons are engaged during the progress of the work, the contractor shall seek Wellington Water's direction as to what work they may be engaged upon pending production of a certificate.~~

~~(i) No person will be employed in making connections to existing water mains unless that person has clearance. Wellington Water reserves the right to order from the Site, at any time, any person for whom a satisfactory clearance has not been obtained.~~

6.1.2 Equipment

The following applies to the hygienic use of equipment:

(a) All items to be used on the water supply reticulation are required to be disinfected with 100 mg/L chlorine solution and hygienically maintained for work on the water supply reticulation.

(b) ~~No~~ Any tools or clothing used on any work in or on any river, drain, ~~or~~ sewer or other non-potable water work shall not be used on water supply work without first being disinfected. This shall also apply to excavator buckets.

(c) Any vehicle used in water supply work as a service vehicle for making inspections, attending leaks and other call-outs, or making connections, and equipped for the purpose of being a water service vehicle or carrying a permanent stock of spare fittings, ~~shall~~ should not be used on any ~~other~~ non-potable water work:

(i) If used on non-potable water work, ~~unless~~ the vehicle ~~has been~~must be fully decontaminated in a manner approved by Wellington Water prior to returning to water supply work.

(ii) The contractor shall provide a Certificate of Decontamination declaring what measures were taken.

(iii) The contractor shall impose identical conditions to the above on any subcontractor they employ~~ed by him~~ in the course of the Contract.

6.2 Materials

6.2.1 Materials compliance

The following applies to materials compliance for water supply:

(a) All materials shall conform to the standard specified. Compliance with the required standards shall be demonstrated by third party certification.

(b) All materials shall, at Wellington Water's discretion, be subject to test under the appropriate standard. Materials shall also be subject to Wellington Water's approval even though they conform to the appropriate standard specification.

(c) Current approved materials are listed in the Approved Products Register published on Wellington Water's website. Approvals are subject to change. Care shall be taken that designers and specifiers are using the most current version.

(d) Materials that do not comply with the prescribed standards and/or specifications listed shall only be used with the written permission of Wellington Water.

6.2.1.1 Suitability for contact with drinking water

Products and materials must comply with the following:

(a) Products, and their components, must be third party certified to AS/NZS 4020 to be considered for use in the public network.

(b) Wellington Water may consider products that are certified compliant with BS 6920 by a third party, or are registered as approved by the:

(i) Drinking Water Inspectorate (DWI)

(ii) Water Regulation Advisory Scheme (WRAS) or

(iii) American National Standards Institute/National Sanitation Foundation standard ANSI/NSF 61.

(c) Compliance with the organisations listed in **Section 6.2.1.1**(b) **Suitability for contact with drinking water** does not necessarily mean it is compliant with AS/NZS 4020. ANSI/NSF 61 does not consider taste and odour effects or the potential for materials to promote the growth of microorganisms. BS 6920, which WRAS base their approvals on, does not test for leaching of mutagenic compounds or include testing for metallic products. DWI is the preferred alternative certification to AS/NZS 4020, as this uses BS 6920 test, plus a suite of other tests to ensure products are suitable for use in a public waters supply network.

(d) When assembling rubber ring joints, a water-based lubricant specifically made for this purpose, which is certified to AS/NZS 4020, shall be used in accordance with the manufacturer's instructions. The joint lubricant shall incorporate a bactericide.

6.2.1.2 Existing non-compliant pipes

If, during the course of construction work, a non-compliant pipe material is identified, Wellington Water, or their contracted representative, shall be contacted to gain approval for its renewal. This will include existing copper, PE80b, PE80c, alkathene, PVC and galvanised iron service pipes.

6.2.2 Concrete

See:

- **Section 5.3.1 Cement**
- **Section 5.3.3 Reinforcing steel**
- **Section 5.3.5 Non-structural concrete**
- **Section 5.3.6 Structural concrete**

6.2.3 PVC pipes

The only PVC variant pipes that are permitted for use in the network are PVC-U and modified polyvinyl chloride (PVC-M).

PVC pipes shall not be used in the following conditions:

(a) Where the pipeline is a pumped rising main.

(b) Where the pipeline is an above ground pipeline.

(c) Where lateral spreading is expected to occur.

(d) Where slope stability issues are expected to occur.

(e) Where ground liquefaction is expected to occur.

(f) Where the ground is contaminated by aromatic industrial solvents.

PVC-U and PVC-M pipes shall comply with the following:

(g) Pipes shall be jointed using EPDM elastomeric sealing rings in a socket spigot push fit arrangement.

(h) Jointing lubricant that complies with AS/NZS 4020 and comprising water based emulsions and a bactericide shall be used on all joints.

(i) Bends and tees used with PVC pipe shall be ductile iron and comply with AS/NZS 2280 or ISO 2531.

(j) Series 1 pipe shall be specified for all new subdivision and renewal projects.

(k) Series 2 pipe of a similar class as existing may be specified for repairs of an existing Series 2 compatible pipeline.

(l) Pipes shall be, as a minimum, rated to an operating pressure of 12 bar (PN12) although the pipe rating shall be designed and specified as per the method outlined in the ~~RSWS~~Regional Standard for Water Services.

6.2.3.1 PVC-U pipes

PVC-U pipes shall comply with AS/NZS 1477.

~~(g) Pipes shall be jointed using EPDM elastomeric sealing rings in a socket spigot push fit arrangement.~~

~~(h) Jointing lubricant that complies with AS/NZS 4020 and comprising water based emulsions and a bactericide shall be used on all joints.~~

~~(i) Bends and tees used with PVC pipe shall be ductile iron and comply with AS/NZS 2280 or ISO 2531.~~

~~(j) Series 1 pipe shall be specified for all new subdivision and renewal projects.~~

~~(k) Series 2 pipe of a similar class as existing may be specified for repairs of an existing Series 2 compatible pipeline.~~

~~(l) Pipes shall be, as a minimum, rated to an operating pressure of 12 bar (PN12), although the pipe rating shall be designed and specified as per the method outlined in the RSWS.~~

6.2.3.2 PVC-M pipes

The following applies to PVC-M pipes:

(a) PVC-M pipes shall comply with AS/NZS 4765.

~~(b) Pipes shall be jointed using EPDM elastomeric sealing rings in a socket spigot push fit arrangement.~~

~~(c) Jointing lubricant that complies with AS/NZS 4020 and comprising water based emulsions and a bactericide shall be used on all joints.~~

~~(d) Bends and tees used with PVC pipe shall be ductile iron and comply with AS/NZS 2280 or ISO 2531.~~

~~(e) Series 1 pipe shall be specified for all new subdivision and renewal projects.~~

~~(f) Series 2 pipe of a similar class as existing may be specified for repairs of an existing Series 2 compatible pipeline.~~

~~(g)~~(b) ~~Pipes shall be, as a minimum, rated to an operating pressure of 12 bar (PN12) although the pipe rating shall be designed and specified as per the method outlined in the RSWS.~~PVC-M pipes shall not be used in areas contaminated with, or may potentially be contaminated with, chemicals, especially organic solvents.

6.2.4 Polyethylene pipes

The following applies to PE pipes:

(a) PE pipe manufactured with PE 100 material, a minimum of PN 16, SDR11 wall thickness to conform to AS/NZS 4130 and AS/NZS 4131. Metric diameters (Series ~~2~~1) shall only be used.

(b) They shall be blue in colour, or black with blue stripes or black walled with blue external "jacket". Black pipes shall be used for any above ground applications.

~~For bulk water pipelines, the pipe and material is to be tested in an International Accreditation New Zealand (IANZ) registered laboratory. The pipes shall be supplied with manufacturer's quality assurance data and test results for the batch of pipes to be used.~~

(c) For PE pressure pipelines pipe compliance to AS/NZS 4130 shall be demonstrated by providing copies of the BRTs specified in Table A-1 of AS/NZS 4130.

(d) For PE pressure pipelines material compliance to AS/NZS 4131 shall be demonstrated by providing copies of the BRTs specified in Table A-1 of AS/NZS 4131.

(e) For PE fittings for pressure pipelines compliance to AS/NZS 4129 shall be demonstrated by providing copies of the BRTs specified in Table A-1 of AS/NZS 4129.

(f) Laboratories undertaking this testing shall be Third Party Certified to ISO 17025 by an accredited certifying authority.

(a) PE pipe should not be used where ~~high concentrations of~~ hydrocarbons are ~~present~~detected as it may result in tainting of potable water or long-term weakening of the pipe and reduction in the factor of safety.

~~(c)~~(b) Any pipe with a surface scoring deeper than 10% shall not be used.

6.2.5 Ductile iron pipes

The following applies to ductile iron pipes:

(a) Pipelines conforming to AS/NZS 2280 may be used when repairing existing compatible pipelines, ~~only~~ for new bulk water pipelines, or on special application to Wellington Water.

(b) New pipelines, other than those covered in (a) above, shall be laid with ductile iron pipe complying with ISO 2531. Pipes shall be securely wrapped with a polyethylene sleeve with a minimum thickness of 200 microns. The sleeve shall be wrapped with a minimum 48 mm wide PVC, polypropylene or polyethylene tape at 600 mm spacing.

(c) Additional protection will be specified by Wellington Water for installation in corrosive soils.

~~(c)~~(d) Ductile iron pipe shall not be used in estuarine conditions or in soils with soil resistivity less than 1,000 Ohm-cm (because of corrosion) or where the ground is contaminated by hydrocarbon fuels.

~~(d)~~(e) Allowable ductile iron pipe diameters for the bulk water distribution network are shown in **Table 6-1**.

(f) Refer to **Section 6.4.7 Ductile Iron Pipe**.

Table 6-1 – Allowable ductile iron and steel pipe diameters for the bulk water distribution network

Nominal diameter (mm)	Outside diameter (mm)
100	122
150	177
200	232
250	286
300	345
375	426
500	508
600	610
650	667
750	762
900	914
1050	1067
1200	1220
1400	1420

6.2.5.1 ISO 2531 for new pipelines

The following applies to ductile iron pipe ISO 2531 requirements:

(a) Ductile iron pipe shall comply with ISO 2531 and be of a minimum rating of PN25 (pipe's pressure rating when unrestrained).

(b) Restraining systems shall be used for all installations. The joint restraint system shall be selected based on the proposed laying environment and will have a minimum pressure rating of 16 bar.

(c) The pipe exterior shall be zinc coated under an epoxy coat at least 100 microns thick. The internal lining shall be concrete or epoxy coating.

(d) Ductile iron fittings shall be ISO 2531 and comply with the requirements in **Table 6-2**.

Table 6-2 – Ductile iron pipe ISO 2531 requirements

Item	Requirement
Compliance with manufacturing standard	ISO 2531
ISO 2531 Clause 4.1.4	AS/NZS 4020

Item	Requirement
ISO 2531 Clause 4.2.2.1	100 mm to 300 mm - 1.5 mm 400 mm to 600 mm - 2.5 mm 700 mm to 1,000 mm - 4.0 mm
ISO 2531 Clause 4.2.4.1	Standard pipe length shall be 5.5 m or 6.0 m
ISO 2531 Clause 4.4.2	Pipes shall be Portland cement mortar lined, or blast furnace slag cement mortar lined
ISO 2531 Clause 4.5.2	Fittings shall be FBE lined
Minimum allowable pressure class	C 40 (4 MPa) – for pipes 100 mm to 300 mm C 30 (3 MPa) – for pipes 350 mm to 600 mm C 25 (2.5 MPa) – for pipes 700 mm to 1,000 mm
Minimum allowable DN	100 mm
Maximum allowable DN	1,000 mm

6.2.5.2 AS/NZS 2280 for repairing bulk water pipelines and existing compatible pipelines

The following applies to ductile iron pipe AS/NZS 2280 requirements:

(a) For bulk water pipelines, ductile iron pipes shall be cement mortar lined internally and bituminous paint exterior coated conforming to AS/NZS 2280 PN35.

~~(e)~~(b) Ductile iron pipes for reticulation complying with AS/NZS 2280 and rated to a minimum PN20 may be used.

~~(f)~~(c) All socket-spigot DI pipe shall be joined using restraining gaskets to prevent joint pull-out. The proprietary gaskets shall ensure a minimum PN16 ~~bar rating~~ is retained by the pipe system and joint.

~~(g)~~(d) Factory applied concrete internal lining in compliance with the above standard, and bitumen external coating is required as a minimum. Approved epoxy linings will be accepted as will zinc and/or epoxy coatings.

~~(h) Pipes shall be securely wrapped with a polyethylene sleeve with a minimum thickness of 200 microns. The sleeve shall be wrapped with a minimum 48 mm wide PVC, polypropylene or polyethylene tape at 600 mm spacing.~~

~~(i)~~(e) Ductile iron pipes with factory applied protective coatings may be installed without polyethylene sleeving, but it must be demonstrated that the receiving ground conditions do not adversely impact on the durability of the pipe coating and design life of the pipe.

6.2.6 Steel pipes

The following applies to steel pipes:

(a) Steel pipe shall not be used in estuarine conditions (because of corrosion).

(b) Steel pipes shall be to NZS 4442 with wall thicknesses to NZS 4442 Table 2, column (b). Notwithstanding the values in column (b):

(i) Pipes from 400 mm to 600 mm shall have a minimum wall thickness of 6.4 mm. ~~and~~

(ii) Pipes larger than 600 mm shall have a wall thickness no less than the outside diameter divided by 95.

(c) Pipe to AS 1579 of similar dimensions may be considered on special application to Wellington Water.

(d) Steel pipe shall have a factory applied concrete lining and polyethylene wrapped external coating to the standard set out in NZS 4442. Factory applied epoxy or fusion bonded coatings will also be acceptable provided they are certified as compliant with the requirements of AS/NZS 4020.

(e) For pipes DN ~~600~~ 650 (667 OD) and greater, the pipe shall have hemi-spherical slip in joints to BS 534 to permit welding both internally and externally with a full width fillet weld. The pipe bell shall be supplied with a tapped hole for nitrogen pressure testing of the completed joint.

(f) For pipes less than 600 mm, the pipes shall be plain ended and joined using full penetration butt weld.

(g) Welding bands may be required where a butt weld is not practicable.

(i) The mating ends of the pipe shall be cut square and any exposed steel coated with a self-priming AS/NZS 4020 approved solvent free steel primer to prevent post installation corrosion.

(ii) The joint shall be internally lined with mortar for pipes 600 mm nominal bore and greater.

(h) Flanged steel pipe is acceptable for all pipe sizes.

(i) Ferrules shall not be used on steel pipes.

(j) Allowable steel pipe diameters for the bulk water distribution network are shown in **Table 6-1**.

6.2.7 Copper pipes

Copper pipe shall comply with NZS 3501.

6.2.8 ABS pipes

The following applies to ABS pipes:

(a) ABS pipes and fittings shall comply with AS/NZS 3518 and dimensions shall be Series 1 (metric).

(b) Bends and tees shall be factory moulded and not fabricated post-production.

(c) All connections shall be cold solvent welded.

(d) ABS pipes will typically only be accepted in smaller pumping stations where ductile iron or steel pipework is impractical. It shall not be used for buried pipe applications.

6.2.9 Stainless steel pipes

The following applies to stainless steel pipes:

(a) Stainless steel pipes shall not be used in underground applications.

(b) The following may be used for above ground situations such as pumping stations or valve chambers: 316~~,~~ or 316L~~, 304 or 304L~~.

(c) A minimum grade Schedule 40 stainless steel pipe conforming to ASTM A312 shall be used.

(d) Flanged joints are the preferred method of joining stainless steel pipes.

6.2.10 Manholes

Manholes are designed around the use of standard diameter concrete chamber risers (e.g., 1,500 mm and 2,100 mm) to allow the use of precast concrete top slabs to be used. The following applies to all manholes for water supply:

(a) The top slabs shall be capable of withstanding HN-HO-72 loadings and a minimum of AS 3996 Class D.

(b) All joints shall be rendered neat with mortar.

(c) The manholes shall be designed with a drainage discharge point into the bedding metal of the pipe.

(d) Stainless steel step irons at 300 mm centres shall be installed.

6.2.10.1 Bulk water pipeline access manholes

The following applies to manholes on bulk mains with 650 mm or larger diameters:

(a) Pipeline access manholes shall be installed no further apart than 300m.

(b) The 600 mm nominal diameter flanged branches shall be welded to the pipeline in accordance with this specification.

(c) The 600 mm nominal diameter cover plate shall be prepared and coated with 300 microns of Carboguard 690 in two layers or approved alternative potable water protective coating.

(d) A 25 mm stainless steel ball valve shall be fitted to the access chamber cover plates. Before fitting the access chamber cover plate, the faces of the flanges shall be perfectly clean.

(e) The joint shall be made with a 3 mm thick insertion rubber gasket. The bolts shall be carefully tightened in opposite pairs until the joint gasket is sufficiently compressed between the flanges to ensure water tightness at the pipeline hydraulic test pressure.

6.2.10.2 Manhole covers

The following applies to water supply manhole covers:

(a) Only approved covers shall be used on public pipelines.

(b) All covers shall be capable of withstanding HN-HO-72 loadings and comply with a minimum load rating to AS 3996 Class D. Higher loadings may be required depending on the anticipated application (e.g., airports or loading yards).

(c) General cover specifications are as follows:

(i) The top surface of the frame and cover shall be flush.

(ii) The cover shall allow a 600 mm diameter minimum clear opening.

(iii) The cover shall be a heavy duty ductile iron Sika 1200 x 600mm or similar cover with hinged joints, bolted to the concrete top, to allow access to manually operated fittings e.g. air valves, flow meters.

(d) Particular attention is drawn to the need to ensure that the covers shall not rock.

6.2.11 Valves

For gate valves and butterfly valves (see **Standard Detail WS05 – Typical Valve Details**):

(a) The valve body shall be internally and externally coated with an approved coating conforming to AS/NZS 4158.

(b) Valves shall be fitted with a key dolly for operation with a standard valve key.

(c) Valve spindle extensions shall be installed, if required, to bring the top of the square drive to between 150 mm and 450 mm of the ground surface, with a target depth of 200 mm.

(d) All valves shall include a tag or other means to clearly indicate closing direction.

~~6.2.9.1~~6.2.11.1 Gate valves

The following applies to gate valves DN 80 mm and greater:

(a) Gate valves to be used on the network as line, branch or scour valves, DN 80 and above, shall be resilient seated with a ductile iron body. They shall comply with AS/NZS 2638.2 and shall be anti-clockwise closing.

(b) Flanged valves shall be used for all installations.

(c) Socket, spigot, shouldered or groove end valves are not permitted for use in the network without special permission. The standard acceptable valves available for use in the network are listed in the Approved Products Register.

(d) Valves complying with BS 5163.1 may be considered for trunk water supply pipelines.

(e) For bulk water pipelines, gate valves shall be flanged to AS/NZS 4331.2

~~(e)~~(f) All gate valves shall be a PN16 minimum, unless design conditions require a higher pressure class.

~~(f)~~(g) Valves in ~~chambers or~~ buildings shall have hand-wheels.

~~(g)~~(h) Buried valves DN 80 or greater shall be operated by a standard key and bar.

(i) Spindle caps shall be a maximum of ~~350~~ 450 mm below the finished ground level.

(ii) Where unavoidable, extension spindles may be used to meet this requirement where mains are necessarily at depth, but the means of positively fixing the extension to the spindle shall be approved by Wellington Water to ensure a non-friction based fixing system is adopted that is not susceptible to failure over the required design life due to corrosion or wear. Extension spindles shall be one piece, secured to the valve spindle, colour-coded white or red to indicate closing direction and epoxy coated.

~~(h)~~(i) Valves DN 100 and greater shall be flanged both ends.

~~(i)~~(j) On rubber-ring jointed pipelines, including pipelines with restraint gaskets, in-line thrust blocks shall be installed on valves to resist forces due to differential pressures across the valve.

~~(j)~~(k) Valves DN 375 ~~mm~~ and greater shall incorporate a bypass valve of no less than DN 100 ~~mm~~.

~~(k)~~(l) Wellington Water may require valve chambers for large diameter valves, especially those with an actuator. Where valve chambers are required, the connection between the valve chamber and the pipeline shall ~~have full seismic resilience~~be seismically resilient.

~~(l)~~(m) Hand-wheels, spindle caps and nuts and bolts shall be protected against corrosion and, with the exception of hand-wheels, shall be suitable for buried application.

The following applies to gate valves less than DN 80~~ mm~~:

~~(m)~~(n) Gate valves less than DN 80~~ mm~~ shall be manufactured to DIN 3552 Part 4 and of ductile iron with a resilient seated gate.

~~6.2.9.2~~6.2.11.2 Butterfly valves

The following applies to butterfly valves:

(a) Butterfly valves shall comply with AS 4795.2 and be double flanged, resilient sealed, anti-clockwise closing, with a minimum pressure rating of PN 16 and suitable for bi-directional flow and end-of-line service.

(b) For pipes larger than 300 mm diameter, the valve seal shall be fixed on the valve.

~~(b)~~(c) Face to face dimensions shall be to AS 4795.2 or ISO 5752.

~~(c)~~(d) Lugged valves complying with AS 4795.1 will also be considered for certain applications where space is a premium, such as manhole applications.

~~(d)~~(e) Semi-lugged or wafer style valves require specific approval for use anywhere in the water supply network and are not typically accepted without good reason.

~~(e)~~(f) Butterfly valves shall have a handwheel and gearbox for valves DN 200 or greater. A position lockable lever is required for all valves smaller than DN 200. Position indication shall be fitted on the butterfly valve.

~~(f)~~(g) Butterfly valves shall be fusion bonded epoxy coated to AS/NZS 4158 and designed for a 50 year service life.

6.2.11.3 Ball valves

Ball valves shall be:

(a) Typically used for applications up to DN 50.

(b) Two piece, full bore, lever operated heavy duty stainless steel ball valves with BSP threaded connections, suitable for a working pressure of at least PN 40.

~~6.2.9.3~~6.2.11.4 Hydrant valves

Hydrants shall:

(a) Comply with NZS 4522 screw-down type.

(b) Be clock-wise closing with a non-rising spindle.

(c) Be bolted onto a ductile iron DN 80 riser or tee branch.

(d) Be installed with an outlet cap to prevent debris from entering the outlet when not in use.

(e) Be installed such that the top of the spindle cap is between ~~115~~ 125 mm and 300 mm of the ~~finished ground level~~underside of the hydrant lid.

(f) Not have a frost plug.

(g) Have the following markings:

(i) Surface markings shall be as outlined in SNZ PAS 4509 (see **Section 4.11.2.1 Hydrants**).

(ii) Blue reflective pavement markers shall be required for all hydrants.

(iii) Circles shall be placed around any hydrant that attracts a high risk of being obstructed by a parked vehicle. This typically includes:

1. Hydrants within 2.5 m of a kerb where parallel parking is allowed.
2. Where the centre of the hydrant is within 600 mm of a marked parking bay.
3. Any other area where Wellington Water considers the hydrant to be at risk of being obstructed.

~~6.2.9.4~~6.2.11.5 Service valves

The following applies to services valves (tobies):

(a) Service valves (tobies) for residential properties requiring a DN 20 service pipe or less shall be an approved manifold as listed in the Approved Products Register.

(i) They shall be housed in an approved manifold box (see **Standard Detail WS08 – Typical Domestic Manifold and Water Meter)**.

(ii) The box shall be high density PE if in the berm or footpath or cast or ductile iron if in a residential driveway.

~~(b) The minimum load rating of the box shall be AS 3996 Class B.~~

~~(c)~~(b) Service pipes greater than DN 20 shall have a gate valve of the same nominal diameter that meets the requirements of **Section 6.2.11.1 Gate valves**. Only valves listed in the Approved Products Register shall be used in the public network.

~~(d)~~(c) Where a service pipe is replaced, or the existing service valve excavated, and the existing service valve is a 15 mm or 20 mm gate valve, this service valve shall be replaced with a manifold (see **Section 6.2.12 Service covers, boxes and blocks**), except where the valve is exposed (e.g. where the service pipe is laid up the side of a bank).

~~(e)~~(d) See **Section 4.11.2.3 Service valves** for information on service valve markings.

~~6.2.9.5~~6.2.11.6 Valve markings

The following applies to valve markings:

(a) Valves on water mains shall be marked by a 50 mm wide white painted “V” painted on the top of the kerb.

(b) The “V” shall point to the valve (it shall point toward the carriageway for valves in the carriageway and the opposite direction for valves in the berm).

(i) For valves in the carriageway, a single vertical stripe shall be painted on the vertical face of the kerb below the apex of the “V”.

(ii) For valves in the berm, two vertical stripes shall be painted on the vertical face of the kerb below each leg of the “V”.

(c) Valves that are normally shut (e.g., by-pass and boundary valves) shall be marked with red paint. The entire top block shall be painted red.

(d) Valve markings shall be made using road marking paint. The concrete surface shall be cleaned by wire brushing back to sound concrete to remove all concrete latence and organic matter before marking the valve.

~~6.2.10~~6.2.12 Service covers, boxes and blocks

~~6.2.10.1~~6.2.12.1 Service valve boxes

The following applies to services valve boxes:

(a) Service valve (toby) boxes shall be rated to AS 3996 Class B when located in the berm, Class C when located in the footpath and driveways and Class D in the carriageway.

(b) When a service valve is located in a metalled or asphaltic concrete drive, and the box is high density PE, the box shall be set with a 20 MPa concrete surround a minimum 100 mm thick and 150 mm wide. This is to prevent the box from being "squeezed" by the weight of the traffic onto the flexible surface. Alternatively, a cast or ductile iron box shall be used.

(c) All boxes shall use a base to both centrally locate the service valve and to spread vertical loads onto the bedding.

(d) All boxes should contain enough metallic material to enable the buried box to be located, using a metal detector, under at least 100 mm of soil.

~~6.2.10.2~~6.2.12.2 Manifold boxes

Manifold boxes shall comply with **Section 6.2.12.2 Manifold boxes** (see **Standard Detail WS08 – Typical Domestic Manifold and Water Meter)** and the requirements listed below.
Manifolds shall be:

(a) Centrally located within the plan area of the box.

(b) Housed in a box with a minimum clear opening of 300 x 260 mm and shall have a minimum depth of 350 mm.

(c) Vertically located so the base of the manifold is within 20 mm of the plastic base of the box.

(d) Located such that access to the connections is practicable without excavation.

(e) Located such that a manifold meter can be installed into the manifold port without adjustment of the box.

~~6.2.10.3~~6.2.12.3 Meter boxes

The following applies to meter boxes:

(a) Meters shall be housed in an approved box that provides adequate space for removal of the meter, access to the isolation valve and visual inspection of the joints.

(b) The box shall be able to be drained to natural ground and in a position that is safe for meter readers to read.

(c) The lid shall be light and durable enough to be opened with a single person lift with a lifting weight of no greater than 15 kg and using a simple lifting key (e.g., a hinged 30 kg lid would be acceptable).

~~6.2.10.4~~6.2.12.4 Valve blocks

The following applies to valve blocks:

(a) Gate valve blocks and covers shall be an approved system rated to AS 3996 Class D.

(b) Valves shall have a 150 mm PVC insert pipe extending from below the valve stem gland to just below the valve box lid.

(c) It shall be installed such that there is no traffic loading onto the PVC pipe and clear access from ground level down to the valve's spindle cap.

~~6.2.10.5~~6.2.12.5 Hydrant blocks

The following applies to hydrant blocks:

(a) Hydrant blocks and covers shall be an approved system rated to AS 3996 Class D.

(b) Hydrant blocks shall be installed as per the requirements of NZS 4522.

(c) When a hydrant standpipe is installed on the threaded outlet, the standpipe does not contact the hydrant box at any point.

~~6.2.11~~6.2.13 Fittings

~~6.2.11.1~~6.2.13.1 Mechanical tapping bands

Mechanical tapping bands:

(a) Shall only be used for customer connections to the reticulation main.

(b) Shall not be used for rider main connections or the junction of two reticulation pipes.

(c) Shall be made from LG2 gunmetal, aluminium bronze, stainless steel or fusion bonded epoxy coated ductile iron and shall be of a two part fully encircling design.

(d) Shall be used to connect up to and including a 32 mm connection on a DN 100 pipe or 40 mm connection on to a DN 150 or DN 200 pipeline.

(e) Shall be installed with PP or PE insulators where tapping bands are used on ductile iron, cast iron or steel pipelines to protect against corrosion and stray currents. Alternatively, the tapping band shall be fusion bonded epoxy coated.

(f) If used on PVC pipelines, tapping bands shall be designed such that the fully tightened band will not cause ovalisation of the pipe by more than 3%.

(g) May have a "mains-cock" installed to aid in commissioning of pipelines. The mains-cock shall be an LG2 gunmetal, bronze ball valve or a ~~screw~~ screw-type proprietary valve (Talbot) that shall be left in the open position and ~~Denso~~ wrapped with the full Denso system (primer, mastic, petrolatum tape and PVC outer wrap) after commissioning of the main.

(h) Shall not be used on polyethylene pipes.

~~6.2.11.2~~6.2.13.2 Electrofusion tapping saddles and branch saddles

Electrofusion tapping saddles and branch saddles shall:

(a) Comply with AS/NZS 4129

(b) Manufactured from PE100 material

~~(b)~~(c) Have a ~~compound with a~~ minimum installed pressure rating of PN16.

~~(c)~~(d) Be installed using a welding clamp to ensure the saddle maintains the recommended welding contact area and pressure during installation.

(e) Be installed in accordance with the manufacturer's recommendation, notwithstanding the requirements of PIPA POP001[21].

6.2.13.3 Electrofusion reducing couplers and elbows

Electrofusion reducing couplers and elbows shall:

(a) Comply with AS/NZS 4129.

(b) Be manufactured from PE100 material.

(c) Have a minimum installed pressure rating of PN16.

(d) Be installed using a quad clamp alignment tool and re-rounding clamp to ensure the alignment of the fitting does not move during installation.

(e) Be installed in accordance with the manufacturer's recommendation, notwithstanding the requirements of PIPA POP001.

~~6.2.11.3~~6.2.13.4 Mechanical compression fittings

Mechanical compression fittings:

(a) For use on polyethylene pipe shall not be used for new pipelines.

(b) Where permitted in writing, may be used where the pipeline is less than ~~DN~~ 63 OD. These shall be screw-type compression fittings when used on PE100 pipelines, manufactured from polypropylene and listed in the Approved Products Register. Inserts/pipe stiffeners shall be used.

(c) Shall comply with AS/NZS 4129 and rated to a working pressure of PN16.

(d) Large diameter compression couplings maybe considered when connecting to an existing pipe where a dry shut-off may not be possible and time is critical.

~~6.2.11.4~~6.2.13.5 Direct tapping

The following applies to direct tapping:

(a) Direct tapping using a ferrule is not permitted on any pipe material type.

(b) All service and fire connections to a water supply main must be made via a proprietary fitting such as a tee, tapping band or electrofusion saddle.

(c) Steel branches or sockets may be welded onto existing steel pipes to create a suitable connection in-situ.

~~6.2.11.5~~6.2.13.6 Mechanical couplings

Mechanical couplings:

(a) Are considered to be a repair fitting; use on new mains is to be minimised as much as practical through the use of socketed joints, welding or fusion jointing. Examples of permitted connection methods between new and existing mains are provided in ~~the~~ **Standard Detail WS14 – Examples of Water Main Connections**.

[21] *Industry guidelines. Electrofusion jointing of PE pipes and fittings for pressure applications. Issue 8.0. POP001. Plastics Industry Pipe Association of Australia Limited (PIPA). 2019.*

(b) That are unrestrained (Gibaults) shall comply with AS/NZS 4998 up to 750mm pipes, or with ANSI/AWWA C219/06 for larger pipelines.

(c) Shall use nuts, bolts and washers that are either 316 stainless steel or hot dip galvanised. An anti-galling compound shall be used on all stainless-steel threads.

(d) Shall be wrapped with the full Denso system (primer, mastic, petrolatum tape and PVC outer wrap) when buried or within a buried chamber. Mechanical couplings within pumping stations or other ventilated structures need not be wrapped, but shall have stainless steel nuts, bolts and washers.

(e) Shall be tightened to the torque specified on the fitting and in the manufacturer's recommended tightening pattern.

(f) Shall have a minimum pressure rating of PN16 when used with water. A higher-pressure rating may be required where design circumstances dictate.

(g) Shall not have an internal register, except for mechanical flange adapters which shall have a full circle register.

(h) That use metal teeth to form a restrained joint shall only be used by special permission. The restrained gasket shall be specifically designed for the pipe material it is mated to and rated to a minimum of PN16 when fully end loaded.

The following also applies to mechanical couplings:

(i) Where mechanical couplings are joining a PVC pipe to a more rigid pipe (cast-iron, ductile iron or steel pipe), the end ring with the tightening nuts shall be tightening on the rigid pipe. This provides a more even compression and seal. The sealing ring shall be lubricated with a potable approved lubricant.

(j) At locations requiring installation of mechanical joint couplings, pipe ends shall be cut square and, in the case of spirally welded steel pipe, the spiral welds ground smooth for a sufficient distance to allow installation of the coupling.

(k) For bulk water pipelines, the exposed steel shall be prepared and coated with 300 microns of *Carboguard 690* in two layers or approved alternative potable water protective coating.

~~6.2.11.6~~6.2.13.7 Dismantling joints

The following applies to dismantling joints:

(a) Dismantling joints shall be PN16 rated (as a minimum), ductile iron or steel and coated to AS/NZS 4158 or AS/NZS 3862.

(b) Stainless steel components will be accepted provided they are electrically insulated from other non-stainless steel components.

(c) Elastomeric seals shall comply with AS 1646 and all wetted components shall comply with the requirements of AS/NZS 4020.

(d) All dismantling couplings shall be ~~denso~~ wrapped with the full Denso system (primer, mastic, petrolatum tape and PVC outer wrap) if buried.

~~6.2.11.7~~6.2.13.8 Bends and tees

The following applies to bends and tees:

(a) Bends, tees, tapers, spools and tapped connectors shall be ductile iron fittings manufactured to AS/NZS 2280 and coated to AS/NZS 4158.

(b) Bends certified to ISO 2531 shall be used on pipelines with a metric outside diameter (Series 1).

(c) ~~They~~ All fittings shall have a minimum pressure rating of PN16 unless the design ~~working pressure~~ requires a higher pressure class.

(d) Flanged or spigot bends, tees and "specials" fabricated from STCL may be permitted where ductile iron fittings are not practicable.

(i) These shall be manufactured to the requirements of NZS 4442 for pipe up to DN 450.

(ii) For pipes exceeding DN 450, they shall be manufactured in accordance with AWWA Manual M11[22].

(iii) Fabricated steel fittings shall be either polyethylene tape wrapped and concrete lined at the fabricators, or epoxy coated to AS/NZS 3862.

(e) PVC bends and fabricated or moulded PE tees shall not be permitted.

(f) Socketed DI fittings used on PVC pipes shall be of a "long socket" pattern and use the minimum depth of engagement as outlined in WSA TN2[23].

(g) Coatings on DI and STCL fittings shall be free of holidays and rust.

(h) DI fittings installed in PVC pipelines that result in unbalanced thrust (such as tapers) shall be flanged so that they can be fixed into assembles that will control the unbalanced thrusts.

(i) DI fittings installed in PE pipelines shall be flanged.

(j) All bends and fittings shall be of sufficient length to allow anchorage against natural ground with concrete thrust blocks without encasing the pipe joints in concrete.

~~(j)~~(k) Socket-socket electrofusion bends are permitted to be used on PE pipelines. Bends shall be of the correct material and SDR for the pipeline.

~~(k)~~(l) Post-formed PE bends and mitred PE bends are permitted to be used on PE pipelines.

(i) The maximum angle for butt fusion welded bends shall be 12 degrees.

(ii) Both post-formed and mitred bends shall be de-rated.

(iii) PE bends shall be long-spigot to allow butt fusion welding to the pipe string.

~~6.2.12~~6.2.14 Pressure reducing valves

The following applies to pressure reducing valves (PRV):

(a) PRVs shall typically be hydraulically operated globe valves of an approved type and model as specified in the Approved Products Register.

(b) A concept design for a typical PRV installation is available from Wellington Water on request.

(c) PRVs and all associated fittings shall be PN16 pressure rated.

[22] *M11 Steel pipe: A guide for design and installation.* American Water Works Association

[23] *WSA-TN2 Guidelines for the use of non-metallic pipes with ductile iron elastomeric joint fittings and spread sheet calculation.* Water Services Association of Australia

(d) They shall be selected to provide a minimum 10 year service life at design flows (average daily peak flow) without requiring replacement of any parts, including seals and diaphragms. The bonnet shall vent into the downstream pipe and not to the atmosphere.

(e) Noise shall be a consideration and selection shall be carried out to minimise the noise during higher flows. This may require two PRVs in series or parallel to eliminate excessive pressure differential and the associated noise.

(f) Where a PRV is to be used as the primary source of supply for an area, a low-flow bypass may be required to maintain suitable flow and pressure during low flow periods. This will be ascertained during the design stage to ensure the full range of design flows are achievable through the installation without excessive noise and cavitation, and with an acceptable design life:

(i) PRV sizing shall be designed with a nominal life of 20 years at the design flows before overhaul is required.

(ii) Design flows shall be 60% of time at min flow, 10% at peak flows and 30% at half peak flow.

(g) Fire hydrants shall be installed upstream and downstream of the PRV's isolation valves of any PRV that is to be used as a primary supply.

(h) An approved top-entry strainer shall be installed within the chamber between the upstream isolation valve and the PRV.

(i) Tappings, ball valves and oil filled pressure gauges with a 100 mm diameter dial face shall be installed immediately upstream and downstream of the PRV. Tappings on the PRV body shall not be used for the purpose of permanent gauges.

(j) A combination air-valve shall be installed immediately downstream of the PRV installation on pipelines 100 mm and greater.

~~6.2.12.1~~6.2.14.1 Pressure relief valves

The following applies to pressure relief valves:

(a) A pressure relief valve shall be installed downstream of the PRV to prevent the downstream network from being over-pressurised due to a fault in the PRV.

(b) The relief valve shall be sized to carry the full flow at static pressure and shall be located on the main pipe.

(c) The pressure relief valve discharge shall be piped to the kerb or other point where the discharge will be visible.

(d) A contact plaque may be required, and supplied for installation, by the Wellington Water.

(e) The discharge pipe shall be sized appropriately but shall be a minimum of ~~DN~~ 63 OD PE100.

(f) It shall be located such that the discharge is channelled safely into the stormwater system without scouring or flooding. The potential for scour of a natural waterbody must~~Water discharged is to~~ comply with permitted activity standard in regional plan rule or consent for discharge will be required under RMA.

~~6.2.12.2~~6.2.14.2 Chamber

The PRV, bypass PRV, pressure relief valve, strainer and gauges shall be housed in a precast concrete chamber. The chamber shall be:

(a) Located out of the carriageway where practicable and provide safe operator access.

(b) Drained, either to the ground where the chamber floor is above the water table, or to a kerb or open channel. The drain shall be designed such that stormwater cannot back-up through the drain into the chamber.

(c) Installed with an approved cover. An AS 3996 Class D rated frame and cover is required in the carriageway with a minimum 600 mm diameter clear opening. In the berm, an AS 3996 square Class C frame and cover is required with minimum dimensions of 600 x 900 mm.

~~6.2.13~~6.2.15 Non-return valves

The following applies to non-return valves:

(a) Non-return valves used in the network shall comply with AS 4794.

(b) Resilient seated swing-check valves shall be used in the general reticulation.

(c) Non-slam wafer-check valves shall be used in water supply pumping stations.

~~6.2.14~~6.2.16 Air valves

Air valves shall:

(a) Comply with AS 4956.

(b) Be either an air release, air/vacuum or combination type valve. The valve shall be selected by the designer to admit or expel air to prevent negative ~~surges~~ pressures and remove air from the system during adverse operating conditions. Combination valves are typically preferred on mains.

(c) Be of a make and model approved by Wellington Water.

(d) Be installed with an approved stainless steel ball valve for installation less than 50 mm, or an approved gate valve for larger installations, providing a means to isolate the valve for maintenance without affecting the operation of the main. Where the valve cannot be safely operated from the surface, a mitred gear box on a gate valve or butterfly valve shall be used to allow safe operation from the surface.

(e) Contain a small and a large orifice. The air valve float shall not prematurely seal the orifice at very high air discharge rates.

(f) Have flange joints encapsulated in the full Denso system (primer, ~~(paste,~~ mastic, petrolatum tape and PVC outer wrap).

~~6.2.14.1~~6.2.16.1 Chamber

The air valve shall be housed in a precast concrete chamber that:

(a) Allows the valve to be safely isolated and maintained without excavation.

(b) Is located out of the carriageway where practicable, and provides safe operator access.

(c) Is positioned such that it is clear of potential ponding and areas with secondary overland flow to prevent the chamber filling with water during rainfall events.

(d) Has a drain; either to the ground where the chamber floor is above the water table, or to a kerb or open channel. The drain shall be located at the lowest point of the chamber and designed such that stormwater cannot back-up through the drain into the chamber.

(e) Has an approved cover on it. An AS 3996 Class D rated frame and cover is required in the carriageway with a minimum 600 mm diameter clear opening.

(f) Has an air vent that shall allow the exit of the air valve exhaust without pressurising the chamber.

(i) The vent shall allow the entry of air into the chamber without drawing water or debris into the chamber.

(ii) The vent shall be epoxy coated steel or ductile iron and shall not present a trip or vehicle hazard.

(iii) Holes drilled into the manhole lid or a horizontal grate is not an acceptable air vent.

(iv) The vent shall be sized to limit air velocity.

~~6.2.15~~6.2.17 Water meters

Only brands listed in the Approved Products Register may be used within the public water supply system. Notwithstanding this, the following specification shall apply.

Meters shall:

(a) Have a current MID Pattern Approval Certificate to OIML-R49.

(b) Be suitable for outdoor and in-ground installation and maintain a service life of at least 20 years.

(c) Not have a pressure a rating less than PN16.

(d) Be installed such that:

(i) There is an isolation valve upstream of the meter and strainer.

(ii) There is a backflow prevention device or isolation valve downstream of the meter (for commercial properties only).

(iii) It is in an approved underground box or externally accessed cabinet.

Where meters are mechanical, they shall:

(e) Have a design to allow the register to be clearly read throughout the life of the meter. This shall be either:

(i) A sealed protected totalizer liquid filled register, or

(ii) A copper and mineral glass dry register.

(f) Be installed such that there is a proprietary or approved strainer upstream of any mechanical meter.

~~6.2.15.1~~6.2.17.1 Meter accuracy

Water meter performance (Q1, Q2, Q3 and Q4) shall be greater or equal to the performance calculated using the Q3 (permanent flow) and Q3/Q1 ratio, as listed in **Table 6-3**.

(a) Meter body lengths shall conform to those outlined in **Table 6-3**, which are the common lengths used in New Zealand[24].

(b) Meters DN 50 or less may be BSP threaded.

(c) Meters DN 50 or greater shall be flanged as per **Section 6.4.6.8 Flanged connections**.

(d) DN 50 meters may be either flanged or BSP threaded.

Table 6-3 – Minimum performance specification for meters

Nominal bore (mm)	Q3 (m^3/hr)	Meter body length (mm)	Minimum Q3/Q1 ratio	Typ. No. dwellings served*
15	2.5	134	R160	1
Manifold (40mm port)	2.5	n/a	R160	1 to 2
20	4	165	R160	3 to 5
25	6.3	260	R160	6 to 10
32	10	260	R160	11 to 22
40	16	300	R160	23 to 45
50	25	n/a	R315	By design
65	40	n/a	R400	By design
80	63	n/a	R400	By design
100	100	n/a	R400	By design
150	250	n/a	R630	By design

* Based on calculations for multiple residential dwellings from NZS 3500.1 where Q3 is not exceeded by the maximum probable simultaneous flow. This is conservative and is suitable for dense housing complexes or apartment buildings.

~~6.2.15.2~~6.2.17.2 Magnetic flow meters

The following applies to magnetic flow meters:

(a) Magnetic flow meters shall be installed in chambers with suitable access for inspection and maintenance.

(b) Meters shall be supported as per the manufacturer's recommendations.

(c) Appropriate straight lengths of pipe are required both upstream and downstream of the meter. A standard guideline is 5 diameters length upstream and 3 diameters length downstream.

(d) Transmitter heads shall be remotely mounted in an above ground cabinet with safe pedestrian access for reading.

[24] *Water Meter Code of Practice 2003, WaterNZ*

(e) Chambers shall be provided with drains, except in areas with a high water table.

~~6.2.15.3~~6.2.17.3 Meters on a fire service or sprinkler connection

See **Section 6.11 Fire Services**.

~~6.2.15.4~~6.2.17.4 Detector check meters

See **Section 6.2.18.2 Detector check meters**.

~~6.2.16~~6.2.18 Backflow preventers

The follow applies to backflow preventers:

(a) Backflow preventers shall be certified to comply with AS/NZS 2845.1. Approved backflow preventers are listed within the Approved Products Register.

(b) The installation of backflow prevention devices shall be in accordance with AS/NZS 3500.1.

(c) Installation of backflow prevention devices must be compliant with the relevant Standard Details in **Appendix 1**, unless prior approval is obtained from Wellington Water.

~~6.2.16.1~~6.2.18.1 Reduced pressure zone device

The following applies to reduced pressure zone (RPZ) devices:

(a) RPZ devices shall be installed above ground and with:

(i) A strainer immediately upstream of the device.

(ii) An isolation valve both upstream and downstream of the RPZ and strainer.

(iii) A suitable cabinet/cage around the device that will allow inspection and free drainage of the device.

(b) RPZ devices can eject some water from the port so drainage of the discharge is to be considered within the context of the environment it is installed in.

(c) The area around the RPZ shall be paved, or finished in concrete so that vegetation cannot grow up under the RPZ device.

(d) The clearance between the paved surface and the discharge point of the RPZ shall not be less than ~~600~~ 300 mm.

(e) A meter may be installed between the strainer and the RPZ provided suitable diameters are provided upstream and downstream of the meter.

~~6.2.16.2~~6.2.18.2 Detector check meters

The following applies to detector check meters:

(a) Detector check meters are required on all non-return valves that are on fire-services or other non-revenue connections.

(b) The non-return device shall be a double check detector assembly as a minimum that complies with AS/NZS 2845.1.

(c) The meter on the bypass shall comply with the requirements of **Section 6.2.17 Water meters**.

~~6.3 Excavation~~

~~See Section 4.5 Excavation~~

~~6.4 Bedding~~

~~See Section 4.6 Bedding, haunching and surrounds~~

~~6.5 Backfilling~~

~~See Section 4.7 Backfilling~~

~~6.6 Reinstatement~~

~~See Section 4.9 Reinstatement~~

~~6.7~~6.3 Pipe laying

~~6.7.1~~6.3.1 Minimum cover to pipeline

Minimum cover to pipes shall be as set out in **Table 6-4**.

Table 6-4 – Minimum cover to pipelines (in metres)

Nominal bore (mm)	Carriageway / Motor crossing	Footpath	Berm
20 to 25	0.75	0.75	0.60
40 to 50	0.75	0.75	0.60
100 to 200	0.75	0.75	0.75
300 to 600	0.90*	0.90*	0.90*
≥700 ~~to 1000~~	1.00**	1.00**	1.00**

* May be less than 0.90 m for sections not exceeding 60 m in length and not less than 750 mm minimum depth of cover

** May be less than 1 m for sections not exceeding 60 m in length and not less than 750 mm minimum depth of cover

~~6.7.2~~6.3.2 Maximum cover to pipeline

Maximum cover to pipes shall be as set out in **Table 6-5**.

Table 6-5 – Maximum cover to pipelines ~~(in metres)~~

Nominal bore (mm)	Maximum cover (m)
20 to 25	0.80
40 to 50	1.20
≥100	2.50*

~~Nominal bore (mm)~~	~~Carriageway / Motor crossing~~	~~Footpath~~	~~Berm~~
~~20 to 25~~	~~0.80~~	~~0.80~~	~~0.75~~

~~Nominal bore (mm)~~	~~Carriageway / Motor crossing~~	~~Footpath~~	~~Berm~~
~~40 to 50~~	~~1.20~~	~~1.20~~	~~1.20~~
~~100 to 200~~	~~2.50~~	~~2.50~~	~~2.50~~
~~300 to 600~~	~~3.00*~~	~~3.00*~~	~~3.00*~~
~~700 to 1000~~	~~3.50**~~	~~3.50**~~	~~3.50**~~

* May exceed ~~3.00~~2.5 m for sections not exceeding 30 m in length and not greater than 4.0 m maximum depth of cover

~~** May exceed 3.50 m for sections not exceeding 30 m in length and not greater than 4.50 m maximum depth of cover~~

It shall be acceptable to exceed this depth of cover where the pipe is installed in a duct or a tunnel and can be withdrawn for repair. This would normally be achieved by horizontal directional drilling or micro tunnelling and would be a specific design approved by Wellington Water.

~~6.7.3~~6.3.3 Minimum clearances from other utilities

The following applies to minimum water pipeline clearances from other utilities:

(a) Pipes shall be laid parallel to other services whenever practicable.

(b) Where a pipe crosses another utility, it shall be as close to perpendicular as practicable, and shall maintain minimum horizontal and vertical clearances equal to the greater of the minimum clearances ~~as~~ outlined by the other utility and ~~Where these are not provided, the minimum clearances~~ shown in **Table 6-6** ~~shall be observed~~.

Table 6-6 – Minimum water main clearances from utilities

Utility	Minimum horiz. Clearance (mm) Non-~~critical~~bulk ~~bulk~~ main	Minimum horiz. Clearance (mm) ~~Critical~~ Bulk main	Min. vertical clearance (mm) when crossing All
Other water mains	300	600	150~~/500**~~
Gas mains	300	600	150
Telecommunications conduits and cables	300	600	150
Electricity conduits and cables	500	1000	225
Stormwater drains	300	300	150
Wastewater mains[+]	1000*	1000*	200[+]

[+] Wastewater mains ~~shall~~ should always be below watermains to reduce the risk of cross-contamination as a result of a watermain failure.

* or 1000 mm radial distance from a watermain (i.e. horizontal can reduce when vertical increases).

~~** where a critical main cross another critical main.~~Note: Clearances are between utility pipe/conduit barrels

~~6.7.4~~6.3.4 Pipe handling

The following applies to handling pipes:

(a) Pipes and fittings shall be transported and handled in a manner that is safe and meets industry guidelines and the manufacturer's instructions.

(b) Pipes shall be secure during transport and shall not be allowed to roll or skid during transit.

(c) Sockets shall be clear of adjacent pipes and other sockets and shall be protected from damage.

(d) Pipes shall not be tipped or dropped onto the ground from the transport. Lifting equipment shall be used to unload pipes from the transport. Spreader bars shall be used for long (12 m) lengths of PVC and PE pipes to avoid undue bending stress on the pipe

(e) In storage, pipes shall be stacked on dunnage, on flat ground and with supports. Scalloped dunnage is preferred to minimise rolling potential. The ends of the pipe shall be sealed to ensure rubbish and animals cannot enter the pipe whilst in storage.

(f) Where PVC and PE pipes are to be stored long-term (longer than 3 months), they shall be protected from heat and ultra-violet radiation with covers or warehousing.

(g) Chains shall not be used to lift pipes.

6.3.5 Allowable grade

On bulk water pipelines the minimum fall gradient is 0.2%, and the minimum rising gradient is 0.1% relative to the flow direction.

~~6.7.5~~6.3.6 Thrust and anchor blocks

Thrust blocks restrain the pipe by transferring pipe-thrust to the immediately adjacent undisturbed natural ground. Anchor blocks use their weight to hold the pipe in position.

Thrust and anchor blocks:

(a) Are required even where restrained joint pipes and fittings are used. This is to protect against future repairs and/or cut ins which may compromise the integrity of the restrained system.

(b) Shall be constructed from 20 Mpa concrete at 28 days. The bearing face shall be poured against firm, clear and undisturbed natural ground. Flanges and sockets are to be kept clear of concrete and under no circumstances shall a joint be embedded in the thrust block. The concrete shall have a contact area with the pipe of at least a third of the pipes outside circumference. A polythene sheet shall be set between the concrete and the fitting.

(c) Pipes larger than DN 300 ~~may~~ require specific design regarding reinforcement and concrete strengths due to the large loads.

(d) Shall not be placed under working or test load for at least 3 days after pouring.

~~6.7.5.1~~6.3.6.1 Thrust blocks

Thrust blocks (see **Standard Detail WS03 – Typical Thrust Block Details**):

(a) Shall not be installed on PE pressure pipelines at changes of direction, tees and changes in pipe diameter unless specifically required by the designer.

(b) Thrust blocks are required at on PE pipelines any point where the PE pipeline terminates, or is connected to a different pipe material or is connected to a structure that is not able to provide the required thrust restraint. In the case of connection to a structure, the thrust restraint may be provided by the structure.

(c) Thrust blocks that are loaded during pressure testing shall be sized to resist forces when the pipe is pressurised to full test pressure.

(d) Thrust blocks that are not loaded during pressure testing (for example thrust blocks on cut-in specials) shall be sized to resist forces when the pipe is pressurised to maximum operating pressure.

~~6.7.5.2~~6.3.6.2 Anchor blocks

The following applies to anchor blocks:

(a) Irrespective of whether an anchor can be constructed, vertical changes in direction shall, wherever possible, be designed so that they are thrust neutral in the vertical direction (see **Standard Detail WS04 – Typical Anchor Block Details**).

(b) Where straps are used to secure the pipe or bend to a block, 6 mm insertion rubber shall be placed along the full area of contact between the pipe wall and the strap. Insertion rubber shall be placed along the full contact area with the concrete block also.

(c) Straps and anchors shall be 316 stainless steel.

~~6.7.5.3~~6.3.6.3 Precast thrust and anchor blocks

The following applies to precast thrust and anchor blocks:

(a) Precast blocks may be used to allow faster working reinstatement of the pipeline for pipes DN 200 and smaller.

(b) Precast blocks shall conform with the minimum standards outlined in this specification.

(c) Where there is a gap between the block and the natural ground, the gap may be filled with compacted lean-mix to ensure tight contact between the soil, block and fitting. The gap between the precast block and the natural ground shall be no greater than 75 mm.

(d) 6 mm insertion rubber shall be placed between the precast block and the fitting.

(e) Precast blocks are not permitted for pipe diameters larger than DN 200.

~~6.7.5.4~~6.3.6.4 Allowable bearing pressure

The following is allowable bearing pressure:

(a) The bearing pressure of the soil shall be checked to ensure it has the minimum required bearing strength as specified in the design.

(b) A Scala Penetrometer maybe used to determine the in-situ bearing strength of the soil.

(c) As a guide for pipe DN 300 and smaller:

(i) The ***vertical*** bearing pressure of the soil can be taken as:

1. 65 kPa for 2 blows per 100 mm
2. 100 kPa for 3 blows per 100 mm and
3. 200 kPa for 7 blows per 100 mm.

(ii) The ***horizontal*** bearing pressure shall be less than this and, in the absence of better geotechnical information, shall be taken as half the estimated vertical bearing pressure.

(d) For pipes larger than DN 300, suitable geotechnical advice shall be sought to calculate allowable bearing pressure and the size of the thrust block.

~~6.7.6~~6.3.7 Fittings

All fittings shall be swabbed with a 50 mg/L chlorine solution and maintained as hygienically clean until installed within the pipeline. Only the surfaces which will come into contact with potable water need to be swabbed and maintained.

Magnetic flowmeters shall not be treated topically as the chlorine solution can damage the meter's lining.

~~6.7.7~~6.3.8 Warning tape / tracer wire

The following applies to warning tape and tracer wire:

(a) Warning tape shall be placed 300 mm above all bulk, trunk, principal and rider main pipes and 100 mm above service pipes.

(b) The warning tape shall be:

(i) Blue polyethylene or polypropylene

(ii) A minimum of 100 mm wide and

(iii) Detectable by either stainless steel wire or aluminium laminate.

(c) Where a pipe is installed by means of pipe bursting, a 2.5 mm compacted 316 stainless steel wire rope is to be co-drawn with the pipe as a tracer wire (see **Section 4.15 Pipe-bursting**).

(d) Where a pipe is installed by means of directional drilling, slip lining or impact mole:

(i) A 4 mm^2 copper polythene sleeved tracer wire is to be co-drawn with the pipe.

(ii) Warning tape and wires shall be electrically continuous and joints must be adequately overlapped and jointed to ensure no degradation of the electrical continuity over the life of the asset.

(iii) This may require the use of electrical connectors.

(e) Where warning tape/wire is damaged due to a pipe repair or new connection, the warning tape/wire is to be fixed to maintain electrical continuity along the length of the pipe.

(f) Tape shall continue through service valve, hydrant and valve enclosures whilst maintaining tape conductivity (see **Standard Detail WS05 – Typical valve details**).

~~(f)~~(g) Warning tape for a pipe is to be connected to warning tape above adjoining service connections and other pipelines and fittings such as service valves, hydrants and valves.

~~(g)~~(h) The tape/wire shall be wrapped around the fitting with the tail end protruding above the fitting to just below any spindle cap or hand-wheel to avoid any fouling or obstruction to valve key operation.

6.3.9 Cathodic protection

(a) Electrical contact between buried metallic structures and the metallic pipe and pipe fittings shall be prevented.

(b) Insulating flanged joints shall be installed at flanges connecting above ground installations and magnetic flow meters.

(c) All non-welded joints in metallic pipe, including flanged connections, shall be joint bonded to provide electrical continuity. Joint bonds shall be insulated 16 mm^2 copper wire loops, sealed to prevent the ingress of moisture. Buried joint bonds shall be duplicated at each joint (i.e., two bonds per joint).

(d) The overall length of the conductor shall permit sufficient flexibility across the joint to prevent tensile stress on the bond cable. Cable to fitting connections shall be a dedicated corrosion-free stud or earthing boss welded to the pipe and liberally coated with Denso. The mechanical strength of a bond shall be sufficient to withstand the effects of backfilling and maintenance.

(e) Bare copper bond straps, conductivity screws and conductivity wedges shall not be used to provide electrical conductivity.

(f) Where electrical continuity bond cables are installed, the contractor shall prove the electrical continuity of the pipeline before and after backfilling.

(g) A multimeter continuity test or resistance test shall be carried out between each nut and an unprotected part of the flange on the opposite flange of the joint.

(i) A resistance value above 100k ohms is considered satisfactory for these flange joints.

~~6.8~~6.4 Pipe jointing

The following applies to pipe jointing:

(a) PVC pipes shall be rubber-ring jointed with a proprietary in-joint rubber ring.

(b) Ductile iron pipes may be rubber-ring jointed or flanged.

(c) Steel pipes shall be welded as per the requirements of this specification.

(d) To achieve the majority of the minor changes of grade and/or direction without installing fabricated bends, pipes shall be laid on smooth transition curves using the allowable deflection in the pipe joint.

(i) Allowable deflection is 3 degrees in ductile iron pipes with rubber ring joints.

(ii) Allowable deflection is 2 degrees in ductile iron pipes with Tyton-loc rings.

~~(d)~~(e) Polyethylene pipes shall be butt fusion or electrofusion welded. Approved compression fittings may be used on 63 OD pipes and smaller. Axially restrained mechanical couplings may be used on PE pipes for maintenance repairs, or when connecting to an existing in-service PE pipe during cut-ins.

(f) In liquefiable land refer to the Regional Standard for Water Services for seismic design.

~~6.8.1~~6.4.1 Rubber-ring joint

The following applies to rubber-ring jointing:

(a) Pipes may be joined to other pipe bends and tees using rubber-ring moulded socket-spigot joints. Elastomeric rings shall comply with AS 1646 and shall typically be EPDM. Other compounds such as NBR may be used where appropriate, such as where hydrocarbons are present or are potentially present in the soil.

(b) Witness marks shall be employed to ensure the appropriate insertion depth is obtained.

(c) Spigots are to be chamfered as per manufacturers recommendations. This is typically a 15-degree angle with the pipe axis and from a depth of half the pipe wall thickness.

(d) An AS/NZS 4020 approved lubricant shall be liberally applied to each socket and spigot prior to insertion to ensure the seal is not unseated or "pinched". Lubricant shall only be placed on the sealing face of the ring and care shall be taken to ensure lubricant is not placed on the underside of the ring. Lubricant shall also be used on factory fitted sealing rings.

~~6.8.1.1~~6.4.1.1 Restraining gaskets

Restraining gaskets shall:

(a) Only be used ~~with~~ on PN35 ductile iron pipelines. Only specific brands shall be approved. These brands are listed in the Approved Products Register.

(b) Be lubricated in the same style as non-restraining gaskets.

(c) Not be reused if removed from an in-situ installation.

~~(d) Only be used on PN35 ductile iron pipe.~~

~~6.8.2~~6.4.2 Mechanical compression fittings

~~6.8.2.1~~6.4.2.1 Mechanical fittings for PE pipe

The following applies to PE mechanical compression fittings:

(a) All compression fittings shall be certified to AS/NZS 4129 and only those listed within the Approved Products Register shall be permitted for use in the water supply network.

(b) Proprietary stainless steel or plastic inserts/pipe stiffeners shall be used with all mechanical compression fittings used on polyethylene pipes.

(c) The pipe spigot shall be clean, free of scores, burrs, scratches and solvents and shall be inserted into the fitting square until the pipe reaches refusal.

(d) Fittings shall be hand tightened for fittings less than DN 40, or using a proprietary wrench as specified by the manufacturer for fittings DN 40 and greater. Do not over-tighten as this can damage the grip ring or the fittings threads resulting in pull-out.

(e) PE mechanical compression fittings shall be only be used for the repair of PE pipelines up to 630 mm OD.

(f) Approved, axially restrained, mechanical fittings may also be used for the connection of new PE watermains to existing PE watermains.

~~6.8.2.2~~6.4.2.2 Mechanical fittings for other pipes

The following applies to mechanical compression fittings for other pipes:

(a) All compression fittings shall be certified to AS/NZS 4998 and only those listed within the Approved Products Register shall be permitted for use in the water supply network, and only when socket, flanged, threaded or welded joints cannot practically be employed.

(b) The pipe spigot shall cut square, clean, free of scores, burrs and scratches.

(c) The pipe ends shall be marked with witness marks to ensure the correct end-gap is centred in the coupler before the fasteners are tightened.

~~6.8.3~~6.4.3 Polyethylene butt fusion and electrofusion welding

The following applies to PE butt fusion and electrofusion welding (see also **Section 4.19 Polyethylene welding**).

(a) Where polyethylene pipes are connected to existing or new copper pipes, electrofusion transition couplings shall be used to join the two materials.

(b) Where ~~replacement~~ PE water mains are connected to existing, in-service, PE water mains less than 315 mm OD, electrofusion couplers are preferred when site conditions allow. For larger mains or where the conditions for installation of electrofusion couplers (see **Section 4.19 Polyethylene welding**) cannot be met, connections ~~the connection~~ shall be made using an approved PE mechanical compression fitting. ~~Except where specifically instructed by the Council, electrofusion couplers shall not be welded to in-service PE pipelines.~~

6.4.4 Flanges

~~6.8.3.1~~6.4.4.1 ~~Flanges for~~ General reticulation pipes

The following applies to flanges for general reticulation pipes:

(a) All flanges used in the water supply network shall be AS/NZS 4087 or BS EN 1092 rated to PN16. The following patterns are permitted:

(i) Figure B5 for ductile iron fittings and

(ii) Figure B7 for steel fittings.

(b) These patterns have an equivalent drilling pattern to BS10 Table D.

(c) 3 mm fibre reinforced EPDM gaskets shall be used with all flanges. NBR gaskets may be considered where the ground has, or may potentially have, hydrocarbons present.

(d) Bolts, washers and nuts to be used on all flanges shall be hot dipped galvanized or 316 stainless steel. An anti-galling compound shall be used with all stainless-steel threads to ensure threads do not seize.

(e) All flanges that will be buried, or have the potential to be buried, shall be coated and wrapped in the full Denso system (primer, mastic, petrolatum tape and PVC outer

wrap)~~(primer, mastic, wrap and over wrap)~~. Flanges that are in a dry, ventilated environment, such as a pumping station, do not need to be wrapped.

(f) Prior to mating, the flange face shall be clean of dust, solvents, oil, grease and other materials. The flange faces shall be mated and the bolts tightened in a sequence of opposing pairs, with pairs generally perpendicular to each other. A torque wrench shall be used where specified by the manufacturer.

(g) Washers shall be used under all bolt heads and nuts.

~~6.8.3.2~~6.4.4.2 PE stub flanges

The following applies to PE stub flanges:

(a) Flanged connections from a PE pipe to a flanged connection shall be made using butt fusion welded stub-flange or electrofusion stub flange.

(b) An adapter flange will be required for pipe above DN 180.

(c) Fittings such as "Slimline" stub flanges that reduce the wall thickness or reduce the pipe internal diameter will normally not be allowed.

~~6.8.3.3~~6.4.4.3 Bulk water pipelines, trunk pipelines and general reticulation greater than DN 500

The following applies to bulk water pipelines, trunk pipelines and reticulation pipelines greater than DN 500:

(a) Flanges shall comply with AS/NZS 4331.1 PN16 unless otherwise specified.

(b) AS/NZS 4331.1 PN25 flanges shall be used where design pressures dictate.

(c) Flanges on steel pipes shall be flat faced, slip-on style flanges.

(d) All Blank flanges and flanges on access manholes shall be coated with 300 microns of Carboguard 690 or an alternative approved in writing by Wellington Water. The sealing faces of the flanges shall remain uncoated.

~~6.8.4~~6.4.5 Copper pipe

The following applies to copper pipes:

(a) Copper pipes shall be joined to adjacent copper pipe by brazing.

(b) Where a connection to fittings or other material types is required, gunmetal crox nuts and nipples onto a BSP threaded transition piece is the approved method of connection.

(c) Jumper cables shall be used when working on existing copper services. This is to protect the pipe fitter from potential electric currents from properties earthed to the pipe.

~~6.8.5~~6.4.6 Steel pipe welding

~~6.8.5.1~~6.4.6.1 Welding specification procedure

All welding shall be carried out to the requirements of BS 2971 or ASME B31.4.

A Welding Procedure Specification (WPS) shall be provided to Wellington Water representative for approval at least 5 days prior to beginning work. The WPS shall include:

(a) Type of welds required

(b) Welders and their qualifications

(c) Equipment to be used and

(d) Methodology to be used.

~~6.8.5.2~~6.4.6.2 Qualifications

All welding is to be carried out by a welder certified to AS/NZS 2980:2007. The certificate of any welder employed on the project shall be produced on request.

~~6.8.5.3~~6.4.6.3 Safety

The following applies to steel pipe welding safety:

(a) Appropriate practices are described in ~~NZS 4781,~~ AS/NZS 2865 and ~~*Health and Safety in Welding 2004 – Technical Note 7 (*~~WTIA TN7[25]~~*)*~~ adopted by Worksafe Mahi Haumaru Aotearoa.

(b) Ventilation shall be appropriately addressed in Health and Safety procedures for both internal and external welding operations.

~~6.8.5.4~~6.4.6.4 Welding considerations

The following considerations shall be accommodated in all WPS and welding operations:

(a) All welding shall be carried out with the pipework in a clean and dry condition. Where the work consists of pipework leak repair or a cut-in, every effort shall be made to obtain a watertight isolation

(b) Windbreaks and shelters shall be provided to protect the weld area from inclement weather.

(c) Butt welds must be full penetration.

(d) Fillet welds shall have equal leg length and have a throat of 0.7 x leg length plus 0 to 20% leg length and shall be mitred or slightly.

(e) A distance of at least 300 mm or 30 degrees of the pipe diameter shall be used to stagger any longitudinal welded joints between adjacent pipe sections.

(f) All circumferential lap welds in pipelines of DN 600 or greater shall be seal welded internally and externally, with the lining repaired post-welding and testing.

(g) The out-of-roundness of the pipe shall not exceed the lesser of 10% of pipe diameter or 10 mm.

(h) Welds joining temporary attachments to the pipeline must be to the same quality as the final weld is required. Temporary attachments must be removed carefully and the area visually inspected for any deleterious surface flaws

(i) All welding consumables shall be stored to the manufacturer's instructions and shall meet the recommendations given in ASME B31.4.

[25] *Health and Safety in Welding – Technical Note 7 (TN7).Welding Technical Institute of Australia (WTIA). 2006. See https://worksafe.govt.nz/topic-and-industry/welding/health-safety-in-welding/*

~~6.8.5.5~~6.4.6.5 Welding preparation

The following applies to the preparation of steel pipe for welding:

(a) The weld preparation shall be clean, dry and free from grease, oxides, paint, dirt, slag or any foreign material that will affect the welding process and quality.

(b) All pipe materials 15 mm either side of the weld preparation shall be clean and rust free prior to any welding.

(c) All cut material shall be free of burrs.

(d) Surfaces to be welded shall be free of laminations, gouge marks, slag and any harmful condition that may affect the quality requirements of the deposited weld metal.

(e) Prior to commencing any welding, defects to the following maximum depths shall be removed by grinding to produce a cavity with a weld to depth ratio of not less than 4 to 1:

(i) For manual welding (MMAW, GTAW): 2 mm

(ii) For automatic welding (MMAW, GTAW): 1 mm, and

(iii) Imperfection exceeding the above limits shall be weld repaired using an approved repair welding procedure.

(f) Pipes shall be held in the correct alignment and position using an alignment device until welding has been completed.

(g) Packers shall not be used when using welding bands. Gaps are to be filled using a 'buttering' method.

(h) Where unintentional excessive gaps occur due to ovality, buttering of the pipe with a layer no more than 10 mm thick of weld metal may be permitted to achieve the required root gap.

(i) Buttering is not be used as a general fabrication technique.

(ii) All deposited weld metal shall be dressed smooth to meet the shape required before completing the weld.

(iii) Buttered weld metal shall not protrude into the pipeline bore.

~~6.8.5.6~~6.4.6.6 Butt welds and branch connection welds

The following applies to butt welds and branch connection welds:

(a) The root gap shall not be greater than 3 mm.

(b) The bevel angle shall be prepared within -0 to +5 degrees of the tolerance specified in the welding procedure.

(c) For single sided welding, the tolerance on the root gap shall not be -1.5 mm to +3.0 mm of the tolerance specified in the WPS.

(d) The gap between the mating surfaces of fillet welds shall not exceed 2.0 mm.

(e) Butt weld cap reinforcement shall not exceed 3 mm with a slope not exceeding a ratio of 4:1.

(f) The weld penetration into the pipe bore shall be even and not exceed 3 mm.

(g) The weld toes of butt and fillet welds shall blend smoothly with the parent material.

~~6.8.5.7~~6.4.6.7 Tack welds

The following applies to tack welds:

(a) Tack welds must be to the same quality and workmanship as the final weld and strong enough to withstand the fabrication welding stresses.

(b) They should have a length of not less than the lesser of 40 mm or four times the thickness of the material.

(c) Tack welds that are not removed must be fully melted and incorporated into the completed weld.

(d) The size of tack welds shall be proportioned to withstand the load requirements and restraint of the weld joint being made.

(e) All cracked tack welds shall be completely removed before final welding commences.

(f) Tack welds that form part of the completed welds shall be ground at the start and the finish and completely fused into the final weld. The suitability of the technique shall be demonstrated to the satisfaction of Wellington Water or their delegated representative.

6.4.6.8 Flanged connections

The following applies to flanged connections:

(a) Flanges shall be welded to the pipe, square to the pipe end.

(b) The flange shall not be a tight fit on the pipe. However, the clearance between the outside diameter of the pipe and the bore of the flange shall not exceed 3 mm at any point, and the sum of the clearance on any diameter shall not exceed 5 mm during welding.

(c) Flanges shall be welded on both sides.

(d) See **Section 6.4.6.12 Repairs to concrete lining**.

~~6.8.5.8~~6.4.6.9 Workmanship

The following applies to the workmanship of steel pipe welding:

(a) For double sided full penetration butt welds, the second side shall be cleaned to sound metal prior to depositing the second side runs. Should carbon arc air gouging be used, all carbon and other residue shall be completely removed by grinding or other approved mechanical means. Only qualified welders competent in gouging techniques shall be employed.

(b) All welds shall blend smoothly with the parent material and have a consistent profile.

(c) The use of backing bars requires the prior written approval of Wellington Water.

(d) The width of individual submerged arc weld beads shall not exceed seven times the consumable wire diameter.

(e) Peening of the final pass is not permitted.

~~6.8.5.9~~6.4.6.10 Welding interruptions

The following applies ~~to welding interruptions~~interruptions to the welding process:

(a) Wherever possible, welding shall be a continuous operation.

(b) Welding shall not be discontinued before at least the root run and the hot pass are complete.

(c) If welding must be interrupted, the weld area shall be covered with a heat blanket to permit slow cooling.

(d) Before resumption of welding, on welds cooled to ambient temperature, the area shall be inspected visually for the presence of cracks. Where cracks are suspected, the weld shall be inspected by magnetic particle or dye penetrant examination by qualified specialist in non-destructive testing to determine acceptability.

(e) Following an interruption in welding, any required preheat shall be restored to the value indicated in the WPS before resumption of welding.

~~6.8.5.10~~6.4.6.11 Testing and inspection

The following applies to testing and inspection of steel pipe welding:

~~(a) The contractor shall supply all equipment and materials to execute the testing as required.~~

~~(b)~~(a) Following completion of joint welding and prior to the protective coatings and linings being applied, all welds shall be visually inspected.

(b) The weld metal as deposited shall meet the requirements of AS/NZS 2980:2007.

(c) No melting of the corners shall be allowed to occur to such an extent as to reduce the throat thickness of the weld.

(d) The weld metal shall be properly fused with the parent metal without undercutting or overlapping at the toes of the weld. Slight, intermittent occurrences may be permitted provided that the undercut or overlap does not form a sharp notch. The stop and start of each run of weld shall merge smoothly and shall show no pronounced hump or crater in the weld.

(e) All double lap welds of hemi-spherical joints shall be pressure tested. Nitrogen shall be introduced into the ~~joint through the tapping~~annular cavity between the welds, through tapped holes to a pressure of 1,000 kPa within the joint.

(i) Oxygen or acetylene shall not be used for this test.

~~(i)~~(ii) The source of pressure shall be removed and the pressure in the joint monitored for 10 minutes using a suitably calibrated gauge.

(iii) If the pressure in the annular cavity drops, both the welds shall be checked for leaks by applying a film of soap solution.

(iv) Detected leaks shall be marked and repaired by grinding and re-welding and the joint retested.

~~(ii)~~(v) The soap solution shall be washed off prior to any remedial work and at the completion of the inspection.

(f) Test results and any rework involved to complete a successful joint test, shall be recorded. A copy of this record shall be provided to Wellington Water.

~~(f)~~(g) Wellington Water may ~~employ~~ require a specialist welding consultant to carry out further non-destructive testing. If defects exceed the acceptable limits, the defects shall be repaired and the welds retested ~~at the contractor's expense~~.

~~(g) Any defects found in any weld shall be remedied and the location and remedial works recorded. The weld shall then be retested using the appropriate method.~~

~~6.8.5.11~~6.4.6.12 Repairs to concrete lining

Welded pipe joints, bends and reducers shall be concrete lined by the hand application of an epoxy bonding agent and mortar as specified below.

(a) The bare steel between the ends of the pipe interior lining shall be cleaned of rust and other contaminants by wire brushing. At the time of application of the epoxy bonding coat the steel surface shall be free from all foreign substances liable to initiate rusting or liable to impair the bond between the pipe surface and the bonding coat.

~~(a)~~(b) A bonding primer shall be used for large areas of pipe lining repair including welding bands, slip-in joints. The steel pipe surface shall be coated with ~~BASF Emaco Nanocrete AP~~Nitobond EP or a similar product approved in writing by Wellington Water. The coating shall be sufficiently mixed in accordance with the manufacturer's specification, and in sufficient batched lots to complete the bond priming of the bare steel.

~~(b)~~(c) ~~Any cracks in the concrete lining greater than 1 mm, and any pipe joints including welding band joints, slip-in joints, mitre bends and tapers,~~ The concrete lining shall be repaired to the same thickness as the adjacent factory lining.

~~(c)~~(d) Concrete lining must be reinstated up to the pipe end at flange joints and pipe ends.

~~(d)~~(e) The existing concrete lining adjacent to the repair shall be cut back to sound material, with the cut face at right angles to the lining surface.

~~(e)~~(f) The surface of the cured bond primer shall be scarified to improve adhesion, and a pre-mixed cement mortar with polymer fibres shall be applied to complete the lining repair. The mortar shall be ~~Emaco Nanocrete R4~~ Renderoc HB70 or a similar product approved in writing by Wellington Water, and shall be hand applied in such a manner to produce a tight, well compacted pipe lining, with the surface trowelled smooth to conform to the minimum mortar thickness.

~~(f)~~(g) Small areas may be repaired using a Wellington Water approved AS/NZS 4020 compliant epoxy mortar such as Emaco S88C or Humebond when applied to the manufacturer's recommendations. ~~Emaco Nanocrete R4~~ Renderoc HB70 mortar or similar product approved in writing by Wellington Water can be used without bonding primer where there is only a thin strip of lining to repair such as at the end of pipe at flanges and couplings.

~~(g)~~(h) The mortar lining, when completed, shall be well finished with no evidence of laitance and surface irregularities to give a smooth, true, dense surface, entirely continuous with the factory applied pipe lining. Where irregularities are identified, the lining shall be cut back and relined.

(i) Concrete lining that has not adhered to the steel surface shall be replaced. Lack of adhesion shall be identified by tapping the surface with a hammer and listening for a distinct hollow sound.

~~6.8.5.12~~6.4.6.13 Repairs to external coatings

Any damaged **polyethylene wrapped** external coating on steel pipe shall be repaired in the following sequence:

(a) Cut away any loose coating and thoroughly clean the damaged area.

(b) Thoroughly wire brush the area.

(c) Apply primer as per manufacturer's instructions, overlapping the undamaged area by 100 mm.

(d) Apply a double layer of polyethylene tape starting 150 mm beyond the damaged area and 50 mm clear of the primer, wrapping in a spiral form similar to the existing coating. Ensure joints overlap by 25%. A second layer of outer wrapping shall be applied for added protection. Wrapping shall be applied in accordance with the tape manufacturer's recommendations.

(e) Alternatively, heat shrinkable sleeves may be used as described below.

Heat shrink sleeves shall be used to protect slip-in welded joints, ~~welds and~~ welding bands and welded mitre joints less than 15 degrees ~~after they have been tested and passed~~. ~~Heat shrink sleeves shall~~The following applies to heat shrink sleeves:

~~(d) Be used to protect mitred joints less than 15 degrees.~~

~~(e)~~(f) Heat shrink sleeves shall be adhesive bonded wraparound shrink sleeves lined with a thick aggressive hydrophobic adhesive.

~~(f)~~(g) The overlap patch is coated with a high softening point hot melt adhesive that bonds to the sleeve to protect the overlap from being peeled back while in service.

~~(g)~~(h) The sleeve width shall be 450 mm.

~~(h)~~(i) The correct temperature of the closure patch during application shall be shown with thermochromic paint.

~~(i)~~(j) The sleeves shall be *Raychem* wraparound heat shrink sleeves, *UBE* shrinkable sleeves, or equivalent as approved in writing by Wellington Water.

~~(j) The sleeve nominated to be used by the applicator shall be submitted to Wellington Water for approval.~~

(k) Be installed within two hours after a successful weld test. The following sequence shall be followed for applying heat shrink sleeves, although the manufacturer's instructions are to be strictly adhered to:

(i) After welding, the weld area shall be power wire brushed to bright metal ~~remove all weld slag, dirt or loose scale~~. The pipe coating shall be cleaned by brushing to 100 mm back from the edge of the proposed sleeve position to remove dirt.

(ii) The area to be sleeved shall be evenly preheated to the manufacturer's recommended requirements. The sleeve shall overlap undamaged coating by a minimum of 80 mm.

(iii) The sleeve shall be positioned and heat applied ~~using a propane or butane gas heating torch unless otherwise~~ as recommended by the manufacturer.

~~(l) Be used to reinstate polyethylene coating on a mitre bend. The sleeve shall be trimmed on the inside of the bend to obtain a wrinkle free fit.~~

6.4.7 Ductile Iron Pipe

The following applies to joints in ductile iron pipe:

(a) Ductile iron pipe jointing shall follow the joint manufacturer's specification.

(b) If repairs are needed to sleeving, it shall be repaired using tape for holes or tears smaller than the width of the tape. Sleeving shall be repaired using a patch of sleeving sealed with either tape or strap and buckle for larger holes or tears.

~~6.8.6~~6.4.8 Cold solvent cement welds

The following applies to cold solvent cement welds:

(a) Only ABS pipes shall be jointed using cold solvent cement welds. ABS pipe shall only be welded to other ABS pipes and ABS fittings.

(b) The pipe shall be cut square, chamfered and free of burrs. Mating surfaces shall be abraded with emery tape.

(c) All mating surfaces shall be wiped and cleaned with a methyl ethyl ketone (MEK) solvent to ensure all water, dust, dirt, oil, grease and solvents are removed prior to applying a proprietary ABS solvent cement. Thinners shall not be used on the solvent cement or MEK.

(d) Solvent cement shall be applied as per manufacturer's recommendations. This may require multiple coats on larger pipe diameters. The spigot and socket shall then be immediately joined and axial pressure sustained for the appropriate welding period. Pipe sizes greater than DN 150 require a mechanical means of applying the sustained axial pressure such as a lever winch and strops or similar.

(e) Excess solvent cement at the join shall be cleaned up immediately.

~~6.9~~6.5 Pressure testing of pipelines

Prior to commissioning of a pipeline, the pipeline and associated valves and fittings shall be pressure tested:

(a) Long pipelines shall be ~~broken~~ divided into smaller sections for testing. Test sections shall not exceed ~~300~~ 400 m ~~except where the approval is given in writing~~unless approved by Wellington Water.

(b) Long steel pipelines with slip-in welded joints can be pressure tested in one length.~~For subdivisions, all water supply pipes, pumping stations, reservoirs and any relevant appurtenant structures and fittings will be pressure tested upon completion of construction at the applicant's expense, and as part of the council's approval process, prior to the issue of any section224c certificate under the RMA.~~

(c) ~~The council's representative shall be present during the tests and~~All tests shall be carried out in the presence of Wellington Water who will sign the appropriate documentation provided by the ~~council~~ developer to verify acceptability of the test ~~if successful~~results.

(d) A minimum of ~~24~~ 48 hours of notice is required to be given to ~~the council~~Wellington Water prior to the test being carried out.

(e) The developer shall provide all ~~labour, plant, fittings and~~equipment and materials needed to carry out the test.

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

(i) All trenches excavated and pipes ~~trenched and~~ laid.

(ii) All lines thoroughly flushed and all residual debris cleaned out.

(iii) All fittings and connections ~~to have been~~(except to the live network) installed prior to pressure test.

(iv) Pipe anchored securely.

~~(iii)~~(v) ~~Any required~~ Pre-test soaking completed.

~~(g) All equipment and materials required to affect the test shall be supplied by the developer.~~

~~(h) For water main renewals, all renewed water pipes and fittings including valves, hydrant installations, air valve installations and branch connections shall be pressure tested.~~

(g) All air must be released from the pipeline during the filling operation. After all air has been released the pressure in the pipeline shall be allowed to build up to normal working pressure.

(h) The new pipeline shall be left to stand at this pressure for at least 24 hours prior to the pressure test.

(i) The test design must address potential health and safety risks of pipe fitting failure during filling, pre-test soaking and during the pressure test.

~~6.9.1~~6.5.1 Testing of steel, ductile iron, and PVC pipes

Steel, DI and PVC pipelines shall be tested in accordance with the constant pressure (water loss) method as specified in AS/NZS 2566.2 and Appendix M4. Test duration shall follow **Table 6-7.**

Table 6-7 – Pipeline test durations for the constant pressure (water loss) method

Pipeline Nominal Diameter	Test Duration h (hours)
100 mm to 200 mm	1 h
200 mm to 600 mm	2 h
600 mm and above	3 h

The specified test pressure, measured at the lowest point in the pipeline, shall be:

(a) 1.25 x the working pressure of the pipeline with a minimum test pressure of 1,200 ~~1,500~~ kPa for PN12 PVC pipe ~~– when measured at the lowest point in the pipeline section~~.

(b) 1.25 x the working pressure of the pipeline with a minimum test pressure of 1,600 ~~1,800~~ kPa for ~~PN16~~ PN15 PVC pipe ~~– when measured at the lowest point in the pipeline section~~.

(c) 1.5 x the working pressure of the pipeline with a minimum test pressure of 1,200 ~~1,800~~ kPa for DI and steel pipe ~~– when measured at the lowest point in the pipeline section~~.

~~6.9.2~~6.5.2 Testing of polyethylene pipes

PE pipes shall be tested by either the pressure rebound method or the pressure decay method.

~~6.9.2.1~~6.5.2.1 Pressure rebound method

The pressure rebound method shall be used to test short sections of small pipe. This test method shall be limited to the pipe sizes and lengths in **Table 6-8**.

Table 6-8 – Pipe sizes and lengths suitable for pressure rebound method

Pipe size	Maximum allowable test length
63 mm	400 m
125 mm	350 m
180 mm	300 m
250 mm	250 m

The test shall not be used to test pipes larger than that listed in **Table 6-8**.

The PE pipeline shall be tested in accordance with pressure rebound as specified in AS/NZS 2566.2 and Appendix M7 except that:

(a) Specified test pressure (STP) for PE100 SDR11 (PN16) pipe shall be 1,700 kPa – when measured at the lowest point in the pipeline section.

(b) STP for PE100 SDR13.6 (PN12) pipe shall be 1,500 kPa – when measured at the lowest point in the pipeline section.

(c) The pressure drop shall be 30% of STP.

(d) The main test phase shall be 90 minutes.

(e) The pressure shall not drop at any time during the 90 minutes.

~~6.9.2.2~~6.5.2.2 Pressure decay method

The PE pipeline shall be tested in accordance with pressure decay as specified in AS/NZS 2566.2 and Appendix M6. The STP shall be:

(a) For PE100 SDR11 (PN16) pipe shall be 1,700 kPa – when measured at the lowest point in the pipeline section.

(b) STP for PE100 SDR13.6 (PN12) pipe shall be 1,500 kPa – when measured at the lowest point in the pipeline section.

(c) The loading time t_L shall be not less than 50 minutes.

~~6.10~~6.6 Pipe repairs

~~6.10.1~~6.6.1 AC pipe failures

The following applies to the failure and repair of an AC pipe:

(a) The failure of a section of an AC pipeline shall result in the entire section of pipe between existing pipe joints being removed and replaced with a suitably rated length of approved PVC pipe.

(b) The PVC pipe shall be joined to the existing AC pipe with mechanical couplings at either end.

(c) Under no circumstances shall the AC pipe section be locally cut out around the point of failure and replaced, as the integrity of the remaining section of pipe is likely to be compromised by both the failure and initial aged condition.

(d) The AC pipe shall be bagged as per **Section 4.4 Working with asbestos cement pipes**.

~~6.10.2~~6.6.2 PVC pipelines

The following applies to the failure and repair of PVC pipe:

(a) For PVC-U and PVC-O pipeline failures, the entire section of pipeline shall be removed and replaced with PVC-U pipe of the same or greater pressure rating. Jointing shall be achieved with mechanical couplings.

(b) PVC-M pipelines may be repaired by cutting out the failed section 300 mm either side of the failure, and at least 1 metre in length in total, and replacing with a suitable length of PVC-M pipe of the same pressure rating and joined with a mechanical coupling. If the failure is within 1 metre of a joint, the repair shall extend to, and include the joint.

(c) Where the failure is due to a leaking fitting, such as a tapping band, then a repair clamp is permitted to be used to make the repair.

~~6.10.3~~6.6.3 Ductile iron and cast iron pipe failures

The following applies to the failure and repair of ductile and cast iron pipe:

(a) Failures due to pin holes can be repaired with a blank tapping band or a repair clamp.

(b) Cast-iron failures can be repaired using a section of ductile iron pipe and unrestrained mechanical couplings. Longitudinal splits require the entire pipe section to be replaced. Circular fractures can be repaired by either a repair clamp or by removing a section of pipe and replacing with a section of ductile iron pipe and joined with mechanical couplings.

(c) Ductile iron pipe failures should be repaired with a section of ductile iron pipe and restrained mechanical couplings. The plastic PE overwrap will also require reinstatement once the pipeline itself has been satisfactorily repaired.

(d) All couplings, repair clamps and tapping bands shall be suitably protected from corrosion by applying the full Denso system (primer, mastic, petrolatum tape and PVC outer wrap)~~Denso paste, mastic and petrolatum tape system~~.

~~6.10.4~~6.6.4 Steel pipe failures

The following applies to the failure and repair of steel pipe:

(a) Failures due to pin holes can be repaired with a blank tapping band or a repair clamp. Alternatively, a patch can be welded over the hole once all external coating has been removed.

(b) Larger failures will require the damaged section to be removed. Where the steel pipe section is in a continuously welded pipeline, the replacement section will need to be of the same diameter and joined to the existing pipe with butt welds and or welding

bands. If unrestrained mechanical couplings are used, then tie-bolts shall be specifically designed and incorporated into the repair.

(c) Where the failure is not in a continuously welded pipeline, then the pipe can be joined using unrestrained mechanical couplings.

(d) All repairs shall be protected from corrosion using a suitable coating method such as heat-shrink sleeves, polyethylene tape wrap or the full Denso system (primer, mastic, petrolatum tape and PVC outer wrap).

~~6.10.5~~6.6.5 Polyethylene pipe failures

The following applies to the failure and repair of PE pipe:

(a) Where possible, polyethylene pipe failures shall be repaired using electrofusion couplings and PE pipe of the same compound and diameter.

(b) Sufficient length of pipe either side of the repair shall be exposed to allow flexing of the pipe to maintain alignment across the electrofusion coupler.

(c) Electrofusion repair couplers shall be slip-on couplers.

(d) Electrofusion couplers shall NOT be used to repair the pipe where:

(i) The peel depth is less than the depth of scoring present on the pipe wall exceeds the depth of peel required.

(ii) The depth of indentation of the pipe wall by bedding chip exceeds the depth of peel required.

(iii) A drip-tight shut cannot be achieved.

(iv) Moisture lining the pipe wall cannot be controlled and removed.

(v) Adverse weather conditions.

(vi) Wet and muddy trench conditions.

(e) Care shall be taken to ensure suitable welding conditions are present before repairing the pipe.

(f) An electrofusion weld shall not be pressurised until the weld has reached ambient temperature. Typically, a period equivalent to twice the cool time shall elapse AFTER cool time is complete, and before the main is pressurised.

(g) Where electrofusion welding is not practicable due to in-situ conditions, approved mechanical couplings using grip-rings designed for PE pipe may be used. These shall be used with appropriate stainless steel pipe inserts. Where an electrofusion coupling or saddle has failed, the section with the faulty weld shall be removed and replaced with new PE pipe of the same compound and SDR.

~~6.11~~6.7 Tapping of mains under pressure

The following applies to tapping mains under pressure:

(a) Under pressure tapping into a water main may be made using suitably designed equipment.

(b) Tapping saddles with built-in self-tapping connections are permitted.

(c) Tapping drills shall be either a twist drill for metallic pipes (20 mm to 32 mm connections) or a coupon retaining type for non-metallic pipes.

(d) Specialist equipment used for tapping large diameter connections shall be approved on a case by case basis. These shall retain the coupon after drilling for removal.

(e) Live tapping shall be carried out through a ball or gate valve (mains cock).

(f) After connecting the service pipe, the valve shall be secured in the open position by wrapping with petrolatum tape prior to backfilling.

~~6.12~~6.8 Water supply shutdowns (cut-ins)

The following applies to temporary water supply shutdown (cut-ins):

(a) Temporary interruptions to the water supply network shall only be carried out ~~with the authority of~~ in accordance with Wellington Water's supply shutdown process.

~~(b) The persons undertaking the physical works shall be responsible for organising all notifications and alternative and temporary supplies where required.~~

(b) ~~A shut-down plan shall be submitted to Wellington Water for approval at least 5 working days prior to the proposed works.~~All personnel carrying out shutdowns of the water supply must be under the supervision of a water qualified person on site at all times (Level 4 Water Reticulation) and must follow the Water NZ "Good Practice Guide – Hygiene Practices to prevent Water Supply Contamination".

(c) The shutdown plan shall ~~detail, as a minimum~~use the correct template for water supply shutdowns:

~~(i) Required notifications,~~

~~(ii) Scope of shut-down and affected properties~~

~~(iii) Date, time and duration of shut-down,~~

~~(iv) Sequence for valve and hydrant operation,Cut-in milestones and expected timeframes,~~

~~(v) Any temporary water supplies and~~

~~(vi) Contact details of key personnel.~~

(i) Level 1

(ii) Level 2 or

(iii) Level 3.

~~6.12.1~~6.8.1 General

The following applies to planned water supply interruptions:

(a) A shutdown plan must be submitted to Wellington Water at least five working days prior to the shutdown.

~~(a)~~(b) Planned interruptions to normal water supply services shall, where possible, not be carried out during peak demand periods. The peak periods are:

(i) 6am to 9am on any day

(ii) 5pm to 9pm on any day and

(iii) 7am to 11am Saturday, Sunday and public holidays.

~~(b)~~(c) ~~No~~ Where possible, shutdown shall be planned such that it does not last longer than 4 hours.

~~(c)~~(d) Section 695 of the Health Act 1956 requires approval from the medical officer of health for ~~that~~ any planned restriction or interruption of the provision of drinking water by a network supplier or a bulk supplier that is expected to exceed 8 hours ~~must have approval from the medical officer of health~~.~~The contractor undertaking the work shall be satisfied that the work can be carried out within the limitations of the prescribed times frames, and that all equipment, labour and materials is available prior to issuing notifications. Any doubt shall be communicated to Wellington Water and alternative arrangements or requirements discussed.~~

~~6.12.2~~6.8.2 Notifications

Interruptions shall be notified to the affected residents and business, as ~~well as~~follows:

~~(a) Council customer contact centre~~

~~(b) Maintenance contractors,~~

~~(c) Fire and Emergency New Zealand,~~

~~(d) Wellington Water Network Operations Engineer and~~

~~(e) Wellington Water Pump Station Engineer~~

~~(f) Affected residents and business shall be notified by letter drop at least **24 hours** prior to implementation of the shut-down in addition to any other formal pre-notifications (see **Section 6.12.4**).~~

(a) Level 1 – Approved shutdown letters to domestic customers 24 hours prior to shutdown.

(b) Level 2 – Approved shutdown letters to affected business customers 5 working days prior to shutdown and to affected domestic customers 24 hours prior to shutdown.

(c) Level 3 – Approved shutdown letters to affected business customers within 5 working days prior to trial and shutdown and to affected customers 24 hours prior to trial and shutdown.

(d) Email shutdowns@wellingtonwater.co.nz 24 hours prior to any trial or actual shutdown. The Customer Hub will then advise the Client Council Call Centre and the New Zealand Fire Services. (This email address includes the Network Controller, all Customer Planning Engineers, the Customer Hub and Community Engagement Team.

(e) Email to the Project Engineer or Contracts Officers 24 hours prior to any trail or actual shutdown confirming that the shutdown is ready to proceed.

(f) Critical customers (dialysis patient, hospital, school or early childhood education facility) shall be notified 5 working days prior to any planned interruption of supply.

~~6.12.3~~6.8.3 Critical and key account customers

The following applies to water supply shutdown and critical and key account customers:

(a) Critical and key account users include dialysis patients, hospitals, clinics, schools and educational facilities, and all non-residential customers.

(i) The designer shall contact Wellington Water (Customer Hub) to check for any ~~will provide a list of Critical Users (~~dialysis patients ~~etc)~~ within the planned shutdown area.

(ii) Critical and key account users shall be notified ~~7 days in advance of any planned shut-down. This will be carried out~~ verbally as well as in writing.

(iii) A suitable time for the shutdown shall be negotiated with businesses where water is critical to the business (dialysis patient, schools, bakeries etc), or an alternative supply organised.

~~6.12.4~~6.8.4 Trial shutdown

A trial shutdown will be required for all ~~high-risk, planned interruptions to the network~~Level 3 shutdowns. In addition, Level 1 and Level 2 shutdowns may require checking ~~This is~~ to ensure all valves and hydrants are operable, and that there are no incorrectly closed valves in the network.

~~A trial shut-down shall be required for, but not limited to:~~

~~Reservoir shut-down,~~

~~Large number of affected residents (typically greater than 100 properties),~~

~~High risk shut-down in the CBD,~~

~~Any complicated cut-ins that require alternative supplies such as a PRV or by-pass and~~

~~Commissioning and connection of water main renewals to the existing reticulation system.~~

~~6.12.5~~6.8.5 ~~Emergency~~Reactive shutdown

The following applies to emergency and unplanned shutdowns:

(a) Emergency and unplanned shutdowns include reactive repairs to bursts, emergency situations, significant and major leaks and other situations which require an immediate isolation of the network to prevent further damage or risk to public health.

(b) Only Wellington Water Customer Operations Group (COG) shall carry out reactive shutdowns.

(c) In addition to following the Wellington Water Supply Process, reactive shutdown shall follow the Wellington Water COG Standard Operating Procedures (SOP).

~~(b)~~(d) Affected customers shall be personally notified prior to the water being shut-off. Where customers are not present, a notice shall be left with the customer informing them of the interruption.

~~(c)~~(e) Alternative supplies shall be arranged for critical and key account users where practicable.

~~(d)~~(f) Where it is not practical to notify customers individually, the use of a clear and concise message broadcast over a vehicle mounted public address system may be used. This message shall be broadcast along the full length of all affected streets.

~~6.12.5.1~~6.8.5.1 Emergency shutdown during planned construction works

Where the water supply network is inadvertently damaged during planned construction works, the contractor undertaking the works shall notify the Engineer to the contract, and the Wellington Water ~~representative and the maintenance contractor~~Customer Hub. The ~~maintenance contractor~~ Wellington Water ~~COG~~ shall undertake a reactive shutdown~~shall notify customers, isolate the network~~ and carry out any required repairs.

~~6.12.6~~6.8.6 Temporary supplies

~~Customers to be connected to a temporary supply shall be notified in writing 2 days prior to the connection. The notification will outline the reasons for the supply, timeframes and contact details of the contractor for both general queries and emergency repairs.~~Any shutdown that requires a temporary supply into the network (such as trailer mounted temporary PRV, hydrant feed, tanker supplies, temporary pipes etc.) shall be classified as a Level 3 shutdown and follow the appropriate processes. These alternate supplies may require hydraulic calculations to confirm they are suitable.

6.9 Manholes

The following applies to manhole design:

(a) Manholes shall be designed to withstand HN-HO-72 loadings as a minimum, or greater in areas where additional loading is anticipated, such as airports or loading yards.

(b) Risers shall typically be precast reinforced concrete units complying with AS/NZS 4058 as a minimum for manufacturing. The manufacturer is to certify the riser design is suitable for the design loading.

6.9.1 Manhole construction

The following applies to manhole construction:

(a) The diameter of cast-in-situ bases of precast manholes shall be at least 300 mm plus the outside diameter of the manhole and shall be at least 150 mm thick.

(b) Manholes with a precast base shall be placed on a wet concrete bed or on 150 mm of bedding material.

(c) Precast manhole bases shall be used for all manholes constructed below the water-table or sea level.

(d) Manholes shall have the minimum practical number of risers. For the majority of manholes, only one riser will be necessary.

(i) If more than one riser is used, a layer of mortar or an appropriate epoxy shall be placed on the joint before positioning the next riser.

(ii) Proprietary rubber rings or butyl mastic strips shall also be used to seal between riser sections. Rubber rings shall be appropriately lubed and set before jointing.

(iii) Similarly, a layer of mortar shall be placed on the top of the top riser before placing the manhole roof.

(iv) Epoxy ***shall not*** be used between the lid and the riser in case the lid needs to be removed in the future.

6.9.1.1 Manhole design against liquefaction

See **Section 5.6.1.1 Manhole design against liquefaction**.

6.9.2 Manhole rungs

See **Section 5.6.3 Manhole rungs**.

6.9.3 Manhole lid construction

See **Section 5.6.10 Manhole lid construction**.

6.9.4 Hinged manhole covers

Where hinged manhole covers are installed in the carriageway, covers shall be oriented such that the hinge is oriented towards oncoming traffic.

6.9.5 Manhole safety grilles

See **Section 5.6.4 Manhole safety grilles**.

~~6.13~~6.10 Connections to the main

The following applies to main connections:

(a) Any service pipe or fire service connection to a main, excluding a junction with another rider main or principal main, shall comply with this section.

(b) Pipes shall comply with the permitted types in **Section 6.2 Materials**.

(c) Tapped connections through the pipe wall shall be the greater of 500 mm, or 5 times the diameter of the principal main, from any other connection, pipe joint or fitting.

(d) It is important that the swarf from any tapping activity is removed from the pipe before commissioning.

(e) Tapped clamps shall only be used to repair a main where a ferrule has blown out or similar.

(f) All connections shall be installed with warning tape as per **Section 6.3.8 Warning tape / tracer wire**.

(g) Ductile iron tee sections or tapped connectors shall be used on:

(i) Connections 40 mm or greater on 100 mm principal mains and

(ii) Connections 50 mm or greater on principal mains 150 mm and greater.

6.10.1 Connections to the bulk water pipeline

The connections to existing in-service bulk water pipelines will be carried out by Wellington Water.

~~6.13.1~~6.10.2 Service connections

~~A property shall typically only be serviced by a single service. Where a property is serviced by multiple service connections, Wellington Water may request that the connections are amalgamated. This typically applies to residential connections.~~

Connections to the mains shall be made with:

(a) Tapping bands as per **Section 6.2.13.1 Mechanical tapping bands**.

(b) Electrofusion saddles as per **Section 6.2.13.2 Electrofusion tapping saddles**.

(c) Tee sections as per **Section 6.2.13.8 Bends and tees**.

(d) Tapped connectors as per **Section 6.2.13.8 Bends and tees**.

~~6.13.1.1~~6.10.2.1 Existing galvanised iron service pipes

Existing galvanised service iron pipes shall be replaced where practicable. Where renewal is not practicably imminent, connections to the existing galvanised iron pipe shall be made using compression fittings designed specifically for this purpose.

~~6.14~~6.11 Fire Services

The following applies to fire services:

(a) Branches off a principal main for a dedicated fire service~~s~~ supplying a building or complex shall be either concrete lined steel, concrete lined ductile iron or ~~copper between the fire service valve on the main, and the non return valve/secondary isolation valve in private property~~PE100 materials compliant with this specification.

(i) The fire service branch shall be buried when in road reserve and shall be constructed in compliance with this specification up to the fire service valve (point of supply).

(ii) PE100 shall only be used where:

1. The principal main it connects to is also PE100.
2. The fire service branch does not require the installation of bends between the principal main and the fire service valve.
3. A minimum depth of cover equivalent to that required for a principal main is maintained between the principal main and the fire service valve.

(b) Fire service layouts shall comply with the requirements of NZS 4541 and NZS 4517~~, except where amended by this specification~~.

(c) The fire service valve shall be located in the berm or footpath where possible, at least 500mm from the boundary.

~~(c)~~(d) The fire service valve cover shall ~~have an approved valve cover clearly identifying the valve as a fire service valve~~ be clearly marked with the letters FS and painted green.

~~(d)~~(e) Mechanical meters are not permitted on fire/sprinkler services for non-~~domestic~~residential installations that are greater than 50 mm in diameter. Where a meter is required, a magnetic meter shall be installed.

~~6.15~~6.12 Disinfection

~~6.15.1~~6.12.1 New or lined pipelines

Prior to the commissioning of any pipeline, the pipeline and associated valves and fittings shall be disinfected and bacteriologically tested to eliminate risks to the public.

~~6.15.1.1~~6.12.1.1 ~~Disinfection~~Chlorination

The following applies to disinfecting new or relined pipelines:

(a) The pipeline shall be thoroughly flushed with potable water to clear any debris.

(b) It shall be completely filled with water with a consistent level of ~~residual~~ chlorine ~~greater than 50~~ between 20 and 30 ppm (mg/L).

(c) All hydrants and valves shall be operated to ensure all surfaces make contact with the ~~solution~~highly chlorinated water.

(d) The pipeline shall be left to sit for 24 hours and the level of residual chlorine measured at three locations along the pipeline.

(e) The pipeline ~~shall be deemed to have passed~~will be sufficiently chlorinated if the ~~level of residual~~ chlorine is 10 ppm or greater ~~for new pipes, or 20 ppm or greater for newly lined pipelines~~at all sample points.

(f) Prior to completion of the pipeline end connections, the highly chlorinated water shall be flushed from the pipe and replaced with potable water.

(i) ~~If the residual chlorine level is less than 2 ppm,~~ The flushed water may be discharged to the nearest convenient stormwater ~~or wastewater~~ system if the water is dechlorinated using sodium thiosulphate and the remaining residual chlorine concentration meets the permitted activity standard in the regional plan.

(ii) ~~If the level is greater than 2 ppm, then the level of residual chlorine shall be reduced using sodium thiosulphate, or the water can be~~If the flushed water is to be discharged to the wastewater system, written approval is needed from Wellington Water, which may include the need to consider trade waste bylaws and the rate of discharge so as not to overload the sewer pipes or any downstream wastewater pumping stations.

(iii) An air gap must be maintained at the point of discharge.

~~(iii) The pipeline shall then be thoroughly flushed with potable water and readied for bacteriological testing.~~

~~6.15.1.2~~6.12.1.2 Bacteriological testing

After disinfection and flushing, and prior to commissioning, the pipeline shall be tested to ensure disinfection was successful.

(a) A technician from a Wellington Water approved testing laboratory shall take samples over the full length of the pipe.

(b) If possible, two samples shall be taken over the first 100 m of the pipeline, and an additional sample from locations approximately every 100 m thereafter.

(c) A minimum of two samples is required for any pipeline.

(d) The samples shall be tested for residual chlorine levels and *E.coli*.

(e) The pipeline shall be deemed acceptable for commissioning if residual chlorine < 1 mg/L ~~or~~ and *E. coli* < 1.

(f) If a pipeline fails the bacteriological tests, or if it is contaminated after testing, the pipeline shall be disinfected again, and bacteriological testing repeated prior to placing the pipeline into service.

~~6.15.2~~6.12.2 Repairs

Repairs to pipelines that are in service shall be cleaned and disinfected in the following way:

(a) All fittings and pipes shall be sprayed and swabbed with a super-chlorinated solution (50 ppm residual chlorine) and protected from contamination.

(b) The internal lining of the open ends of pipelines shall be sprayed and swabbed with the super-chlorinated solution. Care shall be taken to ensure water from the trench does not enter the pipeline.

(c) After the repair is made, and where practicable, the repaired pipe shall be flushed such that potable water is drawn both ways through the repair location.

~~6.15.3~~6.12.3 Reservoirs

Please note that these sections on reservoirs are currently under review and the most up-to-date guidance must be sought from Wellington Water.

~~6.15.3.1~~6.12.3.1 Chlorination

Where it is necessary to chlorinate an existing reservoir to improve the level of free available chlorine, the following specification shall be followed:

(a) The standard chemicals used for chlorine dosing of potable water reservoirs are calcium hypochlorite in the form of HTH granules and sodium hypochlorite in the form of a solution.

(i) Calcium hypochlorite (HTH) typically has an available chlorine level of between 60% and 65%.

(ii) Sodium hypochlorite (SHS) typically has an available chlorine level of 15%.

(iii) The level of available chlorine shall be checked prior to calculation for both HTH and SHS.

(b) A Ct = 7200mg/Lmin shall be achieved to provide effective chlorination of reservoirs.

(c) The use of other chemicals for the dosing of reservoirs is not permitted without the approval of Wellington Water.

(d) Previous experience has shown that the introduction of undissolved HTH granules or SHS solution through the reservoir hatches and allowing circulation by filling the reservoir is effective.

~~6.15.3.2~~6.12.3.2 Chlorine dosage

The following applies to the chlorine dosage for reservoirs:

(a) Dosing of reservoirs is generally carried out to between 0.1 ppm and 0.3 ppm depending on the severity of the contamination and sensitivity of the consumers supplied. This has been found to be effective for treating low levels of bacterial contamination. Dosage levels are to be specified by Wellington Water.

(b) Once the required dosage has been verified, the amount of chlorine to be added to the reservoir must be determined. This can be done by physically measuring the depth of water within the reservoir to be dosed and calculating the volume by multiplying the depth measured by the reservoir floor area. Reservoir levels and storage volumes can also be obtained for most reservoir sites directly from the Wellington Water's SCADA system.

(c) Once the required dosage and volume of water are known, the amount of HTH or SHS can be calculated using the following formula:

$$HTH(g) or SHS(L) = \frac{Vol(m^3) \times req.dosage(ppm) \times 100}{AvailableCl(\%)}$$

Available Cl for HTH = 65%

Available Cl for SHS = 15%

(d) Where a chlorine residual is or may be present prior to chlorinating the reservoir, a chlorine residual test shall be carried out on the reservoir water to determine the available chlorine already present. This must be allowed for when calculating the amount of chlorine to be added to ensure the correct dosage is achieved.

(e) Measurement of the quantity of HTH or SHS can be by weight or volume. Measurement by volume is generally more convenient and should be carried out using a measuring cylinder graduated to 20 ml.

(i) 100 g of HTH will measure 90 ml. For smaller quantities 1 teaspoon of HTH is 5 g by weight.

~~6.15.3.3~~6.12.3.3 Dosing procedure

The following applies to the dosing procedure for reservoirs:

(a) Water shall be fed into the reservoir through either manual operation of the pumps or other means of inflow control (e.g., control valve) prior to the addition of any chlorine into the reservoirs.

(b) This is arranged through the maintenance contractor and may involve liaison with the Wellington Water bulk water supply operators for those reservoirs supplied from the bulk water supply system.

(c) Flow of water into the reservoir shall be maintained for a minimum of ½ hour following the addition of chlorine or until the reservoir is full. Inflow into the reservoir shall stop before the reservoir top water level reaches the overflow level.

(d) The quantity of Chlorine shall be determined and introduced into the reservoir by uniformly scattering over the water surface over as large an area as possible via the reservoir entry hatches.

(e) Reservoirs having separate inlet and outlet pipelines shall have the Chlorine added through the hatch at the opposite end of the reservoir to the outlet pipeline.

(f) Regular water samples shall be taken from the reservoir outlet sampling tap and within the reticulation system over a 24 hour period to ensure satisfactory dispersion of the chlorine has been achieved.

~~6.15.3.4~~6.12.3.4 Communication

The following applies to communication of cleaning and disinfection of reservoirs:

(a) Co-ordination with the Wellington Water bulk water operators may be required with regards to filling the reservoir if the reservoir is directly supplied from the bulk supply network.

(b) It is important to maintain communications with the drinking water assessor (Regional Public Health) throughout the process.

(c) Any anomalies in the commissioning process or sample results should be conveyed to the drinking water assessor for consideration of its significance.

(d) The disinfection procedure requires the handling of chemicals, and all staff handling the products should be appropriately equipped and trained in the safe handling and use of the chemicals.

~~6.15.3.5~~6.12.3.5 Disinfection equipment

The following applies to disinfection of reservoir equipment:

(a) All equipment should be disinfected using a 50 mg/L chlorine solution.

(b) This includes all equipment to be taken into the reservoir and all clothing that will be in contact with the interior such as boots and gloves.

(c) A boot wash should be present at the hatch so footwear can be cleaned prior to entry.

(d) All brushes, shovels, hoses, machinery etc should be disinfected.

(e) Reservoirs are a confined space and petrol driven water blasters should not be used inside the reservoir without proper precaution.

~~6.15.3.6~~6.12.3.6 Washdown

The following applies to the washdown of reservoirs:

(a) The walls, floor, ceiling and columns should all be scrubbed with a 50 mg/L (min) chlorine solution and hard bristled brushes.

(b) Care should be taken not to damage any internal seals and water blasting should be considered with care.

(c) Once the reservoir has been washed down; all equipment shall be evacuated and a pre-filling inspection carried out by the Wellington Water to ensure all areas have been suitably cleaned and all material has been removed to Wellington Water's satisfaction.

(d) The reservoir shall not be filled until Wellington Water is satisfied with the results of the wash down and has issued clearance.

~~6.15.3.7~~6.12.3.7 Filling and dosing

The following applies to filling and dosing reservoirs:

(a) Once clearance has been received, the reservoir can be filled by opening the inlet valve (if the reservoir is designed with a top entry filling arrangement) or by water entering the reservoir via a hose through the hatch to maintain an air-gap.

(b) The reservoir should be filled to the overflow level.

(c) The reservoir is required to have a final free available chlorine concentration of at least 10 mg/L post-filling. This can be achieved through the use of a continuous dosing plant or by regular introduction of disinfectant solution as the reservoir fills.

(d) Any disinfectant introduced should be in a dilute solution form (i.e., do not introduce dry form HTH granules directly).

(e) Some mixing of the reservoir is likely to be required, and this can be achieved using a suitably disinfected powered mixer.

(f) Dosing should be calculated at:

$$HTH(g) = \frac{Vol(m^3) \times req.dosage(ppm) \times 100}{AvailableCl(\%)}$$

Where:

Vol	is the volume of water in the reservoir in m^3
HTH	(High Test Hypochlorite) is Calcium Hypochlorite dry granules. This can be replaced with Sodium Hypochlorite liquid (mL)
Req. dosage	is the target chlorine residual, typically around 0.3 ppm (mg/L) for reservoirs in normal operation
AvailableCL	is the available chlorine in the additive, either HTH (typically ~65%) or Sodium Hypochlorite (typically ~15%)

~~6.15.3.8~~6.12.3.8 Sampling

The following applies to chlorine sampling in a reservoir:

(a) The chlorine residual of the tank should be tested 48 hours after filling to ensure suitable levels have been maintained.

(b) The chlorine residual should be at least 10 mg/L.

(i) If the sample results drop below 10 mg/L, it is indicative of some form of contamination and the water quality should be considered compromised.

(ii) The reservoir should be drained as per **Section 6.12.3.9 Draining the reservoir**, and thoroughly investigated to locate the source of the contamination.

(iii) The contamination may be due to animal or vegetable matter in the reservoir or a residual construction chemical depleting the chlorine. Once the source is identified, the disinfection procedure can be repeated from the washdown stage.

(c) Alternatively, the chlorine residual could be increased back above 10 mg/L by introducing additional disinfectant and monitoring for an additional 24 hours.

~~6.15.3.9~~6.12.3.9 Draining the reservoir

The following applies to draining a reservoir after disinfection:

(a) If the residual chlorine concentration meets a permitted activity standard in the regional plan, the water may be discharged to the nearest convenient stormwater system.~~Super chlorinated water can be discharged directly into the sewer or stormwater network provided the chlorine residual is < 2 mg/L. If it is > 2 mg/L, and it is not possible to discharge to a sewer, the isolated reservoir water will need to be dechlorinated with a Sodium Thiosulphate solution before discharging to the stormwater.~~

(b) If the water is to be discharged to the wastewater system, the discharge needs written approval from Wellington Water, which may include the need to consider trade waste bylaws and the rate of discharge so as not to overload the sewer pipes or any downstream wastewater pumping stations.~~The water should be tested before~~

~~discharging to ensure depleted chlorine residual to ensure the FAC levels are < 2 mg/L. If draining to a sewer, consideration will need to be made to the rate of discharge so as not to overload the sewer pipes or any downstream wastewater pumping stations.~~

~~6.15.3.10~~6.12.3.10 Refilling of the reservoir

If the sampling results are satisfactory, the outlet and scour valves should be checked to ensure they are tightly closed, and the reservoir can be refilled using the normal inlet works. No air gap is required for this filling stage.

~~6.15.3.11~~6.12.3.11 Pre and post-commissioning sampling

The following applies to pre- and post-commissioning sampling of reservoirs:

(a) A three day sampling programme shall begin once the reservoir has been filled.

(b) The drinking water assessor (Regional Public Health) shall be given at least two days advanced warning of the filling to ensure the drinking water assessor is aware of the sampling programme.

(c) Sampling of the waters should be sub-surface (at least 300 mm below the surface) and may require specialist equipment (suitably disinfected).

(d) The samples shall be sent immediately to the laboratory (if the samples were not collected by lab staff), where they shall be tested for:

(i) Total coliforms

(ii) E.Coli (<1)

(iii) Free available chlorine (<1 mg/L)

(e) The sample results shall be sent to the drinking water assessor who will advise of any concerns they may have with the results.

(f) An upper limit has not been set for total coliforms; however, a high result may result in the disinfection process being repeated as elevated total coliform counts may indicate poor disinfection contact time or non-faecal contamination.

~~6.15.3.12~~6.12.3.12 Commissioning

The following applies to commissioning of reservoirs:

(a) The reservoir outlet valve can only be opened on the advice of Regional Public Health. The outlet valve will be operated by Wellington Water staff.

(b) The Wellington Water bulk water operators will need to be informed if the reservoir is filled directly from the bulk supply to ensure communication between the reservoir and the pumping station/filling valve is properly established and monitored.

(c) A commissioning plan should be established to detail the valving sequence to both commission the reservoir and terminate any alternative supply in operation.

(d) Wellington Water operational staff will take over full operational control of the reservoir once the final set of sample results are cleared by the Regional Public Health. All locks will be changed to the appropriate security series locks and access to the reservoir interior by the contractor is strictly forbidden without permission from Wellington Water.

(e) The contractor is still permitted to carry out works on the exterior, but care is to be taken around operational fittings such as air-valves and hydrants.

~~6.16~~6.13 Reservoirs

The following applies to reservoirs:

(a) Reservoirs shall be above ground or buried reinforced concrete tanks.

(b) Reservoirs shall only be buried if required by the District Plan or by a resource consent condition.

(c) The concrete cover to reinforcement shall be increased 10 mm over and above the requirements of NZS 3101.1&2 to improve the durability of the reservoir.

(d) The minimum standard for fencing shall be a 1.8 m high, 50 mm diamond, 2.5 mm wire diameter chain link fence with rails top and bottom. However, any fence must be agreed with Wellington Water to complement the surrounding environment.

~~6.16.1~~6.13.1 Foundation and geotechnical assessment

The following applies to reservoir foundation and geotechnical assessments:

(a) A geotechnical assessment shall be carried out to determine the suitability of the foundation material for the reservoir.

(b) Drilling on the proposed site, bore logging and interpreting of the data shall be carried out to support any geotechnical investigations.

(c) A spectra assessment shall be carried out on the proposed site by a recognised seismologist.

~~6.16.2~~6.13.2 Structural design requirements

The structure shall be designed with a 100 year life expectancy and the design shall comply with contemporary design codes which shall include, but not limited to, the NZBC, NZS 3106 and AS/NZS 1170. For serviceability (SLS) and ultimate limit state (ULS) definition, see **Section 2.2 Definitions**.

~~6.16.2.1~~6.13.2.1 General requirements

The following applies to general structural reservoir design:

(a) All roof and floor grades shall have a minimum grade of 1%~~1:100~~.

(b) Walls shall be either cast in-situ reinforced, pre-stressed concrete or precast concrete wall panels. Precast column, beam and roof units are acceptable.

(c) Loadings design shall include those from slosh, excavation for repair and rapid changes in water level.

(d) Any floor, wall or roof joint (including construction joints) shall have the same life as the structure. The Consultant shall consider the alternatives available for the floor slab construction (e.g., continuous floor slab versus construction joints) and demonstrate the best jointing system with the same life as the structure has been chosen.

(e) The use of water stops and sealants shall be avoided or minimised where possible.

(i) This is important, as many jointing materials have only limited lives of 15 to 20 years. That replacement can be costly involving isolation of the reservoir and uncovering of the reservoir.

(ii) Careful detailing of joints is required, as the financial cost of retesting the structure for watertightness is considerable.

(iii) Additional measures to mitigate leakage should be incorporated in the structure. Measures could include additives to the concrete to promote autogenous healing at cracks, bandages on interior joints and membrane coatings on the interior.

(f) The reservoir structure is to be designed to cope with a water pressure of at least one metre above the top of the reservoir walls.

(g) The lowest roof beam must be 300 mm above top water level (TWL) or 50 mm above the maximum water level expected when the reservoir is overflowing (250 mm above TWL). The minimum level of the roof slab shall be at least 450 mm above the TWL. The beams must be away from the overflow.

(h) The roof structure shall be watertight and graded so as to drain water satisfactorily from the roof area.

~~6.16.2.2~~6.13.2.2 Buried reservoirs

For buried reservoirs:

(a) A continuous waterproof membrane shall cover the roof.

(b) Site concrete shall cover the membrane.

(c) A layer of drainage material shall cover the site concrete to ensure water will not pond on the graded roof.

(i) The roof must be strong enough to take the required landscaping, tractor mowing loadings and large digger (at least 10 tonnes) loading for possible future maintenance.

(ii) The landscaped material must be adequate to support turf all year around.

(iii) A minimum of 300mm of fill, including top soil, is to be provided over the site concrete which protects the membrane.

(d) The walls of the reservoir that will be backfilled against, shall be sealed with at least two coats of Mulseal or equivalent after a successful water tightness test.

(e) A drainage blanket is required on the walls.

(f) Drainage material is required to be laid against the walls and must be of a grading and size such that the surface seal coat is not damaged.

~~6.16.3~~6.13.3 Pipework

The following applies to reservoir pipework:

(a) Crossing of large pipes is to be avoided.

(b) Consideration must be given to location of pipes relative to ground levels, avoidance of dead legs, access to manually operated valves in an emergency, connection of pipes to the reservoir as they may be below reservoir floor level, means of assembling of pipework, any subsequent maintenance or replacement of valves or equipment, differential movements between pipes and structures, support and

anchoring of pipes, access for staff, provision for differential movements where pipes connect to rigid structures, location of changes in diameter and access to interior of pipes for welded joints and lining reinstatement.

(c) All pipe and fittings shall comply with the materials specified in **Section 6.2 Materials**. Jointing and laying shall comply with this specification also.

(d) All pipework shall be protected against corrosion and braced against seismic forces as anticipated by the structural design.

(e) Consideration shall be given to water testing new reservoirs. Means shall be provided to ensure that the water-tightness of the isolation valves on the inlet, outlet and scour pipes can be confirmed. This may require:

(i) Designing downstream pipework such that the valve face can be exposed and witnessed as drip tight.

(ii) A second valve being installed downstream of the isolation valve, with a tapping point on the underside of the pipe between the two valves.

~~6.16.3.1~~6.13.3.1 Valves

The following applies to reservoir valves:

(a) Valves used in reservoirs shall typically be resilient seated gate valves as per **Section 6.2.11 Valves.**

(b) For valves 600 mm and greater, resilient seated butterfly valves as per **Section 6.2.11.2 Butterfly valves** may be used with appropriate gearing and handwheels. Butterfly valves shall be in a chamber.

(c) Electrically actuated auto-closing valves of any size may be a resilient seated butterfly valve.

~~6.16.3.2~~6.13.3.2 Inlet pipework

The following applies to reservoir inlet pipework:

(a) The inlet pipe shall have a resilient seated gate valve immediately adjacent to the reservoir wall to isolate the reservoir. Any seismic coupling shall be installed immediately upstream of this isolation valve. There are to be no fittings between that valve and the reservoir wall.

(b) For gravity filled reservoirs, the inlet shall have either a motorised plug valve or an altitude valve upstream of the isolation valve to control the flow into the reservoir as per the proposed filling logic. Reservoirs filled directly from a pumped rising main shall rely on the pump logic to control the filling rate.

(c) An approved, bi-directional magnetic flow meter shall be installed upstream of the control valve, or isolation valve if no control valve is required.

(d) The inlet shall enter the reservoir at a lower level, through the floor or wall of the reservoir, and rise as a standpipe to at least 80% of the height of the reservoir. This is to provide a non-return function to prevent the reservoir from emptying in the event of an inlet main failure. Alternatively, the inlet may rise up the outside of the reservoir and enter through the wall at the 80% level.

(e) The stand-pipe shall have a return pipe to the reservoir floor to ensure the final discharge enters is below the 25% level and opposite to the outlet to encourage

turnover and maintain chlorine residual. An anti-siphon orifice approximately 25% of the standpipe diameter shall be positioned at the top of the standpipe to prevent back siphoning in the event of a failure.

(f) All pipes and fittings shall be flanged or axially restrained between the reservoir and the control valve. A flexible, seismic coupling is required immediately downstream of the inlet valve which is adjacent to the reservoir wall. The coupling shall meet the requirements of deflection, pull-out resistance and elongation as outlined in **Section 6.4 Pipe jointing**. Flex-tend couplings are an example of a fitting that would comply with this requirement.

(g) A valved bypass (normally shut) shall be provided between the inlet and outlet pipework. This bypass shall be:

(i) Upstream of the inlet control valve

(ii) Downstream of the inlet magflow meter

(iii) Upstream of the outlet magflow meter and

(iv) Downstream of the auto-closing valve.

~~6.16.3.3~~6.13.3.3 Outlet pipework

The following applies to reservoir outlet pipework:

(a) The outlet pipe shall draw from the base of the reservoir through the floor of the tank.

(b) The outlet pipe shall have a resilient seated gate valve immediately adjacent to the reservoir wall to isolate the reservoir. There are to be no fittings between that valve and the reservoir wall. Any seismic coupling shall be installed immediately downstream of this isolation valve.

(c) A tapping shall be provided downstream of the resilient seated gate valve and include a 20 mm stainless steel ball valve which may be used as an alternative pressure tapping for monitoring reservoir level when the scour is being operated.

(d) The outlet shall have an automatic closing valve downstream of the reservoir isolation valve with a bypass around the valve to allow testing and a manually operated gate valve on it sized to allow average day demand flow through it over a short period.

(e) A hydrant, or 80 mm resilient seated gate valve with a hydrant outlet, shall be installed between the auto-closing valve and the reservoir isolation valve. This point shall be for emergency distribution of water in the event of catastrophic pipe failure downstream of the auto-closing valve.

(f) A combination air-valve is required downstream of the auto-closing valve in a chamber or tunnel that complies with the requirements of **Section 6.2.16.1 Chamber**. It shall be sized to ensure the outlet pipeline does not experience negative pressures in the event of a catastrophic pipe failure.

(g) An approved, bi-directional magnetic flow meter shall be installed downstream of the auto-closing valve.

(h) All ~~pipes and fittings~~pipe joints shall be flanged or axially restrained between the reservoir and the meter, which is located downstream of the auto-closing valve.

~~6.16.3.4~~6.13.3.4 Scour pipework

The following applies to reservoir scour pipework:

(a) A scour valve is required to enable the reservoir to be drained in a controlled fashion.

(b) The inlet to the scour pipe shall be from a sump in the reservoir floor graded to at a slope of no flatter than 1%.

(c) The scour main and associated drains shall be sized to enable the full reservoir volume to be drained over a maximum of 24 hours.

(d) A resilient seated gate valve shall be located in the valve chamber/tunnel to enable isolation of the scour from the downstream network. The flanged valve shall be immediately adjacent to the reservoir wall or floor. A seismic coupling shall be installed immediately downstream of the isolation valve.

(e) A 20 mm pressure tapping with a stainless steel ball valve shall be included on the scour pipe between the reservoir wall and the isolation valve. The tapping is for a pressure transducer that will record the reservoirs operating level.

(f) The scour pipe shall connect to the stormwater network. The downstream stormwater network shall be checked to ensure the scour discharge can be conveyed without surcharge during dry-weather including the discharge point and any consenting concerns. The stormwater network shall be upgraded if it is not able to convey the flows.

(g) All pipes and fittings shall be flanged or axially restrained between the reservoir and the isolation valve immediately downstream of the reservoir wall.

~~6.16.3.5~~6.13.3.5 Overflow pipe and stormwater assessment

The overflow pipe shall:

(a) Be sized to convey twice the maximum possible inflow of water when the water level is not less than 200 mm below the top of the reservoir wall (or freeboard).

(i) The driving head between the overflow inlet and a point 200 mm below the top of the reservoir wall shall be sufficient to convey twice the maximum inflow regardless of whether water is supplied by pump or by gravity to the reservoir.

(ii) The additional capacity is to cater for future increases in pump size or network upgrades increasing the inflow.

(b) Be an internal standpipe with a bell-mouthed entry. It shall be flanged near the floor to allow future replacement if required. The overflow rim shall be 75 mm above the nominal top water level of the reservoir.

(c) Connect to a manhole outside the reservoir which will subsequently connect to the stormwater network. The overflow pipe shall have a non-return valve on it to prevent rodent entry into the overflow pipe. The non-return valve shall be accessible from the manhole. The scour pipe may connect to this manhole also. The overflow manhole and subsequent drainage system shall comply with **Section 5 Drainage Specifications**.

The downstream stormwater network shall:

(d) Be investigated to ensure it can carry the design overflow event (current design pumped or gravity inflow) without surcharge or erosion. It shall be assumed that it is a dry-weather overflow event.

~~6.16.3.6~~6.13.3.6 Water quality sampling taps

The following applies to reservoir water quality sampling taps:

(a) A 20 mm connection on the inlet and outlet pipe shall allow both pipes to have water drawn off them for the purposes of testing the incoming and outgoing water quality.

(b) The sampling taps shall be located either in a valve chamber or tunnel for buried reservoirs, or in the telemetry shed for above ground reservoirs. The location shall be selected to ensure there is a low health and safety risk for monitoring staff.

(c) The taps shall discharge to a small stainless steel basin that will discharge to a drain or natural ground.

~~6.16.3.7~~6.13.3.7 Under drainage

Under drainage is for floor and walls (if reservoir is buried) and includes the following:

(a) A sump is to pick up water from the under drainage outlets and be pumped or piped by gravity to the overflow/scour pipe system.

(b) The system shall be designed to prevent any surcharging from the scour/overflow when the reservoir is overflow or scouring.

(c) The under drainage pipework is to drain specific sectors for monitoring purposes. A minimum of six sectors is required. Each sector outlet pipe is to have permanent engraved signage and discharge so any source of any leakage through the reservoir floor and/or walls can be identified.

(d) The underflow drains are to be laid in a grade away from the reservoir. There shall be no springs or seepage water flows into the under drainage. Any spring/seepage water is to be diverted away from the under drainage.

~~6.16.4~~6.13.4 Roof hatches and ladders

The following applies to roof hatches and ladders into reservoirs:

(a) Hinged airtight access hatch covers shall be provided as non- venting hatches and will require a concrete, not steel, up-stand on the roof.

(b) A minimum of two hatches are required with each hatch being on opposite sides of the reservoir. A hatch shall be situated adjacent to the rim of the overflow pipe and another above the primary outlet. At least one of the hatches shall provide inclined access to the interior of the reservoir.

(c) All ladders and safety rails shall have extendable handrails and shall be designed to provide a safe environment for people working on the reservoir and shall be designed to meet the latest standards and codes.

(i) Landings will be required on ladders.

(ii) More than one ladder into the reservoir may be required for safe egress.

(d) At least one set of water level probes will be required. Water level probes are to be adjacent to the overflow which is adjacent to a hatch.

(e) The internal access ladder(s) shall incorporate handrails and be installed at a slope of 65 to 70 degrees from the horizontal.

(i) Internal steelwork shall be stainless steel or galvanised steel.

(ii) Provision shall be made at the hatch covers for the installation of limit switches and associated cabling to indicate when the lids are open as well as one set of water level probes.

(iii) Wellington Water shall advise switch and probe requirements.

(f) Where compartments or inner/outer tanks are adopted the hatches are to be positioned in such a way that there are two hatches per compartment or inner/outer tanks. Care should be taken that the foot of the ladders do not interfere with the pipe work inside the reservoir.

~~6.16.5~~6.13.5 Electrical, monitoring and control equipment

The electrical and SCADA specification shall be obtained from Wellington Water prior to design. Notwithstanding this, the reservoir shall have:

(a) An approved seismically activated trigger system which shall provide the stimulus to operate the auto-closing valve in the event of an emergency.

(b) A pressure transducer accurate to 0.5 kPa (50 mm H_2O~~0.05 mH_2O~~) to record the water level in the reservoir.

(c) Monitoring equipment to measure the instantaneous and cumulative inflow and discharge of water to and from the reservoir.

(d) Security monitoring equipment which shall monitor access alarms to the hatches and doors.

(e) Control equipment to operate the auto-closing valve as required

(f) A telemetry hut where the electrical and control equipment shall be housed in a dry and ventilated valve chamber, tunnel or external building. It shall be designed and constructed to the same structural standards as the reservoir it serves.

~~6.17~~6.14 Water supply pumping stations

The following applies to water supply pumping stations:

(a) Water supply pumps shall generally be housed in an above ground structure.

(b) Underground stations will not typically be permitted.

(c) Water supply pumping stations shall have 100% standby for a duty-standby pump arrangement, or 50% standby for duty-assist-standby pump arrangement.

~~(d) Be capable of pumping the greater ultimate peak day volume OR reservoir volume over an 18 hour period for volumes over 2500 m³, or 15 hours for volumes 2500 m³ or less.~~

(d) The station site shall be on a separately titled lot in the subdivision with a sealed vehicle access to a formed road. The lot shall be vested with council. If required by the council or Wellington Water, the site shall be secured to prevent public access as outlined by Wellington Water.

(e) Architectural featuring of any visible structures shall be within the context of the proposed subdivision and shall be subject to the approval of Wellington Water.

(f) The minimum standard for fencing is a 1.8 m high, 50 mm diamond, 2.5 mm wire diameter chain link fence with rails top and bottom. In residential areas, fence design shall be considered within the context of the neighbourhood and/or agreed with adjacent landowners.

~~6.17.1~~6.14.1 Building

The following applies to water supply pumping station buildings:

(a) The building that houses the pumps and electrical equipment shall:

(i) Be above ground where possible.

(ii) Have a standard 2100 mm high x 810 mm wide security door as a minimum.

(iii) Have a 2100 mm high by 1600 mm wide or larger doors for stations where the pump unit cannot fit though a standard door.~~with pumps greater than 15 kW.~~

(iv) Contain gantry system which will enable pumps to be placed within 900 mm of the access door or provide another mechanical means to remove pumps from the station.

(v) Be ventilated to ensure suitable volume of air change to meet both NZBC requirements and the cooling needs of the pump/motor sets.

(vi) Have smoke detectors and emergency lighting connected to SCADA for alarming.

(vii) Be positioned clear of land floodable by stormwater under 1% AEP event and clear of any secondary flow path.

~~(vi)~~(viii) Have suitable, covered cable/pipe trenches and ducts to ensure clear working space and access around pumps.

~~(vii)~~(ix) Have suitable drainage of floor and trenches.

~~(viii)~~(x) Have suitable electric lighting.

(b) The building shall have acoustic mitigations to minimise the amount of pump noise that emits from the station. The District Plan guidelines for noise shall be considered an absolute minimum, and further mitigation is required where practical. This includes acoustic consideration for the building including vents, doors and roof.

(c) Electrical switchboards shall be housed above ground.

(d) The switchboards and pumps shall be separated so that the switchboards cannot be water damaged if a leak occurs in the pipework.

(e) Windows are not to be installed ~~for~~ in pumping stations.

~~6.17.2~~6.14.2 Pumps

The proposed pumpset shall be ~~of~~ from a manufacturer and be a model approved by Wellington Water. That approval may be provisional on consideration of duty, efficiency, life and materials.

Pumpsets shall preferably be:

(a) Fitted with TEFC 4 pole electric motors (1450 rpm).

(b) Horizontally mounted and long-coupled configuration.

(c) Variable speed compatible motors and cabling.

(d) Flanged inlet and outlet.

(e) Ductile or cast iron base.

(f) Ductile, cast or stainless steel pump casing.

Concessions on speed and configuration can be made for smaller pumps (less than 15 kW) provided other mitigations are in place to compensate for noise and maintenance access.

All pumps, whether in a two or three pump arrangement, shall be of the same, make, model and duty size.

~~6.17.2.1~~6.14.2.1 Pump plinths

The following applies to pump plinths:

(a) Pumps shall be installed on reinforced concrete plinths.

(b) Where levelling nuts are used to set the pump base before pouring the plinth, 6 mm insertion rubber "washers" shall be used with a standard steel washer between the rubber and levelling nut. This is to ensure full engagement of the base with the subsequently cured concrete plinth.

(c) The weight of pump plinths ~~mass~~ shall typically be ~~between 5 and 10 times~~ the combined weight of the pump, ~~and~~ motor, baseplate, coupling and coupling guard.

~~6.17.3~~6.14.3 Pipework

The following applies to water system pump station pipework:

(a) Pipework shall be ductile iron manufactured to AS/NZS 2280 and fusion epoxy bonded coated to AS/NZS 4158 or STCL manufactured to NZS 4442.

(b) ~~It~~ STCL pipe shall be internally lined with Portland cement mortar and be fusion bonded polyethylene wrapped, Polyken tape wrapped or epoxy coated to AS/NZS 3862.

(c) They shall have a minimum pressure rating of PN35~~16 unless the design working pressure requires a higher pressure class~~.

(d) With the exception of pipework directly connected to the pump flanges, unrestrained mechanical couplers shall NOT be used. ~~Pipeline~~ Pipework shall be continuous and thrust type dismantling joints shall be installed where required for dis-assembly and re-assembly.

(e) Unrestrained couplings such as bellows or mechanical couplings shall be used immediately after the pump discharge and suction flanges in order to prevent vibrations from the pump passing into the pipework, creating noise. The pipework shall be secured to resist the unbalanced forces at the pump connection.

~~(e)~~(f) Flanged bends, tees and "specials" fabricated from STCL may be permitted where ductile iron fittings are not practicable. These shall be manufactured to the requirements of NZS 4442 and polyethylene tape wrapped and concrete lined at the fabricators, or epoxy coated to AS/NZS 3862.

~~(f)~~(g) ~~ABS pipe (Class 15) and~~ 316/316L/304/304L stainless steel (schedule 40 or 80) shall also be permitted.

~~(g)~~(h) The pipework shall be designed such that:

(i) Each pump can be isolated with resilient seated gate valves and butterfly valves, and removed whilst the other pumps are in operation.

(ii) All valves in ground and buildings, for both trunk main and reticulation mains, shall be anti-clockwise closing. All valves shall include a tag or other means to clearly indicate closing direction.

~~(ii)~~(iii) There is a non-slam non-return valve immediately upstream of each pump.

(iv) Air valves installed immediately upstream of the pumps for the release of air when charging the pipework and for entry of air when draining the pipework.

(v) Consideration should be given to installing an air valve immediately downstream if the non-return valve to reduce pressure transience on the discharge pipework.

~~(iii) There is an air valve on the common suction main immediately upstream of the pumps to enable the pumps to self-prime after an outage.~~

~~(iv)~~(vi) There is suitable room around the pipework to access flanges and fittings.

~~(h)~~(i) ~~Flanges shall be AS/NZS 4087 PN16 (Fig B5 ductile iron or Fig B7 steel). This drilling pattern is typically compatible with AS 2129 (BS10) Table D.~~ Flanges in the local water network shall comply with the following:

(i) Ductile iron flanges shall comply with the latest revision of AS/NZS 4087 Figure B5.

(ii) Carbon steel flanges shall comply with the latest revision of AS/NZS 4087 Figure B7.

(iii) No other flange material shall be permissible.

(j) Flanges in the bulk water pipeline shall comply with the following:

(i) Rated PN16 and comply with the latest revision of AS/NZS 4331, except as detailed below.

(ii) Where a higher rated flange is required, flange shall be rated PN25 and comply with the latest revision of AS/NZS 4331.

(iii) Flanges on 375 mm nominal diameter pipe (426 mm O.D.) shall comply with the latest revision of AS/NZS 4087 Figure B5 for ductile iron flanges and AS/NZS 4087 Figure B7 for steel flanges.

~~(i)~~(k) All pipework shall be supported and designed to withstand seismic loadings as determined for the seismic criticality (see **Section 3.7.4 Determination of Seismic Criticality** of the Regional Standard for Water Services) of the structure~~an IL4 structure~~.

~~(j)~~(l) Unrestrained couplings such as bellows or mechanical couplings shall not be used immediately after the pump discharge or suction flange unless the unbalanced forces on the pump are avoided.

~~(k)~~(m) A hydrant shall be installed on both the suction and discharge mains entering the pumping station. This shall allow a PRV bypass or alternative pump connection external to the station. Depending on the zone arrangement, Wellington Water may require a permanent PRV bypass (remotely controlled) is installed as well as any required isolating valves and pipework.

6.14.4 Pumping station serving as a reservoir

The following applies to pumping stations that serve reservoirs:

(a) Stations shall be designed to allow all pumps to run simultaneously.

(b) The duty points of the pumps shall be selected with consideration to the following criteria:

(i) Downstream reservoir set at 85% capacity

(ii) Upstream reservoir set at 85% capacity

(iii) Network demand equivalent to the peak period average day demand.

~~6.17.4~~6.14.5 Electrical, monitoring and control equipment

The electrical and SCADA specification shall be obtained from Wellington Water prior to design. The pump station shall have the following monitoring equipment:

(a) A magnetic flow meter installed on the common discharge, or alternatively, on the common suction.

(b) A pressure transducer on the common discharge capable of reading the gauge pressure to +/- 5 kPa.

(c) A pressure transducer on the common suction capable of reading the gauge pressure to +/- 5 kPa.

(d) A 20 mm tapping on each of the pumps' suction pipework between the isolation valve and the pump, and 6 mm copper tubing leading from the tapping to the gauge board.

(e) A 20 mm tapping on each of the pumps' discharge pipework between the pump and the non-return valve, and 6 mm copper tubing leading from the tapping to the gauge board.

(f) A gauge board with oil filled dial gauges with a minimum 100 mm diameter face.

7 APPENDICES

Appendix 1 Standard Details

The following Standard Details are provided below:

DR01 – Manhole Details

DR02 – Internal Drop Details

DR03 – Typical Trench and Waterstop Details

DR04 – Baffled Sump Plan and Sections

DR05 – Trapped Yard Sump

DR06 – Possible Location for Stormwater Soakage in Upper Hutt

DR07 – ~~Private~~ Lateral Connections to Public Stormwater or Wastewater Mains

DR08 – Tree Dripline

DR09 – Building ~~over & near pipe~~in Close Proximity

WS01 – Typical Water Reticulation Layout

WS02 - Water Distribution Pipe Junctions and Connections

WS03 – Typical Thrust Block Details

WS04 – Typical Anchor Block Details

WS05 – Typical Valve Details

WS06 – Rider Main Scour Detail~~Scour Pipes~~

~~WS07 – Scour Pipes~~

WS07 ~~WS08~~ – Fire Hydrant Box

WS08 ~~WS09~~ – Typical Domestic Manifold and Water Meter

WS09 ~~WS10~~ – Below Ground Meter and Backflow Installation

WS10 ~~WS11~~ – Above Ground Meter and Backflow Installation

WS11 ~~WS12~~ – Below Ground Meter and Backflow Installation

WS12 ~~WS13~~ – Above Ground Meter and Backflow Installation

WS13 ~~WS14~~ – Fire Service and Metered Supply

~~WS15 – Typical Trench and Leak Detection Bar~~

~~WS16 – Slip-in Joint, Welding Band and Mitre Bend Details Sections~~

~~WS17 – Branch, Socket and Access Cover Plate Details~~

~~WS18 – Access Branch Chamber Details~~

~~WS19 – Air Valves~~

~~WS20 – Access Chamber with Air Valve~~

~~WS21 – Typical flow meter installation~~

WS14 ~~WS22~~ – Examples of Water Main Connections