QUEENSTOWN LAKES DISTRICT COUNCIL

Queenstown Lakes District Council

Land Development and Subdivision Code of Practice

Superseding NZS 4404:2004 and Council Amendments

(Only applies to Queenstown Lakes District Council's subdivision and development design standards)

QLDC LDSC 2020

Queenstown Lakes District Council

Land Development and Subdivision Code of Practice

This document supersedes all previous Queenstown Lakes District Council subdivision and development design standards adopted by Council prior to 23/9/2020

The Queenstown Lakes District Council under copyright licence has reproduced NZS 4404:2004 and Council amendments with further modifications to produce this document for its use as a land development and subdivision Code of Practice within this geographical area of jurisdiction.

Any update of NZS 4404:2010 does not automatically update this Queenstown Lakes District Council Land Development and Subdivision Code of Practice.

2020 amendments are shown in purple in this document. The text in black is the original NZS 4404:2010 text.

Document History

	Date	Prepared	Approved
Content adopted by Council	03/06/15	R Flitton – Principal Resource Management Engineer	Full Council
Amendment to water supply requirements	17/08/15	R Flitton – Principal Resource Management Engineer	Ulrich Glasner - Chief Engineer
Amendment road safety audit requirements for private networks	24/08/15	Keri Garrett – Senior Resource Management Engineer	R Flitton – Principal Resource Management Engineer
Requirement for sumps to be fitted with siphons	24/08/15	Mike Healy – Resource Management Engineer	R Flitton – Principal Resource Management Engineer
Vehicle Crossing types added	07/09/15	Lyn Overton – Resource Management Engineer	R Flitton – Principal Resource Management Engineer
Amendments as per requirements from Standards NZ	7/10/15	Polly Lambert – Policy, Standards & Assets Planner	K Garrett – Senior Resource Management Engineer
Water connection requirements added	30/10/15	K Garrett – Senior Resource Management Engineer	Polly Lambert – Policy, Standards & Assets Planner
Amendments as per 2016/17 QLDC review	24/08/17	Polly Lambert – Policy & Performance Programme Manager	David Wallace - Principal Resource Management Engineer
Amendments as per 2016/17 October Submissions	28/02/18	Polly Lambert – Policy & Performance Programme Manager	David Wallace - Principal Resource Management Engineer
Amendments as per 2017/18 Public Consultation March 2018	17/04/18	Polly Lambert – Policy & Performance Programme Manager	Ulrich Glasner – Chief Engineer David Wallace - Principal Resource Management Engineer
Amendments as per 2019 submissions	29/01/20	Asha Schaefer – Civil Engineer	Ulrich Glasner – Chief Engineer David Wallace - Principal Resource Management Engineer
Amendments as per 2020 Submissions	23/9/2020	Asha Schaefer – Civil Engineer	Ulrich Glasner – Chief Engineer David Wallace - Principal Resource Management Engineer

CONTENTS

REFERENCED DOCUMENTS

Reference is made in this document to the following:

NEW ZEALAND STANDARDS

NZS 1170:- - - -	Structural design actions
Part 5:2004	Earthquake actions – New Zealand
Part 5 Supp 1:2004	Earthquake actions – New Zealand - Commentary
NZS 3109:1997	Concrete construction
NZS 3114:1987	Specification for concrete surface finishes
NZS 3116:2009	Concrete segmental and flagstone paving
NZS 3604:2011	Timber-framed buildings (in preparation)
NZS 4121:2001	Design for access and mobility: Buildings and associated facilities
NZS 4241:1999	Public toilets
NZS 4402:- - - -	Methods of testing soils for civil engineering purposes
Part 6:1986	Soil strength tests
NZS 4407:2015	Methods of sampling and testing road aggregates
NZS 4431:1989	Code of Practice for earth fill for residential development
NZS 4442:1988	Welded steel pipes and fittings for water, sewage and medium pressure gas
NZS 4522:2010	Underground fire hydrants
NZS 5828:2015	Playground equipment and surfacing
NZS/AS 1657:1992	Fixed platforms, walkways, stairways and ladders. Design, construction and installation
SNZ HB 5828.1:2006	General playground equipment and surfacing handbook
SNZ PAS 4509:2008	New Zealand Fire Service firefighting water supplies Code of Practice

JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

AS/NZS 1158:- - - -	Road lighting
Part 0:2005	Introduction
Part 1.1:2005	Vehicular traffic (category V) lighting – Performance and design requirements
Part 1.2:2010	Vehicular traffic (Category V) lighting - Guide to design, installation, operation and maintenance
Part 3.1:2005	Pedestrian area (category P) lighting – Performance and design requirements
AS/NZS 1170	Structural Design Actions
AS/NZS 1254:2010	PVC-U pipes and fittings for stormwater and surface water applications
AS/NZS 1260:2009	PVC-U pipes and fittings for drain, waste and vent application
AS/NZS 1477:2017	PVC pipes and fittings for pressure applications

AS/NZS 1546:- - - -	On-site domestic wastewater treatment units
Part 1:2008	Septic tanks
AS/NZS 1547:2012	On-site domestic wastewater management (in preparation)
AS/NZS 2032:2006	Installation of PVC pipe systems
AS/NZS 2033:2008	Installation of polyethylene pipe systems
AS/NZS 2041:2011	Buried corrugated metal structures
Part 1:2011	Design methods
Part 2:2011	Installation
Part 4:2010	Helically formed sinusoidal pipes
Part 6:2010	Bolted plate structures
AS/NZS 2280:2014	Ductile iron pipes and fittings
AS/NZS 2566:- - - -	Buried flexible pipelines
Part 1:1998	Structural design
Part 1 Supp 1:1998	Structural design – Commentary
Part 2:2002	Installation
AS/NZS 3000:2018	Electrical installations
AS/NZS 2638:- - - -	Gate valves for waterworks purposes
Part 2:2011	Resilient seated
AS/NZS 3500:- - - -	Plumbing and drainage
Part 1:2018	Water services
AS/NZS 3518:2013	Acrylonitrile butadiene styrene (ABS) compounds, pipes and fittings for pressure applications
AS/NZS 3690:2009	Installation of ABS pipe systems
AS/NZS 3725:2007	Design for installation of buried concrete pipes
AS/NZS 3845:- - - -	Road safety barrier systems
Part 1:2015	Road safety barrier systems
Part 2:2017	Road safety devices
AS/NZS 3879:2011	Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ABS pipes and fittings
AS/NZS 4020:2018	Testing of products for use in contact with drinking water
AS/NZS 4058:2007	Precast concrete pipes (pressure and non-pressure)
AS/NZS 4129:2008	Fittings for polyethylene (PE) pipes for pressure applications
AS/NZS 4130:2018	Polyethylene (PE) pipes for pressure applications
AS/NZS 4131:2010	Polyethylene (PE) compounds for pressure pipes and fittings
AS/NZS 4158:2003	Thermal-bonded polymeric coatings on valves and fittings for water industry purposes
AS/NZS 4441:2017	Oriented PVC (PVC-O) pipes for pressure applications
AS/NZS 4586:2004	Slip resistance classification of new pedestrian surface materials

AS/NZS 4765:2017	Modified PVC (PVC-M) pipes for pressure applications
AS/NZS 4793:2009	Mechanical tapping bands for waterworks purposes
AS/NZS 4998:2009	Bolted unrestrained mechanical couplings for waterworks purposes
AS/NZS 5065:2005	Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications

AUSTRALIAN STANDARDS

AS 1579:2001	Arc-welded steel pipes and fittings for water and waste-water
AS 1741:1991	Vitrified clay pipes and fittings with flexible joints – Sewer quality
AS 1906:- - - -	Retroreflective materials and devices for road traffic control purposes
Part 3:1992	Raised pavement markers (retroreflective and non-retroreflective)
AS 2200:2006	Design charts for water supply and sewerage
AS 2700:2011	Colour Standards for general purposes
AS 2870:2011	Residential slabs and footings – Construction
AS 2890:- - - -	Parking facilities
Part 5:1993	On-street parking
AS 3571:- - - -	Plastics piping systems – Glass-reinforced thermoplastics (GRP) systems based on unsaturated polyester (UP) resin
Part 1:2009	Pressure and non-pressure drainage and sewerage
Part 2:2009	Pressure and non-pressure water supply
AS 3681:2008	Application of polyethylene sleeving for ductile iron piping
AS 3996:2019	Access covers and grates
AS 4373:2007	Pruning of amenity trees

BRITISH STANDARDS

BS EN 295:- - - -	Vitrified clay pipes and fittings and pipe joints for drains and sewers
Part 1:2013	Requirements
Part 2:2013	Quality control and sampling
Part 3:2012	Test methods
Part 4:2013	Requirements for special fittings, adaptors and compatible accessories
Part 5:2013	Requirements for Perforated Pipes and Fittings
Part 6:2013	Requirements for vitrified clay manholes
Part 7:2013	Requirements for vitrified clay pipes and joints for pipe jacking
BS EN 805:2000	Water supply – Requirements for systems and components outside buildings

OTHER PUBLICATIONS

GENERAL

Ministry for the Environment. *New Zealand urban design protocol*. Wellington: Ministry for the Environment, 2005.

EARTHWORKS AND GEOTECHNICAL REQUIREMENTS

BRANZ. *BRANZ Study Report 004, Assessment of slope stability at building sites*. BRANZ and Worley Consultants Ltd, 1987.

Cook, D, Pickens, G A, and MacDonald, G. *The role of peer review*, Report by Crawford S A. NZ *Geomechanics News* (Dec 1995).

Crawford, S A, and Millar, P J. *The design of permanent slopes for residential building development*, EQC Research Project 95/183, *NZ Geomechanics News* (June 1998).

New Zealand Geotechnical Society Inc. *Field description of soil and rock.* New Zealand Geotechnical Society Inc, 2005.

New Zealand Geotechnical Society Inc. *Geotechnical issues in land development.* Proceedings of New Zealand Geotechnical Society Symposium, Hamilton, 1996.

Opus International Consultants Ltd. *Underground Utilities – Seismic Assessment and Design Guidelines*, GNS Science, Edition 1 March 2017.

ROADS

Auckland Transport Code of Practice (ATCOP). Chapter 20: Public Transport – Busses. Auckland: ATCOP, 2017.

Auckland Transport*. Urban Street and Road Design Guide*, Auckland Transport Design Manual, 2019.

Austroads codes and guides, 2009. (Subject to the relevant New Zealand supplement).

Austroads. *Guide to road design – Part 3: Geometric design*. Austroads, 2009.

Austroads. *Guide to road design – Part 6: Roadside Design, Safety and Barriers.* Austroads, 2010.

Austroads. *Guide to road design – Part 6A:* Paths for Walking and Cycling. Austroads, 2017.

Austroads. *Guide to traffic management – Part 8: Local area traffic management*. Austroads, 2008.

Cement and Concrete Association of Australia. *Guide to residential streets and paths*. Cement and Concrete Association of Australia, 2004.

Ministry of Transport Government Policy Statement on Land Transport Funding 2018-19 - 2027-28.

New Zealand Transport Agency.

Bridge manual. (SP/M/022) 3rd ed. Wellington: NZTA, 2016.

Cycle network and route planning guide. Wellington: Land Transport Safety Authority, 2004. Available at: http://www.nzta.govt.nz/resources/cycle-network-androute-planning/cycle-network.html

Pedestrian planning and design guide. Wellington: NZTA, 2009. Available at: http://www.nzta.govt.nz/resources/pedestrian-planning-guide/docs/pedestrian-planning-guide.pdf

Road safety audit procedures for projects. Wellington: NZ Transport Agency, Interim Release May 2013

RTS 18: New Zealand on-road tracking curves for heavy vehicles. Wellington: Land Transport New Zealand, 2007. Available at: http://www.nzta.govt.nz/resources/road-traffic-standards/rts-18.html

Stormwater treatment standard for state highway infrastructure. Wellington: NZTA, 2010.

Transit Planning Policy Manual. (SP/M/001) Appendix 5B Accessway standards and guidelines. Wellington: NZTA, 2007

New Zealand guide to pavement structural design. Wellington: NZTA, 2017

New Zealand guide to pavement evaluation and treatment design. Wellington: NZTA, 2017

NZTA specifications (available at: http://www.nzta.govt.nz/resources/index.html)

B/2:2005	Construction of unbound granular pavement layers
B/5:2008	In-situ stabilisation of modified pavement layers
F/1:1997	Earthworks construction
F/2:2000	Pipe subsoil drain construction
F/2 notes:2000	Notes on pipe subsoil drain construction specification
M/1:2007	Roading bitumens
M/3:1986	Sub-base aggregate
M/4:2006	Crushed basecourse aggregate
M/10:2014	Dense graded and stone mastic asphalt
P/3:1995	First coat sealing
P/4:1995	Resealing

Queenstown Lakes District Council (QLDC). *Bus Stop Policy and Standards.* Queenstown: QLDC 2020.

Queenstown Lakes District Council (QLDC). *Trail Design Standards and Specifications*: QLDC 2018.

Queenstown Lakes District Council (QLDC). *Southern Light Strategy 2017*. Queenstown: QLDC 2017.

United Kingdom Department for Transport. *Manual for streets.* London: Thomas Telford Publishing, 2007.

United Kingdom Transport Research Laboratory. *TRL661 – The manual for streets: evidence and research.* TRL, 2007.

STORMWATER, WASTEWATER, AND WATER SUPPLY

Auckland Council

Stormwater management devices in the Auckland region. Auckland Council

Guideline Document, GD2017/001, 2017

Water sensitive design for stormwater. Auckland Council Guideline Document GD2015/004. Prepared by Boffa Miskell for Auckland Council, 2015

Soakage Design Manual. Auckland City Council. Prepared by Pattle Delamore Partners Ltd, 2003.

Australasian Society for Trenchless Technology (ASTT). *Guidelines for horizontal directional drilling, pipe bursting, microtunnelling and pipe jacking*. Greenwood, Western Australia: ASTT, 2009.

Austroads. *Guide to road design – Part 5: Drainage design*. Austroads, 2008.

Hicks, D M, and Mason, P D. *Roughness characteristics of New Zealand rivers*, Wellington: Water Resources Survey, DSIR Marine and Freshwater, 1991.

Janson, Lars-Eric. *Plastics pipes for water supply and sewage disposal*. 2003.

Lamont, P. 'Metrication: Hydraulic data and formulae.' *Water Services* Volume 81, numbers 972/3/4 (Reprinted by Kent Meters Ltd, UK)

Ministry for the Environment.

Coastal hazards and climate change – A guidance manual for local government in New Zealand. Wellington: Ministry for the Environment, 2008.

Preparing for climate change – A guide for local government in New Zealand. Wellington: Ministry for the Environment, 2008.

Preparing for coastal change – A guide for local government in New Zealand. Wellington: Ministry for the Environment, 2009.

Preparing for future flooding – A guide for local government in New Zealand. Wellington: Ministry for the Environment, 2010.

Tools for estimating the effects of climate change on flood flow – A guidance manual for local government in New Zealand. Wellington: Ministry for the Environment, 2010.

Ministry of Health. *Drinking-water standards for New Zealand 2005 (Revised 2008)*. Wellington: Ministry of Health, 2008.

Najafi, M. *Trenchless technology – Pipeline and utility design, construction, and renewal*. McGraw-Hill, 2005.

New Zealand Water and Wastes Association (Water New Zealand). *New Zealand pipe inspection manual.* Wellington: New Zealand Water and Wastes Association, 2006.

Queenstown Lakes District Council (QLDC). *QLDC Guidelines for Environmental Management Plans*. Queenstown: QLDC June 2019.

Stein, D. *Trenchless technology for installation of cables and pipelines*. Germany: Stein & Partner, 2005.

Uni-Bell. *Handbook of PVC pipe.* 4th ed. Dallas: Uni-Bell PVC Pipe Association, 2001.

Water Services Association of Australia (WSAA):

WSA 02-2002	Sewerage Code of Australia – 1999 and 2002
WSA 03-2002	Water Supply Code of Australia – 1999 and 2002
WSA 04-2005	Sewage Pumping Station Code of Australia – 2005
WSA 06-2008	Vacuum Sewerage Code of Australia – 2008
WSA 07-2007	Pressure Sewerage Code of Australia – 2007

LANDSCAPE

Talbot, T. *Guidance Document for Sports Field Development*. Auckland: Sport New Zealand, 2019.

NETWORK UTILITY SERVICES

Department of Labour. *Guide for safety with underground services*. Wellington: Department of Labour, 2002.

New Zealand Utilities Advisory Group (NZUAG). *National* Code of Practice *for utilities' access to the transport corridors.* Wellington: NZUAG, 2008.

NOTE – The NZUAG Code of Practice is an interim measure until a national Code of Practice is approved under the Utilities Access Act 2010.

NEW ZEALAND LEGISLATION

The provisions of this Code of Practice shall be read subject to the provisions of regional and district plans and to any applicable statutes, regulations, bylaws, and any subsequent amendments, including (but not limited to):

Building Act 2004, Building Regulations, and New Zealand Building Code (NZBC) 1992

Civil Defence Emergency Management Act 2016

Conservation Act 1987

Electricity Act 1992

Health and Safety at Work Act 2015

Health (Drinking Water) Amendment Act 2007

Historic Places Act 1993

Infrastructure (Amendments Relating to Utilities Access) Act 2010

Land Transfer Act 2017

Land Transport Rule (Traffic Control Devices) 2004

Local Government Act 1974 and Local Government Act 2002

Reserves Act 1977

Resource Management Act 1991

Utilities Access Act 2010

RELATED DOCUMENTS

When interpreting this Code of Practice it may be helpful to refer to other documents, including but not limited to:

GENERAL

Land Information New Zealand. *New Zealand geodetic datum 2000 (NZGD2000)*

Ministry for the Environment. *Climate change effects and impacts assessment – A guidance manual for local government*. 2nd ed. Wellington: Ministry for the Environment, 2008.

Queenstown Lakes District Council Town Centre Design Guidelines 2018

Queenstown Lakes District Council Town Centre Spatial Framework 2018

EARTHWORKS AND GEOTECHNICAL REQUIREMENTS

Fraser Thomas Ltd (B J Brown, P R Goldsmith, J P M Shorten, L Henderson) *BRANZ Study Report 120, Soil expansivity in the Auckland region.* Judgeford: BRANZ, 2003.

Ministry for the Environment. *Planning for development of land on or close to active faults – A guideline to assist resource management planners in New Zealand*. Wellington: Ministry for the Environment, 2004.

Sanders, W, and Glassey, P. (Compilers)*. Guidelines for assessing planning policy and consent requirements for landslide prone land,* GNS Science Miscellaneous Series 7. Lower Hutt: Institute of Geological and Nuclear Sciences Limited, 2007.

ROADS

Concrete Masonry Association of Australia. *Concrete segmental pavements – Design guide for residential accessways and roads*. Sydney: Concrete Masonry Association of Australia, 1997.

Jones, P, Boujenko, N, and Marshall, S. *Link and place – A guide to street planning and design*. London: Landor Books, 2007.

Ministry of Justice. *National guidelines for crime prevention through environmental design in New Zealand Part 1: Seven qualities of safer places, and Part 2: Implementation guide*. Wellington: Ministry of Justice, 2005.

Ministry of Transport. *Connecting New Zealand: A summary of the government's policy direction for transport*. Wellington: Ministry of Transport, 2011.

Ministry of Transport *Government policy statement on land transport funding 2018-19 - 2027-28.* Wellington: Ministry of Transport, 2018.

Ministry of Transport. *Safer journeys – New Zealand's road safety strategy 2010 – 2020.* Wellington: Ministry of Transport, 2010.

New Zealand Transport Agency

Traffic note 48 – Light vehicle sizes and dimensions: Street survey results and parking space requirements – Information. Land Transport New Zealand, December 2004. Available at: http://www.nzta.govt.nz/resources/traffic-notes/docs/traffic-note-48.pdf

Manual of traffic signs and markings (MOTSAM) Parts 1 – 4

NZTA register of network standards and guidelines. Wellington: NZTA, 2009.

Available at: http://www.nzta.govt.nz/resources/nzta-register-network-standards-guidelines/

SNZ HB 44:2001 *Subdivision for people and the environment.* Wellington: Standards New Zealand, 2001.

STORMWATER, WASTEWATER, AND WATER SUPPLY

Auckland City Council. *On-site stormwater management manual*. Auckland: Auckland City Council, 2002.

Auckland City Council. *Soakage design manual.* Auckland: Auckland City Council, 2003.

Christchurch City Council. *Waterways, wetlands and drainage guide – Part A: Visions and Part B: Design.* 2003. Available at: http://www.ccc.govt.nz/cityleisure/ parkswalkways/environmentecologywaterwayswetlandsdrainageguide/index.aspx

Environment Protection Authority (EPA) Victoria. *Maintaining water sensitive urban design elements*. Melbourne: EPA Victoria, 2008.

Greater Wellington Regional Council. *Fish friendly culverts*. June 2003. Available at: http://www.gw.govt.nz/bridges-and-culverts/

New Zealand Water Environment Research Foundation (NZWERF) *On-site stormwater management guideline*. Wellington: NZWERF, 2004.

Puddephatt, J, and Heslop, V. *Guidance on an integrated process – Designing, operating and maintaining low impact urban design and development devices*. Landcare Research, July 2008.

Queenstown Lakes District Council (QLDC). *Asbuilt Plan Specification Requirements*. Queenstown: QLDC 2010

Sustainable urban drainage systems (SUDS) design manuals for countries in the United Kingdom

Water sensitive urban design (WSUD) manuals from various Australian states and cities

LANDSCAPE

Queenstown Lakes District Council (QLDC). *Community Open Spaces Asset Management Plan 2015-2030.* Queenstown: QLDC 2015

WEBSITES

Auckland Council	http://www.aucklandcouncil.govt.nz
Austroads	http://www.austroads.com.au
Ministry for the Environment	http://www.mfe.govt.nz
National Pest Plant Accord	http://www.biosecurity.govt.nz/nppa
New Zealand Historic Places Trust	http://www.historic.org.nz
New Zealand Legislation	http://www.legislation.govt.nz
New Zealand Transport Agency	http://www.nzta.govt.nz/
Plastics Industry Pipe Association of Australia:	http://www.pipa.com.au
Trips Database Bureau	http://www.tdbonline.org/home
Water Services Association of Australia	https://www.wsaa.asn.au/

LATEST REVISIONS

The users of Code of Practice should ensure that their copies of the above-mentioned New Zealand Standards are the latest revisions. Amendments to referenced New Zealand and Joint Australian/New Zealand Standards can be found on http://www.standards.co.nz.

REVIEW OF NZS 4404:2010

Suggestions for improvement of NZS 4404:2010 will be welcomed. They should be sent to the Manager, Standards New Zealand, Private Bag 2439, Wellington 6140.

FOREWORD

A significant proportion of all new infrastructure is created by land development and subdivision projects. As a community, we need to get this right. This is why NZS 4404:2010 aims to encourage good urban design and remove road blocks to liveability and economic development in communities.

Some of the key changes from NZS 4404:2004 are:

(a) That road design needs to allow 'context' or 'place' to be given significant emphasis, and to require roads to achieve safe (slower) operating speeds;

(b) An emphasis on managing and treating stormwater 'before it gets into a pipe', together with a requirement to consider climate change.

(c) Grassed swales, natural or artificial waterways, ponds and wetlands, for example, may in certain circumstances be not only part of the stormwater system, but also be a preferred solution, especially if low impact on receiving waters downstream is critical;

(d) The sections on landscaping and reserves have been combined and significantly rewritten; and

(e) The section on utility services (section 8) has also been significantly amended in accordance with the latest network authorities' codes.

The change in the title from 'engineering' to 'infrastructure' signals that good subdivision design involves a multidisciplinary collaborative approach. NZS 4404 was first published in 1981 as the Code of Practice for urban land subdivision. In 2004 it became the Standard for Land development and subdivision engineering. In response to submissions on the draft 2010 version, and to clarify the place and role of NZS 4404, the committee has decided that the new name, Land development and subdivision infrastructure, best reflects its function.

NZS 4404:2010 is applicable to greenfield, infill, and brownfield redevelopment projects. It provides local authorities (LAs) and developers a Standard for the design and construction of subdivision infrastructure. It can be used on its own or, together with local codes, as a means to comply with Resource Management Act (RMA) consent conditions. It is not an urban design policy, guide, or method of master planning.

The impetus for the review of NZS 4404:2004 came from requests for changes from:

(f) The New Zealand Transport Agency (NZTA);

(g) Local Government New Zealand (LGNZ);

(h) The Ministry for the Environment (MfE);

(i) Pipe manufacturers;

(j) Territorial authorities (TAs), and;

(k) A number of individual users of the Standard.

The Queenstown Lakes District Council (QLDC) under copyright licence has reproduced NZS 4404:2010 and Council amendments with further modifications to produce this document for its use as a land development and subdivision Code of Practice within this geographical area of jurisdiction.

The revision was sponsored by LGNZ, NZTA, and MfE.

Innovative subdivision has been discouraged to some extent under the 2004 version of NZS 4404. The objectives of the 2004 version were to permit alternative solutions. However, in practice, well designed solutions that were not in accordance with the acceptable solutions specified by the Standard often had difficulty gaining RMA consents. This led to delays and additional costs or a less desirable design being adopted.

The review committee therefore challenged itself to produce a new Standard that:

(l) Encourages sustainable and modern design;

(m) Provides some certainty for designers and LAs; and

(n) Prevents the outcomes that can arise when the sole focus is cost minimisation, and adherence to minimum standards.

The committee recognises that there are tensions between these sometimes conflicting objectives and has balanced those tensions when deciding between allowing flexibility and prescribing clear rules.

The committee would like to thank the many people who between them made more than 1,900 comments and suggestions for improvements. The submissions were overwhelmingly in support of the new direction of the Standard. Every single comment and suggestion was reviewed by committee members and many have found their way into the final document. It is a significantly better Standard because of those submissions. The committee would also like to thank all those organisations that have allowed their documents to be used in the Standard or as reference documents. The committee has tried not to 'reinvent the wheel' where existing documents provide the appropriate standards. This is why many other publications including Standards are referenced by NZS 4404:2010.

Finally, we all need to applaud and be grateful for the countless hours and effort committee members contributed to this review. The only payment is the satisfaction of a well-written Standard that enjoys good community support. It is a Standard that helps develop people-oriented communities with land development and subdivision infrastructure that has a long life, and the minimum environmental impact compatible with good urban design.

OUTCOME STATEMENT

NZS 4404:2010 provides local authorities, developers, and their professional advisors with standards for design and construction of land development and subdivision infrastructure. NZS 4404:2010 encourages sustainable development and modern design that emphasises liveability and environmental quality. It will also provide as much consistency as possible on land development and subdivision infrastructure while still allowing flexibility for local variations to suit local circumstances.

QLDC

Land Development and Subdivision Code of Practice

1 GENERAL REQUIREMENTS AND PROCEDURES

Subdivisions and developments shall also comply with all relevant policies or procedures adopted by the Council. Where ambiguities and inconsistencies exist between this code and any Policy or procedure adopted by the Council it is the developers responsibility to identify these and obtain guidance from the Council confirming which document should be followed.

This Code of Practice represents a set of minimum standards for developers, ensuring high quality and consistency of infrastructure provision across all of QLDC's various communities. These standards may be exceeded but not compromised, unless specifically agreed to by Council for a deviation.

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development. Where community specific considerations cannot be met, written acceptance of an alternative method shall be obtained from the Council.

Any work carried out on Council Assets requires Council approval.

1.1 Scope

NZS 4404:2010 is recommended for adoption by local authorities (LAs). It is applicable to greenfield and infill development, as well as brownfield redevelopment projects. The Standard also serves as a basis for technical compliance for the subdivision and development of land where these activities are subject to the Resource Management Act. LAs may develop their own standards for land development or tailor outcomes sought to the particular needs of their local environments through their design guides, district plans, and codes of practice or development engineering manuals. However, it is recommended that NZS 4404 be adopted as the basis for these standards.

For some types of infrastructure, but not all, specific guidance and standards have been developed by QLDC, some of which have parameters which are reflected in this Code of Practice. Where QLDC has not developed its own standards, reference is often made to best practice guidance or standards developed by external agencies. Developers shall consider these referenced documents as starting points for design that may need to be adapted to the specific conditions and context of QLDC communities, in consultation with QLDC staff.

Section 1 of this Code of Practice concerns matters of general application and general requirements to be observed. Sections 2 to 8 of this Code of Practice provide good practice guidelines on particular types of infrastructure to be provided.

C1.1

NZS 4404:2010 does not include a statement of all minimum requirements for land development and subdivision infrastructure. It is not an urban design guide. LAs may specify their own minimum requirements, citing NZS 4404:2010 or their own bylaws or district plan as appropriate.

NZS 4404:2010 does not deal with the processes of compliance with the requirements of a district plan for subdivision or development activities or obtaining a resource consent for such activities. For these purposes reference can be made to the Ministry for the Environment website, http://www.mfe.govt.nz, and the plans and policies of the relevant TA.

1.2 Interpretation

1.2.1 General

1.2.1.1

The full titles of referenced documents cited in this Code of Practice are given in the list of referenced documents.

1.2.1.2

The word 'shall' refers to practices which are mandatory for compliance with the Code of Practice. The words 'should' or 'may' indicate a recommended practice.

1.2.1.3

Clauses prefixed by '*C*' and printed in italic type are intended as comments on the corresponding mandatory clauses. They are not to be taken as the only or complete interpretation of the corresponding clause. This Code of Practice can be complied with if the comment is ignored.

1.2.1.4

The terms 'informative' and 'normative' have been used in this Code of Practice to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance. Informative provisions do not form part of the mandatory requirements of this Code of Practice.

1.2.1.5

Schedules containing information to be provided in certificates or as-built plans are included at the end of sections to which they relate. Each schedule is copyright waived, meaning it may be photocopied for use in accordance with the Code of Practice.

1.2.2 Definitions

For the purpose of this Code of Practice, the following definitions shall apply:

Annual exceedance probability (AEP)	The probability of exceedance of a given occurrence, generally a storm, in a period of 1 year (1% AEP is equivalent to a 1 in 100-year Average Recurrence Interval (ARI) storm)

Carriageway	That part of a road consisting of the movement lane, sealed shoulder, and includes parking and loading areas when provided within the road
Corridor manager	Has the same meaning given to it by the proposed utilities access legislation NOTE – In preparing NZS 4404:2010, the Committee made every effort to align it with the infrastructure legislation and the utilities access legislation still before Parliament at the time this Standard is published. Readers will need to satisfy themselves on the final form of the definitions of code (see section 8) and corridor manager once this utilities access legislation comes into effect.
Crime prevention through environmental design	Has a set of four principles: surveillance, access management, territorial reinforcement, and quality environments of the built environment. These CPTED principles lead to a reduction in the incidence and fear of crime as well as an improvement in the quality of life
Developer	An individual or organisation having the financial responsibility for the development project. Developer includes the owner
Developer's professional advisor	The person, appointed by the developer, who shall be responsible for: (a) The investigation, design and obtaining of approvals for construction; (b) Contract administration and supervision of construction; (c) Certification upon completion of construction
Drinking water	As defined in the Health (Drinking Water) Amendment Act
Dwelling unit	Any building or group of buildings, or part thereof used, or intended to be used principally for residential purposes and occupied, or intended to be occupied by not more than one household. This definition shall exclude Residential Flats.
Earthworks	The disturbance of land by the removal or deposition on or change to the profile of land. Earthworks includes excavation, filling, cuts, foot rating and blading, firebreaks, batters and the formation of roads, access, driveways, tracks and the deposition and removal of cleanfill.
Footpath	So much of any road or other area as is laid out or constructed by authority of the TA primarily for pedestrians; and may include the edging, kerbing, and channelling of the road
Freeboard	A provision for flood level design estimate imprecision, construction tolerances, and natural phenomena (such as waves, debris, aggradations, channel transition, and bend effects) not explicitly included in the calculations

Geo-professional	A chartered professional engineer (CPEng) or an engineering geologist with recognised qualifications and experience in geotechnical engineering, and experience related to land development
Ground	Describes the material in the vicinity of the surface of the earth whether soil or rock
Independent qualified person (IQP)	A specialist approved by the TA and having the appropriate skills and qualification to carry out specific procedures
Local authority	As defined in the Local Government Act 2002, and includes territorial authorities and regional councils
Low impact design	An approach to land development and stormwater management that recognises the value of natural systems in order to mitigate environmental impacts and enhance local amenity and ecological values
Movement lane	That part of the formed and sealed road that serves the link function in a road. It may have a shared use for other activities such as walking, cycling, parking, and play
Network utility operator	Has the same meaning given to it by section (s.) 166 of the Resource Management Act
Owner	In relation to any land or interest in land, includes an owner of the land, whether beneficially or as trustee, and their agent or attorney, and a mortgagee acting in exercise of power of sale; and also includes the Crown, the Public Trustee, and any person, TA, board, or other body or authority however designated, constituted, or appointed, having power to dispose of the land or interest in land by way of sale
Place	The function of space as a destination for people, influenced by the design of the space itself, as well as the adjacent land use. The strength of place function can vary depending on the intensity of use and character of the activity, whether formal as in a pedestrian shopping street or public park, or more informal as in play or casual interactions between neighbours on a public street.
Potable water	As defined in the Health (Drinking Water) Amendment Act
Primary flow	The estimated surface water run-off specified to be managed by the primary stormwater system. This flow may be piped or contained within relatively narrow confines under public control by reserve or easement
Private road	Any roadway, place, or arcade laid out within a district on private land by the owner of that land intended for the use of the public generally and has the same meaning given to it by s. 315 of the Local Government Act 1974

Private way	Any way or passage over private land within a district, the right to use which is confined or intended to be confined to certain persons or classes of persons, and which is not thrown open or intended to be open to the use of the public generally and includes any shared access or right of way and has the same meaning given to it by s. 315 of the Local Government Act 1974
Receiving water	The water body that receives the discharge from the stormwater conveyance system and is usually a watercourse, stream, river, pond, lake, or the sea
Residential flat	A residential activity that, consists of no more than one flat in the same ownership as the residential unit; and is contained within the same residential unit; and if attached to a detached accessory building does not cover more than 50% of the total Gross Floor Area of the building containing the flat and detached accessory building; and contains no more than one kitchen and one laundry; and does not cover more than 35% of the total Gross Floor Area of the building(s) containing the residential unit and flat (but excluding accessory buildings)
Residential Unit	A residential activity which consists of a single self-contained household unit, whether of one or more persons, a nd includes accessory buildings. Where more than one kitch en and/or laundry facility is provided on the site, other than a kitchen and/or laundry facility in a residential flat, there shall b e deemed to be more than one residential unit.
Review and Acceptance	The purpose of QLDC completing a design/construction review and accepting the design/construction is to ensure the developer has provided sufficient supporting documentation. Acceptance or approval of the design and or construction does not transfer any liability to the Council and it has been provided on the basis that the developer has confirmed all elements of this Code of Practice have been complied with unless stated otherwise in the acceptance/approval letter.
Road	Has the same meaning given to it by s. 315 of the Local Government Act 1974
Secondary flow	The estimated surface water run-off in excess of the primary flow. In most cases this flow will be managed in an overland flowpath or ponding area that is protected by public ownership or easement
Stormwater	Rainwater that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, channels, or pipes into a defined surface water channel, open watercourse, or a constructed infiltration facility
Street	Has the same meaning as 'road' as defined by s. 315 of the

	Local Government Act 1974
Surface water run-off	All naturally occurring water, other than subsurface water, which results from rainfall on the site or water flowing onto the site, including that flowing from a drain, stream, or river
Survey plan	A survey plan under s. 2 of the Resource Management Act
Swale	A constructed watercourse shaped or graded in earth materials and stabilised with site-suitable vegetation or rocks, for the safe conveyance and water-quality improvement of stormwater run-off
Target operating speed	The desired maximum speed for motor vehicles identified by the designer to suit the land use context and road classification. This speed can be managed by physical and psychological devices such as narrowed movement lanes, reduced forward visibility, parking, slow points, build outs, leg lengths, chicanes, planting, landscaping, street furniture, and art works
Territorial authority	A territorial authority (TA) defined in the Local Government Act 2002
Wāhi tapu	Means a place sacred to Māori in the traditional, spiritual, religious, ritual, or mythological sense
Wastewater	Water that has been used and contains unwanted dissolved or suspended substances from communities, including homes, businesses, and industries
Waterway	Means fresh water or geothermal water in a river, lake, stream, pond, wetland, or aquifer, or any part thereof, that is not located within the coastal marine area
Zone of Influence	A triangular area defined by lines extending 45° upwards from 150 mm below a pipe invert, to the ground surface.

1.2.3 Abbreviations

The following abbreviations are used in this Code of Practice:

ABS	acrylonitrile butadiene styrene
AEP	annual exceedance probability
AV	air valve
°C	degrees Celsius
CBD	central business district
CBR	California bearing ratio
CCTV	closed circuit television
CLS (SCL)	concrete lined steel (steel concrete lined)
CPTED	Crime prevention through environmental design
Code of Practice	Queenstown Lakes District Council Land Development and Subdivision Code of Practice

DI	ductile iron
DN	nominal diameter under the pipe manufacturing standard
du	dwelling unit
ESA	equivalent standard axle
FAC	free available chlorine
FAR	floor-to-area ratio
FL	flange
FSL	finished surface level
GL	ground level
g/m^3	grams per cubic metre
GRP	glass reinforced plastic
H	head (in metres)
h	hour
ha	hectare
HDD	horizontal directional drilling
IQP	independent qualified person
km	kilometre
km/h	kilometres per hour
kPa	kilopascal
L	litre(s)
LID	low impact design
m	metre
MDD	maximum dry density
MH	manhole or maintenance hole
min	minute(s)
MPa	megapascal
MS	maintenance shaft
m/s	metres per second
m^3/s	cubic metres per second
mm	millimetres
NAASRA	National Association of Australian State Road Authorities
NES	National Environmental Standard
NIWA	National Institute of Water and Atmospheric Research
NPS	National Policy Statement
NZBC	New Zealand Building Code
NZHPT	New Zealand Historic Places Trust
NZTA	New Zealand Transport Agency

OSH	Occupational Safety and Health
p	person
PE	polyethylene
PE 80B	polyethylene with minimum required strength (MRS) of 8 MPa as defined in AS/NZS 4130 and AS/NZS 4131
PE 100	polyethylene with MRS of 10 MPa as defined in AS/NZS 4130 and AS/NZS 4131
PF	peaking factor
PIPA	Plastics Industry Pipe Association of Australia Ltd
PN	nominal pressure class (maximum rated operating pressure)
PP	polypropylene
PRV	pressure reducing valve
PVC	polyvinyl chloride
PVC-U	unplasticised polyvinyl chloride
PVC-M	modified polyvinyl chloride
PVC-O	orientated polyvinyl chloride
RMA	Resource Management Act
RRJ	rubber ring joint
s.	section
Soc	socket
STP	specified test pressure
TA	territorial authority
TMS	terminal maintenance shaft
UV	ultraviolet
VC	vitrified clay
vpd	vehicles per day

1.3 Context

This Standard is relevant to Acts such as the Resource Management Act, Building Act, Historic Places Act and other legislation. The purpose of NZS 4404:2010 is to provide standards for the implementation of well-designed land development and subdivision infrastructure projects that have obtained the necessary resource consents under the RMA, and comply with other legislation. LAs will be able to invoke compliance with this Standard and their own local additions and variations, to ensure that the sustainability, urban design, and environmental impact objectives of land development and subdivision projects are carried through to completion. The TA can agree to deviations of the Code at their discretion. The interrelationship between this Standard and these Acts is outlined below.

The Standard also provides best practice land development and subdivision infrastructure techniques in low impact design, climate change, and urban design.

1.3.1 Resource Management Act

The Resource Management Act 1991 (RMA) is the principal statute under which the development and subdivision of land is controlled.

Regional and district plans prepared under the RMA are the key resource management instruments that LAs implement to achieve sustainable management of natural and physical resources, which is the overarching purpose of the RMA.

This Code of Practice does not have a binding effect unless incorporated into a regional/district plan or bylaw. If the Code of Practice is not referred to in the plan or any bylaw, the Code of Practice can still serve as a technical compliance manual to assist in guiding decision-making and forming conditions of resource consent.

A national policy statement (NPS) and national environmental standard (NES) may also apply to a proposed development in addition to regional and district planning documents. However NPS and NES only apply once they are finalised and gazetted whereas regional and district plan provisions may apply to consent applications as soon as they are notified.

> ***C1.3.1***
>
> *Over time, central government may develop other NPS and NES which may affect decision-making by LAs on land development and subdivision, including national policy on freshwater management, and flood risk. The Ministry for the Environment's website should be referred to for any relevant NPS and NES.*

The protection of historic heritage from inappropriate subdivision, use, and development is a matter of national importance under s. 6(f) of the RMA. The RMA's definition of historic heritage includes: historic sites, structures, places, and areas; archaeological sites; sites of significance to Māori including wāhi tapu; and surroundings associated with the natural and physical resources. Therefore regional/district plans should be reviewed to ascertain whether any development proposal affects historic heritage. Most plans have a historic heritage schedule, which lists the item protected, its location, and its sensitivity. A precautionary approach should be taken prior to any land development and subdivision infrastructure affecting historic heritage, with the TA consulted at the earliest stage (see 1.3.2).

Where applications for resource consents may affects sites of significance to Māori, consultation with the appropriate tangata whenua groups should occur prior to finalising plans or submitting applications for resource consent in order to give effect to Part II of the RMA.

1.3.2 Historic Places Act

In addition to the RMA, the Historic Places Act regulates the modification of archaeological sites on all land and provides for substantial penalties for unauthorised destruction, damage, or modification of these sites.

The Act makes it unlawful for any person to destroy, damage, or modify the whole or any part of an archaeological site registered with the New Zealand Historic Places Trust (NZHPT), without the prior authority of the NZHPT. This is the case regardless of whether:

(a) The site is registered or recorded by the council in planning documents;

(b) The land on which the site is located is designated;

(c) The activity is permitted under the district or regional plan; or

(d) A resource or building consent has been granted.

Therefore approval from the NZHPT is required if a site registered with the NZHPT is affected, in addition to any council approval that may be required.

Furthermore, if the site is known to be associated with pre-1900 human activity, or there is reasonable cause to suspect such an association, the developer should consult with the NZHPT prior to undertaking any earthworks or ground disturbance.

1.3.3 Building Act

The Building Act provides a national framework for building control to ensure that buildings are safe and sanitary and have suitable means of escape from fire. The Building Regulations made under the Act provide the mandatory requirements for building control in the form of the New Zealand Building Code. The Building Code contains the objective, functional requirements, and performance criteria that building works shall achieve.

Where the development of land and subdivision infrastructure involves the creation of structures with associated site works, including specific aspects of stormwater management and the interaction of buildings, fences, and walls with stormwater flows, the requirements of the Building Act shall be observed. Nothing in this Code of Practice shall detract from the requirements of the Building Act or the Building Code. The Code of Practice may be a higher standard than the Building Act and if bound by a Resource Consent Condition, the Code of Practice requirements will supersede the Building Act requirement where the Code of Practice is more stringent.

> ***C1.3.3***
>
> *Systems owned or operated by a network utility operator for the purpose of reticulation are not included in the definition of building under the Building Act.*

1.3.4 Other legislation

The Reserves Act, Conservation Act, and other Acts may also require consideration when undertaking land development and subdivision infrastructure. Covenants (a legal restriction or agreement recorded on the title of a property that is a matter of private contract) may also require consideration. For example, a Queen Elizabeth II Act Open Space Covenant is a legally binding protection document agreed between a landowner and the QEII National Trust.

1.4 Low impact design

Low impact design (LID) is both a design approach and a range of structural techniques that can be applied to urban development and stormwater management. As a design approach, LID provides an opportunity to identify and recognise natural features and integrate these into the design of development layouts in order to minimise environmental impacts or enhance natural features. The integration of natural processes in the design stage of a development can result in more attractive, multifunctional landscapes with greater social, environmental, cultural, and transport outcomes.

Low impact design solutions that use natural processes and add value to urban environments are the preferred approach.

1.5 Climate change

Climate change is likely to increase the magnitude of some hazards, therefore it is important to incorporate risk management in the design of infrastructure supporting new developments to maintain the same level of service throughout the design lifetime. The design of infrastructure for land development and subdivision needs to provide for the impact of the increased frequency of extreme weather events.

> ***C1.5***
> *Amendments to the Resource Management Act, the Local Government Act 2002, and the Building Act require LAs to have particular regard to the effects of climate change when making decisions under these Acts.*
>
> *The government is considering the development of a number of other national policy instruments which may affect decision-making by local authorities, including a 'National policy statement on flood risk'. These would not take effect until they are gazetted.*

1.6 Urban design protocol

The *New Zealand urban design protocol* seeks to ensure that the design of buildings, places, spaces, and networks that make up our towns and cities, work for all of us, both now and in the future. NZS 4404 includes recommended best practices that support urban design protocol initiatives. The *New Zealand urban design protocol* identifies seven essential design qualities for good urban design:

(a) Context: seeing that buildings, places, and spaces are part of the whole town or city;

(b) Character: reflecting and enhancing the distinctive character, heritage, and identity of our urban environment;

(c) Choice: ensuring diversity and choice for people;

(d) Connections: enhancing how different networks link together for people;

(e) Creativity: encouraging innovative and imaginative solutions;

(f) Custodianship: ensuring design is environmentally sustainable, safe, and healthy;

(g) Collaboration: communicating and sharing knowledge across sectors, professions, and with communities.

The *New Zealand urban design protocol* has been the primary influence on the urban layouts that are encouraged in this Code of Practice.

1.7 Requirements for design and construction

1.7.1 Investigation and design

All investigation, calculations, design, supervision, and certification of the infrastructure outlined in this Code of Practice shall be carried out by or under the control of persons who:

(a) Are experienced in the respective fields;
(b) Hold full membership in the respective professional bodies;
(c) Have appropriate professional indemnity insurance and public liability insurance.

The provisions of this Code of Practice do not reduce the responsibility of those professionals to exercise their judgement and devise appropriate solutions for the particular circumstances of each development.

1.7.2 Construction

All construction carried out in any development shall be done by persons who:

(a) Have the appropriate experience in the relevant areas;
(b) Have the appropriate equipment;
(c) Have the appropriate public liability insurance;
(d) Meet the requirements of the Health and Safety in Employment Act.

1.8 Acceptance of design and construction

1.8.1 Documents to be submitted for design review and acceptance

1.8.1.1
Prior to, or as a condition of, granting a resource consent for subdivision or development of land, or as otherwise required by a district plan, or as otherwise considered necessary by QLDC when considering applications to construct infrastructure, QLDC may require documents to be submitted including the following:
(a) Engineering review and acceptance application form and deposit
(b) Design, construction, operation and maintenance documentation including drawings, specifications and calculations for the following:
   (i) Earthworks and geotechnical requirements
   (ii) Roading and site access including a design and access statement (see 3.2.6 of NZS4404:2010) and a road safety audit (see 3.2.7 of NZS4404:2010). Documentation shall demonstrate compliance with relevant resource consent conditions or explanations if deviations are proposed.
   (iii) Stormwater (including overland flow paths and a catchment wide assessment if required by the Council)
   (iv) Wastewater
   (v) Water supply
   (vi) Landscape
   (vii) Network Utility Services
   (viii) Lighting (including design parameters and isolux plot lines (provides the points of equal illuminance, in lux, from a specific stated mounting position. The diagram can be used to assess the distribution characteristics of the luminaire in addition to determining lighting levels)
   (ix) Three Waters Facility Asset Identification Specifications (refer Appendix K)
(c) A geo-professional's report on the suitability of the land for subdivision or development if required by the Council
(d) Other reports as considered necessary by QLDC in the circumstances of the proposed infrastructure in order to meet the requirements of this code
(e) An access and maintenance strategy shall be provided for all non-standard assets to be vested to QLDC. Please refer to Council's Vesting of Roads and Reserves

policy 2016 on Council's website. Unless otherwise agreed in writing with QLDC, or as required by relevant legislation, the strategy document shall be prepared on the basis that no specialist training or equipment shall be required to access the vested asset.

(f) A design certificate, for each design discipline, in the form of the certificate in schedule 1A of NZS 4404:2010. Each certificate shall include a schedule of documents to which it applies. The limit of damages shall be agreed with the Council.

All documents other than signed certificates shall be submitted electronically as an enabled PDF (searchable PDF, not a scanned copy). Colour hard copies of all documents shall be provided at any time if requested by QLDC.

All documents shall demonstrate that they have passed through an internal Quality

Management System. As a minimum they shall clearly show that they have been checked and approved by a suitable person (refer to section 1.7 for the requirements of a suitable person) different from the document author.

1.8.2 Drawings

1.8.2.1 General

Design drawings shall be prepared in accordance with the LA's practices. Except where otherwise notified, the requirements are as set out in this section and in sections 2 to 8 of this Code of Practice. Drawings shall be accepted by the TA. All drawings shall be provided in a form required by the TA.

Drawings shall be to adequate detail to clearly illustrate the proposals and enable assessment of compliance with this Code of Practice and enable accurate construction.

1.8.2.2 Composition of drawings

Design drawings generally include the following:

(a) A locality plan giving the overall layout and location;

(b) Detailed plans, longitudinal sections, cross sections, and diagrams of the proposed developments;

(c) Special details where the standard drawings are not sufficient;

(d) A north point and level datum, the scale or scales used, the date of preparation and the date of any amendments, the designer's name and contact details, and a unique number or identifier.

1.8.2.3 Scale

The scale for plans is generally 1:500 but other accepted scales may be used to suit the level of detail on the plans. Special details shall be to scales appropriate for clarity. Individual LAs may require other specific scales to be used.

1.8.2.4 Content of drawings

The following information when relevant shall be shown on the design drawings:

(a) The extent of the construction showing existing and proposed roads, and the relationship with adjacent construction, services, or property;

(b) Significant existing vegetation to be removed and any special or protected trees, areas of heritage significance, and existing water bodies that may be affected by the construction;

(c) The extent of earthworks, including earthworks on proposed reserves, existing and proposed contours, areas of cut and fill, batter slopes, subsoil drainage, and silt control measures both temporary and permanent;

(d) The design of proposed roads (and their connections with existing roads), including longitudinal and cross section plans, horizontal and vertical geometry and levels, typical cross sections, details of proposed pavement surface, kerbing, swales, berms, footpaths, cycle paths, tree planting, road marking and signals, and all other proposed road furniture;

(e) The horizontal and vertical location and alignment, lengths, sizes (including Outside Diameter (OD), Inside Diameter (ID) and Nominal Diameter (ND) for all PE Pipes), materials, minimum cover, position relative to other services of all proposed water, wastewater, and stormwater systems and service connections, valves, hydrants, manholes, bends, tees, meters and backflow devices, and services that may be reconnected or plugged, and any proposed overland stormwater flow path;

(f) Details and location of mechanically restrained portions of pipelines, pipeline bridges, pumping stations, reservoirs, intake and outlet structures and the location of surface obstructions, hazards, or other features that may be affected by the construction;

(g) For water mains, the nominal static pressure head at the point of connection and at the lowest point; design pressure and maximum design pressure;

(h) Details and location of existing and proposed telecommunications, electricity and gas supply, and street lighting layout, including proposed underground and above ground junction boxes, transformers and similar equipment. This information is typically provided by the service authorities once other design drawings are finalised and approved;

(i) Details of proposed landscaping of roads and allotments, and details of proposed reserve development including earthworks, hydrological features, walkways and accessways, landscaping features, landscaping structures, tree planting, revegetation, hard and soft surface treatment, park and road furniture, and playground equipment.

1.8.2.5 Recording of infrastructure – As-built information

The TA may require the design drawings to be in a certain format, suitable for later addition of as-built information and inclusion in the TA asset map base. In particular, electronic plans may be required.

1.8.3 Design basis for documents submitted for review and acceptance

1.8.3.1 Standard design basis

Proposals submitted on a standard design basis shall conform to this Code of Practice.

1.8.3.2 Alternative design basis

Proposals submitted on an alternative design basis may differ from this Code of Practice and shall apply specifically to a particular proposal. TA review and acceptance of an alternative design does not confer approval in general by the TA to any design criteria, construction technique or material forming part of the alternative design.

An explanation of the design basis or construction method is to be submitted, for review and acceptance in principle. It will be considered on its merits and should be approved provided that the design results in infrastructural development equivalent or superior in performance to that complying with this Code of Practice.

Alternative designs provide flexibility to meet the circumstances and requirements peculiar to the site, or as a means of encouraging innovative design, or to meet the principle of life-cycle costing.

1.8.3.3 Life-cycle costing

Life-cycle costing may be used to consider options within a proposal or a proposal as a whole. In undertaking a life-cycle costing, consideration shall be given to the initial costs borne by the developer and the maintenance and replacement costs borne by the future owners or the TA. A reasonable balance shall be maintained between these short-term and long-term costs.

1.8.4 Review and acceptance of design

1.8.4.1

When it is satisfied that the design meets the requirements of this Code of Practice, or the TA's own provisions, or in the case of an alternative design, that the design satisfies the requirements of 1.8.3.2, the TA shall notify the owner that the design has been approved and endorse the plans, specifications, and other documents accordingly. For the purpose of this review and acceptance the TA may require the owner to make amendments to any plans, specifications, and other documentation and to submit further or other reports. In considering project design and giving its review and acceptance, the TA shall act without undue delay.

1.8.4.2 Review and acceptance before commencing construction

Construction shall not commence on site unless and until:

(a) Resource consents have been issued, except when no such consents are required; and

(b) The TA(s) have approved any other consents and the drawings, specifications, and calculations for the specific infrastructure that is required in accordance with 1.8.4.1.

C1.8.4.2

S. 116 of the Resource Management Act sets out when a resource consent commences. Generally this will be when any appeals against the grant of the consent have been disposed of. Where any appeals are unresolved, approval to commence work will need to be obtained from the Environment Court.

1.8.4.3 Suitably Qualified and Experienced Persons

Where investigations and reports are required by a Suitably Qualified and Experienced Person (SQEP), this person or persons will have nationally recognised qualifications and experience in the field they are working in. The person or persons will normally be expected to be professionally recognised in the area of competence claimed and to carry professional indemnity insurance to a level suitable for the purpose but in any case not less than $1,000,000 per project.

Council reserves the right to have any work peer reviewed regardless of any prior approval as to the acceptability of the suitably qualified person. The cost of all peer review work will be borne by the developer.

Specific requirements are outlined below that are required for any person to be deemed suitably qualified in these work areas:

a) Traffic and transportation assessment, road safety audits, and road safety audit exemptions – Suitably Qualified and Experienced Person shall be Qualified in Traffic Engineering and work or have worked in a role whose primary activity is Traffic Safety Engineering;
b) Road Pavement Design for pavements designed for a medium load or above (5 x 105 to 5 x 106 ESA / ONRC Primary Collector or above) - Suitably Qualified and Experienced Person is required to sign off design and that person shall be a CPEng with a practice area in Pavement Design;
c) Stormwater engineering incorporating flood mitigation, catchment analysis or stormwater system design - Suitably Qualified and Experienced Person shall be a CPEng with recognised Stormwater discipline competence. Requirements may be relaxed at Council's sole discretion subject to the development site complying with the each of the following:
    (i) The development does not require the physical alteration, damming or re-routing of natural water courses; and
    (ii) Average ground slope does not exceed 20%; and
    (iii) The increase in stormwater runoff generated due to proposed works and prior to stormwater management is less than 10L/s for the 5% AEP event.

1.8.5 Notification of contracts and phases of construction

1.8.5.1

The developer shall notify the TA, in writing, of the names and addresses of contractors to whom it is proposed to award the contracts, and the nature of the construction in each case.

1.8.5.2

Unless the TA requires otherwise, the developer shall notify the TA when the following phases of construction are reached and such other phases as the TA may determine to enable inspection to be carried out:

(a) Commencement of construction;

(b) Prior to concrete construction;

(c) Prepared earthworks and subsoil drainage prior to filling;

(d) Completed earthworks and prepared subgrade;

(e) Water, wastewater, and stormwater reticulation prior to backfilling;

(f) Water and wastewater reticulation during pressure testing;

(g) Finished basecourse before the commencement of road sealing;

(h) Disinfection of water mains.

At least 24-hours notice shall be given by the developer. Inspection shall be carried out within 24 hours of notification if possible. Further construction phases shall not proceed until inspection has been made.

> ***C1.8.5.2***
>
> *LAs may require the appointment of a 'developer's professional advisor' or 'independent qualified person (IQP)' in which case this requirement will be performed by that person.*

1.8.6 Supervision of construction

The level of supervision undertaken in connection with any construction shall be agreed between the TA and the developer, or, if appointed, the developer's professional advisor or the IQP as the case may be, and shall be appropriate to the circumstances considering the size and importance of the project, the complexity of the construction, and the experience and demonstrated skill in quality management of the person undertaking the construction.

The TA may require completion certification for construction and supervision be submitted to it on completion. Such certification may be required from the contractors undertaking the construction, or the developer, or the developer's professional advisor (if any). The certificates shall be in the form given in Schedules 1B and 1C.

> ***C1.8.6***
>
> *An appropriate level of supervision can be selected by reference to the Construction Monitoring Services information published by the Engineering New Zealand (EngNZ) and the Association of Consulting Engineers New Zealand (ACE New Zealand).*

1.8.7 Connecting to existing services

1.8.7.1

Council's preference is that 3 Waters services are not installed in private property. In situations where 3 Waters infrastructure is required to be placed in private property (including private roads), the planning and development team need to consider who is best positioned to own and hold responsibility for the services prior to obtaining Engineering Acceptance. Council's default position is that water infrastructure should be vested to Council, if designed to Council standard, unless doing so will expose Council to unreasonable risk or expense. Council ownership helps to ensure that an appropriate level of service is provided to the entire community. However, in some situations vesting is not appropriate, these situations include those listed below:

(a) Where the line services multiple properties on a single lot
(b) Where the properties could reasonably be supplied by dedicated laterals supplied from the main located within the road reserve

(c) Where access to the pipe is impeded
(d) Where the pipe poses a significant risk to adjacent buildings or structures e.g. retaining walls
(e) Where the private road finish is to a higher standard than a typical Council road and would require special reinstatement treatments
(f) Where an unacceptable exemption is requested that deviates from the provisions of the Code of Practice
(g) Any other situation not expressly listed, at Council's sole discretion, is deemed to present an unacceptable risk to Council

If the 3 Waters services are deemed suitable for vesting the Resource Consent must require the developer to provide an Easement in favour of Council in regard to the buried services. This easement shall make mention that Council reinstatements will be asphalt or brushed concrete in roadways and no special reinstatements will be undertaken unless agreed by Council. In all instances, a written request shall be submitted to Council clearly stating the reason(s) for the intention to vest.

1.8.7.2

Connection of water, wastewater, stormwater, and other services to existing systems will normally be carried out by the appropriate network utility operator at the cost of the developer, except that at the discretion of the network utility operator connections may be made by the owner, or contractor employed by the owner, if appropriately qualified and under the network utility operator's supervision.

1.8.7.3

The developer shall give the network utility operator 15 working days' notice of intention to connect to existing services. Where required, new services shall be tested and approved by the network utility operator prior to connection.

1.8.7.4

All trade premises connecting to QLDC's infrastructure network must ensure that their discharge limits comply to the parameters as set out in the current bylaw(s) relative to the infrastructure network.

1.8.8 Testing

Any infrastructure required to be tested by the developer shall be pre-tested and proved satisfactory by the developer before test by the network utility operator is requested.

Prior to requesting inspection by QLDC the developer shall submit copies of test certificates/reports confirming that the infrastructure has been inspected and proved satisfactory.

1.8.9 Maintenance

The developer shall maintain the infrastructure until it is formally taken over by the TA or to a date specified in a bond or consent condition for completion of uncompleted infrastructure. The developer shall not be responsible for damage caused by other activities such as building construction or for fair wear and tear or vandalism caused by public use of the roads that have been taken over by the TA or network authority.

Extended maintenance periods may be imposed if adequate testing and supervision cannot be demonstrated.

1.8.10 Completion documentation

On completion of all subdivision and land development infrastructure, the developer shall provide the TA with the following:

(a) The geotechnical reports and as-built plans required by 2.6 of this Code of Practice;

(b) Asbuilts submitted for all Parks, Roading and Three Waters infrastructure and landscaping assets listed in Schedule 1D, and submitted according to the Asbuilt/Data Specifications on the QLDC Land Developments and Subdivisions website.

(c) Evidence that all testing required by this Code of Practice has been carried out and that the test results comply with the requirements of this Code of Practice;

(d) Evidence that reticulation and plant to be taken over by network utility operators have been installed to their standards and will be taken over, operated and maintained by the network utility operator concerned;

(e) Completion certificates as per Schedules 1B and 1C;

(f) Certification by a suitably qualified person where they have recommended a specific design and construction has been undertaken in accordance with that recommendation. The certification shall state that the suitably qualified person supervised the construction and it has been completed in accordance with the recommended design principles;

(g) Other documentation required by the TA including, but not limited to:

- operation and maintenance manuals for 3 waters facilities, irrigation systems, specialised playground equipment, playground safety surfaces, toilets, all-weather sports surfaces, sports field lighting, drinking fountains;
- warranties for new facilities (involves electrical and mechanical plant or stormwater low impact design facilities); and
- asset valuations for all infrastructures to be taken over by the TA.

(h) A schedule of all assets to be taken over (vested) by Council. The schedule shall utilise either QLDC's Three Waters As-Built Specification or Asset Register Templates, as applicable. Please refer to Council's Vesting of Roads and Reserves Policy 2016 on Council's website.

(i) Following completion, the electrical contractor shall supply the following:

- Signed and completed Electrical Certificate of Compliance (CoC) and Electrical Safety Certificate (ESC).
- Signed and completed Record of Inspection (RoI) form.

1.8.11 Acceptance of uncompleted work

Where in the opinion of the TA it is assessed as reasonable, and unlikely to materially affect the safe operation of public assets and expectations and interests of the public and directly affected private parties, the TA may approve the deferral of completion of an element of a consented and approved work, subject to satisfactory bonds being arranged.

1.9 Bonds and charges

1.9.1 Uncompleted works

1.9.1.1

Bonds to cover uncompleted works, especially where a subdivision or development has been substantially completed, are recognised as an acceptable procedure and should be permitted at the discretion of the TA. Acceptance of a bond for uncompleted works shall not be unreasonably withheld.

1.9.1.2

Bonds shall be secured by an appropriate guarantee or shall be in cash and lodged with the TA. Where necessary bonds shall be executed and registered.

1.9.1.3

The amount of the bond shall be the estimated value of the uncompleted work plus a margin to cover additional costs estimated to be incurred by the TA in the event of default.

The bond amount shall be a minimum of 1.5 times the higher amount of two quotes approved by QLDC.

1.10 Defect Liability Bond

Prior to the issue of a 224c certificate a defects liability bond shall be entered into by the developer for all assets to be vested to the Council. The bond shall be valued at 5% of the construction costs for all assets to be vested. The bond shall be for a minimum of 12 months commencing on the date of 224c certification issue and will only be released following a site inspection by the Developer and the Council. The bond shall be secured by an appropriate guarantee or shall be in cash and lodged with the Council. Alternative arrangements may be agreed with the Council

C1.9.1

A satisfactory system of bonding uncompleted works is needed to overcome delays in obtaining the deposit of land transfer plans for subdivision. A major factor can be the practical difficulties of fully completing the construction of a subdivision caused by inclement weather, shortages of machinery, materials, and labour and the difficulty of coordinating the many aspects required to achieve full completion of a substantially completed subdivision.

The authority to require bonds is given in s. 108(2)(b) and s. 108A of the Resource Management Act, and s. 109 of that Act deems bonds and covenants to be instruments registerable under the Land Transfer Act, running with the land and binding subsequent owners. Section 109 of the Resource Management Act also gives the TA the power to enter land and complete the work. Additional powers are given by s. 223 of the Resource Management Act to allow the deposit of a survey plan notwithstanding uncompleted work.

SCHEDULE 1A

DESIGN CERTIFICATE – LAND DEVELOPMENT/SUBDIVISION

ISSUED BY:…………………………………………………………………………………………………

(Approved certifier firm/suitably qualified design professional)

TO: …………………………………………………………………………………..…………………

(Developer/owner)

TO BE SUPPLIED TO:…………………………………………………………………..…………………

(Territorial authority)

FOR: ………………………………………………………………………..……………………………….

(Description of land development/subdivision)

AT:……

……………………………………………………………………………………………..…………………

(Address)

……………………………………. has been engaged by ....………………..

(Consultant/designer) *(Developer/owner)*

to provide……………………………………. services for the land development and/or subdivision described above.

I ……………………………………have the qualifications and experience relevant to this project as set out herein and have designed the land development/subdivision and confirm that the design is to current engineering practice, and that I believe on reasonable grounds that it satisfies all relevant resource consent conditions, all relevant …………………………………………………….(insert name of authority) requirements and applicable codes and standards.

I / My practice holds professional indemnity insurance to the amount of $……………….and includes run-off cover.

…………………………………………… *Date* ………………………………………………………..

(Signature of approved certifier on behalf of the approved certifier firm)

……

(Name, title, and professional qualifications)

NOTE – This statement shall only be relied upon by the territorial authority named above. Liability under this statement accrues to the approved certifier firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the territorial authority on this land development/subdivision, whether in contract, tort, or otherwise (including negligence), is limited to the sum of $............................ (insert)

SCHEDULE 1B

CONTRACTOR'S CERTIFICATE UPON COMPLETION OF LAND DEVELOPMENT/SUBDIVISION

ISSUED BY:…………………………………………………………………………………………………

(Contractor)

TO: ………………………………………………………………………………………………………

(Principal)

TO BE SUPPLIED TO:…………………………………………………………………………………

(Territorial authority)

FOR: ………………………………………………………………………………………………………

(Description of land development/subdivision)

AT:……

………

(Address)

………………………………… has contracted to ………………………………………………………..

(Contractor) *(Principal)*

to carry out and complete certain land development and/or subdivision construction in accordance with a contract, titled Contract No. ………… for ………………………………(‘the contract’).

I …………………………… a duly authorised representative of …………………………………………

(Duly authorised agent) *(Contractor)*

hereby certify that ……………………………………………… has carried out and completed

(Contractor)

the construction, other than those outstanding works listed below, in accordance with the contract and in accordance with approved engineering drawings and specifications.

………………………………………………… Date …………………………………………………

(Signature of authorised agent on behalf of)

…………………………………………………

(Contractor)

………………………………………………… ……………………………………………………

(Address)

Outstanding works

………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………

SCHEDULE 1C

CERTIFICATION UPON COMPLETION OF LAND DEVELOPMENT/SUBDIVISION

ISSUED BY:…………………………………………………………………………………………………

(Approved certifier firm)

TO: ……………………………………………………………………………………………………

(Developer/owner)

TO BE SUPPLIED TO:……………………………………………………………………………

(Territorial authority)

FOR: ……………………………………………………………………………………………………

(Description of land development/subdivision)

AT:………………………………………………………………………………………………………

……

(Address)

………………………………… has been engaged by ………………………………………

(Consultant/designer) *(Developer/owner)*

to provide construction observation review and certification services for the above subdivision which is described in the specification and shown on the drawings numbered

……………………………………… accepted by……………………………………………………

(Territorial authority)

I have sighted the ……………………………………………… consent and conditions of subdivision

(Territorial authority)

and the accepted specification and drawings.

On the basis of periodic reviews of the construction and information supplied by the contractor in the course of the construction, I believe on reasonable grounds that the infrastructure other than those outstanding works listed below, is complete and has been constructed in accordance with:

(a) The approved engineering drawings and specifications and any approved amendments;
(b) The Council's Engineering Standards; and
(c) The manufacturer's instructions

…………………………………………… Date ………………………………………

(Signature of approved certifier on behalf of the approved certifier firm)

……

(Name, title, and professional qualifications)

NOTE – This statement shall only be relied upon by the territorial authority named above. Liability under this statement accrues to the approved certifier firm only. The total maximum amount of damages payable arising from this statement and all other statements provided to the territorial authority in relation to this land development/ subdivision, whether in contract, tort, or otherwise (including negligence), is limited to the sum of $......................... (insert).

Outstanding works

……

Copyright waived

SCHEDULE 1D

AS-BUILT PLANS / ASSET DATA SPECIFICATION

As-built Information shall be submitted in accordance with the specifications below:

Three Waters	
Format: Pipes and Nodes - GIS, Facilities - Excel	
Three Waters and Open Spaces Asbuilt Submission Package **Three Waters Facilities Asset Register** **Three Waters Facilities Asset Identification Specification**	
Stormwater Pipes	Storm mains, mudtank/inlet leads, and laterals.
Stormwater Nodes	Storm manholes, valves, end structures, meters, treatment devices, mudtank/inlets, bends, and junctions
Wastewater Pipes	Wastewater mains and laterals
Wastewater Nodes	Wastewater manholes, lampholes, valves, meters, bends, and junctions
Wastewater Facilities	Wastewater pumpstations and treatment plants
Watersupply Pipes	Watersupply mains and service laterals
Watersupply Nodes	Wastersupply valves (tobies/service, backflow preventers, boundary, line), meters, hydrants, bends, and junctions
Watersupply Facilities	Watersupply pumpstations, treatment plants, and reservoirs
Flood and secondary flow information, flood water levels and the extent of any overland secondary flows shall be shown where these have been obtained or derived during the design.	

Roading / Transport	
Format: RAMM Update sheet, GIS (where applicable)	
QLDC Website/Services/Resource Consents/land developments & subdivisions	
General	Approved Road Names, Metadata, traffic and testing information (e.g. roughness, CBR), and second coat detail, Details of any warranty's, especially any electrical
Road Structure	Surfacing and Pavement layers
Street Lighting	Poles, Brackets, Lights, illuminated signs, point of power supply, Installation Control Point (ICP), Electrical Certificate of Compliance (CoC), Electrical Safety Certificate (ESC), Record of Inspection (RoI) form.
Above Ground Assets	Signs, road markings, edge markers, minor structures, bus stops, manhole covers, railings, barriers, traffic islands, traffic calming
Structures	Retaining walls, Bridges, large Culverts
Drainage	Kerb and Chanel, surface water channels, mudtanks
Traffic Signals	Traffic signal apparatus (poles, lights, controls, communications)
Footpaths	Footpaths, cyclepaths, crossing points (tactiles)

Parks & Open Spaces	
Format: GIS	
Three Waters and Open Spaces Asbuilt Submission Package	
General	Approved reserve or development names where available
Vested Reserves	Lots to be vested as reserve
Furniture	Picnic tables, seats, benches
Structures	Boardwalks, bridges, fences, steps, walls, art and monuments, bike pumps, bike stands, bollards, cattlestops, culverts, cut-off drains, drink fountains, gates, pergolas, rotundas, shade sails, shelters, signs, stiles, BBQs
Irrigation	Pipe, electricity connections, emitters, plumbing, control boxes, pumps, drainage
Playgrounds	Playground area, equipment, safety surfaces
Sports Areas	Bike parks, bowls green, cricket ground, cricket net, cricket wicket, golf course, half court, petanque, pump track, rugby/football, skate park, sport court multi, sport wall, sports field, swimming pool, tennis/cricket practice wall, tennis court, posts, post sleeves, nets, sportsfield lighting
Vegetation	Gardens, grass/turf, hedges, park trees, street trees
Carparks	Carparks and vehicle accessways for the purpose of the adjoining park or reserve. Includes street parking.
Services	Services in reserves only – Amenity lighting, power outlets, septic tanks, stormwater sumps (mudtanks), water pumps, water taps. Usually an underlying Three Waters or Aurora asset
Toilets	Toilets
Tracks & Trails	Tracks, trails, footpaths, cycleways, pump tracks
Water Body	Ponds, streams, lakes

1.11 Council Approved Materials List

The current listing of Council approved materials can be found on the QLDC website.

(a) Approved Materials – 1 Stormwater
(b) Approved Materials – 2 Wastewater
(c) Approved Materials – 3 Water Supply

NOTE – Approved Materials for Street Lighting can be found in Southern Light Technical Specification.

2 EARTHWORKS AND GEOTECHNICAL REQUIREMENTS

2.1 Scope

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development. Where community specific considerations cannot be met, written acceptance of an alternative method shall be obtained from the Council.

This section sets out requirements for the assessment of land stability and the design and control of earthworks to ensure a suitable platform for the construction of buildings, roads, and other structures. A low impact design approach is preferred. Geotechnical assessment shall be undertaken by a geo-professional defined in 1.2.2 of this Code of Practice where:

(a) The assessment of land stability requires specialist expertise;

(b) The construction of earthworks associated with any development requires initial planning and design to ensure that banks and batters remain stable and that fill material is placed in such a way that it remains stable and can support the future loads imposed on it;

(c) There is historical fill which has not been undertaken in accordance with any Standard or where natural slopes, banks, or batters are involved;

(d) The assessment of ground for the foundations of buildings, roads, services, and other infrastructure requires specialist expertise as weak ground may require special design;

(e) The wide range of soil types, physical conditions, and environmental factors applying in different areas make it difficult to specify precise or prescriptive requirements for land stability assessment or earthworks.

In setting design, construction requirements, or development limitations the designer shall take account of all relevant standards and TA requirements.

> ***C2.1***
>
> *NZS 4431 is applicable to the construction of earth fills for residential development including residential roading.*

2.2 General

2.2.1 Objective

The objective of this section is to set out some, but not necessarily all of the matters which need to be considered in planning and constructing a land development project. The aim is to provide information for professionals involved in designing and constructing a land development project and to require geotechnical expertise in projects where land stability could be an issue or where earthworks other than of a minor nature will occur.

The geo-professional needs to be involved in the choice of final land form. This decision depends on many factors which may be specific to the development. These include the relationship with surrounding landscapes, the size of the development, the proposed and existing roading patterns, the preservation of natural features, wāhi tapu, and other historic and archaeological sites, the land stability and underlying structural geology, the function and purpose of the development and the potential for flooding, and erosion and other natural hazards and events including earthquakes. The aim is to also give guidance on the identification of and assessment of the order of importance of the above factors which will vary from project to project.

A geo-professional shall meet the requirements of section 1.7.1 as amended by QLDC's Land Development and Subdivision Code of Practice Part 1, as well as:

- Ensure modifications to the existing natural environment are to be minimised or avoided in order to preserve the existing landscape and habitat features as far as is practicable;
- Ensure the resultant land forms for the completed subdivision are to provide for stable, safe landforms and access to these landforms for the proposed developments intended purpose.
- Where landforms require specialist design assessment to satisfy the point above. The landform design and construction compliance or limitations on the land forms post construction shall be adequately detailed and reported to council via a geotechnical completion report for inclusion on the landforms title or consent conditions to ensure landform conditions are adequately addressed in perpetuity.

2.2.2 Referenced documents

A selection of useful guidance material on geotechnical and geomechanical issues in land development is set out in Referenced Documents. Related Documents lists additional material that may be useful.

2.2.3 Local authorities' requirements

The TA may require an assessment of land stability to meet the provisions of the Resource Management Act and Building Act. The TA requires and relies on the assessment made by the geo-professional.

Special requirements apply when land is subject to erosion, avulsion, alluvium, falling debris, subsidence, slippage, rotation, creep, or inundation from any source. In such situations reference needs to be made to s. 106 of the Resource Management Act and, for subsequent building work, s. 71 of the Building Act.

Advice should be sought from the regional council for earthworks and consent requirements.

The methods used and investigations undertaken are defined by the TA and the geo-professional.

This Code of Practice does not set those requirements or set standards for assessing geotechnical risk.

2.2.4 Geotechnical requirements

Where any proposed development involves the assessment of slope stability or the detailed evaluation of the suitability of natural ground for the foundations of buildings, roading, and other structures, or the carrying out of bulk earthworks, then a geo-professional shall be appointed by the developer to carry out the following functions:

(a) Check regional and district plans, records, and requirements prior to commencement of geotechnical assessment;

(b) Prior to the detailed planning of any development, to undertake a site inspection and such investigations of subsurface conditions as may be required, and to identify geotechnical hazards affecting the land, including any special conditions that may affect the design of any pipelines, underground structures, or other utility services;

(c) Before construction commences, to review the drawings and specifications defining any earthworks or other construction and to submit a written report to the TA on the foundation and stability aspects of the project;

(d) Before and during construction, to determine the extent of further geo-professional services required (including geological investigation);

(e) Any work necessary to manage the risk of geotechnical instability during the construction process;

(f) Before and during construction, to determine the methods, location, and frequency of construction control tests to be carried out, determine the reliability of the testing, and to evaluate the significance of test results and field inspection reports in assessing the quality of the finished work;

(g) During construction, to undertake regular inspection consistent with the extent and geotechnical issues associated with the project;

(h) On completion, to submit a written report to the TA attesting to the compliance of the earthworks with the specifications and to the suitability of the development for its proposed use including natural ground within the development area. Where NZS 4431 is applicable, the reporting requirements of that Standard shall be used as a minimum requirement.

2.3 Design

2.3.1 Design factors

The design process shall include, but not be limited to:

(a) Preliminary site evaluation;

(b) Identification of special features to be retained/protected;

(c) Low impact design considerations;

(d) Selection of the choice of landform;

(e) Stability assessment;

(f) Assessment of special soil types where applicable;

(g) Setting of compaction standards for fill material;

(h) Erosion, sediment, and dust control;

(i) Seismic considerations;

(j) Geothermal issues where applicable;

2.3.2 Preliminary site evaluation

During the preliminary site evaluation phase the developer's professional advisor shall engage a geo-professional at an early stage to undertake a preliminary site evaluation and prepare a geotechnical assessment report where there is doubt about the stability or suitability of the ground for the proposed development, or there are any TA or local practice requirements for geotechnical involvement in the project.

In cases where more than a visual appraisal is deemed to be required, particular attention will need to be given to the following matters, as appropriate, which should normally be considered prior to preparing a proposal for development:

(a) Low impact design factors:

The preliminary site evaluation needs to take into account low impact design factors. These include consideration of maintaining and improving natural waterway features and optimising waterway crossing locations. Protection of well-drained soils and natural soakage areas also need to be taken into account.

(b) Drainage:

Identify the existing natural drainage pattern of any area and locate any natural springs or seepage. Where any overland flow paths or natural surface or subsurface drainage paths are interfered with or altered by earthworks, then appropriate measures should be taken to ensure that adequate alternative drainage facilities are provided to ensure there is no increase in flood hazard risk to the site or adjoining properties;

(c) Slope stability:

Some natural slopes exist in a state of only marginal stability and relatively minor disturbance such as trenching, excavation for streets or building platforms, removal of scrub and vegetation, or the erection of buildings, can lead to failure. Signs of instability include cracked or hummocky surfaces, crescent-shaped depressions, crooked fences, trees or power poles leaning uphill or downhill, uneven surfaces, swamps or wet ground in elevated positions, plants such as rushes growing down a slope, and water seeping from the ground. In addition, a simple desktop study of aerial photographs may show indications of historic failures as well as faulting, resulting in linear ground features. Refer to BRANZ Study Report 004, Crawford and Millar 1998, or the New Zealand Geotechnical Society publications Field description of soil and rock and Geotechnical issues in land development. For a sample checklist for geotechnical assessments refer to Crawford and Millar 1998. Existing or potential surface creep effects also need to be investigated and reported upon;

(d) Foundation stability:

A study of the general topography of the site and its surroundings may indicate areas which have previously been built up as a result of natural ground movement or by the deliberate placing of fill material. Unless such fill has been placed and compacted under proper control, instability or long-term differential settlement could occur causing damage to superimposed structures, roads, services, or other structures;

(e) Stream instability:

There is a potential for instability through changes to the current ground conditions, such as stream erosion;

(f) Local conditions:

A wide range of soil types exists throughout New Zealand which may need special consideration. Expansive soils, volcanic soils, soft alluvial sediments, and compressible soils are examples of these. Liquefaction of saturated non-cohesive soils should also be considered. The TA may have information on the soil types in its area, including potentially contaminated land;

(g) Peer review:

Where risk for the land prior to development is assessed as being medium to very high risk, a peer review of the geotechnical assessment for the proposed development may be required and this would need to be carried out by an independent geo-professional. (For guidance see *NZ Geomechanics News* (Crawford and Millar) for risk classification and (Cook et al) for peer review.)

> ***C2.3.2***
>
> *The preliminary evaluation should be carried out in the context of the total surroundings of the site, and should not be influenced by details of land tenure, territorial, or other boundary considerations. Where the preliminary evaluation discloses the potential for slope instability, other geotechnical or geological hazards, or the need for major foundations or for earthworks, the geo-professional should be involved at an early stage in the planning of the development.*

2.3.3 Landform selection

The final choice of landform shall represent the most desirable compromise between the development requirements and the preservation of natural features and the natural character and landscape amenity values of the site including the retention of natural watercourses. Landform selection needs to take into account low impact design principles including retention of existing landforms and natural features where possible, and avoiding earthworks where there are existing habitats of indigenous species, wetlands, or areas of high natural character. The design shall take into account the following factors in making the selection of the final choice of the landform:

(a) The choice of a suitable landform may be specific to a particular site. An earthworks approach that respects and reflects the natural topography of the site is preferred. Considerations for carrying out earthworks include:

  (i) The minimisation of the risk of damage to property occurring through ground movement in the form of slips, subsidence, creep, erosion, or settlement

  (ii) The minimisation of the risk of damage to property occurring through flooding, or surface water run-off

  (iii) The development of a more desirable roading pattern with improved accessibility to and within the site and the creation of a better sense of orientation and identity for the area as a whole

  (iv) The efficiency of overall land utilisation including the quality of individual sites and amenity areas around buildings, the economics of providing engineering services, and the standard of roading and on-site vehicular access

(v) The need to create suitably graded areas for playing fields and other community facilities, and

(vi) The enhancement of the general environmental character of the area;

(b) The general nature and shape of the ground including:

(i) The geological nature and distribution of soils and rock

(ii) Existing and proposed drainage conditions, and the likely effects on groundwater

(iii) Previous history of ground movements in similar soils in the area

(iv) Performance of comparable cuts and fills (if any) in adjacent areas, and

(v) Air photography and other sources of information which should be reviewed and incorporated into any slope stability assessment;

(c) Soil data as applicable for areas which:

(i) Are intended to form in situ bases for fills

(ii) Are intended to yield material for the construction of fills

(iii) Are intended to be exposed as permanent batters, and

(iv) Are to remain as permanent slopes or cut areas;

(d) Borings, probings, or open cuts as necessary to:

(i) Classify the soil strata by field and visual methods

(ii) Evaluate the likely extent and variation in depths of the principal soil types, and

(iii) Establish the natural groundwater levels;

(e) Soil information required for:

(i) Further sampling and testing which may be required on representative soil types

(ii) Relating subsequent soil test properties to relevant strata over the site

(iii) Assessment and design for slope stability

(iv) Assessment and design for foundations suitable for the finished site, and

(v) Assessment and design for road subgrades.

The test data appropriate in different areas should be determined by the geo-professional.

2.3.4 Stability criteria

In making an assessment of the stability of slopes and earth fills, the geo-professional shall use accepted criteria and analysis methods. Stability criteria applicable to land development in New Zealand are published or recommended by the New Zealand Geotechnical Society (see Referenced Documents).

2.3.5 Special soil types

If special soil types are known to exist in a locality or are identified, then a geo-professional shall be engaged to advise on appropriate measures for incorporation of these soils into a development. Special soil types include, but are not limited to:

(a) Soils with high shrinkage and expansion;

(b) Compressible soils;

(c) Volcanic soils;

(d) Soils subject to liquefaction;

(e) Soils prone to dispersion (such as loess).

> ***C2.3.5***
>
> *The geo-professional should refer to the TA for hazard maps or information on special soil types in the locality if unfamiliar with the area.*

2.3.6 Compaction standards for fill material

The standard of compaction and method of determination shall be as set out in NZS 4431. Where NZS 4431 is not applicable, the methods and standards of compaction shall be specified by the geo-professional.

> ***C2.3.6***
>
> *Commercial and industrial developments often have specialised requirements for fill materials and compaction. In these cases the requirements of NZS 4431 may not be applicable. The geo-professional should set the fill standards and procedures for these developments.*

2.3.7 Erosion, sediment, and dust control

2.3.7.1 Minimisation of effects

Earthworks shall be designed and constructed in such a way as to minimise soil erosion and sediment discharge. Where necessary, permanent provision shall be made to control erosion and sediment discharge from the area of the earthworks.

Generation of dust during and after the earthworks operation shall be considered during the planning and design phase. If necessary, specific measures shall be incorporated to control dust.

> ***C2.3.7.1***
>
> *Most LAs have requirements for erosion, sediment, and dust control or these will be set in resource consents for the project. Such conditions should be referred to and taken into account in the early stages of planning a project.*

2.3.7.2 Protection measures

Where surface water could cause batter erosion or internal instability through infiltration into the soil, open interceptor drains shall be constructed in permanent materials, and benches in batter faces should be sloped back and graded longitudinally and transversely to reduce spillage of stormwater over the batter.

Water from stormwater systems shall be prevented from flowing into fill or into natural ground near the toe or sides of the fill.

No stormwater or wastewater soakage systems shall be constructed in fill or natural ground which could impair the stability of the ground.

Content requirements for the preparation of Environmental Management Plans (EMP) associated with land development activities shall be in accordance with QLDC Guidelines for Environmental Management Plans.

Protection measures shall include the following as appropriate:

(a) Erosion control mechanisms:

 (i) Temporary drains to be constructed at the toe of steep slopes to intercept surface run-off and to lead away for treatment where required before discharge to a stable watercourse or pipe stormwater system

 (ii) Surface water to be diverted away from or prevented from discharging over batter faces and other areas of bare earth by bunds formed to intercept surface run-off and treated where required prior to discharge through stable channels or pipes, preferably into stable watercourses or piped stormwater systems

 (iii) The upper surface of fills to be shaped and compacted with rubber-tyred or smooth-wheeled plant when rain is impending, or when the site is to be left unattended to minimise water infiltration

 (iv) The completed battered surfaces of fills to be topsoiled and vegetated, or otherwise resurfaced to reduce run-off velocities

 (v) Control of erosion and sediment discharge may require planting, environmental matting, hydroseeding, drainage channels, or similar measures at an early stage in the earthworks construction phase

 (vi) Dust control may require frequent watering during construction along with establishment of the permanent surface at an early stage in the construction phase;

 (vii) Where final level organic topsoil is to be re-spread to satisfy erosion and revegetation requirements across the completed earthfills or bare stripped soils and where future buildings are proposed then the thickness of organic topsoil shall be more than 100mm and less than 300mm. this is not applicable in landscaping areas.

(b) Sediment management devices:

 (i) The surfaces of fills and cuts to be graded to prevent ponding

 (ii) Sediment traps and retention ponds to be constructed where they are necessary. These should be cleaned out, as required, to ensure that adequate sediment storage is maintained, with appropriate plans for decommissioning

 (iii) Temporary barriers or silt fences using silt control geotextiles, to be used to reduce flow velocities and to trap sediment

 (iv) Sections of natural ground to be left unstripped to act as grass (or other vegetation) filters for run-off from adjacent areas.

2.3.8 Seismic considerations

The geo-professional shall consider the seismic effects on earth fills, slopes, and liquefiable ground and shall take these into account in design and construction of any development in accordance with the scale of the development.

2.3.9 Retaining Walls

Where retaining walls are needed, specific design is required. Initial designs should be discussed with the Council before detailed design is carried out. The following are general criteria for retaining walls.

Retaining walls shall be designed of permanent materials and have an expected life in excess of 50 years. They should also be aesthetically designed to be compatible with the appearance of the surrounding area.

Safety barriers shall be provided in accordance with NZS 4404:2010 section 3.3.4 as modified by this code.

A building consent is required when there is a surcharge weight on the upper side of a retaining wall, or if the retaining wall is over 1500mm in height.

The approval of the Council is required for any works or structures on the road reserve. Approval will only be given where the Council is satisfied that no practical alternative exists to installing the structure on the road carriageway.

All walls within the road reserve shall be designed by a Chartered Professional Engineer in accordance with the NZ Building Code and a building consent obtained where required. Retaining walls below any road carriageway, and supporting road reserve shall be designed to allow for future vehicle surcharging (from anywhere in the road reserve) against the wall.

The design shall consider future maintenance requirements including drainage maintenance. This includes allowance for mowing of grassed areas by installing mowing strips.

2.3.10 Cut and fill batters

A suitably qualified person shall provide a site-specific design (including benching if appropriate) for approval by Council where cut or fill batters:

- Are steeper than 2 horizontal to 1 vertical;
- Exceed 3m in height;
- Are constructed using moisture content susceptible soils; or
- Have features that Council deems to require specific engineering input.

The minimum width of any bench shall be 1.8m. Stormwater shall be conveyed to a point clear of the filling and discharge in such a manner as to prevent erosion.

Unless formed in rock, all batters shall be formed such that they may be reinstated with grass or other consistent vegetation.

The edge of the batter should be a minimum of 600mm behind the kerb or back edge of the footpath.

Safety barriers shall be provided in accordance with NZS 4404:2010 section 3.3.4 as modified by this code.

2.4 Approval of proposed works

The approval process for land development and subdivision design and construction shall be in accordance with section 1 of this Code of Practice. Land stability assessments and the design and control of earthworks require approval from the LAs.

2.5 Construction

Earthworks shall be carried out to the standards detailed in the approved specifications and drawings, and any requirements in a regional or district plan or consent issued by the TA.

The construction control testing shall be carried out by a testing laboratory or competent person under the control of the geo-professional, and to the recognised testing standards as deemed appropriate.

The testing laboratory shall have recognised registration or quality assurance qualifications.

2.6 Final documentation

2.6.1 Geotechnical completion report

- For all developments where a new title or lot is created a geo-professional shall submit a geotechnical completion report to the developer and the TA accompanied by a statement of professional opinion as set out in Schedule 2A. The geotechnical Completion report shall identify the following: Any specific design requirements which would necessitate the building design deviating from NZS 3604;
- Any specific design requirements or recommendations which would necessitate alternative foundation designs deviating from NZS 3604;
- The Schedule 2A certification shall include a statement under Clause 3(e) covering Section 106 of the Resource Management Act 1991;
- The expected level of site movement from reactive soil (expansive soils) under AS 2870:1996 shall be identified by their respective class and included in the geotechnical completion report. The soil properties used in determining the class are to be recorded in the report
- The site subsoil class to the provisions of NZS 1170.5 section 3 and NZS 1170.5 Supp 1 C3.1.3 shall be identified in the geotechnical completion report;
- The report shall describe the extent of inspection, revisit and review all inferences and assumptions made during the investigation, assess the results of testing and state the geo-professional’s professional opinion on the compliance of the development with the standards set by the geo-professional;
- The report shall also include all geotechnical reports prepared for the development;
- Documentation on the testing of the soils for compaction shall be included in the geotechnical completion report. This documentation should clearly show the areas in which compaction met the required standards, as well as any areas requiring retesting, and areas which did not meet the standards;
- The documentation will also detail any areas with development constraints or geotechnical conditions;

- For other developments where there are no earthworks or the natural ground is unaffected by earthworks the geotechnical completion report will comprise the geotechnical assessment report if prepared, or if absent the completion report shall investigate and provide as a minimum the investigations in accordance with section 2.3.2 of this COP and section 3.3.7 of NZS 3604:2011 or subsequent versions and sections related to subsurface investigations for each building platform area or lot;
- For large or more complex developments where there may have been several stages of geotechnical reporting, all prior reports covering the subject area of land under certification shall be included in the geotechnical completion report.

2.6.2 As-built drawings for earthworks and subsoil drains

Where earthworks have occurred, an as-built plan shall be prepared showing finished contours. The plans shall also show original contours where earthworks have occurred to illustrate the extent and depth of cuts and fills. Alternative methods of representing earthwork depths may be acceptable including plans showing lines joining all points of equal depth of cut and fill at appropriate vertical intervals. The as-built plans shall also record the position, type, and size of all subsoil drains and their outlets, and show any areas of fill or natural ground which the geo-professional considers do not comply with this Code of Practice or areas where the standards have been varied from the original construction specification.

These plans shall be made available to the TA and the developer in conjunction with the geotechnical completion report.

SCHEDULE 2A

STATEMENT OF PROFESSIONAL OPINION ON SUITABILITY OF LAND FOR BUILDING CONSTRUCTION

Development ....

Developer ....

Location..

I .... of ....
(Full name) *(Name and address of firm)*

Hereby confirm that:

1. I am a geo-professional as defined in clause 1.2.2 of NZS 4404:2010 and was retained by the developer as the geo-professional on the above development.
2. The extent of my preliminary investigations are described in my Report(s) number ...., dated ...., and the conclusions and recommendations of that/those document(s) have been re-evaluated in the preparation of this report. The extent of my inspections during construction, and the results of all tests and/or re-evaluations carried out are as described in my geotechnical completion report dated ....
3. In my professional opinion, not to be construed as a guarantee, I consider that (delete as appropriate):
   (a) The earth fills shown on the attached Plan No...................... have been placed in compliance with the requirements of the .... Council and my specification.

   (b) The completed works take into account land slope and foundation stability considerations, subject to the appended foundation recommendations and earthworks restrictions, (which should be read in conjunction with the appended final site contour plan).

   (c) Subject to 3(a) and 3(b) of this Schedule, the original ground not affected by filling is suitable for the erection of buildings designed according to NZS 3604 provided that:

   (i)..

   (ii)...

   (d) Subject to 3(a) and 3(b) of this Schedule, the filled ground is suitable for the erection of buildings designed according to NZS 3604 provided that:

   (i) ....

   (ii)...

   (e) The original ground not affected by filling and the filled ground are not subject to erosion, falling debris (including soil, rock, snow and ice), subsidence (including liquefaction induced subsidence), inundation (including flooding, overland flow, storm surge, tidal effects and ponding) or slippage in accordance with the provisions of section 106 of the Resource Management Act 1991 provided that:

   (i) ....

   (ii)...

NOTE – These subclauses may be deleted or added to as appropriate, to include such considerations as expansive soils where excluded from NZS 3604, and site seismic characteristics as covered in clause 3.1.3 of NZS 1170.5.

4. This professional opinion is furnished to the TA and the developer for their purposes alone on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building.
5. This certificate shall be read in conjunction with my geotechnical report referred to in clause 2 above and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

Signed.. Date..

....

....

....

(Name, title, and professional qualifications)

Copyright waived

3 ROADS

3.1 Scope

Where community specific guidelines are available these shall be followed throughout the design and construction of subdivisions and development. Where community specific considerations cannot be met, written acceptance of an alternative method shall be obtained from the Council.

This section sets out requirements for the design and construction of roads for land development and subdivision. Section 3 provides engineering design and construction solutions for most situations.

3.2 General

3.2.1 Objective

The objective is to provide roads that are safe for all road users and designed to the context of their environment. Roads shall be capable of carrying all utility services underground, provide for the management of stormwater, and contribute to quality urban design.

3.2.2 Related Standards and guidelines

A selection of currently available documents which provide an appropriate basis for road design is set out in Referenced Documents. Related Documents lists additional material that may be useful. These are not exclusive. Other Standards, guidelines, and design responses may be used where appropriate and accepted by the TA.

Standards and Guidelines shall include all policies and guidelines adopted by QLDC.

3.2.3 Road purpose

Roads serve a number of purposes that enhance quality of life in neighbourhoods, towns, and cities; improve opportunities for business in commercial areas; and meet a range of local, regional, and national goals for access, mobility, and land use.

Every street functions as both a movement corridor and a place for activity by people, with the relative balance between the two informed by the predominant nature of activity on the street. The strength of a street as a place is primarily dependent on the number of people using the street for everyday activities, and its importance as a destination. The strength of a street as a link is primarily dependent on the number of people using the street to pass through to destinations elsewhere. In addition, streets are also corridors for utilities and community amenities.

Roads serve the following functions:

(a) A **place** for access and interaction, including:

- (i) Providing for human interaction
- (ii) Facilitating commerce and business
- (iii) Enabling access to buildings, lots, and public spaces
- (iv) Parking;

(b) A **link** for connection and movement of people and goods including the following user groups:

(i) Pedestrians

(ii) Cyclists

(iii) Public transport

(iv) Freight and goods vehicles

(v) Private motor vehicles

(vi) Other modes which are not vehicles;

(c) A **corridor** for utility and amenity infrastructure, including:

(i) Stormwater treatment and conveyance

(ii) Road lighting

(iii) Landscaping and street furniture

(iv) Utility services

(v) Signals, signs, and markings

(vi) Safety, convenience, and crime prevention.

3.2.4 Place and link context

The two fundamental roles of a road are to provide a space for interaction between people for a range of purposes and access to land uses so that movement between places can occur.

3.2.4.1 Place context

Place context is defined for both the specific land use served and the broader area type in which it is located.

The land use characteristic is defined according to the description of predominant activities in individual areas. Descriptions include live, play, shop, work, and learn, in addition to activities associated with growing, manufacturing, and transporting goods and products.

Table 3.1 describes the relationship between land use, area type, and transport context. Table 3.1 should be used as a guide for decision-making on transport infrastructure and services. This table addresses:

(a) **Geographic area**: Four area types are identified to establish the context of place: rural, suburban, urban, and centre.

(b) **Land use**: Four land use types are identified: live and play (residential and parks), shop and trade (retail and services), work and learn (offices and schools), and make, grow, and move (agricultural, industrial, and warehouses).

(c) **Transport**: As a matrix, the area context and land use classification system describe sixteen individual place contexts that indicate the types, times, intensity, and mode of trips that can be expected to occur in neighbourhoods. This land use framework describes the typical elements of road links that are to accommodate the needs of the expected users.

3.2.5 Defect Liability Period

All roads are covered by at least one-year defects liability period whereby the performance of the completed road is closely monitored. Defects liability will be extended where required for any agreed exceptions from the Code or where it is considered to be a risk of early failures. If a second coat chip seal is applied by the Developer, a pavement inspection shall be arranged with QLDC prior to expiry of the 12 months Defect liability period. The Defect liability period will be extended to 12 months from the second coat seal date to cover the new seal.

During the defects liability period, the Contractor and Designer are to inspect the site a minimum of every 8 weeks, defects which appear during this time are to be remedied within 7 days of identification. Council may notify the Developer of any defects during this period.

Reasons for defect failure must be clearly understood and the proposed remediation must be relayed to Council for acceptance prior to remediation taking place. Liability for defects will remain the developers' until QLDC accept the remediation.

QLDC will undertake an inspection prior to the end of the defects liability period to identify outstanding defects. Details of any identified defect will be passed to the developer to address as per the above process. Once all defects are resolved, QLDC will issue a certificate stating that defect liability period has come to an end.

Table 3.1 – Land use and area type matrix describing typical place and transport context

LAND USE	AREA TYPE			
	RURAL	SUBURBAN	URBAN	CENTRE
LIVE AND PLAY (Residential and parks) Homes, home-based businesses, and mixed use developments with residential uses, as well as parks and low impact recreation. *Transport: These land uses primarily generate home-based and internal circulation trips (recreation, social, school, and retail). Home-based work trips are concentrated at peak periods, while other types of trips are dispersed across time periods. Streets to these land uses prioritise recreation walking and cycling over vehicle movement.*	Low density, generally no more than 4 units per hectare located outside the urban limits. *Transport: Private motor vehicles are the predominant form of transport with low trip volumes throughout the day.*	Low and moderate density housing generally up to 15 units per hectare in an area where housing is the exclusive or dominant use. *Transport: Private vehicles are the predominant form of transport but public transport should provide peak period service on arterials and connector/collectors. Non-motorised trips are primarily recreational and occur on local roads.*	Moderate and high density housing often in combination with other uses such that combined population of residents, employees, and students is typically 50 per hectare or greater. *Transport: A higher portion of trips are made on public transport and by walking and cycling. There is lower priority for the provision of residential parking in urban areas.*	Moderate and high density housing often in combination with other uses such that combined population of residents, employees, and students is typically 200 per hectare or greater. *Transport: Residents typically walk or cycle to nearby destinations and rely on public transport for longer trips, and they may choose not to own a vehicle. Provision for residential and commuter parking is a low priority in centres.*
SHOP AND TRADE (Retail and services) Retail or other service where most trips to the business are by customers and clients, rather than employees. *Transport: A large volume of destination trips occur across time periods, especially weekends and peak shopping times to these land uses. A low-to-moderate volume of freight truck traffic is served. Streetscapes may serve as connections for destination users to reach several or numerous businesses in the area.*	Isolated or small clusters of stores or service-based businesses located outside the urban limits. *Transport: Most trips are made in private motor vehicles with low trip volumes throughout the day.*	Includes both traditional town centres and newer shopping centres of generally 1-2 storeys where the dominant use is retail and services businesses and the combined retail and commercial floor-to-area ratio (FAR) is typically under 0.3 (gross). *Transport: Most trips are made in private motor vehicles with moderate and high trip volumes, especially on weekends, requiring these land uses to have large amounts of parking allocated to each site.*	Retail and services focused in a town centre or concentrated along an urban corridor in combination with other uses. The combined population of residents, employees, and students is typically 50 per hectare or greater. *Transport: Trips are made on a variety of modes at all times with limited amounts of shared and paid parking.*	Moderate to high density land uses include retail mixed with other uses in an urban or town centre. Centres typically have, or are planned to have, a combined population of residents, employees, and students of 200 per hectare or greater. *Transport: Public transport services are typically focused on centres, and centres are among the most highly connected and walkable environments. Provision for parking is the lowest land use priority in centres.*

Table 3.1 – Land use and area type matrix describing typical place and transport context (continued)

LAND USE	AREA TYPE			
	RURAL	**SUBURBAN**	**URBAN**	**CENTRE**
WORK AND LEARN (Offices and schools) Areas dominated by businesses or schools where the most important trips to the business are made by employees (typically offices) and students. *Transport: A large volume of destination trips occur at peak periods on weekdays. A low-to-moderate volume of freight truck traffic is served. Streetscapes may serve as connections for a variety of users, especially during lunch periods as well as other times when clients or customers may visit work places. Roads near schools will require special design needs to accommodate younger pedestrians.*	Individual or small clusters of activities located outside the urban limits, such as school campuses and research facilities. *Transport: Most trips are made in private motor vehicles with most trips occurring during peak periods.*	Low rise office buildings (typically 1-2 storeys) and school campuses with an area wide average FAR of less than 0.3, including any retail component. *Transport: Most trips are made in private motor vehicles during peak periods, requiring these land uses to have large amounts of parking allocated to each site.*	Low and mid-rise office buildings that often include street-front retail and services focused in a town centre or concentrated along an urban corridor. The combined population of residents, employees, and students is typically 50 per hectare or greater. *Transport: Trips are made on a variety of modes at all times with limited amounts of shared and paid parking.*	Mid-rise and high-rise office buildings that usually include mixed uses, including street-front retail and multi-family housing. Centres typically have, or are planned to have, a combined population of residents, employees, and students of 200 per hectare or greater. *Transport: Public transport services are typically focused on centres, and centres are among the most highly connected and walkable environments. Provision for parking is the lowest land use priority in centres.*
MAKE, GROW, AND MOVE (Agricultural, industrial, and warehouses) Areas dominated by businesses where the most important trips to the business are made by heavy delivery trucks (typically farms, warehouses, and industries). *Transport: A moderate-to-large volume of freight trips occur (year around or seasonally) and should be accommodated in the road link network. Streetscapes are designed to accommodate heavy freight movements. Where these are larger in number and need to be served, the freight, link function is crucial to service the land use function.*	Farms, light industry, and warehouses located outside the urban limits. *Transport: Road links are predominantly designed to accommodate freight truck movements and those generated by employees and business customers, Special vehicle areas may be provided to accommodate specialised freight needs.*	Industrial parks. *Transport: Road links are predominantly designed to accommodate freight truck movements and those generated by employees and business customers. Parking may also be provided for some employees, and special vehicle areas may be provided to accommodate specialised freight needs*	Would not normally occur except where activities have little impact on or otherwise support surrounding land uses.	Would not normally occur except where activities have little impact on or otherwise support surrounding land uses.

3.2.4.2 Link context

Link context is classified by the extent of access and the degree of through movement intended to be served. This Code of Practice includes three levels of link context:

(a) Lane and Shared Space: A road, or in the case of shared space a public space with vehicular access, that provides very high local access and very limited through movement connectivity. Very low vehicle speeds with shared pedestrian and vehicle access predominate.

(b) Local road: A road that provides access and connectivity for a local area. Low vehicle speeds, pedestrian and local amenity values predominate.

(c) Connector/collector road: A road that provides circulation in local areas and links to arterial roads, while balancing this with pedestrian and local amenity values. Higher vehicle speeds and access for all modes of transport including public transport predominate.

> ***C3.2.4.2***
>
> *Arterial roads and motorways are not included in this* Code of Practice*. These roads are subject to specific design standards to be agreed with the road controlling authority to ensure through movement connectivity associated with the broader sector in which such roading is located. The following descriptions are included for information:*
>
> (a) ***Minor arterial road****: A road that provides access between connector/collector and major arterial roads. Minor arterial roads have a dominant through vehicular movement and carry the major public transport routes. Access to property may be restricted and rear servicing facilities may be required. Urban traffic volumes are typically 8,000 vpd to 20,000 vpd and rural from 1,000 to 5,000 vpd with a higher proportion of heavy vehicles. Typical urban operating speeds are 40 to 60 km/h and rural 80 to 100 km/h.*
>
> (b) ***Major arterial road****: A road that provides interconnections between major sectors of a large area linked with external areas and distributes traffic from major intercity links. Access is generally at grade but may be limited. Urban traffic volumes are typically greater than 20,000 vpd and rural 5,000 vpd with a significant number of heavy vehicles. Typical urban operating speeds are 50 to 70 km/h and rural 80 to 100 km/h.*
>
> (c) ***Motorway****: Motorways have the highest link function and have no frontage access. Typical operating speed is 100 km/h.*
>
> *Where a development connects to the NZTA state highway network, the developer should refer to the NZTA approval process as per the Transit Planning Policy Manual: Appendix 5B.*

3.2.5 Network connectivity

Well-connected networks (roads and other links) are achieved with smaller block sizes and regular connections. Network connectivity shall be designed to achieve:

(a) Shorter travel distances;

(b) An increased number of alternative routes for all types of users;

(c) Increased opportunity for interaction;

(d) Improved access to public transport, cycling and walking networks, and access to destinations.

Development design shall ensure connectivity to properties and roads that have been developed, or that have the potential to be developed in the future. The design process should ensure the following maximum walking distances from a lot to a connector/collector or arterial road:

(a) **Rural**: No maximum distance. The design should maximise future connectivity to a suburban network;

(b) **Suburban**: 400 m. A shorter distance shall be considered near centres and public transport routes;

(c) **Urban**: 300 m;

(d) **Centre**: 200 m.

Where factors, such as topography or barriers, limit the ability to achieve the network connectivity standard, the designer shall optimise network connectivity and access to the maximum extent practical. The designer shall maximise connectivity to existing development.

3.2.6 Design and access statement

A design and access statement shall be submitted with the application for design approval. The statement shall cover all relevant aspects of 3.2 and 3.3 of this Code of Practice and specifically address:

(a) Road dimensions and layout;

(b) Link and place functions;

(c) Connectivity;

(d) How target operating speeds will be achieved;

(e) How LID principles have been considered for stormwater run-off from the roads.

(f) How cyclists will be provided for

(g) Car parking

In addition a design and access statement shall evaluate the effects of the proposed development at its ultimate extent (and staged, where applicable) on the surrounding communities and transportation network.

> ***C3.2.6***
>
> *Design and access statements allow the basis of the road design to be independently reviewed, and should be sufficient to illustrate the reasons for the design selections.*

3.2.7 Road safety audit

Road safety audits carried out in accordance with the NZTA Road safety audit procedures for projects shall be provided for the design phase of all publicly accessible roads in the Queenstown Lakes District. Post construction road safety audits may be required at Councils discretion.

Road Safety Auditors shall also provide confirmation of the design's compliance with relevant resource consent conditions or identify any deviations from those conditions. Any recommendations of the Safety Audits shall be completed to the Council's satisfaction. Exemption from providing road safety audits shall be granted by the Council at its sole discretion. Road safety audits shall also be provided for private road networks when considered necessary by QLDC.

Safety audits should cover all road users, including the needs of pedestrians, cyclists, and disabled/elderly users. Where appropriate, the requirements of these groups may demand specific audit procedures.

3.2.8 Vesting

All roads that provide access to 12 or more dwelling units shall vest in the Queenstown Lakes District Council as Legal Public Road.

Exemptions to vesting requirements above will only be provided at Council's discretion and demonstration of compliance with clause 3.3.16.

3.2.9 Curb side rubbish collection services

QLDC will not provide curb side rubbish collection services to private roads or no exit roads that do not comply with this Code of Practice.

3.3 Design

3.3.1 Design requirements

Table 3.3 should be used as the basis for road design. Road widths shall be selected to ensure that adequate movement lanes, footpaths, berms, and batters can be provided to retain amenity values (including landscaping) and enable utility services to be provided safely and in economically accessible locations. Road widths shall be planned to cope with estimated long-term community needs even though construction may be carried out only to shorter-term requirements.

Alternative carriageway widths may be adopted to suit particular design considerations. These shall be subject to specific design consideration and approval by the TA. Such cross sections may include landscaped features, painted median facilities, or variations to parking provision. Carriageways should avoid widths of 5.7 m to 7.2 m and 7.5 m to 9.0 m where these widths may cause confusion between movement and parking functions.

C3.3.1

In the case of a rear access lane, the concept relies heavily on minimal garage setback from the lane frontage. Rear access lanes are required to provide for manoeuvring for access to/from garages. Where the garages are located on or close to the lane edge the manoeuvring requirement may necessitate a wider lane dimension or increased setback. In this sense, a key function of the lane is to operate akin to an aisle within a car parking area and needs to be designed accordingly. A single lane sealed width with widening at the garage locations for turning is the minimum requirement. Sealing the entire lane increases opportunities for the lane to be used in a social sense. It is therefore desirable for the entire lane to be sealed, although a narrow berm for services may be necessary.

There are three carriageway types. These are:

(a) *A width in the range 5.5 m – 5.7 m providing for ability to park on one side of the road and one through lane, or alternatively two through lanes. This is often not defined at the engineering stage and is instead left to road users to choose. This type of road is provided for in the standard and is typically appropriate for shorter streets of up to approximately 250 m, to assist with achieving a slower operating speed.*

(b) *A width in the range of 7.2 m – 7.5 m providing an ability for either two parked cars and one through movement, or one parked car and two through movements. This is typically not defined through the provision of parking bays although it may be. There may be cases in lower parking demand situations where this width is achieved with varied pinch points to provide a road with two through lanes and a parking bay.*

(c) *A width in the range 9.0 m – 9.5 m providing ability for two through lanes and two parking lanes. Depending on parking demand this can either be achieved with landscaping such as tree boxes/pits and recessed parking, or by maintaining full flexibility with a straight edge.*

The designer shall consider the environment, purpose, and function of the road being designed. In developing a design cross section the designer shall consider the relationships between speed, parking and its frequency, and the shared or recessed nature of parking in the movement lanes. In general a wider standard total carriageway cross section can be developed where parking is shared in the movement lane, however if this is not a frequent occurrence then the outcome will be an unnecessarily wide road and the target speed outcome will not be achieved without other managed intervention. Where parking is less frequent, consideration shall be given to narrowing the travelling carriageway and recessing the parking or to introducing landscaping into the carriageway to reduce the appearance of apparent formed width. Where the designer proposes to develop a shared street design that varies from that shown in table 3.3, a full description and assessment of the frequency and extent of interactions of this nature shall be described in the design and access statement.

Roads shall be designed to account for stormwater and keep potential groundwater below structural pavement layers. On rural roads, side drains or swales shall be provided to carry stormwater and keep potential groundwater below structural pavement layers. All roads, including footpaths and cycleways, shall be adequately drained in accordance with good engineering practice. Roads also have the potential to provide stormwater ponding and overland flow paths when the primary system is overloaded (see 4.3.4.2).

In soils of adequate permeability and favourable topography, the use of low impact design soakage systems and devices shall be considered to provide benefits of attenuating peak flows and improving run-off quality. For detailed design criteria for soakage systems and devices see 3.3.19.5, 4.3.7.6, and 4.3.7.9.

Any design should be coordinated with the relevant landscape design requirements covered in section 7.

Table 3.3 should be read in conjunction with 3.3.1.1 to 3.3.1.10.

All designs shall be suitable for the climatic conditions experienced in the Queenstown Lakes District.

The assessment of traffic loading shall be on the basis of full development to the extent defined in the current district plan. Where a road services adjacent land then the full development to the extent defined in the current district plan of all the land serviced by the road shall be included in the assessed traffic loading.

The assessment of residential traffic loading shall be on the basis of eight vehicle movements per Residential Unit per day.

Where the new roads being installed are required by Council to service adjacent future development as part of the future Council network then those roads will be designed and constructed on the basis of full development to the extent defined in the current district plan.

The cost of increased road construction to service adjacent future development will be apportioned between the applicant and the Council and agreed in writing with the Council's Strategy and Asset Planning Team prior to construction.

3.3.1.1

A movement lane may include a single lane operating in a one-way configuration or in two directions. Normal camber is 4%, except asphalt may be 3%. Maximum superevaluation is 6%. Superelevation is not required where design speed is less than or equal to 50 km/hr.

3.3.1.2

No more than one movement lane in each direction is typical. Streets in urban areas and centres may include a single movement lane operating as a one-way street.

3.3.1.3

Each on-street/road parking/passing area should be a minimum 2.1 x 6 m, and a loading area a minimum 2.5 x 12 m, each with appropriate entry and departure tapers outside of the movement lane. Indented car parking shall be a minimum of 2.5m x 6.1m. To allow vehicles to pass, accesses shall have widening to not less than 5.5 m over a 15 m length.

3.3.1.4

Where not shown in the table cyclists shall be provided with separate movement lanes if identified in a local or regional cycle network.

3.3.1.5

Side and rear access should not be the primary access.

3.3.1.6

Minimum gradient is 0.4%. Maximum gradients shall be as indicated in the table. Steeper gradients may be acceptable for shorter lengths of road in hilly country or low overall speed environments subject to TA approval.

3.3.1.7

In some circumstances an increased overall road reserve may be necessary for utilities provision or increased amenity, landscape or urban design element. Specific design shall be undertaken and agreed with the territorial authority where road reserves are to be reduced. In other circumstances, reserve widths may be reduced if a one way road, or development is on one side of the road

3.3.1.8

All carriageways shall be sealed for the first 10 m from the intersection with another sealed road.

Private access ways and drive ways shall also be sealed from the carriageway to the property boundary

Where a private way adjoins a Collector Road or higher, it shall have a 5m traffic width and 6.5m road reserve width for a minimum of 6m from road boundary.

3.3.1.9

Where the gradient of a public road is steeper than 12.5%, a resolution of the TA or a District Plan allowance is required. Refer to s. 329 (road gradients) of the Local Government Act 1974.

NOTE – The typical plan and cross section images in table 3.3 are also set out in Appendix E. Copyright on these is waived.

3.3.2 Road geometric design

3.3.2.1 Design parameters

Roads shall be designed to the basic standards in Table 3.3 of this Code of Practice which take precedence over any other referenced design guides. Detailed design must be completed following the relevant Austroads guides, and supplemental guides and technical memoranda listed in on the NZTA's Geometric Design webpage at:

https://www.nzta.govt.nz/roads-and-rail/road-engineering/geometric-design/

Parking provisions for narrow carriageways as per 3.3.2.4 below.

3.3.2.2 Sight distance

All roads shall be designed with sight distances that match the target operating speed. Reducing a driver's field of vision in conjunction with other design and management measures is a recognised method for achieving an appropriate speed environment (see 3.3.5).

On connector/collector and arterial roads, sight distance criteria at intersections as well as for stopping, overtaking, on curves, and to avoid obstructions should be applied in accordance with the relevant Austroads or NZTA guides.

Planting within sight lines of pedestrian crossing access areas is to have a maximum mature height of 500mm. Any deviations will require approval from Council.

3.3.2.3 Widening on horizontal curves

In some areas the developed road geometry may be constrained, horizontal alignments may involve low radius, or the proportion of commercial vehicles may predominate, such as in a make and move environment. In such instances, movement lanes shall be assessed to determine the need for localised additional width, for example on low radius horizontal curves where the passage of vehicles has the potential to reduce safety. The Austroads *Guide to road design* – Part 3: *Geometric design* provides useful guidance on this.

3.3.2.4 Parking provisions for narrow carriageways

Parking on carriageways less than 7.2m in width shall be restricted to one side of the carriageway and road markings will be required to outline where parking is not permitted to meet this criteria.

3.3.2.5 Design and check vehicle requirements

Roads and intersections shall be designed to accommodate the check and design vehicles in table 3.2, unless otherwise approved or required by the TA. Design vehicles shall be shown to undertake all applicable manoeuvres on roads and at intersections within the lane lines for the direction of travel. Check vehicles shall be shown to undertake all applicable manoeuvres on roads and at intersections within the kerb lines. An additional 500mm clearance shall be added to each side of all vehicles.

Table 3.2 – Design/Check Vehicle Requirements

Intersection Type	Typical standard design vehicle	Typical standard check vehicle
Intersections with arterial roads and rural intersections	To be agreed with QLDC on a case-by-case basis	
Intersections between collector roads or between a collector road and a local road	Tour coach Radius: 12.5m	Semi-trailer Radius: 12.5m
All other intersections	Medium rigid truck Radius: 10m	Tour coach Radius: 12.5m

Table 3.3 – Road design standards

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Rural (3.3.1.7, 3.3.1.8, & 3.3.1.9)	**Live and play**	Access to lifestyle or clustered housing	1 to 6 du	20	6	16%	Shared (on shoulder and berm)	Passing bay required every 100m if visibility is available from bay to bay. If visibility is not available, passing bays every 50 m. total shoulder 0.5 m, sealed	Shared (in movement lane)	2.50	Lane (this would normally be a private road or private way)		**E1**
	Live and play	Access to lifestyle or clustered housing	1 to 20 du	30	9	16%	Shared (on shoulder and berm)	Total shoulder 0.5 m, sealed	Shared (in movement lane)	5.5 - 5.7	Lane (~ 200 vpd)		**E2**

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Rural (3.3.1.7, 3.3.1.8, & 3.3.1.9)	Live and play	Access to housing	1 to 150 du	70	15	12.5%	Shared (on shoulder and berm)	Total shoulder 1.0 m, sealed shoulder 0.5 m	Shared (in movement lane)	5.5 - 5.7	Local road (~ 1000 vpd)		E3
	Shop and trade	Side or rear service access	Up to 100 m in length between streets, 1 to 20 lots	10	6	16%	Shared (in movement lane)	Passing bay required every 100m if visibilty is available from bay to bay. If visibility is not available, passing bays every 50 m. Kerbed edge or total shoulder 0.5 m, sealed	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E4

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Shop and trade	Access to trade	Rural village shops	40	15	10%	1.5 m each side	Parking and loading may occur in the movement lane or be separate and recessed. See 3.3.6. Kerbed edge or total shoulder 1.0 m, sealed shoulder 0.5 m	Shared (in movement lane)	5.5 - 5.7	Local road (~ 1,000 vpd)		E5
	Make and move	Primary freight access	Rural activities	up to 100	20	10%	1.5 m each side	Total shoulder 1.0 m, sealed shoulder 0.5 m	On sealed shoulder where it is a local authority defined cycle route	5.5 - 5.7	Local road (~ 1,000 vpd)		E6

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road reserve width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder (each side)	Cyclists	Movement lane (excluding shoulder)	Classification		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Rural (3.3.1.7, 3.3.1.8, & 3.3.1.9)	Make and move	Access to office and education	1 to 200 lots	up to 60	20	10%	1.5 m each side	Parking and loading may occur in movement lane or be separate and recessed. Refer clause 3.3.6. Total shoulder 1.0 m, sealed shoulder 0.5 m	On sealed shoulder where it is a local authority defined cycle route	5.5 - 5.7	Local road (~ 1,000 vpd)		E7
	All other situations (where not specified elsewhere)	All (serving land uses not specified elsewhere in this table)	-	up to 100	20	10%	Separate from the carriageway, 1.5 m each side	Total shoulder 1.5 m, sealed shoulder 1.0 m	On sealed shoulder where it is a local authority defined cycle route	5.5 - 5.7	Connector/collector (~ 2,500 vpd)		E8

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Suburban	**Live and play**	Access to houses/ townhouses	1 to 3 du or 1 to 6 du	10	3.6 m for up to 3 du or 4.5 m for up to 6 du	16%	Shared (in movement lane)	Allow for passing up to every 50 m	Shared (in movement lane)	2.75 - 3.0	Lane (this would normally be a private road or private way)		**E9**
Suburban	**Live and play**	Side or rear service access	Up to 100 m in length between streets, 1 to 20 lots	10	6	16%	Shared (in movement lane)	Allow for passing up to every 50 m	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		**E10**

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road reserve width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder (each side)	Cyclists	Movement lane (excluding shoulder)	Classification		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Live and play	Access to houses/ townhouses	1 to 20 du	20	9	16%	Shared (in movement lane)	Shared (in movement lane)	Shared (in movement lane)	5.5 - 5.7	Lane (~ 200 vpd)		E11
	Live and play	Primary access to housing	1 to 200 du	40	15	12.5%	1.5 m one side or 1.5 m each side where more than 20 du or more than 100 m in length	Shared parking in the movement lane up to 100 du, separate parking required over 100 du	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		E12

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road reserve width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder (each side)	Cyclists	Movement lane (excluding shoulder)	Classification	SEE APPENDIX E FOR LARGER VERSION OF FIGURES	
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Suburban	Live and play	Primary access to housing	Up to 800 du	50	20	10%	2.0 m each side	Parking is separate and recessed. See 3.3.6. Public transport is likely (see clause 3.3.1.4, 3.3.1.5)	Separate provision where local authority defined cycle route	2 x 4.2	Connector/collector (~ 8,000 vpd)		E13
	Shop and trade, work and learn	Side or rear service access	Suburban village, access to office and education, 1 - 20 lots	10	6	10%	Shared (in movement lane)	Recessed loading bays in accordance with 3.3.6	Shared (in movement lane)	3.5	Lane (~ 200 vpd)		E14

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Shop and trade, work and learn	Access to trade, office and education	Suburban village 1 - 200 lots	40	18	10%	3.0 m each side	Parking and loading bays both sides may be in the movement lane or recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		E15
Suburban	Make and move	Side or rear freight access	Industrial area	10	11	10%	Separate footpath one side	Loading bays shall be separate and recessed. See 3.3.6	Shared (in movement lane)	3.5	Lane (~ 200 vpd)		E16

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Make and move	Primary freight access	Industrial area	40	18	10%	1.5 m each side	Parking and loading bays both sides may be in the movement lane or recessed. See 3.3.6	Shared (in movement lane)	2 x 4.2	Local road (~2,000 vpd)		E17
	Shop and trade, work and learn, make and move	All, roads serving multi-purpose areas involving most or all of the indicated land uses, not specified elsewhere in this table.	All, or combinations of these land uses	50	23	10%	2.5 m each side, 3.5 m each side for shop and trade, work and learn	Parking separate and recessed. See 3.3.6. Public transport is likely (see 3.3.1.4, 3.3.1.5)	Separate provision where local authority defined cycle route	2 x 4.2	Connector/collector (~ 8,000 vpd)		E18

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Urban	Live and play	Access to lifestyle or clustered housing	1 to 3 du or 1 to 6 du	10	3.6 m for up to 3 du or 4.5 m for up to 6 du	16%	Shared (in movement lane)	Allow for passing up to every 50 m	Shared (in movement lane)	2.75 - 3.0	Lane (this would normally be a private road or private way)		E19
Urban	Live and play	Side or rear service access	1 to 20 du	10	6	16%	Shared (in movement lane)	Parking is required and shall be separate and recessed	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E20

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder** (each side)	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Live and play	Access to houses / townhouses	1 to 20 du	20	9	16%	Shared (in movement lane)	Shared (in movement lane)	Shared (in movement lane)	5.5 - 5.7	Lane (~ 200 vpd)		**E21**
Urban	**Live and play**	Primary access to housing	1 to 200 du	30	15	12.5%	1.5 m one side or 1.5 m both sides where more than 20 du or more than 100 m in length	Parking may occur in the movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		**E22**

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**	SEE APPENDIX E FOR LARGER VERSION OF FIGURES	
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Live and play	All other land use activity types within this area type not specified elsewhere in this table.	All	50	20	10%	2.0 m each side	Parking separate and recessed. See 3.3.6. Public transport is likely (see 3.3.1.4, 3.3.1.5)	Separate provision where local authority defined cycle route	2 x 4.2	Connector/collector (~ 8,000 vpd)		E23
	Shop and trade	Side or rear service access	1 to 20 lots	10	6	16%	Shared (in movement lane)	Loading bays shall be recessed	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E24

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road reserve width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder (each side)	Cyclists	Movement lane (excluding shoulder)	Classification		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Urban	Shop and trade	Access to lots or shop or trade units	1 to 20 lots	10	11	12%	Shared (in movement lane)	Parking may occur separate and recessed. See 3.3.6	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E25
	Shop and trade	Primary access to trade	1 to 200 lots	30	20	10%	3.5 m each side	Parking and loading bays may occur in the movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		E26

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	Land use	Local attributes	Locality served	Target operating speed (km/h)	Min. road reserve width (m)	Max. grade	Pedestrians	Passing, parking, loading, and shoulder (each side)	Cyclists	Movement lane (excluding shoulder)	Classification		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Work and learn	Side or rear service access	1 to 20 lots	10	6	16%	Shared (in movement lane)	Parking and loading bays shall be separate and recessed. See 3.3.6	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E27
Urban	Work and learn	Access to lots or work or learn activities	1 to 20 lots	10	11	12%	Shared (in movement lane)	Parking and loading bays shall be separate and recessed. See 3.3.6	Shared (in movement lane)	2.75 - 3.00	Lane (~ 200 vpd)		E28

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Work and learn	Primary access to office and education	1 to 200 lots	30	20	10%	3.5 m each side	Parking and loading bays may occur in the movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		E29
	Mixed use	Multiple user access	1 to 200 lots	30	20	10%	3.5 m each side	Parking and loading bays may occur in the movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~2,000 vpd)		E30

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**	SEE APPENDIX E FOR LARGER VERSION OF FIGURES	
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
Urban	Mixed use	Neighbourhood centres (and all other areas serving multiple land uses not listed elsewhere in this table)	200 to 800 lots	50	23	10%	2.5 m each side	Parking is preferred separate and recessed. See 3.3.6. Public transport is likely (see 3.3.1.4, 3.3.1.5)	Separate provision where local authority defined cycle route.	2 x 4.2	Connector/collector (~ 8,000 vpd)		E31
Centre	Mixed use	Side or rear service access	1 to 20 lots	10	6	16%	Shared (in movement lane)	Parking and loading bays (shared in movement lane). See 3.3.6	Shared (in movement lane)	5.7	Lane (~ 200 vpd)		E32

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**	SEE APPENDIX E FOR LARGER VERSION OF FIGURES	
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Mixed use	Access to lots or mixed use activities	1 to 20 lots	20	11	12%	Shared (in movement lane)	Parking and loading bays may occur in movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Lane (~ 200 vpd)		E33
Centre	Mixed use	Primary access and local movement	1 to 200 lots	30	20	10%	2.5 m each side	Parking and loading bays may occur in movement lane or be separate and recessed. See 3.3.6	Shared (in movement lane)	5.5 - 5.7	Local road (~ 2,000 vpd)		E34

PLACE CONTEXT			DESIGN ENVIRONMENT				LINK CONTEXT					TYPICAL PLAN AND CROSS SECTION SEE APPENDIX E FOR LARGER VERSION OF FIGURES	FIGURE NUMBER
Area	**Land use**	**Local attributes**	**Locality served**	**Target operating speed** (km/h)	**Min. road reserve width** (m)	**Max. grade**	**Pedestrians**	**Passing, parking, loading, and shoulder (each side)**	**Cyclists**	**Movement lane (excluding shoulder)**	**Classification**		
Notes	See 3.2.4 & table 3.1	See table 3.1	See table 3.1	See 3.3.5	See 1.2.2, 3.3.1.9, & 3.4.16		See 3.3.11	See 3.3.6 & 3.3.1.4	See 3.3.1.4, 3.3.8, & 3.3.11.2	See 1.2.2, 3.3.1.1, 3.3.1.2, 3.3.1.3, 3.3.1.10, 3.3.11.3	See 3.2.4.2 & 3.3.16 (Typical max. volumes)		
	Mixed use	Shared spaces, accessway, mall, and community reserve	Varies, specific design required	10	11	None if steps	Shared (in movement lane)	Activity space	Shared (in movement lane)	2.75 - 3.00 vehicle movement space, total space by design	Local road (~ 2,000 vpd)		E35
	Mixed use	Urban street	200 to 800 lots	40	23	10%	4.0 m each side	Parking and or loading is separate and recessed. See 3.3.6. Public transport is likely (see 3.3.1.4, 3.3.1.5)	Where local authority defined cycle route	2 x 4.2	Connector/collector (~ 8,000 vpd)		E36

Table 3.3 (continued)

3.3.3 Pavement structural design

Generally pavements shall be flexible designs. Other types of pavements shall be subject to TA approval. Pavements shall be designed in accordance with the NZTA NZ Guide to pavement structural design and NZ guide to pavement evaluation and treatment design with a design life of 25 years.

Where applicable the assessment of Equivalent Standard Axels (ESA) shall include a growth rate of 6% per annum for any existing traffic loading.

> ***C3.3.3***
>
> *For roads of connector/collector class or above, structural design should be undertaken by mechanistic design methods. For other roads, mechanistic or other industry standard chart based methods may be used.*

3.3.3.1 California bearing ratio design method for rigid and flexible pavements

Soaked California bearing ratio (CBR) values of the pavement subgrade shall be used and the pavement designed for the estimated number of equivalent standard axle (ESA) loadings over a 25-year design life.

3.3.3.2 California bearing ratio tests

CBR values shall generally be determined in the laboratory according to 6.1 of NZS 4402.6.

For local roads an alternative method of determining subgrade CBR in non-granular materials by Scala Penetrometer (10 m alternating lane) may be acceptable for clay and colluvial materials.

Figure 3.1 shows a correlation between Scala penetration and CBR values. This should be used conservatively.

The CBR value used in the design shall be the 10th percentile value of the CBR tests taken on the subgrade material. A selection of tests shall be taken at 150, 300, and 450 mm below final subgrade level.

Where CBR values are required for aggregates, these shall be based on laboratory tests prepared on the fraction passing the 19 mm sieve but a CBR of more than 30 shall never be used. The use of CBR on metal layers shall only be in conjunction with consideration of the CBR and stiffness of lower layers.

The use of Scala Penetrometer to determine the CBR value on local roads with clay and colluvial materials shall be approved by the Council at its sole discretion.

And

CBR values shall be determined by an IANZ (International Accreditation New Zealand) accredited laboratory. Details of the CBR values determined, together with certification by the accredited laboratory shall be submitted for approval by Council prior to the issue of a certificate in accordance with clause 224c of the Resource Management Act 1991.

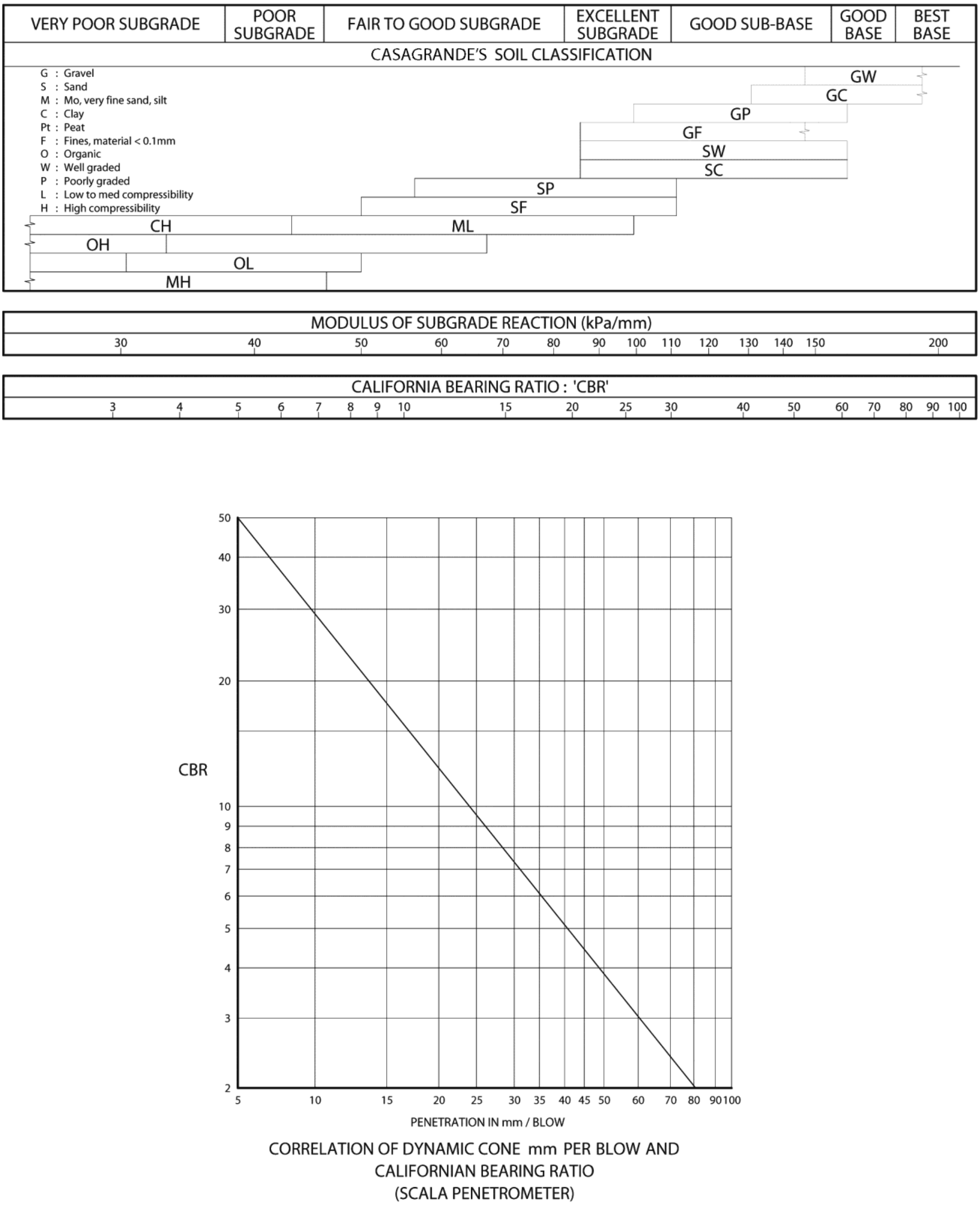


Figure 3.1 – Parameter relationship

3.3.4 Safety barrier provisions

Where roads, private ways or other vehicular accesses, where the target operating speed is 60 km/hr or less, whether public or private, runs parallel with land which drops away to a height of greater than 1.0m within 2.0m of the road or footpath, the side shall be provided with safety barriers to protect vehicular traffic.

For roads with speeds greater than 60 km/hr, the clear zone requirements defined in Austroads *Guide to Road Design - Part 06* apply, and if these cannot be achieved, then a barrier may be necessary and the final decision is at the discretion of Council.

3.3.4.1 Pedestrian and cycle barriers

Where safety barriers for pedestrian and cyclists are necessary, they shall comply with the design requirements of the New Zealand Building Code and NZS/AS 1657.3.3.4.2 Urban vehicle barriers

Where safety barriers for vehicles in urban areas are necessary, they shall comply with the design requirements of NZTA *RTS 11: Urban roadside barriers and alternative treatments*.

3.3.4.3 Rural vehicle barriers

Where safety barriers for vehicles in rural areas are necessary, they shall comply with the design requirements in AS/NZS 3845.

3.3.5 Target operating speed

Traffic management shall be included in road design to ensure that the target operating speed shown in table 3.3 is achieved. Target operating speed can be managed by physical and psychological devices such as narrowed movement lanes, reduced forward visibility, parking, slow points, build outs, leg lengths, chicanes, planting and landscaping, and street furniture and art works.

The Austroads *Guide to traffic management* – Part 8: *Local area traffic management* provides suitable guidance for designing to a target operating speed. Reference can also be made to the *Manual for streets* (UK Department for Transport 2007). Figure 3.2 provides information on estimating traffic speeds for particular circumstances.

> ***C3.3.5***
>
> *The two key geometric factors that contribute to achieving the target operating speed are carriageway width and forward visibility. Figure 3.2 can be used to give an indication of the speed at which traffic will travel for a given carriageway width/forward visibility combination. (Reference: UK Department for Transport, 'Manual for streets'. Figure 3.2 is adapted from figure 7.16 in the reference and 'TRL661 – The manual for streets: evidence and research'). It is recommended that the user interpolate the design street width between the guide lines shown to determine relative street width and forward visibility.*

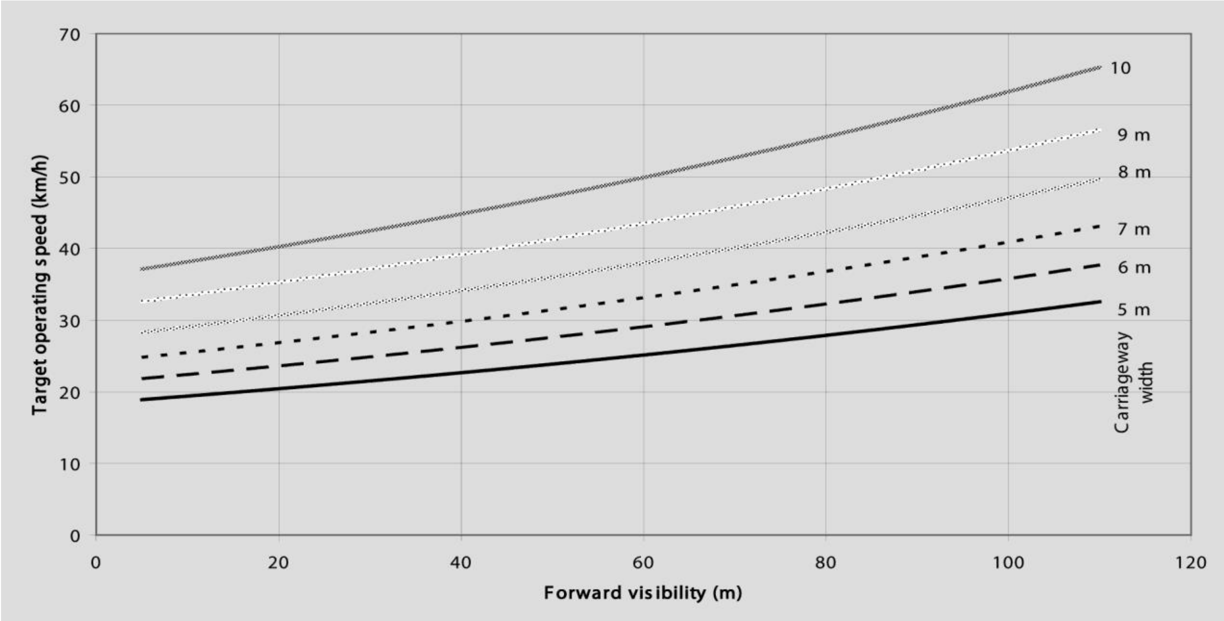


Figure 3.2 – Influence of road geometry on speed

3.3.6 Parking, passing, and loading

Public parking and loading can be provided either on-street including indented, or off-street. Facilities shall meet the needs of the area and the requirements of the TA, and shall be addressed in the design and access statement (see 3.2.6). For a residential subdivision, where physically possible the minimum on-street parking provision will be 1 car park per residential unit/lot (based on permitted density) – see C3.3.6 below. Further guidance on parking demand associated with land use can be found on the Trips Database Bureau website http://www.tdbonline.org/home and NZTA Research Report 363.

C3.3.6

The total number of on-street car parks is to be assessed based on the proposed and surrounding land uses and any requirements for on-site parking as specified in the Transport Section of the District Plan. For example, a residential subdivision in the Low Density Residential Zone with no other non-residential activities/land uses in the vicinity will have a minimum on-street parking requirement of 1 car park per residential dwelling/lot (based on permitted density). This assessment is based on a total (on-street and off-street) parking demand of 3 parking spaces (refer Trips Database Bureau website http://www.tdbonline.org/home and NZTA Research Report 363), with the District Plan requiring 2 of these parking spaces to be provided on-site.

Passing provision shall be in accordance with the design guidance in table 3.3 and the requirements of the TA.

Acceptable and alternative on-street car park and loading dimensions should be taken from AS

2890.5 and/or the Austroads guides. Acceptable dimensions and construction details for indented parallel parking bays in suburban residential areas are shown in Drawing B5-3 Parking Bay. These should have minimum dimensions of 5.4 m x 2.5 m for a middle bay, or 6.0 m for an end bay, with appropriate entry and departure tapers. All indented parking bays shall be designed and constructed to avoid sharp corners. Corners shall be designed and constructed with adequate radii to allow for cleaning by street cleaners utilising rotary brushes.

Parking bays should be evenly distributed along the street. When parking bays are located in front of properties, consider the possible location of the property access, which may need restriction by a Consent Notice or Encumbrance. Parking bays are not permitted over a driveway or within 1 m distance from the prolongation of the driveway.

Parking and loading shall not be provided so that it has the potential to obstruct the movement of emergency or service vehicles along a road (e.g. as a result of parking on both sides of the road). Alternate provision within sites may be demonstrated in addition to the requirements of the district plan, particularly when establishing rules for new subdivisions.

3.3.7 Intersection and alignment design

The angle of intersection should be 90^{o}, although a minimum angle of 70^{o} can be used when justified by other constraints. Carriageway alignment may be offset within the street reserve to achieve the required target operating speed for the road.

All road intersections in ‘live and play’ areas below arterial class should have a kerb radius at intersections of 4 m to 6 m. An alternative and reduced kerb radius may be considered to enhance pedestrian facility in low speed environments, and shall be subject to the approval of the TA. These dimensions shall be superseded by dimensions suitable for the manoeuvring of the design vehicle as outlined in section 3.3.2.5.

All intersections in ‘make and grow’ areas should have a minimum kerb radius of 13.5 m with corner splays of 6 m, or subject to specific design.

Intersections in all other 50 km/h or lower speed environments shall have the lot corners splayed by a minimum of 4 m along both boundaries, although these may be dispensed with in low target operating speed situations provided that there is adequate provision for pedestrians and utility services. Corner boundary splays shall be subject to specific design in higher speed environments, to ensure safe visibility at intersections.

Reference can also be made to Austroads guides.

Intersections between connector/collector roads or intersections of connector/collector roads with arterials shall be a minimum distance of 150 m apart, centre line to centre line.

3.3.8 No-exit roads

‘No-exit’ roads should not be provided where through roads and connected networks can be designed. Where no-exit roads are provided, they should ensure connectivity for pedestrians and cyclists.

No-exit roads and lanes shall provide for road turning at the end of the road for an appropriate vehicle as described in *RTS 18: New Zealand on-road tracking curves for heavy vehicles*. An 8m rigid truck (10m radius) shall be catered for in any areas where rubbish collection will occur. The design of turning facilities for light vehicles shall be in accordance with AS 2890.5. See figure B5-1 and B5-2 for acceptable solutions.

An on-road turning area may provide for parking or landscaping in the centre of the turning area. The minimum kerb gradient around turning heads shall be 0.5%. Appropriate drainage shall be provided.

Areas required for turning shall be suitably marked to maintain access and prevent parking from blocking the turning area. Markings shall be in accordance with clause 3.3.12

3.3.9 Bus stops

Bus stops shall be provided for on connector/collector roads or arterials in accordance with the TA direction in consultation with the regional transport authority. Bus stops shall be designed in accordance with *Auckland Transport Code of Practice Chapter 20: Public Transport – Busses*, 2017, and the *QLDC Bus Stop Policy and Standards,* 2020.

3.3.10 Special road and footpath provisions near places of assembly

Designs for areas adjacent to places of public assembly including schools, hospitals, shopping areas, and public halls, shall incorporate special provisions such as extra parking spaces, stopping lay-bys, widened footpaths, bus and taxi stops, pedestrian crossings, loading zones, and any associated facilities to ensure the safety of concentrations of vehicles and pedestrians.

3.3.11 Footpaths, accessways, cycle paths, and berms

Pedestrians, cyclists, and berms shall be provided for in accordance with table 3.3. Dimensions, strength, durability, and finish shall be appropriate to their use and expected loadings. Paths shall be designed in accordance with Austroads guides and NZTA *Pedestrian planning and design guide.*

Where accessways separate from the roads are to be illuminated, they shall be to the standard of illumination recommended in AS/NZS 1158.3.1.

Footpaths shall be separated from the kerbline by a minimum of 0.9m berm except:

(a) At indented parking bays
(b) In Commercial Town Centres
(c) In steep terrain when approved by Council

3.3.11.1 Footpaths and accessways

Footpaths shall be provided in accordance with the NZTA "Pedestrian Planning and Design Guide", and to a minimum of 1.5m wide surfaced over their full width and timber edging, or an alternative approved material shall be installed for all footpaths. Footpaths that are grass bordered shall be curved at turns or splayed at 45º to prevent damage from grass maintenance. The crossfall should be no greater than 2%. Wider footpaths or areas of local widening will often be required by the TA where higher use or other needs dictate such widening.

Tactile pavers must be designed and installed in accordance with “RTS 14 - Guidelines for facilities for blind and vision impaired pedestrians”. A flat footpath is regarded as having a 1 in 12 slope or less. Refer to NZS 4121:2001, Design for Access and Mobility - Buildings and Associated Facilities and NZTA Pedestrian Planning and Design Guide.

All tactile pavers shall have AS/NZS 4586:2004 Class V slip resistance to be confirmed by suppliers. Tactile pavers shall be either Yellow UV Stabilised Thermoplastic Polyurethane Studs, 316 Marine Grade Stainless Steel Studs or Yellow ceramic tiles or tactile tiles as specified in Council's Approved Materials List. Where tactile tiles are used, an appropriate adhesive shall be used and agreed to by Council.

Pedestrian / cycle accessways should be provided between cul-de-scas, at no-exit roads or where necessary to improve connectivity. They shall be designed for user safety using crime prevention through environmental design (CPTED) principles and should:

(a) Be direct and no greater than two properties long;

(b) Have good sight lines for passive surveillance with fences a maximum height of 1.2 m for 10 m from the road frontage, or no fencing;

(c) Be sited to ensure high levels of community use;

(d) Be amenity landscaped without compromising safety;

(e) Have provision for the disposal of stormwater;

(f) Be provided with pedestrian level lighting; and

(g) Have a legal width not less than 5.5 m.

3.3.11.2 Cycle paths

Separated cycleways shall be provided where they form part of an identified cycling network or where good design requires separation from the carriageway. Useful guidance on cycleway design can be found in *Auckland Transport publication: Urban Street and Road Design Guide, 2019, Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling, 2017, and NZTA webpage: Cycling Network Guidance – planning and design.*

Stormwater disposal shall be provided to all off-road cycle paths.

Lighting on cycle paths is to be provided in accordance with QLDCs Southern Light: Part Two – Technical Specifications, or where Council considers appropriate.

3.3.11.3 Footpath and cycle path surfacing

All footpaths and cycle paths shall be surfaced with a permanent surfacing layer appropriate to the surrounding environment and level of use expected.

Acceptable surfacing for footpaths and cycle paths are:

(a) Concrete;

(b) Asphaltic concrete.

Other acceptable surfacing for footpaths are:

(c) Concrete pavers;

(d) Other pavers may be approved by a TA in areas of high aesthetic value;

(e) Chipseal (grade 6) may be approved by a TA in areas of very low pedestrian traffic;

(f) Metal surfaces may be appropriate in rural areas;

(g) Permeable or porous paving may be approved by a TA.

In all cases the surfacing shall be placed over compacted basecourse which in turn shall be placed over a firm subgrade with all organic soft material removed.

3.3.11.4 Berms

Grassed or planted berms between the road legal boundary and carriageway shall be provided in accordance with the landscape character intent for each street type within the development. For streets with high pedestrian activity, a full footpath (with no berms) may be more appropriate. Residential streets with a lower pedestrian activity may have a ribbon footpath (planted berms between footpath and carriageway, and between footpath and road boundary).

In all cases the combined berm and footpath width shall be as required by the TA to be adequate to enable landscaping and all current and expected services to be installed.

Where a berm crossfall greater than 1 in 12.5 is proposed, the designer shall produce a cross section along suitable individual property access locations to show that the sag or summit curves at crossings can be satisfactorily negotiated by a 90th percentile car.

Berms shall be of adequate width to:

(a) Achieve safe clearances between the carriageway edge and any obstacle;

(b) Allow running of utility services and placing of lighting poles within the berm unless approved otherwise by the utility provider or the TA;

(c) Provide adequate space between the road reserve boundary and the carriageway edge to enable residents to safely enter the road traffic;

(d) Allow room for efficient road edge and edge drain maintenance; and

(e) Allow adequate space for the effective operation and maintenance of any form of stormwater management device.

3.3.12 Traffic signs, marking, and road furniture

The design shall incorporate all required road marking, signs, and other facilities appropriate to the place and link context. Roads should be designed to minimise the need for traffic signs and marking.

Designs shall satisfy the Land Transport Rule: Traffic Control Devices, 2004 (TCD) and linked traffic sign specification, and the NZTA *Pedestrian planning and design guide.* All road markings and traffic signs shall comply with NZ MOTSAM and are to be approved by the TA. NZ MOTSAM and TCD take precedence over Austroads. However, when the above documents don't specify, Austroads should be used as a standard.

Any line marking required must receive two coats with the 2nd coat carried out within 24 hours of the first coat.

All fire hydrants shall be marked in accordance with NZS 4522:2010.

Road name signs shall comply with the TA's current road names standards and their mounting shall be provided by the developer to the TA's requirements. Placement of the road name signs shall be in accordance with TCD (2004), except for the sign positioning in Table 7.7 at T intersections of: (a) minor road with minor road, or (b) minor road with undivided major road shall have positions 1 and 2 switched.

Where mountable or nib kerbs are used adjacent to a grassed berm, 'no parking off a roadway' signage must be used. The use of the signage elsewhere will be approved by Council on a case-by-case basis.

Seats, signs, and other street furniture shall be designed and placed in accordance with the TA's requirements. Furniture used should unless expressly approved otherwise be compatible with a TA's existing street furniture.

Reflective raised pavement markers shall not be used to provide for road marking or to identify fire hydrants.

3.3.13 Trees and landscaping

See section 7 of this Code of Practice.

3.3.14 Road lighting

All road lighting shall be designed and installed in compliance with the recommendations of AS/NZS 1158, Austroads guides or guidelines adopted by the TA at that time.

All lighting should comply with QLDCs Southern Light Part One – A Lighting Strategy and Part Two – Technical Specifications.

And
All lighting assets including but not limited to columns, lamps and mountings shall be approved by Council's Strategy and Asset Planning Team

The electrical installation contractor shall carry out all testing and inspections in accordance with the Electricity Act 1992, the Electricity (Safety) Regulations 2010 and the Australian/New Zealand Wiring Rules (AS/NZS 3000).

3.3.15 Bridges and culverts

Bridges and culverts may require separate resource and building consents. All bridges and culverts shall be designed in accordance with the NZTA *Bridge manual.*

Particular features to be considered/covered include:

(d) Widths/lengths:
All bridges and culverts shall be designed with a width to accommodate movement lane, cycle, and pedestrian needs of the road (see table 3.3);

(e) Roadside barriers:
See 3.3.4;

(f) Batter slope protection:
All culverts shall have anti-scour structures to protect batter slopes, berms, and carriageways;

(g) Clearance over traffic lanes:
Where passing above traffic lanes, bridges shall have the full clearance of 5.2 m to provide clearance for over dimension vehicles able to operate without a permit;

(h) Foundations:
All bridges and culverts shall be founded to resist settlement or scour. Abutments shall be designed to ensure bank stability and provide erosion or scour protection as applicable;

(i) For waterway design see section 4.

3.3.16 Private ways, private roads, and other private accesses

Access to all lots, dwellings, or multi-unit developments shall be considered at the time of subdivision/development and should where possible be formed at that time.

Where access to the lot is to a garage or car deck to be constructed as part of the buildings this shall be noted on the design drawings. This is likely to have been considered as part of the resource consent process.

Accesses shall be designed and constructed to the following requirements or in accordance with the TA's specific requirements, unless alternative designs by the developer's professional advisor are approved by the TA.

3.3.16.1 Plan and gradient design

Table 3.3 should be used as a guide for the widths of elements required for accesses.

A maximum 3-point turning head in the common area shall be provided at the end of all accesses serving three or more rear lots or dwelling units. Circular, L, T, or Y shaped heads are acceptable. Suitable dimensions are shown in Appendix B Drawing B5-1 and Drawing B5-2.

For accesses serving fewer than three lots or dwelling units, turning heads in the common area are not required where it can be shown that adequate turning area is available within each lot or private area.

Centre line grades should:

(a) Not be steeper than 1 in 6 for any private way used for vehicle access

(b) In residential zones where a private way serves no more than 2 residential units the maximum gradient may be increased to 1 in 5 provided:

   i. The average gradient over the full length of the private way does not exceed 1 in 6; and

   ii. The maximum gradient is no more than 1 in 6 within 6m of the road boundary; and

   iii. The private way is sealed with non-slip surfacing.

(c) Not be less than 1 in 250.

> ***C3.3.16.1 (a) and (b)***
>
> *The TA may approve exceptions provided the design includes suitable vertical transitions and adequate safety at the point where the access meets the footpath or road.*

All accesses shall be shaped with either crown or crossfall of not less than 3%.

To allow vehicles to pass, accesses shall have widening to not less than 5.5 m over a 15 m length at not more than 50 m spacing. Rural accesses may have passing bays at up to 100 m distances where visibility is available from bay to bay.

3.3.16.2 Stormwater design

All shared urban accesses shall be surfaced and have their edges defined by a structural edge.

Rural accesses shall be formed with safe water tables/edge drains along but adequately clear of each side of the access.

Accesses sloping up from the road shall have a stormwater collection system at the road reserve boundary so as to avoid stormwater run-off and debris migration onto the public road. Stormwater shall discharge via an appropriately sized and designed stormwater system acceptable to the TA (see Drawing B5-9) for examples of typical sump to driveway or right of way). Rural side drains shall not discharge directly to the roadside drain. Where accesses pass over the side drain they shall be provided with a culvert of size appropriate for the design flow but not less than 300 mm diameter.

Accesses that slope down from the road shall be designed to ensure that road stormwater is not able to pass down the access. Side drainage in context with the area shall be provided to stop the concentration and discharge of stormwater and debris onto adjacent properties or any land which could be at risk of instability or erosion.

Where an overland flow path departs from the road reserve, accesses shall be designed to direct secondary flow away from building floors and to follow designed overland flow paths.

Commercial and industrial accesses shall drain from their sumps through a lead directly or through a stormwater treatment device to a public stormwater main.

3.3.16.3 Pavement design

Private pavements shall be designed as for public roads but no residential or rural pavement shall have a minimum formation thickness of less than 150 mm for flexible pavements or 100 mm for concrete pavements.

Commercial and industrial pavement shall be provided with adequate supporting design to ensure that it will have a life of 20 years.

Acceptable surfacing for accesses includes asphaltic concrete (30 mm minimum thickness), chipseals, in situ concrete or concrete pavers.

Acceptable asphalt concrete design should be in accordance with the NZTA Specification M/10 and all subsequently referenced NZTA specifications.

3.3.17 Crossings

3.3.17.1 Urban

Vehicle crossings shall be provided between the edge of the movement lane and the road boundary at the entrance to all private ways and lanes and to any lots, front or rear where access points are clearly identifiable at the subdivision or development stage.

Where access points are not clearly identifiable at the subdivision or development stage, crossings shall be constructed at the building consent stage.

Vehicle crossings shall be designed to enable the 99th percentile car to use them without grounding any part of the vehicle, and shall be designed in accordance with the NZTA *Pedestrian planning and design guide*. Structural design shall be adequate to carry the loads to be expected over its design life. All crossings shall be surfaced with asphalt or concrete or paving stone as approved by the TA.

Crossings shall be in accordance with diagrams contained in Appendix B.

Where stormwater drainage is provided by swale or open drain, crossings shall be provided as specified in 3.3.17.2.

Pram and wheelchair crossings shall be provided at all road intersections and pedestrian crossings. The crossings shall be sited to facilitate normal pedestrian movements in the road and where possible sumps shall be sited so as to reduce the flow of stormwater in the channel at the crossing entrance. Pram and wheelchair crossings shall satisfy the NZTA *Pedestrian planning and design guide.*

3.3.17.2 Rural

All shared crossings and anywhere the location is obvious at the design stage shall be installed at the development stage. Other crossings shall be provided at the building consent stage.

Crossings shall be provided between the surfaced road edge and the lot boundary at a defined and formed access point to every rural lot. The crossing shall be sealed to not less than the standard of the road surface and to the road boundary. If the access slopes up from the road the crossing shall be sealed to a minimum distance of 10 m from the edge of the carriageway.

The crossing shall not obstruct the side drain. Where the side drain is shallow and only carries small flows during rain, the crossing may pass through the side drain. Where the side drain is of an unsuitable shape or carries flows for significant parts of the year the side drain shall be piped under the crossing. Pipes and end treatments shall be sized appropriately for the catchment intercepted but shall be a minimum of 300 mm diameter.

Rural crossings shall be designed so that vertical curvature transitions are suitable for the passage of the 99th percentile car and control of stormwater and debris run-off.

3.3.18 Fencing

Fencing shall be provided along the road reserve boundaries of all rural subdivisions unless agreed otherwise by the TA. Standards and requirements shall be in accordance with the TA's fencing policy at the time. This shall also apply to fencing of pedestrian, cycle, and reserve accesses in rural areas.

3.3.19 Road run-off

3.3.19.1 Integration of road run-off with development stormwater system

Stormwater management for a subdivision needs to integrate the control of stormwater from the proposed roading network with the overall stormwater system for the land development phase and final subdivision layout. Such planning needs to integrate the control of stormwater peak flows and pollutant removal as set out in section 4 of this Code of Practice with the aim of minimising downstream negative effects and mitigating road instability and erosion problems. Some guidance on integrated catchment management is set out in NZTA Stormwater treatment standard for state highway infrastructure.

3.3.19.2 Design

For stormwater run-off design see section 4 of this Code of Practice.

3.3.19.3 Subsurface drains

Where considered necessary by the TA or the developer's professional advisor, piped subsurface drainage shall be provided to protect road formations from deterioration or loss of strength caused by a high water table and as part of swale stormwater systems. Design shall be in accordance with NZTA specification F/2.

Piped subsurface drains shall be provided on each side of all urban roads where the natural subsoils have inadequate permeability or unacceptably high water table to enable long term strength of the new pavement to be maintained. Piped subsurface drains shall be provided on the upslope side of all urban roads in hill areas and on the down side also where the down slope is in cut.

All piped subsurface drains shall discharge by gravity into a suitable component of the public stormwater system or approved discharge point.

For typical details of under-kerb drainage and subsoil drainage see Appendix B Drawing B5-4.

3.3.19.4 Side drains/water tables

Rural roads shall have normal camber (see table 3.3) to side drains/water tables formed on each side of the carriageway except where the road is on embankment above adjacent land without available formed drains. In such cases the road may be designed so as to provide for sheet run-off to the adjacent land surface provided natural pre-existing drainage patterns are not altered.

For all situations where side drains are required they shall be sized to suit the flows discharging to them. Side drains shall be intercepted at regular intervals and discharge via open drains or pipes to an appropriate discharge point. All discharge points shall have outlets protected from scour and shall be located to minimise the risk of slope instability.

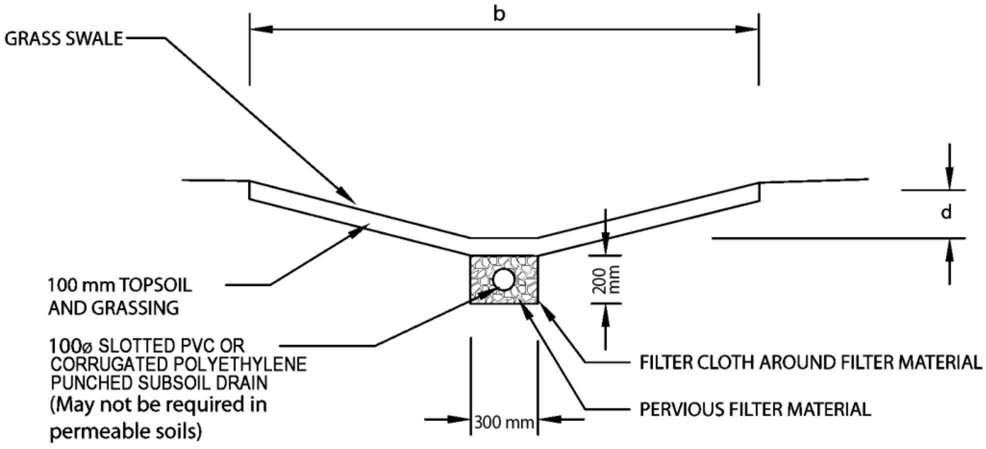
Such discharges shall be subject to the approval of affected property owners and be shown to be neither diverting catchments nor significantly changing peak flows or flow patterns.

3.3.19.5 Swales

Swales should be used wherever appropriate to allow for infiltration to reduce peak discharge flows and to provide stormwater treatment. They can be located either in the berm area or in the centre of the road, and must be of sufficient width to accommodate services (if needed), plant growth and maintenance (see 7.3.5).

Where swales are used they shall be designed by a suitably qualified person in accordance with TA requirements or one of the publications listed in Referenced Documents or Related Documents that cover swale design. Typical details that may be used in swale design are shown in figure 3.3.

See 4.3.7.6 for swale design and section 7 on landscaping design and practice.



SWALE CROSS SECTION

NOTE –

1. Effective catchment area drained = impervious area + 0.72 x pervious area.
2. Maximum swale slope up to 5%. Steeper swales require check dams (see figures 3.6(B) and 3.6(C)).
3. Dimensions 'b' and 'd' to be sized for conveyance of 10% AEP event.
4. Existing ground is regraded, compacted, topsoiled (100 mm depth), and grassed.
5. Side slopes no steeper than 1v:3h if planted (not mown).
6. Side slopes no steeper than 1v:5h if grassed (mown).

Figure 3.3 – Swale Cross Section

3.3.19.6 Kerbs and channels

Where kerbs and channels are to be provided on carriageways they should comply with Appendix B Drawing B5-8 Kerb and Dished Channels, or their slip-formed equivalent may be used subject to the approval of the TA. Pedestrian crossings (pram crossing) should be provided for disability access at regular intervals and at locations where pedestrians are reasonably expected to transition between footpaths and the street. Refer to NZS 4121:2001 for requirements.

3.3.19.7 Sumps

Sumps used in all public places shall comply with the TA's current standard details.

Stormwater sumps are classified as three types according to the design of their inlets:

(a) Grated only inlet sumps: Grated inlets are effective in intercepting gutter flows. They also provide access openings for maintenance. Grated inlets are prone to blockage and problems of increased pavement maintenance in the immediate vicinity of the inlet, therefore, their use in street gutters are discouraged. They are suitable for non-kerbed situations such as yards, end of ditches, open car parks, accessways, driveways, medians, and ponding areas. Appendix B Drawing B5-12 show details of common types of grated inlet;

(b) Back entry inlet sumps: Back entry inlets are less affected by blockage, and they are more effective in intercepting flows in sag areas;

(c) Combined grates and back entry inlet sumps: This system of combining a back entry with the traditional grated inlet significantly improves flow intake and is less prone to blockage from debris. This type of inlet should be used in all situations where possible. Appendix B Drawing B5-11 to B5-14 show typical examples of this type of inlet.

Appendix B Drawing B5-9 shows an acceptable detail for sumps in accessways, footpaths, and rights of way. A flat channel or yard sump and various styles of hillside sump are shown in Drawing B5-10 to Drawing B5-14.

A double back-entry sump for road low points is shown in Appendix B Drawing B5-14.

All grates shall be of a design that are cycle friendly. Grate slots shall not run parallel to the direction of carriageway travel.

And

The invert level of all sump chambers shall be greater than 450mm below the invert level of the outlet pipe.

All sumps shall incorporate a siphon or alternative solution acceptable to the Council

3.3.19.7.1 Sump location

Sumps shall be located:

(a) To ensure that the total system design flow enters the pipe system and that surface flows across intersections are minimised. In hill areas the total design flow shall include run-off from any upslope hillsides that are not specifically drained. In many cases this will mean the use of closely spaced or specially designed sumps to ensure that the flow to which the pipe system is designed can actually get into the system;

(b) At all points in a surface system where a change in gradient is liable to result in ponding due to change in flow velocities or on bends where there may be a tendency for water to leave the kerb and channel;

(c) Not further apart than 90 m along any surface system.

3.3.19.7.2 Sump design

Sumps should be designed to intercept and convey stormwater run-off flow from design storm of the AEP set out by the TA, or otherwise stated in section 4 of this Code of Practice, while allowing a reasonable frequency and degree of traffic interference. Depending on the road classification, as specified by the TAs, portions of the road may be inundated during major storm events. See 4.3.4.2 for allowable floodwater depths.

The following general guidelines should be used in the design of sumps:

(a) General safety requirements

   (i) Provide for the safety of the public from being swept into the stormwater system; the maximum allowable opening shall not exceed 100 mm in width

   (ii) Openings are sufficiently small to prevent entry of debris that would clog the stormwater system

(iii) Openings be sized and oriented to provide for safety of pedestrians and cyclists. Cycle-friendly sump grates shall be used where required by the TAs. These grates may be built either with bars transverse to the side channel direction or closely spaced bars in a wavy pattern in a longitudinal direction;

(b) Sump inlet capacities

Inlet capacities of any sump used should be determined using manufacturers' and suppliers' data which should be based on either rational analysis or first principle calculations, otherwise sump inlet capacities should be calculated using approved design methods where applicable. When no proper data is available, the capacity of the single 675 x 450 back entry sump with standard grating should be limited to 28 L/s. The calculated sump inlet capacities should be reduced to account for partial blockage of the inlet with debris as follows:

On-grade grated back entry sump	10% reduction
On-grade grated sump	50% reduction
On-sag grated sump	50% reduction
On-sag grated back entry	sumps include back entry capacity only

(c) The use of silt traps is encouraged in all sumps to provide partial treatment to stormwater at the source, but in all cases, trapped sumps should be used where discharge to a soakage device is permitted.

3.3.19.7.3 Sump gratings

Sump grating areas shall be sized generously to allow for partial blockage to ensure that side-channel water does not bypass sumps when velocities are high.

Cycle-friendly sump grates shall be used where cyclists can be expected or when required by the TA. These gratings may be built either with bars transverse to the side-channel direction or closely spaced bars in a wavy pattern in a longitudinal direction.

3.3.19.7.4 Sump leads

Sump leads should be designed to be of sufficient size to convey all the design capacity of the sump to the system. The minimum size of the lead for public sumps shall be 200 mm diameter, but 300 mm diameter is desirable to minimise inlet losses and blockage risk. For double sumps with a single outlet and other high capacity sumps, the minimum size of lead required is 300 mm diameter. For private sumps, the minimum diameter should be 150 mm.

3.3.19.7.5 Secondary flow provisions

At all points where sump blockage may occur, or where design capacity may be exceeded, which could lead to overflow into private property, the provision of designed secondary flow paths protected by public ownership or easement shall be made (see 4.3.4.2).

3.4 Construction

3.4.1 Introduction

These requirements apply to flexible pavements. For rigid pavements, such as concrete pavements refer to Austroads guides, and the Guide to residential streets and paths as listed in Referenced Documents.

Road construction shall be carried out to the alignments and standards detailed in the approved drawings and with the specified materials so as to provide the intended design life.

The road construction includes all associated construction required to complete adjacent footpaths, berms, and road reserve areas.

All construction methods and materials shall be suitable for the climatic conditions experienced in the Queenstown Lakes District. Basecourse preparation and subsequent road sealing shall not occur in the period between 15 May and 15 September each year. QLDC may agree to extensions if conditions and treatments allow.

3.4.2 Materials for flexible pavements

3.4.2.1 Transition layer

A transition layer may be required for traffic loading in excess of 1 x 10^5 ESA where the subgrade is soft, to prevent ingress of the soft soils into the pavement layers. The transition layer may be filter metal complying with appropriate NZTA specifications or an approved geotextile filter fabric. The transition layer shall be compatible with the grading of adjacent layers and be regarded as part of the total depth of the sub-base layer.

3.4.2.2 Sub-base

The subbase metal shall be AP 65 and shall meet the following requirements:

(b) Can be crushed or uncrushed
(c) At least 60% by mass shall pass the 37.5 mm standard sieve.
(d) At least 45% by mass shall pass the 19 mm standard sieve.
(e) Not more than 70% by mass shall pass the 9.5 mm standard sieve.
(f) Not more than 10% by mass shall pass the 0.300 mm standard sieve.
(g) Not more than 7% by mass shall pass the 0.075 mm standard sieve;
(h) Crushing resistance to be greater than 110 kN when tested in accordance with Test 3.10 of NZS 4407.
(i) The sand equivalent shall not be less than 40 when aggregate is tested according to NZS 4407, Test 3.6 Sand Equivalent Test. Where uncrushed AP65 is proposed, it is the contractor’s responsibility to ensure that it can achieve the requirements of NZTA B/2 Specification.

3.4.2.3 Basecourse

The thickness of the basecourse layer when used with other metal aggregate layers shall not be less than 100 mm.

Acceptable basecourse specifications are:

(a) NZTA M/4:2006
(b) Local basecourse acceptable to the TA
This may be used for local roads in live and play areas and footpaths, kerb crossings, and shared accessways.

Material sourced from the Shotover River shall not be used in basecourse layers.

3.4.3 Road surfacing

3.4.3.1 Acceptable surfacing materials

All movement lanes shall be provided with a permanent, hard wearing surfacing layer, which shall be either impermeable or formed over an impermeable base. The surfacing shall be capable of carrying all stresses expected during its lifetime.

Acceptable surfacing options may include:

(a) Hot laid asphaltic concrete of minimum compacted thickness 30 mm, laid over a waterproofing sealcoat;
(b) Other asphaltic concrete mixes such as friction course or macadam wearing mix laid over a waterproofing coat;
(c) Chip seals of various types, providing the equivalent of two bound chip coatings;
(d) Concrete block pavers; and
(e) Stone block surfacing where designed for aesthetic effects.
(f) Metalled surface at the sole discretion of TA.

Minimum surfacing standards shall be in accordance with NZTA M/10 Specification, except where given in table 3.4 to the named facilities to resist scuffing and local load effects.

Use of concrete or stone block paving in public traffic areas shall require the specific approval of the Council.

Table 3.4 – Recommended surfacing standards

Facility	**Minimum surfacing**
Residential turning zones (intersections, roundabouts, and turning heads)	Segmental concrete pavers, concrete, 30 mm asphaltic concrete
Public carparks (excl. parallel parks)	Segmental concrete pavers, concrete, 30 mm asphaltic concrete
Commercial and industrial turning zones (intersections, roundabouts, and turning heads)	Segmental concrete pavers, concrete, 50 mm asphaltic concrete
Traffic islands and bus stops	Segmental concrete pavers, concrete, 50 mm asphaltic concrete

3.4.3.2 Road surface tolerances and texture

The finished surface of new roads shall have a NAASRA roughness satisfying the TA's standards at the time of construction. No abrupt or abnormal deviations shall occur and no areas shall pond water. The surface shall be of uniform texture expected by best trade practice and satisfy density standards applicable to the surfacing being used.

Where hard surfacing is required for areas that are not movement lanes, alternative materials and porous pavements that achieve the durability, maintenance, and amenity requirements are acceptable with the approval of the TA.

Roughness readings are not required on lengths 150m or less e.g. cul-de-sacs, as the shape requirements as per NZTA/TNZ Specifications are expected to be sufficient to control isolated bumps over this short length. The average and maximum readings shall exclude values affected by intersecting streets, platforms and road humps.

A NAASRA roughness test is recommended to be undertaken prior to surfacing however it is the finished surface which must satisfy Council Standards. . For possible remedial purposes, it may be prudent to conduct this test at the pre-seal stage at the basecourse level. The Contractor shall supply to the Design Consultant and QLDC sufficient information to confirm all performance criteria have been achieved as part of the RAMM data required by QLDC.

Depending on the road environment, consideration will be taken into account for short, low speed urban roads. It is recognised that survey equipment has operational limits. These include a minimum speed below which the quality of the data collected is compromised. Therefore the Survey Contractor must advise the Client of the minimum speed and other conditions that adversely affect the data quality and advise how the data may be flagged when these situations are encountered. These limitations must be passed to Council along with the completed survey data.

Surface Ride for new, rehabilitated or reconstructed pavements

The new pavement must have an average dynamic roughness, when measured over a length of 100m, of less than 60 NAASRA counts/km for any three consecutive results and no individual value greater than 70 within the extent of the re-surfacing area unless it can be clearly attributable to a permanent feature such as a bridge joint.

Surface Ride for Resurfacing Sites

The pre-resurfacing site roughness measure must be obtained from RAMM database – high speed roughness count. Where these measures do not exist, testing must be performed. The average roughness count must be used to benchmark the resurfacing works, as described below.

The new surface when measured over a length of 100m must achieve an average NAASRA roughness less than the value calculated using the formula below. No two consecutive counts must exceed 70 and no individual count greater than 80 within the extent of the resurfacing are permitted unless this can be clearly attributable to a permanent feature such as a bridge joint.

NAASRA Count Criteria = 0.7D + 5 (D = average NAASRA roughness measure determined before the commencement of asphalt resurfacing.)

Where the roughness improvement criteria is not satisfied, remedial works must be undertaken to bring the roughness to the acceptable limit at no additional cost to the Council.

Surface Irregularities

The finished surface shall be 5mm above channel fenders or concrete kerbs and shall not hold water and there shall be no point where the general surface varies more than 5mm from a 3m straightedge laid longitudinally, with a cumulative total of all visible gaps of not more than 10mm, or more than 5mm from a 1m straight-edge laid transversely, including across service boxes and joints.

All service covers must be raised during new surfacing or resurfacing operations to be flush with the adjacent finished pavement surface level.

Density

The density requirements for the compacted mat are as defined in the NZTA M/10 specification or as stated in the specific contract requirements.

Flushing, Shoving, Segregation and other Defects

The asphalt surfacing must not exhibit any signs of flushing, shoving or segregation following completion of the works and at completion of the defect liability period. Water cutting is not an acceptable remedy for flushed surfaces.

> ***C3.4.3.2***
>
> *In the cases of narrow traffic islands and bus stops, where loading is concentrated, the use of stabilised base course is also desirable.*

3.4.4 Road surfacing materials

All materials used in road surfacing shall comply with the appropriate NZTA specifications.

The Contractor shall supply to the Design Consultant and QLDC details of aggregate grading, residual binder content, details of any polymers used and other relevant information for the material to be used seven days prior to the commencement of work. Once applied to the pre-seal surface, a stand down period of 48 hrs will be enforced. This is to allow time for the emulsion coat to harden and to allow a good adhesion of this coat to the pavement surface. An inspection by the QLDC Inspector will occur during this period to ensure that the entire surface has been covered and that no areas have been missed or damaged.

After any rain event the pavement should be allowed to dry out prior to the application of any membrane surface. This could be a 48 hour period in a big event.

A polymer modified seal should be designed to meet the district's challenging conditions (>2% shall be added where the site stress factor from table 6-2 of CSNZ is greater than 4 and/or where the site is in winter shade for greater than 4 hours daily.)

The following surfacing options will be acceptable for roads covered by the Code of Practice.

3.4.4.1 First and second coat chip seals

When chip seals are used, QLDC require a second coat seal to be undertaken the following season (either a single coat or two coat depending on the situation, single coats are generally not considered appropriate in our urban environment) as the first coat (even a two coat first coat) is not considered to be fully waterproof and therefore leaves the pavement susceptible to the freeze/thaw conditions in the district.

For single coat first coat seals the chip size shall generally be grade 3 on all roads. Alternatively a two coat first coat with grade 3/5 chip may be appropriate where higher stresses from traffic are expected. The binder application rate shall be designed to suit the conditions and chip size, refer to 'Chip sealing in New Zealand' https://www.nzta.govt.nz/resources/chipsealing-new-zealand-manual/chipsealing-in-new-zealand/

When there is a second coat required to be undertaken by the developer, the defects liability period for the second coat will be extended to 12 months beyond the second coat seal date. For second coat seals the chip size shall generally be grade 4 or 5. Two coat second coat seals may also be appropriate with grade 4/6 acceptable for local roads and grade 3/5 for other roads. The second coat seal is the responsibility of the developer and must be applied in the season following the first coat. Refer to Chapter 6 for appropriate treatment selection and Chapter 9 for design of 'Chip sealing in New Zealand' at https://www.nzta.govt.nz/resources/chipsealing-new-zealand-manual/chipsealing-in-new-zealand/

There are 2 options available for completion of the second coat seal, depending on the ownership of the road:

1) Independently by the developer, this includes private roads and right of ways. A bond will be required if this work will occur post-224c certification to ensure it is completed within the next available sealing season following the first coat application. Details of the second coat seal shall be provided to Council on completion via the Roading Asset data provision/RAMM update sheet process. Council will retain 5% of the bond for 12 months following completion of the second coat to cover any defects occurring within that period.

2) For Council-vested roads, the work may be completed as part of the Council's annual sealing programme and the developer covers costs paid to the council for undertaking this work. The developer shall provide payment to Council to cover the cost of this work prior to 224c certification for subdivision.

For either option, the developer is responsible for undertaking the second coat pre-reseal repairs as per 3.4.10. These should be identified and rectified within the defect liability period.

Basis of calculating the estimated costs for a second coat will be based on the average cost of current QLDC reseal rate including a minimum 8% contingency for contract Preliminary and General and design costs.

3.4.4.2 Hot laid asphaltic concrete surfacing

Hot laid asphaltic concrete surfacing shall comply with NZTA specification M/10 or equivalent approved by the TA. The mix used shall be appropriate to the end use and thickness being placed.

A waterproofing seal coat, using asphaltic binder or emulsion, and grade 5 chip, with the requirement that the seal coat comprises a minimum of 1.0 L/m^2 of residual penetration grade bitumen, shall be laid prior to surfacing with asphaltic concrete of 50 mm or lesser thickness. No cut back shall be used in such coats as it can cause flushing of the asphalt overlay.

When using NZTA specification M/10 compliant mixes on roads of connector/collector class, NZTA guidelines on skid resistance and surface texture shall be incorporated in the mix design.

3.4.4.3 Other asphaltic mixes

For special uses other asphalt-based hot mixes may be used such as open grade porous asphalt or macadam wearing mix. When used they shall be placed over a waterproof under layer and shall be designed according to current specifications and guides. In no case shall the laid thickness be less than 30 mm.

3.4.4.4 Concrete

All concrete for roads shall come from a special grade plant as defined in NZS 3109. Concrete of not less than 30 MPa 28-day strength shall be used for any road or crossing slabs.

Concrete for kerbs and channel shall be of not less than 20 MPa, 28-day strength.

3.4.4.5 Concrete pavers

Design and material standards shall comply with NZS 3116. Paver thickness shall be as defined in NZS 3116 for the appropriate traffic loading classification.

When used in roads the basecourse underlayer shall be given a waterproofing seal coat before the sand and pavers are laid, except where part of a porous pavement is approved by the TA.

When used for bus stops or at raised crossings the basecourse shall be cement stabilised under the raised zone and for at least 3 m on either side of the raised zone.

Pavers shall be laid to 5 mm above the lips of channels and other draining features.

3.4.5 Subgrade testing

Testing of the subgrade is required on all roads classified as a Primary Collector or above (ONRC Categories) or at the discretion of the designer for lower road classifications.

The tests required below are mandatory on all roads:

(a) Site specific scalas (see section 3.3.3.2)
(b) Soaked CBR results (see section 3.3.3.2)
(c) Proof Rolling (documented)

The tests required below are optional on roads below Primary Collector classification or at the discretion of the designer (it is the designer’s responsibility to provide target deflections) as follows or mandatory for classifications above Primary Collector:

(d) Benkelman Beam testing or Falling Weight Deflectometer

Where the extent of cut or fill for the project is too great to make subgrade CBR testing feasible at the design stage, it should be done on completion of earthworks when subgrade levels have been exposed. Even in cases where the subgrade has been tested as part of the design its condition shall be reviewed on exposure during construction and pavement thicknesses adjusted accordingly.

The results of such testing or review along with any consequent adjustments to pavement layer thicknesses shall be advised to the TA before placing of pavement layers commences.

Any identified wet spots in the subgrade shall be drained to the under-channel drainage system. Where the wet area is below the level of the under-channel drain, it shall be drained using approved filter drainpipes connected to the nearest stormwater system.

Between the date the subgrade is completed and the application of the first metal-course aggregate, the subgrade shall be maintained true to grade and cross section. Should potholes, soft spots or ravelling develop in the subgrade, the area so affected shall be scarified and clean material added and recompacted.

No tolerance on the subgrade level that reduces the depth of construction will be allowed. Unsuitable foundation soils shall be removed to meet design requirements.

Ordinary traffic shall not be permitted to traverse the excavated subgrade surface. The Contractor's operations shall not cause pugging or sponging of the subgrade, both of which will affect the way the subgrade reacts to water, which in turn will affect the bearing capabilities of the subgrade material. Nor shall the construction traffic be allowed to disturb the subgrade surface, creating undulations in the surface which may disturb any of the allowable tolerances in the Sub-base material thickness above. These layer thickness tolerances ware discussed in section 3.4.7. Contractors shall match site conditions with their plant selection and construction techniques e.g. layer depth, to ensure this does not occur.

The finished subgrade shall be trimmed, rolled and finished in accordance with the requirements of clause 11 of NZTA F/1: 1997.

Where the Design Consultant considers that oversize materials compromise the ability to achieve the specified compaction or the finishing requirements of NZTA F/1, Section 10 and 11, then the requirements of Table 2 of the NZTA F/1 shall apply.

3.4.6 Spreading and compaction of metal course aggregates

The metal course aggregates shall be placed on the prepared subgrade in layers. The aggregate layers shall be of adequate thickness and stiffness to ensure that with adequate compaction the minimum required deflections are achieved.

3.4.7 Sub-base

Sub-base material shall be placed in layers thin enough to ensure requisite compaction and compaction standards are achieved. Sub-base shall be compacted in accordance with NZTA B/2 specification to achieve a mean of 95% of maximum dry density (MDD) and a minimum of 92% of MDD.

The layers shall be so placed that when compacted they will be true to the grades and levels required and in such a condition that there is adequate drainage at all times. The laying procedure shall be arranged to minimise segregation. Grader use shall be restricted to essential shaping and final trimming, with minimum working of the final surface.

The finished compacted surface shall nowhere have depressions that hold water and there shall be no point on the surface that will vary more than 30mm either from a 3m straight-edge laid parallel to the centre of the road, or from a camber board placed at right angles to the centreline.

The sub-base layer may be used by construction traffic, but such traffic shall be managed to ensure no detrimental effects to the final road construction.

3.4.7.1 Sub-base testing

Mandatory sub-base testing requirements:

(a) Nuclear Densometer (NDM)
(b) Stringline or Total Station Grid
(c) Materials Properties
The Contractor shall provide QLDC in total a minimum of two conforming sets of acceptance test results for the subbase from each aggregate source at the start of the project. One additional set for each 1,000m3 required over 2,000m3 for subbase.

   i. Spreader test/ Mat Test in accordance with NZS 4407:2015, Test 2.4.6 (Stockpile Sampling) and/or NZS 4407:2015, Test 2.4.7 (freshly spread layers)
   ii. If stockpiled on site, in accordance with NZS 4407:2015, Test 2.4.6.3.2 (Machine stockpile)

The design consultant shall investigate any tests that fail, including retesting if required. The QLDC inspector shall be notified of the outcome of the investigation for acceptance.

All of the test results and stringline profiles are to be provided to the QLDC inspector at the time of the AP65 inspection.

3.4.8 Basecourse

Basecourse shall be placed in layers not exceeding 150 mm. It shall be placed and compacted to

NZTA B/2 specification density requirements to achieve a mean of 98% MDD and a minimum of 95% MDD.

Where approved by the TA, cement stabilised basecourses should be placed and compacted in accordance with the NZTA B/5 specification.

To assist compaction, water may be added as a fine mist spray to achieve optimum moisture content. Particular care shall be taken to avoid excess water reaching the formation or sub-base course.

Fine aggregate may be hand spread in a comparatively dry state over any open textured portion of the final compacted aggregate surface. The fine aggregate shall be vibrated or rolled into the interstices of the basecourse. The use of such surface choking material shall be kept to a minimum. Special attention shall be paid to the consolidation of the edges of the basecourse.

The finished surface just prior to sealing or surfacing shall be uniform in texture, have no segregated areas, excess dust, or excess moisture. It shall be tightly compacted and present a clean stone mosaic that remains bound when swept. The finished surface shall have no depressions that hold water.

3.4.8.1 Basecourse testing

Mandatory Basecourse testing requirements:

(a) Nuclear Densometer
(b) Benkelman Beam
(c) NAASRA (only mandatory on roads over 150m in length)
(d) Materials Properties
The Contractor shall provide QLDC in total a minimum of two conforming sets of acceptance test results for the subbase from each aggregate source at the start of the project. One additional set for each 1,000m3 required over 2,000m3 for subbase.

    i. Spreader test (pavement additives) / Mat Test (granular layers) in accordance with NZS 4407:2015, Test 2.4.6 (Stockpile Sampling) and/or NZS 4407:2015, Test 2.4.7 (freshly spread layers)
    ii. If stockpiled on site, in accordance with NZS 4407:2015, Test 2.4.6.3.2 (Machine stockpile)

3.4.9 Maintenance of basecourse

The finished aggregate surface shall be maintained at all times true to grade and cross section by placement of a ‘running course’, watering as required, trimming, planning, rolling, and taking appropriate measures to ensure the even distribution of traffic.

Every precaution shall be taken to ensure that the surface of the basecourse does not pothole, ravel, rut or become uneven, but should any of these conditions become apparent, the surface shall be patched with suitable aggregate and completely scarified and recompacted. The basecourse shall be maintained to the specified standards until covered with an impermeable surfacing layer.

3.4.10 Basecourse preparation for surfacing

Any loose or caked material shall be removed from the surface without disturbing the compacted base, and the material so removed shall be disposed of. The surface shall then be swept clean of any dust, dirt, animal deposits, or other deleterious matter. The surface of the road at the time of surfacing shall be clean, dry and uniform, tightly compacted, and shall present a stone mosaic appearance. Immediately prior to any form of surfacing a strip 600 mm wide contiguous to each channel or seal edge shall be sprayed with an approved ground sterilising weed killer at the manufacturer's recommended rate of application.

For second coat sealing, repairs shall be carried out prior to sealing. Areas to be patched shall be cleaned and loose material removed before application of an emulsion tack coat and asphaltic patching material. The repairs shall provide a finished surface flush with the levels and grades of the surrounding pavement and shall not hold water.

Where repairs are required to the carriageway and dense graded hot mix asphalt is used, a texturing coat maybe required. Where it is required, a minimum stand down period of 6 months should be undertaken to limit the potential for flushing of the texturing coat.

Prior to commencement of sealing, the surface preparation shall be inspected by the TA. The road is to be swept at time of inspection; however, this may not be for a period of longer than 24 hours prior to seal.

3.4.11 Deflection testing prior to surfacing

Prior to placing the surfacing layer (except for cast in situ concrete roads) deflections shall be tested by the Benkelman Beam Method or Falling Weight Deflectometer.

Table 3.5 provides deflection requirements for flexible pavements with flexible surfacing. At least 95% of all tests shall comply with the standards appropriate to the road type. Table 3.5 below shall be considered as a minimum standard for deflections. In addition, no test shall give deflections greater than 25% above the specified maximum.

Where an asphaltic surfacing is proposed, it is the designer's responsibility to ensure that the pavement deflections are appropriate to support the surfacing.

The *New Zealand guide to pavement evaluation and treatment design*, table 13, provides guidance on curvature and deflection constraints for thin asphalt overlays based on fatigue behaviour. Designers may find this information helpful.

Table 3.5 – Benkelman beam standards

Live and play	**Deflections**		**Shop and trade Work and learn Make and move**	**Deflections**	
	Average	**Maximum**		**Average**	**Maximum**
Lane	1.50 mm	1.80 mm	Lane	1.00 mm	1.20 mm
Local road	1.50 mm	1.80 mm	Local road	1.00 mm	1.20 mm
Connector/ collector	1.25 mm	1.50 mm	Connector/collec tor	1.00 mm	1.20 mm

Readings shall be taken in the wheel path in both lanes and at a maximum interval of 10 m.

3.4.12 Surfacing specification

Chipsealing construction standards shall comply with NZTA specifications P/3 for first coat seals and P/4 for resealing.

Asphaltic concrete construction standards shall comply with NZTA specification M/10. This code defines the tolerances for all of the components which comprise the asphalt layer. This includes the aggregates used, mineral fillers and binders which all affect the viscosity of the surfacing layer being applied.

The mix designations, namely AC10, AC14, AC20 and AC28 which are used for medium to heavy traffic loads and DG7, DG10, DG14 and DG20 which are for light to medium traffic loads, are all clearly defined

3.4.13 Bitumen application rate

Bitumen application rate for chipseals and tack coats shall be assessed based on current NZTA design methods and ambient weather conditions at the time of construction.

The base and edges of all areas to be covered by the asphaltic concrete, except prime coats, but including membranes shall be tack coated with a bitumen emulsion complying with NZTA M/10 and uniformly applied at a residual application rate of 0.15 l/m 2. The surface prior to tack coating shall be clean and free of surface water, dust, sand, grit or any other material that could impair the adhesion of the tack coat. The application of the tack coat shall consider truck access to the paver and possible tracking by truck wheels which could damage the tack coat surface finish.

Note, all carriageway areas that include asphalt must have a membrane seal. The only areas which do not require a membrane seal are footpaths.

3.4.14 Footpaths and cycle paths

3.4.14.1 Concrete

Concrete footpaths and cycle paths shall be formed over not less than 100 mm of compacted metal. The formation is to be thoroughly compacted by rolling before any concrete is placed. Porous areas shall be blinded with sand prior to placing concrete.

The foundation shall be evenly trimmed to a crossfall of 1 in 50. If the foundation is dry, it shall be moistened in advance of placing concrete.

The concrete paths shall be laid with construction joints at intervals of not greater than 3 m. If paths are constructed by continuous pour techniques, clean, true, well-oiled 5 mm thick steel strips at least 40 mm deep shall be inserted at 3 m intervals to facilitate controlled cracking. These strips shall be carefully removed after the concrete has set. Alternatively, the joints may be cut by means of a concrete-cutting saw. In this case the cutting shall be carried out not more than 48 hours after pouring and shall be to a depth of 40 mm. These joints may also be typically tooled into the concrete when the concrete is still plastic.

Minimum concrete thickness for paths is 100 mm. Concrete in both footpaths and kerb and channel shall be cured for at least 7 days during dry weather.

Concrete used in footpaths shall be of at least 20 MPa, 28-day strength. Concrete for crossings shall be 30 MPa, 28-day strength as detailed in 3.4.4.5.

Where required, vehicle and pedestrian crossings shall be constructed in accordance with the TA standard details (refer to Drawing B5-18, B5-19. And B5-24 and 3.3.11.1 - Tactile pavers shall be required at pedestrian kerb crossings in accordance with *RTS 14 - Guidelines for facilities* for blind and vision impaired pedestrians. A flat footpath is regarded as having a 1 in 12 slope or less).

All tactile pavers shall have AS/NZS 4586:2004 Class V slip resistance. Tactile pavers shall be either Yellow UV Stabilised Thermoplastic Polyurethane Studs, 316 Marine Grade Stainless Steel Studs or Yellow ceramic tiles or tactile tiles as specified in Council's Approved Materials List. Where tactile tiles are used, an appropriate adhesive shall be used and agreed to by Council.

3.4.14.2 Asphaltic concrete

Asphaltic concrete footpaths and cycle paths shall be placed over not less than 100 mm of compacted basecourse after removal of all organic and soft subgrade. Asphaltic concrete shall be laid in a minimum layer thickness of 30 mm of mix M/10 material. Asphalt concrete paths shall not puddle water and shall be edged with either concrete or ground treated timber where abutting berms or other grassed areas.

3.4.14.3 Concrete pavers

Concrete pavers for footpaths shall be placed over not less than 100 mm of compacted basecourse after removal of all organic and soft subgrade. Laying shall be in accordance with NZS 3116. Pavers shall be laid to 5 mm above tops of channels and other drainage features.

3.4.14.4 Surface finish, tolerances

The surface finish should be determined in relation to the anticipated service conditions in accordance with NZS 3114. Reference to the type and frequency of loading, impact, abrasion, chemical resistance, and other factors such as hygiene, dust prevention, skid resistance and aesthetics where applicable shall be provided in the design.

3.4.15 Kerb and channel

Kerb and channel may be either cast in situ or extruded.

For cast in situ kerb and channel, formwork shall be clean dressed timber or steel sections adequately oiled or otherwise treated to allow ease of striking without staining or damaging of the stripped concrete surface.

No formwork shall be stripped until at least 2 days have elapsed from time of pouring concrete.

For extruded kerb and channel, concrete used shall be of such consistency that after extrusion it will maintain the kerb shape without support. The extrusion machine shall be operated to produce a well compacted mass of concrete free from surface pitting.

Concrete used in kerbs and channels shall be of at least 20 MPa, 28-day strength. Finished tolerances and standards shall satisfy the design standards.

3.4.16 Berms and landscaping

Berms shall be formed after all other construction has been completed. Grassed and planted areas shall have a 100 mm thick layer of topsoil free of weeds, stones, and other foreign matter and shall finish 15 mm above adjacent footpath level to allow for settlement.

After topsoiling, the berm shall be either sown or planted, or both, and maintained free of weeds for the contract maintenance period. The seed mix shall be approved by the TA.

When sown, rather than planted, grass coverage of not less than 90% shall be achieved within 1 month of sowing and before completion documentation will be accepted for processing by the TA.

For additional requirements for swales see 3.3.19.5.

Any landscaping in the road reserve shall be in accordance with section 7 of this Code of Practice.

3.4.17 Surface finish and tolerances on kerbs, paths, and accessways

3.4.17.1 Kerbs and channel

All curves both horizontal and vertical shall be tangential to straights and the lines and levels of kerbs shall be such as to give the finished kerbs smooth lines free of kinks and angles. Construction joints shall be placed in all unreinforced kerb and channel at 10 m centres.

Workmanship standards shall be such that, on straights, kerbing shall not deviate from a straight line by more than 6 mm in any length of 3 m. Similar standards shall apply to the gradient line. No visible ponding in new channels shall occur.

The exposed faces of the kerb and channel shall present smooth, uniform appearance free from honey-combing or other blemishes to at least U3 standard in NZS 3114.

3.4.17.2 Paths and accessways

Concrete paths and accessways shall be finished with a crossfall to shed water and an even non-skid brush surface to finish U5 in NZS 3114.

The surface of other paths/accessways shall be of uniform texture as would be expected from best trade standards for the surfacing used. Crossfalls of 2% shall be provided.

The surface of all paths/accessways shall not deviate by more than 6 mm from a 3 m straight edge at any point and no abrupt changes in line or level shall occur. No path/accessway shall pond water.

3.4.18 Progress inspections

The contractor shall give notice to the TA as appropriate to allow the conduct of all inspections required to facilitate eventual acceptance of the project by the TA.

3.4.19 Installation of traffic services, road furniture, benchmarks

Traffic lines and utility services shall be painted and marked after initial surfacing and sweeping has been completed. Road furniture and survey reference marks shall be installed, prior to final inspections being made by the TA.

3.4.20 As-built and completion documentation

On completion of construction, information and documents as required by the TA shall be provided by the developer’s professional advisor. (See Schedule 1D for further information.) The information provided shall provide sufficient detail to enable the TAs to complete the road assessment and maintenance management database input.

4 STORMWATER

4.1 Scope

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development. Where community specific considerations cannot be met, written acceptance of an alternative method shall be obtained from the Council.

This section sets out requirements for the design and construction of stormwater systems for land development and subdivision. The significant issues for stormwater management are the protection of people, property, infrastructure, and the receiving environment. Stormwater management requires the integration of land use, roading, and ecological factors. A catchment-based approach is required with consideration of changes in catchment hydrology and rainfall patterns from climate change effects.

Opportunities exist with stormwater design to use or replicate the natural drainage system. Grassed swales, natural or artificial waterways, ponds and wetlands, for example, may in certain circumstances be not only part of the stormwater system, but also a preferred solution especially if low impact on receiving waters downstream is critical. Low impact design is the preferred approach, particularly where there is a requirement to replicate the pre-development hydrological regime. Nevertheless, piped stormwater systems will often be required either in support of low impact systems or as the primary system.

Stormwater systems serve a number of purposes including the management of storm surface water run-off, treatment of such run-off, and groundwater control. All aspects need to be considered in design and achieved with minimal adverse effects on the environment.

4.2 General

4.2.1 Objectives

The designer shall agree the approach to be taken for stormwater with the Property and Infrastructure Team of Council prior to commencing any work and may agree the approach prior to or when applying for resource consent.

The primary objective of a stormwater system is to manage storm surface water run-off to minimise flood damage and adverse effects on the environment.

The stormwater system shall include provision for:

(a) A level of service to the TA's customers in accordance with the authority's policies;

(b) Minimised adverse environmental and community impact;

(c) Protection from potential adverse effects to aquatic ecosystems;

(d) Compliance with environmental requirements;

(e) Adequate system capacity to service the fully developed catchment;

(f) Long service life with consideration of maintenance and life-cycle cost;

(g) Application of low impact design solutions;

(h) Climate change.

4.2.2 Legislation and guidance manuals

Referenced legislation is listed in the Referenced Documents section of this Code of Practice.

A selection of guidance manuals which may provide a useful resource or basis for stormwater design and management is set out in Referenced Documents and Related Documents. They are non-statutory in themselves but may be required to be complied with under regional or district plan rules.

4.2.3 Local authorities' requirements

The requirements of relevant regional and district plans on stormwater shall be met. Regional plan requirements will generally be limited to effects of stormwater on the natural environment. The TA exercises control over infrastructure associated with land development and subdivision.

Authorisation will be required from the regional council for the discharge of stormwater unless the discharge is to an existing and consented stormwater system and meets any conditions which apply to the existing system. Other activities often associated with stormwater infrastructure which need to be authorised by the regional council include: the diversion of natural water during construction, the permanent diversion of natural water as a consequence of the development, activities in the bed or on the banks of a natural waterway, and damming waterways.

The discharge of clean stormwater and other activities where effects are considered minor may be authorised as a permitted activity subject to certain conditions in the regional plan. Authorisation may also be by way of a comprehensive consent held by the TA for a large area or entire catchment.

In other circumstances site specific discharge permits and water permits shall be obtained. Advice should be sought from the LAs at the earliest stage of planning for stormwater infrastructure and receiving waters.

Discharge and temporary water permits required during construction shall be applied for by the developer and exercised in the name of the developer.

C4.2.3

The division of responsibilities between TAs and regional councils is set out in the Resource Management Act.

4.2.4 Catchment management planning

Stormwater management planning should be carried out on a subcatchment or catchment-wide basis. Where the proposed development is in an area covered by a local authority comprehensive catchment management plan, designers will be required to comply with the design philosophy in the plan.

If there is no catchment management plan for the area of the proposed development, the stormwater planning requirements should be discussed with the LAs at an early stage.

The implications of future development on adjoining land should be on the basis of replicating the pre-development hydrological regime whereby the maximum rate of discharge and peak flood levels post-construction are no greater than pre-development.

Any catchment management planning issues should be discussed with LAs at an early stage.

The designer shall be responsible for checking that the capacity of the downstream network is adequate for any proposed increase in discharge with the Council.

4.2.5 Effects of land use on receiving waters

Impervious surfaces and piped stormwater systems associated with development have an effect on catchment hydrology. Faster run-off of storm flows, reduction in base flows, and accelerated channel erosion and depositions alter the hydrology and adversely affect the quality of receiving waters. Development should aim to minimise the increase in the frequency at which pre-development discharges are exceeded across a range of design rainfall events as this has implications for the biodiversity of the aquatic biological community.

The effects of rural development on receiving waters are generally less significant. The modification to stream hydrology is generally minor. However, any reduction in riparian vegetation increases sediment loads and nutrient concentrations are likely to reduce aquatic biodiversity.

4.2.6 System components

The stormwater system conveys storm surface run-off and shallow groundwater from the point of interception to soakage areas, attenuation areas, or the point of discharge to receiving waters. Components of the primary system may include roadside channels, swales and sumps, stormwater pipelines, subsoil drains, outlet structures, soakage areas, wetlands, ponds, and water quantity and quality control structures. Secondary surface flow paths to convey primary system overflows will also be required.

These different system components are set out on standard construction drawings contained in Appendix B. The drawings are copyright waived and may be adapted by subdivision developers for incorporation into specific designs.

4.2.7 Catchments and off-site effects

All stormwater systems shall provide for the management of stormwater run-off from within the land being developed together with any run-off from upstream catchments. In designing downstream facilities, the upstream catchment shall be considered to be fully developed to the extent defined in the operative district plan or structure plan unless the TA advises that the upstream catchment will be required to be controlled for off-site effects at the time of its development.

For all land development infrastructure (including projects involving changes in land use or coverage) the design of the stormwater system shall include the evaluation of stormwater run-off changes on upstream and downstream properties. This evaluation will be required at the resource consent stage and may be linked to a requirement to replicate the pre-development hydrological regime.

Upstream flood levels shall not be increased by any downstream development unless any increase can be shown to have not more than a minor impact on the upstream properties.

Downstream impacts could include (but are not limited to) changes in flow peaks and patterns, flood water levels, contamination levels and erosion or silting effects, and effects on the existing stormwater system. Where such impacts are more than minor, mitigation measures such as peak flow attenuation, velocity control, and treatment devices will be required.

Fish passage shall be maintained. This is likely to be a requirement of any authorisation from the regional council.

4.2.8 Water quality

Stormwater treatment devices may be required to avoid adverse water quality effects on receiving waters. The type of potential contaminants should be identified and then treatment devices designed to address the particular issues. The need for treatment devices should be considered for every discharge even when it is not a direct discharge to a receiving water, for instance where the discharge is to an existing network. In this instance specific approval from the TA will be required.

Stormwater treatment is to be included in stormwater systems that service off-road carparks that have 10 or more parking spaces. Justification for the stormwater treatment systems for the level of treatment should be provided to QLDC for approval.

4.2.9 Climate change

Climate change is expected to increase the intensity and frequency of heavy rainfall events, even in areas where mean annual rainfall is predicted to decrease.

Rainfall design charts shall be adjusted to take into account the predicted increase in rainfall intensities from the effects of climate change.

> ***C4.2.9***
>
> *Refer to the following Ministry for the Environment publications for guidance on climate change:*
>
> *'Preparing for climate change – A guide for local government in New Zealand' for guidance on adjusting rainfall design charts at selected locations within each regional council area.*
>
> *'Tools for estimating the effects of climate change on flood flow – A guidance manual for local government in New Zealand' for incorporating climate change in flood flow estimation.*
>
> *'Preparing for future flooding – A guide for local government in New Zealand' provides an overview of the expected impacts of climate change on flooding.*

4.3 Design

4.3.1 Design life

All stormwater systems shall be designed and constructed for an asset life of at least 100 years. Some low impact design devices such as rain gardens and other soakage systems may require earlier renovation or replacement.

4.3.2 Structure plan

The TA may provide a structure plan setting out certain information to be used in design, such as flows, sizing, upstream controls, pipe layout, treatment, or mitigation requirements. Catchment management plans should detail the appropriate stormwater management options for the given structure plan area. Where a structure plan is not provided, the designer shall determine the information by investigation using any catchment management plan for the area, this Code of Practice, and any requirements of the TA, as appropriate.

4.3.3 Future development

Unless agreed in writing by the Council where further subdivision or development is allowed for within the current district plan upstream of the one under consideration the council shall require infrastructure to be constructed to the upper limits of the subdivision/development to allow for future connections.

The assessment of required capacity shall be on the basis of full development to the extent defined in the current district plan. Where infrastructure may service adjacent land then the full development to the extent defined in the current district plan of all the land that may be serviced by the infrastructure shall be included in the capacity calculations.

Where the new infrastructure being installed is required by Council to service future development then that infrastructure will be designed and constructed on the basis of full development to the extent defined in the current district plan.

The cost of increased infrastructure to service adjacent future development shall be agreed in writing with the Council's Strategy and Asset Planning Team prior to commencing work.

4.3.4 System design

4.3.4.1 Primary and secondary systems

Stormwater systems shall be considered as the total system protecting people, land, infrastructure, and the receiving environment.

A stormwater system consists of:

(a) A primary system designed to accommodate a specified design rainfall event; and

(b) A secondary system to ensure that the effects of stormwater run-off from events that exceed the capacity of the primary system are managed, including occasions when there are complete blockages of critical culverts and other critical structures in the primary system. Critical structures are determined by Council.

4.3.4.2 Secondary systems

Secondary systems shall consist of ponding areas and overland flow paths to manage excess run-off. Where possible, secondary systems shall be located on land that is, or is proposed to become public land. If located on private land, the secondary system shall be protected by legal easements in favour of the TA or by other encumbrances prohibiting earthworks, fences, or other structures, as appropriate.

Secondary systems shall be designed so that erosion or land instability will not occur. Where necessary the design shall incorporate special measures to protect the land against such events.

Ponding or secondary flow in all events up to 1% AEP design storm event shall be limited to a 100 mm maximum height at the centre line, and roads shall be passable by pedestrians as defined by the flow depth x average velocity ($d_g V_{ave}$) specified below:

Lower likelihood	$d_g V_{ave}$ <0.6 m2/s
Higher likelihood	$d_g V_{ave}$ <0.4 m2/s

NOTE - A higher likelihood of pedestrians crossing the overland flowpath is provided where pedestrians are directed to, or most likely to cross water paths (such as marked crossings and corners of intersections).

d_g = flow depth in the channel adjacent to the kerb i.e. at the invert (m)

V_{ave} = average velocity of the flow (m/s)

The TA should be consulted to confirm design requirements.

> ***C4.3.4.2***
>
> *The Austroads 'Guide to road design – Part 5: Drainage design' provides more information on major and minor stormwater design and acceptable volume and velocity for surface flow.*

4.3.5 Design criteria

When the design process includes the use of a hydrological or hydraulic model, all underlying assumptions (such as run-off coefficients, time of concentration, and catchment areas) shall be clearly stated so that a manual check of calculations is possible. A copy of the model may be required by the TA for either review or records or both.

The design shall accommodate all upstream catchments. (The catchment area shall be based on geographical and topographical boundaries and not development boundaries).

Discharge to an existing reticulated network, or other Council owned stormwater network, shall require consent/permission from the Council.

Discharge to be at a rate no greater than would have occurred for the pre-developed catchment during a 60-minute, 20% AEP rainfall event with no initial infiltration unless greater capacity in the downstream stormwater network can be proven through modelling or first principle hydraulic calculations. The designer shall undertake the necessary design and prepare design drawings compatible with the TA's design and performance parameters. Designers shall ensure the following aspects have been considered and where appropriate included in the design:

(a) The size of pipes, ponds, swales, wetlands, and other devices in the proposed stormwater management system;

(b) How the roading stormwater design is integrated into the overall stormwater system;

(c) The type and class of materials proposed to be used;

(d) System layouts and alignments including:

  (i) Route selection showing infrastructure to be vested located on Council Land only, unless specifically agreed with QLDC;

  (ii) Topographical and environmental aspects (see 5.3.4.3);

  (iii) Easements - The stormwater infrastructure shall be centrally located within the easement. Easements shall be provided for all storm water systems that are to be vested in Council or the system owner where they cross any private land. An easement shall be 3 m wide or to the full extent of the zone of influence, whichever is greater, or unless otherwise agreed by Council;

  (iv) Clearances from underground services and structures (see 5.3.7.9 and 5.3.7.10);

  (v) Provision for future extensions;

(vi) Location of secondary flowpaths;

(e) Hydraulic adequacy (see 4.3.9.5); and

(f) Property service connection locations and sizes (see 4.3.11).

The designer should liaise with the TA, prior to commencement of design, to ensure that sufficient prerequisite information is available to undertake the design.

For catchments less than 50 ha, surface water run-off using the Rational Method will generally be accepted. For larger catchments, or where significant storage elements (such as ponds) are incorporated, surface water run-off should be determined using an appropriate hydrological or hydraulic model.

The New Zealand Building Code (NZBC) clause E1/VM1 provides guidance in the design of pipes, culverts, and open channel hydraulics.

4.3.5.1 Design storms

Council has 3 primary objectives for stormwater quantity management. These are:

I. Preventing onsite flooding and frequent overland flows discharging from sites across adjacent properties;
II. Preventing the surcharge of downstream primary drainage network and flooding of downstream properties; and
III. Preventing downstream flooding and downstream overland flow path and receiving environment erosion.

All developments shall provide onsite primary network drainage capacity for the 5% AEP peak flowrate from all contributing upstream catchments from either the maximum impermeable areas permitted by the District Plan or the maximum impermeable area restricted by a legal instrument (e.g. resource consent, consent notice, etc.).

When discharging to an existing and unknown primary drainage network the onsite primary drainage network discharge peak flow rate shall be no greater than the 60-minute, 20% AEP pre-developed sites peak flow rate unless otherwise approved by Council.

When discharging to new primary drainage networks the onsite primary drainage network downstream discharge peak flow rate shall be no greater than the 5% AEP developed site peak flow rate unless otherwise approved by Council.

Overland flow downstream discharges of the 1% AEP post-development peak flowrate shall be no greater than the 1% AEP pre-development peak flowrate. The location and type of overland flow downstream discharges are to mimic pre-development scenarios unless otherwise approved by Council. If the pre-development scenario is not mimicked it shall be justified to Council satisfaction why this can’t be achieved and why the altered scenario is acceptable.

C4.3.5.1

Rainfall intensity shall allow for climate change. Rainfall intensity design charts developed from NIWA High Intensity Rainfall Design Systems (HIRDS) V4 RCP 8.5 data for 2081-2100 should be used for rainfall design.

4.3.5.2 Freeboard

The minimum freeboard height additional to the computed top water flood level of the 1% AEP design storm should be as follows or as specified in the district or regional plan:

Freeboard	Minimum height
Habitable dwellings (including attached garages)	0.5 m
Commercial and industrial buildings	0.3 m
Non-habitable residential buildings and detached garages	0.2 m

The minimum freeboard shall be measured from the top water level to the building platform level or the underside of the floor joists or underside of the floor slab, whichever is applicable.

Enclosed carparks do not require freeboard, however, where they are basement carparks measure shall be taken to avoid external overland flows being directed into the carpark

4.3.5.3 Hydraulic design of stormwater systems

The hydraulic design of stormwater pipes should be based on either the Colebrook-White formula or the Manning formula. System capacity shall be determined from the Colebrook-White or Manning coefficient as shown in table 4.2. The Colebrook-White and Manning formulae can be found in *Metrication: Hydraulic data and formulae* (Lamont). Manufacturers' specifications should also be referred to.

> ***C4.3.5.3***
>
> *Refer to 'Roughness characteristics of New Zealand rivers' by D M Hicks and P D Mason for further guidance on the selection of Manning's 'n' values. This handbook emphasises that the Manning's 'n' values can vary significantly with flow and the selected value should be based on the graphs of Manning's 'n' versus discharge presented for each site.*

Table 4.2 – Guide to roughness coefficients for gravity stormwater pipes concentrically jointed and clean

Description	**Colebrook-White coefficient** **k** (mm)	**Manning roughness coefficient** (n)
Circular pipes		
PVC	0.003 – 0.015	0.008 – 0.009
PE	0.003 – 0.015	0.008 – 0.009
Vitreous clay	0.15 – 0.6	0.010 – 0.013
Concrete – machine made to AS/NZS 4058	0.03 – 0.15	0.009 – 0.012
Corrugated metal	–	0.012 – 0.024
GRP (glass reinforced plastic)	0.003 – 0.015	0.008 – 0.009
Culverts		
Concrete pre-cast (pipes and boxes)	0.6	0.016
Open channel		
Straight uniform channel in earth and gravel in good condition	–	0.0225
Unlined channel in earth and gravel with some bends and in fair condition	–	0.025
Channel with rough stony bed or with weeds on earth bank and natural	–	0.030
Winding natural streams with generally clean bed but with some pools and	–	0.035
Winding natural streams with irregular cross section and some obstruction	–	0.045
Irregular natural stream with obstruction from vegetation and debris	–	0.060
Very weedy irregular winding stream obstructed with significant overgrown	–	0.100
NOTE – Refer to AS 2200 table 2 and notes, and *Metrication: Hydraulic data and formulae* (Lamont).		

4.3.5.4 Energy loss through structures

Energy loss is expressed as velocity head:

Energy loss $H_e = kV^2/2g$

where k is the entrance loss coefficient and V is velocity.

The entrance loss coefficient table and energy loss coefficient graph in NZBC clause E1/VM1 provide k values for flow through inlets and access chambers respectively.

For bends, see table A1 in Appendix A.

4.3.5.5 Determination of water surface profiles

Stormwater systems shall be designed by calculating or computer modelling backwater profiles from an appropriate outfall water level. On steep gradients both inlet control and hydraulic grade line analysis shall be used and the more severe relevant condition adopted for design purposes. For pipe networks at MHs and other nodes, water levels computed at design flow shall not exceed finished ground level while allowing existing and future connections to function satisfactorily.

In principle, each step in the determination of a water surface profile involves calculating a water level upstream (h_2) for a given value of discharge and a given start water level downstream (h_1).

This can be represented as:

$h_2 + V_2^2 / 2g = h_1 + V_1^2 / 2g + H_f + H_e$

where V is velocity,

H_f is head loss due to boundary resistance within the reach (for pipes, unit head loss is read from Manning's flow charts, for example),

H_e is head loss within the reach due to changes in cross section and alignment (see table 4.3 for loss coefficients).

Table 4.3 – Loss coefficients for bends

Bends	**k**
MH properly benched with radius of bend	
1.5 x pipe	0.5 to 1.0
Bend angle	
90º	0.90
45º	0.60
22.5º	0.25

4.3.6 Stormwater pumping

Stormwater pumping should be avoided wherever possible. However, in certain circumstances for low lying areas, and where gravity drainage is difficult to achieve, stormwater pumping may be required to achieve the appropriate levels of service and protection.

The consequences and risk of pump malfunction and power outages should be considered carefully.

4.3.7 Low impact design

Low impact design aims to use natural processes such as vegetation and soil media to provide stormwater management solutions as well as adding value to urban environments. The main principles of low impact design are reducing stormwater generation by reducing impervious areas, minimising site disturbance, and avoiding discharge of contaminants. Stormwater should be managed as close to the point of origin as possible to minimise collection and conveyance. Benefits include limiting discharges of silt, suspended solids, and other pollutants into receiving waters, and protecting and enhancing natural waterways.

Effective implementation of LID principles typically requires more planning and design input than piped stormwater systems. Aspects in the design process requiring specific consideration include provision of secondary flow paths, land requirements, and provision for effective operation and maintenance.

C4.3.7

Useful guidance on low impact design practices can be found in the following Auckland Council GD01 "Stormwater Management Devices", and GD04 "Water Sensitive Design for Stormwater".

Additional guides that may be useful are listed in Referenced Documents and Related Documents.

4.3.7.1 Low impact design stormwater system

The Council's preferred method of stormwater control is a low impact design solution. The designer shall gain written approval from the Council's Strategy and Asset Planning Team that the proposed maintenance requirements are acceptable prior to submitting a design for acceptance.

Low impact design is a type of stormwater system that aims to minimise environmental impacts by:

(a) Reducing peak flow discharges by flow attenuation;

(b) Eliminating or reducing discharges by infiltration or soakage;

(c) Improving water quality by filtration;

(d) Installing detention devices for beneficial reuse.

4.3.7.2 Low impact design process

Key design considerations include:

(a) Design objective. The need to be clear about what is being designed for is important to informing decisions on the type of device and maintenance approach that is appropriate in a given context. Low impact devices offer many opportunities to deliver multiple outcomes in addition to their stormwater functionality;

(b) Device selection. The proper design and position of a product or device within the stormwater treatment train is important. It is critical to select a device or product that is fit for purpose, robust, and effective for delivering the design objective over its design life. Problems with the operation and maintenance of a device can occur when it is inappropriate for a given location or is undersized for its purpose. The respective position of the various components in the treatment train is an important consideration in ensuring the sustained effectiveness of the system;

(c) Integrated approach. Ensure that those who will become responsible for the ongoing operation and maintenance of low impact devices are involved in the design process. The use of Low Impact Design Considerations shall include a process to provide the most appropriate asset / facility in the long term and its effectiveness shall be demonstrated to the TA. This is critical to informing the development of a practical design that will enable ease of maintenance and develop ownership for ensuring the device performs as it was intended;

(d) Design for maintenance. Maintenance of devices shall be considered early in the design process. This will assist in the identification of features that will facilitate the ease and efficiency of ongoing operation and maintenance of devices. Elements to consider in the design for the maintenance and operation of the systems include:

 (i) Access
 (ii) Vegetation
 (iii) Mulch
 (iv) Sediment
 (v) Mechanical components
 (vi) Vandalism and safety.

4.3.7.3 Low impact design devices

The types of low impact design devices that could be considered for use include:

(a) Detention system;
(b) Wetlands;
(c) Vegetated swales;
(d) Rain gardens;
(e) Rainwater tanks;
(f) Soakage pits and soak holes;
(g) Filter strips;
(h) Infiltration trenches/basins;
(i) Permeable paving;
(j) Green roofs;
(k) Tree pits.

4.3.7.4 Detention ponds

Detention ponds shall only be used with prior approval from the Council.

Stormwater ponds are an accepted method of improving stormwater quality and reducing peak downstream flow rates to replicate the pre-development hydrological regime.

Detention ponds can be of the 'dry' or 'wet' type and can be 'on-line' or 'off-line'. The type of pond required should be discussed with the TA at an early stage.

Specific matters to be considered in pond design include:

(a) Side slope stability;

(b) Shallow ledges or batters for safety;

(c) Ease of access and maintenance including mowing and silt clean out;

(d) Shape and contour for amenity and habitat value;

(e) Effectiveness of inlet and outlet structures;

(f) Overflow design and scour protection;

(g) Fish passage;

(h) Pest control (for example mosquitoes and blue-green algae);

(i) Species to be planted;

(j) Potential effect on downstream aquatic ecology and habitat;

(k) Maintenance requirements.

If the TA is to be responsible for pond maintenance it shall be located on land owned by, or to be vested in, the TA or protected by an appropriate easement.

4.3.7.5 Wetlands

Constructed wetlands can be designed to provide flood protection, flow attenuation, water quality improvement, recreational and landscape amenity, and provision for wildlife habitat.

Specific matters to be considered in wetland design include:

(a) Catchment area greater than 1 ha;

(b) Size calculated to achieve water quality volume;

(c) Forebay to capture coarse sediments;

(d) Depth not to exceed 1 m;

(e) Sufficient hydraulic capacity for flood flows;

(f) Sufficient detention time for sediment retention;

(g) Species to be planted.

If the TA is to be responsible for wetlands maintenance it shall be located on land owned by, or to be vested in, the TA or protected by an appropriate easement.

4.3.7.6 Vegetated swales

Vegetated swales are stormwater channels that are often located alongside roads or in reserves. While their primary function is conveyance, filtration through the vegetation provides some water quality treatment.

Specific matters to be considered in swale design include:

(a) Catchment area not greater than 4 ha;

(b) Longitudinal slope 1% – 5%;

(c) Slopes flatter than 1% may require underdrains;

(d) Slopes greater than 5% may require check dams to reduce effective gradient to less than 5%;

(e) Capacity for a 5% AEP event;

(f) Velocity not greater than 1.5 m/s in a 10% AEP event unless erosion protection is provided;

(g) Grass length 50 mm – 100 mm;

(h) Species to be planted.

An option for swales with very flat longitudinal slopes and high water tables is a wetland swale.

Typical details that may be used in swale design are shown in figures 3.6(A), 3.6(B), and 3.6(C).

4.3.7.7 Rain gardens

Rain gardens are engineered bioretention systems designed to use the natural ability of flora and soils to reduce stormwater volumes, peak flows, and contamination loads. Rain gardens also provide value through attractive design and planting. Specific matters to be considered in rain garden design include:

(a) System designed to manage a 5% AEP event without significant scour or erosion;

(b) Overland flow paths to accommodate flows in excess of the design storm;

(c) Entry and overflow positions to restrict short circuiting;

(d) Geotextile on side walls;

(e) An underdrain with a minimum of 50 mm gravel cover;

(f) Pavement design in vicinity of device;

(g) Soil composition;

(h) A ponding area;

(i) Species to be planted;

(j) Access for maintenance.

4.3.7.8 Rainwater tanks

All potable use rainwater tanks are to be approved by the Council.

Rainwater tanks can be designed to harvest water for non-potable uses such as toilet flushing and watering the garden. This can significantly reduce the demand on the potable water supply from the TA. Where required by the TA rainwater tanks can be configured to provide peak flow attenuation, to reduce stream channel erosion and the load on the stormwater system, with or without reuse.

Specific matters to be considered in rainwater tank design include:

(a) Capacity: Typically 2,000 L – 5,000 L for domestic reuse and 6,000 L – 9,000 L for dual reuse and attenuation;

(b) Primary screening to keep out leaves and other coarse debris;

(c) First-flush diverters to collect first 0.4 mm for slow release to ground through a small chamber;

(d) Backflow prevention;

(e) Low level mains top-up valve;

(f) Overflow outlet;

(g) Gravity or pumped;

(h) Tight-fitting cover;

(i) Cool location;

(j) Aesthetics and convenience.

4.3.7.9 Soakage devices

Soakage devices such as soak pits and soak holes, filter strips, infiltration trenches/basins, permeable paving, green roofs, and tree pits can also be considered for managing stormwater from roofs, parking areas, and roads.

Specific matters to be considered in soakage system design include:

(a) Capacity adequate for a 5% AEP event;

(b) Rate of soakage determined through a soakage test with an appropriate reduction factor (at least 0.5) applied to accommodate loss of performance over time;

(c) Capacity to accommodate the maximum potential impermeable area;

(d) Overland flow paths to accommodate flows in excess of the design storm;

(e) Confirmation that the soakage system will not have an adverse effect on surrounding land and properties from land stability, seepage, or overland flow issues;

(f) Soakage system to be located above static groundwater level;

(g) Pre-treatment device to minimise silt ingress may be required;

(h) Interception of hydrocarbons;

(i) Access for maintenance.

Full or partial subdivision soakage systems shall be designed (including soakage testing) in accordance with Auckland City Council Soakage Design Manual 2003, except that the design storm used shall be based on a 5% AEP rainfall event.

The Council may require a geotechnical assessment to be carried out by an appropriately qualified geo-professional to determine the suitability of soil and groundwater characteristics for any proposed soakage system.

A discharge permit may be required from the regional council for discharge to soakage.

> ***C4.3.7.9***
>
> *National and international references that may be able to be used in the design and maintenance of such systems are listed in Referenced Documents and Related Documents.*

4.3.8 Natural and constructed waterways

Where waterways are to be incorporated in the stormwater system, they shall be located within a reserve of sufficient width to contain the full design storm flow with a minimum freeboard of 500 mm.

Grass berms in reserves shall have a maximum side slope of 1 in 5 and additionally include a vehicular access berm for maintenance purposes.

Reserves should be designed to accommodate off-road pedestrian and cycle access for recreational use. Planted riparian margins should be provided each side of the waterway (see 7.2.4).

All channel infrastructure shall include protection against scour and erosion of the stream banks and stream bed.

If the watercourse is to be in private property and be maintained by the TA it shall be protected by an easement.

4.3.9 Pipelines and culverts

4.3.9.1 Location and alignment of public mains

The preferred location of public mains shall be within the road reserve or within other public land.

In greenfield developments, the stormwater pipes shall always be located below the water pipes and above the wastewater pipes. For infill developments, a stormwater line may only be permitted to cross under a wastewater pipe if no other suitable option is available. In this instance, no sewer PVC joins are permitted within 1m of the stormwater pipe, and the sewer PVC shall be encased in PE at least 200mm beyond each join.

Where required by the TA easements shall be provided for stormwater pipelines located on private property.

A straight alignment between manholes (MHs) is required unless there are special circumstances. See 5.3.7.6 and 5.3.7.7 for further guidance on curved alignments for stormwater pipelines.

4.3.9.2 Materials

All pipes shall be PE100, PVC (minimum class SN8) or rubber ring joint reinforced concrete and meet the relevant standards as listed in Table A1 of NZS4404:2010. Unless otherwise agreed in writing by the Council. Acceptance of design documentation without separate written approval shall not constitute acceptance of an alternative material.

For materials for which there is no New Zealand or Australian Standard the specific approval of the TA is required.

4.3.9.3 Minimum pipe sizes

Minimum pipe sizes for public mains and sump leads unless otherwise specified shall be:

Single sump with single outlet	– 200 mm internal diameter
Double sump with double outlet	– 200 mm internal diameter
Public mains	– 200 mm internal diameter where only taking house leads
	– 300 mm internal diameter for all other mains and double sump leads with single outlets.

4.3.9.4 Minimum cover

Where the TA does not have specific requirements, the minimum covers as described in AS/NZS 2566.2 (for buried flexible pipelines) or AS/NZS 3725 (for buried concrete pipes) may be used.

Within carriageways, trafficable footpaths, and crossings, stormwater mains are to have a minimum of 1.0 m cover unless structural calculations to the appropriate standards have been provided and approved by Council. Laterals and sump leads can have the cover reduced to 0.6 m within these areas. Cover outside of the carriageway, footpaths, crossings or other trafficable areas shall be no less than 0.6m.

Stormwater pipes in trafficable areas with less than 1.0 m cover shall be concrete capped as per Appendix B Drawing B4-2. Stormwater pipes with less than 0.6 m cover shall be concrete encased. The concrete encasement shall be reinforced concrete and structurally designed for required design load by a Structural Engineer.

4.3.9.5 Minimum gradients and flow velocities

In flat areas gradients should be as steep as possible to control silt deposition. The minimum velocity should be at least 0.6 m/s at a flow of half the 50% AEP design flow. For velocities greater than 3.0 m/s see 5.3.5.6.

4.3.9.6 Culverts

In designing culverts the effects of inlet and tailwater controls shall be considered.

Culverts under fills shall be of suitable capacity to cope with the design storm with no surcharge at the inlet, unless the fill is part of a stormwater detention device or has been designed to act in surcharge. All culverts shall be provided with adequate wingwalls, headwalls, aprons, scour protection, removable debris traps or pits to prevent scouring or blocking. Special consideration shall be given to the effects of surcharging or blocking of culverts under fill.

Fish passage through culverts shall always be maintained.

Refer to the NZTA *Bridge manual* for waterway design at bridges and culverts.

Mountable and traversable culverts are required where they are to be located within a clear zone and pipe diameter is 300mm or greater. Cross drainage structures require traversable grates and parallel (to the road) drainage structures require mountable grates. Examples of mountable and traversable grates for culverts are shown in Appendix B Drawing B5-15 and B5-16.

4.3.9.7 Inlets and outlets

Where a pipeline discharges into a natural or constructed waterway, or vice versa, consideration shall be given to energy dissipation or losses, erosion control, and land instability. This is often achieved by an appropriately designed headwall structure.

For outlets the design shall ensure non-scouring velocities at the point of discharge. Acceptable outlet velocities will depend on soil conditions, but should not exceed 2m/s without specific provision for energy dissipation and velocity reduction.

Where inlets or outlets are located on or near natural waterways their appearance in the riparian landscape and likely effect on in-stream values shall be considered. Methods could include cutting off the pipe end at an oblique angle to match soil slope, constructing a headwall from local materials such as rock or boulders, planting close to the structure, and locating outlets well back from the water's edge.

Direct discharge to a waterway or the sea may require a discharge consent from the regional council unless authorised by a comprehensive consent held by the TA, or is a permitted activity in a regional plan.

4.3.9.8 Outfall water levels

Where a pipeline or waterway discharges into a much larger system the peak flows generally do not coincide. Backwater profiles should produce satisfactory water levels when assessed as follows:

(a) Determine the time of concentration and set the design rainfall event for the smaller system;
(b) Determine the peak flow for the design event;
(c) Determine receiving waterway peak water level for the design rainfall event in (a);
(d) Starting with the level from (c) determine the smaller system profile at a flow of 75% of the flow from (b);
(e) Determine the receiving waterway mean annual flood water level;

(f) Starting with the level from (e) determine the smaller system water profile at the flow from (b);

(g) Select the higher of the two profiles determined for design purposes.

Similarly, for tidal outfalls, peak flow may or may not coincide with extreme high tide levels. A full dynamic analysis and probability assessment may be required.

4.3.9.9 Subsoil drains

Subsoil drains are installed to control groundwater levels. Perforated or slotted pipe used under all areas subject to vehicular traffic loads shall comply with NZTA specification F/2 and NZTA F/2 notes. It is good practice to provide regular inspection points.

Bedding and backfill material around a subsoil drain pipe shall be more free-draining than the in situ soil. If filter fabrics are used their susceptibility to clogging, thereby reducing the through flow, should be considered.

Groundwater control shall always be considered when an open drain is piped.

Connection of subsoil drains to collection sumps are to be positioned such that the invert of the subsoil drain is above the soffit of the sump's outlet pipe.

In the absence of any other more appropriate criterion the design flow for subsoil systems shall be based on a standard of 1 mm/h (2.78 L/s/ha).

Refer to manufacturer's literature for information on pipe materials, filter fabrics, bedding, and filter design.

4.3.9.10 Bulkheads for pipes on steep grades

Bulkheads, or anti-scour blocks, shall be detailed on the design drawings. Spacing of bulkheads shall be:

Table 4.4 – Spacing of bulkheads for pipes on steep grades

Grade (%)	**Requirement**	**Spacing (S)** (m)
15 – 35	Concrete bulkhead	S = 100/Grade (%)
>35	Special design	Refer to TA
NOTE – On grades flatter than above where scour is a problem, sand bags may be used to stabilise the trench backfill.		

4.3.9.11 Trenchless technology

See 5.3.6.8 and 5.3.6.9 for guidance on the use of trenchless technology.

4.3.10 Manholes

4.3.10.1 Standard manholes

Access chambers or MHs shall be provided at all changes of direction, gradient and pipe size, at branching lines and terminations and at a distance apart not exceeding 100 m unless approved otherwise. They shall be easily accessible and located clear of any boundary. All public mains shall terminate with a MH at the upstream end.

See 5.3.8.2 and 5.3.8.3 of this Code of Practice for further guidance on the location of MHs.

On pipelines equal to or greater than 1 m diameter, the spacing of MHs may be extended with the approval of the TA.

Appendix B drawings B1-5, B1-6, B1-7, and B1-13 for manholes may be adopted for stormwater systems.

Materials used for the construction of manholes to be agreed by with the TA.

4.3.10.2 Manhole materials

MHs may be manufactured in concrete, or from suitable plastics materials, including glass reinforced plastic (GRP), polyethylene, PVC or polypropylene, or from concrete/plastic lined composites.

MH materials selected shall be suitable for the level of aggressiveness of the surrounding groundwater.

4.3.10.3 Size of manholes

The standard internal diameter of circular MHs is 1050 mm and preferred nominal internal diameters are 1050 mm, 1200 mm, and 1500 mm.

When considering the appropriate MH diameter, consideration shall be given by the designer to the base layout to ensure hydraulic efficiency and adequate working space in the chamber. Where the effective working space is reduced by internal drop pipes, a larger diameter may be required. Where there are several inlets, consultation with the TA on the layout of the chamber is recommended.

The base layout of MHs shall comply with 5.3.8.4.2 of this Code of Practice.

4.3.10.4 Shallow manholes (or mini manholes)

The minimum internal diameter of a manhole shall be 1050 mm.

4.3.10.5 Hydraulic flow in manholes

In addition to the normal pipeline gradient all MHs on pipelines less than 1000 mm diameter shall have a minimum drop of 30 mm within the MH to compensate for the energy loss due to the flow through the MH. See 5.3.8.4.4 and 5.3.8.4.5 for further guidance.

4.3.10.6 Manhole connections

Open cascade is permitted into MHs over 2.0 m in depth and for pipes up to and including 300 mm diameter providing the steps are clear of any cascade. Other situations may be considered and require TA approval.

The bases of all MHs shall be benched and haunched to a smooth finish to accommodate the inlet and outlet pipe.

New inlet pipes shall be cut back to the inside face of the MH and provided with a smooth finish. All chambers are to be made watertight with mortar around all openings.

Minor pipelines connecting to a MH at or below design water level in the MH shall do so at an angle of not greater than 90º to the main pipeline direction of inflow.

Minor pipelines connecting at above design water level may do so at any angle.

The connection of PVC pipes to concrete structures, such as manholes will be with a purpose made PVC starter and finisher with a 'gritted' external surface.

4.3.10.7 Flotation

In areas of high water table, all MHs shall be designed to provide a factor of safety against flotation of 1.25.

4.3.11 Connection to the public system

Where the connection of individual lots and developments are to the public system they shall meet the following requirements:

(a) Connection shall be by gravity flow via laterals to public mains or waterways

(b) All new urban lots shall be provided with individual service laterals, unless on-site disposal is approved by the TA; Connection to kerb adaptors in kerb and channel will not be allowed in new developments.

(c) Each connection shall be capable of serving the whole of the lot. Where, for physical reasons, this is not practicable a partial service to the building area only may be acceptable (subject to approval of the TA);

(d) The minimum internal diameter of connections shall be:

  (v) 100 mm for residential lots

  (vi) 150 mm for commercial and industrial lots and connections serving two dwellings or residential lots

  (vii) 200 mm for connections serving three or more dwellings or residential lots (unless otherwise approved by the TA);

(e) The connection shall be of a type capable of taking the spigot end of an approved pipe;

(f) Where the stormwater pipeline is outside the lot to be served, a connection pipeline shall be extended to the boundary of the lot and be marked by a 50 mm x 50 mm timber stake extending to 600 mm above ground level and painted green;

(g) Connection to stormwater systems such as vegetated swales, soakpits, or soakage basins is acceptable provided the system is approved by the TA;

(h) All connections to pipelines or MHs shall be sealed by removable caps until such time as they are required;

(i) Connections shall be indicated accurately on as-built plans. Location relative to boundaries, depth to invert and ground level shall be given as a minimum.

4.3.12 Connection of lateral pipelines to public mains

Factory made fittings shall be used for all connections to public mains up to 300 mm diameter. Connections to larger mains up to 750 mm diameter shall use properly manufactured saddles. Concrete bondage to the exterior of the main pipe is required.

A hole may be made in a 900 mm diameter and larger main to affect a connection. The connection shall be properly dressed and plastered from inside the main to ensure that no protrusions exist.

When the lateral being connected is larger than 300 mm in diameter it shall be connected at a MH.

4.3.12.1 Permanent disconnection of stormwater lateral

Where existing property connections are to be disconnected, they shall be disconnected and capped off at least 200mm outside the property boundary. The location of the capped end shall be fixed as per as built specifications and included in the as-built data.

4.3.13 Building over Council Infrastructure

No building shall be constructed over any stormwater drain, nor shall any structure foundation be located within a line extending at 45º from 150mm below the pipe invert to the ground surface, or within 1.5m either side of the pipe, without the specific approval of the Council.

The Council will only give approval to construct a building over a stormwater drain if;

I. It is impractical to construct a new main clear of the zone of influence; and

II. A manhole is installed within 10m of both sides of the building; and

III. The pipe runs in a straight line both vertically and horizontally between manholes;

And

I. There are no connections under the building; and

II. The condition of the pipe is checked by closed circuit television survey prior to construction at the applicant's cost and the pipe condition is approved as acceptable by Council;

And

I. Structures straddling or founded within the above zone are designed by a Chartered Professional Engineer such that there is no loading from the building applied to the stormwater pipe;

And

I. Easement to be revised at the applicants expense and in accordance with the conditions of any specific approval.

4.3.14 Sumps

(a) Sumps shall be placed at a maximum of 90 metre intervals

(b) No back entry is permitted for mountable kerbs

(c) Double sumps comprises, two single sumps connected via a single minimum 300mm lead, with one of the sumps discharging via a 300mm lead to the outfall.

(d) Double sumps (or duplicate sumps and leads) shall be provided:

  I. Where a single sump has insufficient intake capacity,

  II. On grades steeper than 1 in 12 (8.3%),

  III. Where two sub-catchments meet.

(e) Specific design requirements are required where design exceeds 12%

4.3.15 Wash bays

A vehicle, machinery or equipment wash bay should be designed to exclude rainwater, and to retain, collect, treat and reuse, or dispose of all wastewater to sewer. Installation of appropriate facilities during the design and construction phase will ensure protection of the stormwater system from contaminated wastewater.

Pre-treatment devices must comply with NZBC G14 Industrial Liquid Waste.

4.3.16 Seismic Design

All pipes and structures shall be designed with adequate flexibility and special provisions to minimise risk of damage during earthquake. Historical experience in New Zealand earthquake events suggests that suitable pipe options, in seismically active areas, may include rubber ring joint PVC or PE pipes. Specially designed flexible joints shall be provided at all junctions between pipes and rigid structures.

In developments where liquefaction has been identified, provisions to create resilient services must be considered and implemented where practicable. Relevant information can be found in the document *Underground Utilities – Seismic Assessment and Design Guidelines* Edition 1 March 2017.

4.4 Approval of proposed infrastructure

The approval process for land development and subdivision design and construction and documents and supporting information on stormwater drainage infrastructure to be provided at each stage of the process shall be in accordance with section 1 of this Code of Practice.

4.4.1 Approval process

Stormwater infrastructure requires approval from the TA and unless the TA holds a comprehensive, or network consent for the catchment, consents from the regional council to discharge, divert, or dam water may also be required.

In these circumstances it is good practice:

(a) To consult with LAs prior to consent application;

(b) To lodge applications with LAs at the same time so that land use and water-related resource consents can, if required, be dealt with at a joint hearing under s. 102 of the RMA.

4.4.2 Information to be provided

Specific information to be provided on any concept plans or scheme plans for development or subdivision incorporating stormwater infrastructure shall include:

(a) The location of any natural waterways or wetlands within the site or in close proximity to a boundary. The location in plan and level of the water's edge and shoulder of the banks shall be indicated;

(b) Typical pre-existing and post development cross sections through any natural waterways or wetlands;

(c) The proposed proximity of buildings to the water's edge or the shoulder of the banks, or both;

(d) Clear identification of the extent of any river, stream, or coastal floodplains on, or in close proximity to the site and overland flow paths within the site; and

(e) The level datum.

TAs may require some of the information following, particularly (h) and (i), in order to assess possible effects of a proposed development.

Applications for design approval shall include the information outlined in 1.8 of this Code of Practice. In addition the following information shall be provided:

(f) A plan showing the proposed location of existing and proposed stormwater infrastructure and flow paths;

(g) Detailed long sections showing the levels and grades of proposed stormwater infrastructure in terms of datum;

(h) Details and calculations prepared which demonstrate that agreed levels of service will be maintained. All applications to develop within a flood plain shall be supported by detailed calculations and plans to determine the floodplain boundaries and building floor levels to meet the freeboard requirements in 4.3.5.2;

(i) Details and calculations prepared which clearly indicate any impact on adjacent area or catchment that the proposed infrastructure may have; and

(j) Operations and maintenance guidelines for any water quantity and or quality control structures/facilities shall be submitted to the TA for design approval along with other documents. The guidelines should describe the design objectives of the structure/facility, describe all major features, explain operations such as recommended means of sediment removal and disposal, identify key design criteria, and identify on-going management and maintenance requirements such as plant establishment, vegetation control, and nuisance control.

4.5 Construction

4.5.1 Pipeline construction

The construction of pipelines shall be carried out in accordance with the requirements of AS/NZS 2032 (PVC), AS/NZS 2033 (PE), AS/NZS 2566 Parts 1 and 2 (all buried flexible pipelines), or AS/NZS 3725 (concrete pipes).

4.5.2 Trenching

Guidance is provided in Appendix B drawings B7-1 and B7-2.

Where a pipeline is to be constructed through areas with unsuitable foundations such material shall be removed and replaced with other approved material or alternatively, other methods of construction shall be carried out to the approval of the TA to provide an adequate foundation, and side support if required, for the pipeline.

4.5.3 Reinstatement

Areas where construction has taken place shall be reinstated to the condition required by the TA.

4.5.4 Inspection and acceptance

Pipe systems of 1200 mm diameter or less shall be inspected using closed circuit television (CCTV) prior to acceptance by the TA.

CCTV inspections and deliverables shall be in accordance with New Zealand pipe inspection manual and the requirements of the TA.

The TA may, at its discretion, also require a water test to be carried out. Testing shall be carried out as specified in Appendix C.

Inspection to reference assets as per provided as builts, and shall reference the Resource Consent Number.

Acceptance will only be for pipe of Grade 1.

4.5.5 Location and marking of laterals

A green painted push on cap shall be installed at the end of the stormwater laterals. The stormwater lateral shall be located on the right hand side of foul sewer lateral (viewed from the road reserve looking into the property).

5 WASTEWATER

5.1 Scope

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development. Where community specific considerations cannot be met, written acceptance of an alternative method shall be obtained from the Council.

This section sets out requirements for the design and construction of wastewater systems for land development and subdivision. Section 5 primarily addresses reticulated systems, but reference is also made to on-site wastewater systems where applicable.

If the scope of the development is sufficiently large to include its own pumping station, then reference should be made to WSA 04.

5.2 General

5.2.1 Objectives

The designer shall agree the approach to be taken for wastewater with the Council prior to commencing any work.

The objectives of the design are to ensure that the wastewater system is functional and complies with the requirements of the TA’s wastewater systems.

In principle the wastewater system shall provide:

(a) A single gravity connection for each property;

(b) A level of service to the TA’s customers in accordance with the authority’s policies;

(c) Minimal adverse environmental and community impact;

(d) Compliance with environmental requirements;

(e) Compliance with statutory OSH requirements;

(f) Adequate hydraulic capacity to service the full catchment;

(g) Long service life with minimal maintenance and least life-cycle cost;

(h) Zero level of pipeline infiltration on commissioning of pipes;

(i) Low level of pipeline infiltration/exfiltration over the life of the system;

(j) Resistance to entry of tree roots;

(k) Resistance to internal and external corrosion and chemical degradation;

(l) Structural strength to resist applied loads; and

(m) ‘Whole of life’ costs that are acceptable to the TA.

5.2.2 Referenced documents and relevant guidelines

Wastewater designs shall incorporate all the special requirements of the TA and shall be in accordance with the most appropriate Standards, codes, and guidelines including those set out in Referenced Documents. Related Documents lists additional material that may be useful.

5.3 Design

5.3.1 Design life

All wastewater systems shall be designed and constructed for an asset life of at least 100 years. Some components such as pumps, valves, and control equipment may require earlier renovation or replacement. Refer to WSA 02 for the classification of life expectancy for various components in conventional gravity systems.

5.3.2 Structure plan

The TA may provide a structure plan setting out certain information to be used in design, such as flows, sizing, upstream controls, recommended pipe layout, or particular requirements of the TA. Where a structure plan is not provided, the designer shall determine this information by investigation using this Code of Practice and engineering principles.

5.3.3 Future development

Unless agreed in writing by the Council where further subdivision or development is allowed for within the current district plan upstream of the one under consideration the council shall require infrastructure to be constructed to the upper limits of the subdivision/development to allow for future connections.

The assessment of required capacity shall be on the basis of full development to the extent defined in the current district plan. Where infrastructure may service adjacent land then the full development to the extent defined in the current district plan of all the land that may be serviced by the infrastructure shall be included in the capacity calculations.

Where the new infrastructure being installed is required by Council to service future development then that infrastructure will be designed and constructed on the basis of full development to the extent defined in the current district plan.

Before commencing development a developer shall liaise with the Council's Strategy and Asset Planning Team as to whether infrastructure should be upsized to service adjacent future development. If such upgrades are required, agreement shall be reached with QLDC for Council to cover the costs of upgrades.

5.3.4 System design

5.3.4.1 Catchment design

Pipes within any project area shall be designed to be consistent with the optimum design for the entire catchment area and any future extension of the system shall be accommodated. This may affect the pipe location, diameter, depth, and maintenance structure location and layout. Designers shall adopt best practice to ensure a system with lowest life-cycle cost.

Pipes shall be designed with sufficient depth and capacity to cater for all existing and possible development of the catchment. Where future extension of the pipe is possible, it may be necessary to carry out preliminary designs for large areas of subdivided and unsubdivided land. This design shall use safety factors defined by the TA for hypothetical subdivision and service for layouts to determine the necessary depth and diameter for an extension.

The designer shall be responsible for checking with the Council that the downstream network is adequate to accommodate the proposed subdivision/development.

5.3.4.2 Extent of infrastructure

Where pipes are to be extended in the future, the ends of pipes shall extend past the far boundary of the development by a distance equivalent to the depth to invert and be capped off, unless otherwise agreed to by the TA. This ensures that a future extension of the pipe does not require unnecessary excavation within lots or streetscapes already developed.

5.3.4.3 Topographical considerations

In steep terrain the location of pipes is governed by topography. Gravity pipelines operating against natural fall create a need for deep installations which may require trenchless installation. The pipe layout shall conform to natural fall as far as possible.

5.3.4.4 Geotechnical investigations

The designer shall take into account any geotechnical requirements determined under section 2 of this Code of Practice.

5.3.5 Design criteria

5.3.5.1 Design flow

The design flow comprises domestic wastewater, industrial wastewater, infiltration, and direct ingress of stormwater.

The design flow shall be calculated by the method nominated by the TA. In the absence of information from the TA the following design parameters are recommended:

(a) Residential flows

- (i) Average dry weather flow of 250 litres per day per person
- (ii) Dry weather diurnal PF of 2.5
- (iii) Dilution/infiltration factor of 2 for wet weather
- (iv) Number of people per dwelling 3;

> ***C5.3.5.1(a)***
>
> *For small contributing catchments, PFs can be significantly higher but, due to the requirement for a minimum pipe size of DN 150, such flows will not govern the design.*

(b) Commercial and industrial flows

Where flows from a particular industry or commercial development are known they should be used as the basis of design. Where there is no specific flow information available and the TA has no design guide, table 5.1 is recommended as a design basis. These flows include both sanitary wastewater and trade wastes and include peaking factors.

All trading businesses must ensure that they comply with the current bylaw(s) relative to the infrastructure network.

5.3.5.2 Hydraulic design of pipelines

The hydraulic design of wastewater pipes should be based on either the Colebrook-White formula or the Manning formula. The coefficients to be applied to the various materials are shown in table 5.2.

5.3.5.3 Minimum pipe sizes

Irrespective of other requirements, the minimum sizes of property connection and reticulation pipes shall be not less than those shown in table 5.3.

Table 5.1 – Commercial and industrial flows

Industry type (Water usage)	**Design flow** (Litre/second/hectare)
Light	0.4
Medium	0.7
Heavy	1.3

Table 5.2 – Guide to roughness coefficients for gravity sewer lines

Material	**Colebrook-White coefficient** **k** (mm)	**Manning roughness coefficient** (n)
VC	1.0	0.012
PVC	0.6	0.011
PE	0.6	0.009 – 0.011
GRP	0.6	0.011
Concrete machine made to AS/NZS 4058	1.5	0.012
PE or epoxy lining	0.6	0.011
PP	0.6	0.009 – 0.011

NOTE –

(1) These values take into account possible effects of rubber ring joints, slime, and debris.

(2) The n and k values apply for pipes up to DN 300.

(3) For further guidance refer to WSA 02:1999 table 2.4; AS 2200 table 2; *Plastics pipes for water supply and sewage disposal* (Janson), Metrication: *Hydraulic data and formulae* (Lamont), or the *Handbook of PVC pipe* (Uni-Bell).

Table 5.3 – Minimum pipe sizes for wastewater reticulation and property connections

Pipe	Minimum size DN (mm)
Connection servicing 1 dwelling unit	100
Connection servicing more than 1 dwelling unit	150
Connection servicing commercial and industrial lots	150
Reticulation servicing residential lots	150
NOTE – In practical terms, in a catchment not exceeding 250 dwelling units, and where no pumping station is involved, DN 150 pipes laid within the limits of table 5.4 and table 5.5 will be adequate without specific hydraulic design.	

5.3.5.4 Limitation on pipe size reduction

In no circumstances shall the pipe size be reduced on any downstream section.

5.3.5.5 Minimum grades for self-cleaning

Self-cleaning of grit and debris shall be achieved by providing minimum grades specified in tables 5.4 and 5.5.

Table 5.4 – Minimum grades for wastewater pipes

Pipe size DN	Absolute minimum grade (%)
150	0.55
200	0.33
300	0.25

Table 5.5 – Minimum grades for property connections and permanent ends

Situation	Minimum grade (%)
DN 100 property connections	1.65
DN 150 property connections	1.20
Permanent upstream ends of DN 150, 200, and 300 pipes in residential areas with population ≤20 persons	1.00

5.3.5.6 Maximum velocity

The preferred maximum velocity for peak wet weather flow is 3.0 m/s. Where a steep grade that will cause a velocity greater than 3.0 m/s is unavoidable or where a pipe of grade >7 % drains to a manhole, the following precautions shall be taken:

(a) Depth of a manhole to exceed 1.5m to invert for 150mmØ and 225mmØ pipes.

(b) Depth of a manhole is to exceed 2.0m deep for 300mmØ pipes.

(c) Change of direction at the manhole is not to exceed 45º.

(d) No drop junctions or verticals shall be incorporated in a manhole.

(e) Inside radius of channel inside a manhole is to be greater than 6 times the pipe diameter and benching is to extend 150mm above the top of the inlet pipe.

To avoid excessively deep channels within manholes, steep grades (>7 %) shall be "graded-out" at the design phase where practicable. The design of pipelines on gradients over 7% must be agreed with Council.

5.3.5.7 Gravity wastewater applications

See Appendix A for appropriate gravity pipe Standards for wastewater.

The pipe shall be designed to:

(a) Have adequate capacity, grades, and diameters;

(b) Have adequate grade for self-cleaning;

(c) Be deep enough to provide gravity service to all lots;

(d) Comply with minimum depth requirements to ensure mechanical protection and safety from excavation;

(e) Avoid all underground services, while maintaining all the necessary clearances; and

(f) Allow for various drops and losses through MHs.

5.3.5.8 Pressure and vacuum wastewater applications

The introduction of pressure or vacuum systems into a network requires approval from the TA. See Appendix A for appropriate pressure pipe and fittings Standards for wastewater. See also 5.3.12.

Design of pressure and vacuum wastewater applications shall consider the following:

(a) Selection of pipe material and PN class shall take account of design for dynamic operation stresses (fatigue), and water temperature. Refer to Plastics Industry Pipe Association of Australia Ltd (PIPA) guidelines for PVC and PE pipes (http://www.pipa.com.au), or WSA-07;

(b) Sump and pump design;

(c) Maintenance requirements;

(d) Access for servicing and maintenance.

5.3.6 Structural design

5.3.6.1 General

The design shall be in accordance with AS/NZS 2566.1, or AS/NZS 3725, including the structural design commentary AS/NZS 2566.1 Supplement 1. Details of the final design requirements shall be shown on the drawings.

5.3.6.2 Seismic design

All pipes and structures shall be designed with adequate flexibility and special provisions to minimise risk of damage during earthquake. Historical experience in New Zealand earthquake events suggests that suitable pipe options, in seismically active areas, may include rubber ring joint PVC or PE pipes. Specially designed flexible joints shall be provided at all junctions between pipes and rigid structures.

In developments where liquefaction has been identified, provisions to create resilient services must be considered and implemented where practicable. Relevant information can be found in the document *Underground Utilities – Seismic Assessment and Design Guidelines* Edition 1 March 2017.

5.3.6.3 Structural consideration

Pipelines shall be designed to withstand all the forces and load combinations to which they may be exposed including internal forces, external forces, temperature effects, settlement, and combined stresses.

5.3.6.4 Internal forces

Pipelines shall be designed for the range of expected pressures, including transient conditions (surge and fatigue) and maximum static head conditions. In the case of transient conditions, the amplitude and frequency shall be estimated. Mains subject to negative pressure shall be designed to withstand a transient pressure of at least 50 kPa below atmospheric pressure.

5.3.6.5 External forces

The external forces to be taken into account shall include:

(a) Trench fill loadings (vertical and horizontal forces due to earth loadings);

(b) Surcharge;

(c) Groundwater;

(d) Dead weight of the pipe and the contained water;

(e) Other forces arising during installation;

(f) Traffic loads;

(g) Temperature (expansion/contraction).

The consequences of external forces on local supports of pipelines shall also be considered.

5.3.6.6 Geotechnical investigations

The designer should take into account any geotechnical requirements determined under section 2 of this Code of Practice. Where required, standard special foundation conditions shall be referenced on the drawings.

5.3.6.7 Pipe selection for special conditions

Pipeline materials and jointing systems shall be selected and specified to ensure:

(a) Structural adequacy for the ground conditions and water temperature;

(b) Water quality considering the lining material;

(c) Compatibility with aggressive or contaminated ground;

(d) Suitability for the geotechnical conditions;

(e) Compliance with the TA's requirements.

5.3.6.8 Trenchless technology

Trenchless technology may be preferable or required by the TA as appropriate for alignments passing through or under:

(a) Environmentally sensitive areas;

(b) Built-up or congested areas to minimise disruption and reinstatement;

(c) Railway and major road crossings;

(d) Significant vegetation;

(e) Vehicle crossings;

Wastewater pipes used for trenchless installation shall have suitable mechanically restrained joints, specifically designed for trenchless application, which may include integral restraint, seal systems, or heat fusion welded joints. Any pipes installed using trenchless technology under roads shall be sleeved, unless an acceptable reason for not sleeving is accepted by Council.

Trenchless installation methods may include:

For new pipes:

(f) Horizontal directional drilling (HDD) (PVC with restraint joint/fusion welded PE)

(g) Uncased auger boring/pilot bore microtunnelling/guided boring (PVC with restraint joint/fusion welded PE)

(h) Pipe jacking (GRP/reinforced concrete)

For pipe rehabilitation/renovation:

(i) Slip lining/grouting (PVC with restraint joint/fusion welded PE)

(j) Closefit slip lining (PVC with restraint joint/fusion welded PE)

(k) Static pipe bursting (PVC with restraint joint/fusion welded PE)

(l) Reaming/pipe eating/inline removal (PVC with restraint joint/fusion welded PE)

(m) Soil displacement/impact moling (fusion welded PE)

(n) Cured in place pipe (thermoset resin with fabric tube)

Any trenchless technology and installation methodology shall be chosen to be compatible with achieving the required gravity pipe gradient – refer to manufacturer's and installer's recommendations.

The following details including location of access pits and exit points shall be submitted to the TA for approval:

(o) Clearances from services and obstructions;

(p) The depth at which the pipeline is to be laid to ensure minimum cover is maintained;

(q) The pipe support and ground compaction;

(r) How pipes will be protected from damage during construction;

(s) Any assessed risk to abutting surface and underground structures.

> ***C5.3.6.8***
>
> *Further information on trenchless technologies may be found in 'Trenchless technology for installation of cables and pipelines' (Stein), 'Trenchless technology – Pipeline and utility design, construction, and renewal' (Najafi), and 'Guidelines for horizontal directional drilling, pipe bursting, microtunnelling and pipe jacking' (Australasian Society for Trenchless Technology).*

5.3.6.9 Marking tape or pipe detection tape

Appropriate marking tape or detection tape shall be installed at the top of the embedment zone, or tied to the pipe during HDD, to aid future location of the pipe. Refer to AS/NZS 2032 section 5.3.15 and figure 5.1.

5.3.7 System layout

5.3.7.1 Pipe location

The preferred layout/location of pipes within roads, public reserves, and private property may vary and shall be to the requirements of each TA. QLDC's preference is for all infrastructure to be located within public land. Where this is impractical and that is agreed with Council, access shall be legally secured and it shall be demonstrated how the infrastructure can be readily accessed for routine or emergency maintenance.

Pipes should be positioned as follows:

(a) Within the street according to the locally applicable utilities allocation code. In the absence of a code, a location clear of carriageways is preferred;

(b) Within public land with the permission of the controlling authority;

(c) Within reserves outside the 1% AEP flood area;

(d) Within private property parallel to front, rear, or side boundaries.

5.3.7.2 Materials

All pipes shall be PE100, PVC (minimum class SN8) or rubber ring joint reinforced concrete and meet the relevant standards as listed in Table A1 of NZS4404:2010. Acceptance of design documentation without separate written approval shall not constitute acceptance of an alternative material.

5.3.7.3 Pipes in reserves and public open space

Pipes in reserves and public open space shall be located in accordance with the TA's requirements.

Crossings of roads, railway lines, waterways, and underground services shall, as far as practicable, be at right angles.

5.3.7.4 Pipes in private property

Where pipes are designed to traverse any vacant or occupied public or private properties, the design shall as far as practicable allow for possible future building plans, preclude maintenance structures and specify physical protection of the pipe within or adjacent to the normal building areas and all engineering features (existing or likely) on the site, such as retaining walls.

The design shall allow access for all equipment required for construction and future maintenance. Except where obstructions or topography dictate otherwise, pipes shall run parallel to boundaries at minimum offsets of 1.0 m.

Where pipes are designed to traverse properties containing existing structures such as retaining walls, buildings, and swimming pools, the current and future stability of the structure shall be considered. Pipes adjacent to existing buildings and structures shall be located clear of the 'zone of influence' of the foundations. If this is not possible, protection of the pipe and associated structures shall be specified for evaluation and approval by the TA.

Where pipes to be vested to the TA are designed to traverse private properties, they should be protected by legal easements of the TA.

Pipes shall be centrally located within an easement. An easement shall be 3 m wide or to the full extent of the zone of influence, whichever is greater, or unless otherwise agreed by Council.

5.3.7.5 Minimum cover

Pipelines shall have minimum cover in accordance with the TA or utility owner's requirements. Where the TA does not have specific requirements, the minimum covers as described in AS/NZS 2566.2 may be used.

Within carriageways, trafficable footpaths, and crossings, wastewater mains are to have a minimum of 1.0 m cover unless structural calculations to the appropriate standards have been provided and approved by Council. Laterals can have the cover reduced to 0.6 m within these areas. Cover outside of the carriageway, footpaths, crossings or other trafficable areas shall be no less than 0.6m.

Wastewater pipes in trafficable areas with less than 1.0 m cover shall be concrete capped as per Appendix B Drawing B4-2. Wastewater pipes with less than 0.6 m cover shall be concrete encased. The concrete encasement shall be reinforced concrete and structurally designed for required design load by a Structural Engineer.

5.3.7.6 Horizontal curves

Horizontal curves shall only be used where authorised by the TA.

The term 'curved pipes' is used to describe either cold bending of flexible pipe during installation or small deflections at joints for rubber ring jointed flexible and rigid pipes. The radius of curvature and pipe deflection shall meet manufacturer's specifications. Curved alignments are used in curved streets to conform with other services and to negotiate obstructions, particularly in easements. The use of curves in locations other than curved street alignments shall be justified by significant savings in life-cycle cost. The straight line pipe is usually preferred as it is easier and cheaper to set out, construct, locate, and maintain in the future.

5.3.7.7 Vertical curves

Vertical curves may be specified where circumstances provide a significant saving or where maintenance structures would be unsuitable or inconvenient. The curvature limitations for vertical curves are the same as those for horizontal curves in 5.3.7.6.

5.3.7.8 Underground services

The location of underground services affecting the proposed pipe alignment shall be determined. Where pipes will cross other services, the depth of those services shall be investigated, and exposed where necessary. Services upstream of the project area may affect the design. A future extension of the pipe that will cross existing and proposed upstream services may determine the level for the current project infrastructure.

5.3.7.9 Clearance from underground services

Where a pipe is designed to be located in a road which contains other services, the clearance between the pipe and the other services shall comply with SNZ HB 2002, unless the TA has its own specific requirements.

In greenfield developments, the wastewater pipes shall always be located below both water and stormwater pipes. For infill developments, a wastewater line may only be permitted to cross a stormwater pipe if no other suitable option is available. In this instance, no sewer PVC joins are permitted within 1m of the stormwater pipe, and the sewer PVC shall be encased in PE at least 200mm beyond each join.

For normal trenching and trenchless technology installation, clearance from other service utility assets shall not be less than the minimum vertical and horizontal clearances shown in table 5.6. Written agreement on reduced clearances and clearances for shared trenching shall be obtained from the TA and the relevant service owner.

Table 5.6 – Clearances between wastewater pipes and other underground services

Utility **(Existing service)**	**Minimum horizontal clearance for new pipe size ≤DN 300** (mm)	**Minimum vertical clearance**(1) (mm)
Gas mains	300(2)	150
Telecommunication conduits and cables	300(2)	150
Electricity conduits and cables	500	225
Drains	300(2)	150
Water mains	1000(3)/600	500

NOTE –

(1) Vertical clearances apply when wastewater pipes and other underground services cross one another, except in the case of water mains when a vertical separation shall always be maintained, even when the wastewater pipe and water main are parallel. The wastewater pipe should always be located below the water main to minimise the possibility of backflow contamination in the event of a main break.

(2) Clearances can be further reduced to 150 mm for distances up to 2 m when passing installations such as poles, pits, and small structures, providing the structure is not destabilised in the process.

(3) When the wastewater pipe is at the minimum vertical clearance below the water main (500 mm) maintain a minimum horizontal clearance of 1000 mm. This minimum horizontal clearance can be progressively reduced to 600 mm as the vertical clearance increases to 750 mm.

(4) Where possible, stormwater pipes should be located above wastewater pipes to prevent possible contamination if the wastewater pipe were to fail. Any instance where this is not planned needs to be specifically raised and agreed to by QLDC.

5.3.7.10 Clearance from structures

Pipes adjacent to existing buildings and structures shall be located clear of the 'zone of influence' of the building foundations. If this is not possible, a specific design shall be undertaken to cover the following:

(a) Protection of the pipeline;

(b) Long term maintenance access for the pipeline; and

(c) Protection of the existing structure or building.

The protection shall be specified by the designer for evaluation and acceptance by the TA.

5.3.7.11 Bulkheads for pipes on steep grades

For bulkheads, or anti-scour blocks, see 4.3.9.10 and Appendix B

5.3.8 Maintenance structures

5.3.8.1 General

This describes the requirements for structures which permit access to the wastewater system for maintenance.

The minimum internal diameter of a manhole shall be 1050 mm.

Maintenance structures include:

(a) Manholes (or maintenance holes) (MHs);

(b) Maintenance shafts (MSs); and

(c) Terminal maintenance shafts (TMSs).

5.3.8.2 Location of maintenance structures

The selection of a suitable location for maintenance structures may influence the pipe alignment. Generally, a minimum clearance of 1.0 m should be provided around maintenance structures clear of the opening to facilitate maintenance and rescue. The TA may determine other specific requirements subject to the individual site characteristics.

The design shall include maintenance structures at the following locations:

(a) Intersection of pipes except for junctions between mains and property connections;

(b) Changes of pipe size;

(c) Changes of pipe direction, except where horizontal curves are used;

(d) Changes of pipe grade, except where vertical curves are used;

(e) Combined changes of pipe direction and grade, except where compound curves are used;

(f) Changes of pipe invert level;

(g) Changes of pipe material, except for repair/maintenance locations;

(h) Permanent or temporary ends of a pipe;

(i) Discharge of a pressure main into a gravity pipe.

Table 5.7 summarises maintenance structure options for wastewater reticulation.

Table 5.7 – Acceptable MH, MS, and TMS options for wastewater reticulation

Application	**Acceptable options**[1]		
	MH	MS	TMS
Intersection of pipes[2]	YES	NO	NO
Change of pipe grade at same level	YES	YES for DN 150 pipe only and using vertical bend	NO
Change of grade at different level	YES MH with internal/external drops	NO	NO
Change in pipe size	YES MH is the only option	NO	NO
Change in horizontal direction	YES within permissible deflection at MH	YES MS prefabricated units or MS used with horizontal bends of max 33º deflection	YES for DN 150 pipe only
Change of pipe material	YES	NO	NO
Permanent end of a pipe[3]	YES	YES	YES
Pressure main discharge point	YES MH is the only option and shall include a vent	NO	NO

NOTE –

(1) Where person entry is required down to the level of the pipe, a MH is the only option.

(2) This table refers to reticulation mains. DN 100 connections can be made to any maintenance structure or, using a proprietary junction, at any point along the main.

(3) Some TAs permit the use of London Junction or Rodding Eye at the end of the pipe, but it is recommended that TMSs are used.

5.3.8.3 Maintenance structure spacing

For reticulation pipes, the maximum distance between any two consecutive maintenance structures shall be 100 m.

At the permanent end of a wastewater main, the distance from the end maintenance structure to the nearest downstream MH shall not exceed 240 m (see figure 5.1).

Where a combination of MHs and MSs is used along the same pipe, the maximum spacing between any two consecutive MHs shall not exceed 400 m irrespective of how many MSs are used between the two MHs (see figure 5.2).

5.3.8.4 Manholes

5.3.8.4.1 Manhole materials

MHs may be manufactured in concrete, or from suitable plastics materials, including GRP, polyethylene, PVC or polypropylene, or from concrete/plastic lined composites.

MH materials selected shall be suitable for the level of aggressiveness of the wastewater and surrounding groundwater.

The connection of PVC pipes to concrete structures, such as manholes will be with a purpose made PVC starter and finisher with a 'gritted' external surface.

5.3.8.4.2 Base layout

Each MH base shall have:

(a) One minimum standing area of 350 mm x 350 mm or of 350 mm diameter (where the ladder or step irons are located), and a second minimum width standing area of 250 mm x 250 mm or of 250 mm in diameter, as shown in Appendix B Drawing B1-5 and Drawing B1-6;

(b) A minimum working space of 750 mm clear of drop pipes, ladders, and step irons; and

(c) Channels with a minimum inside channel wall radius of 300 mm (in plan).

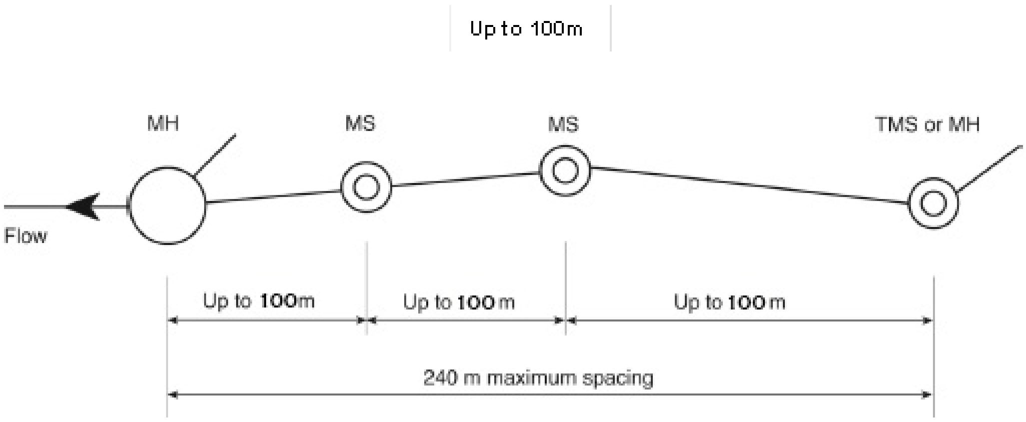


Figure 5.1 – Multiple MSs between MH and 'last' MH/TMS

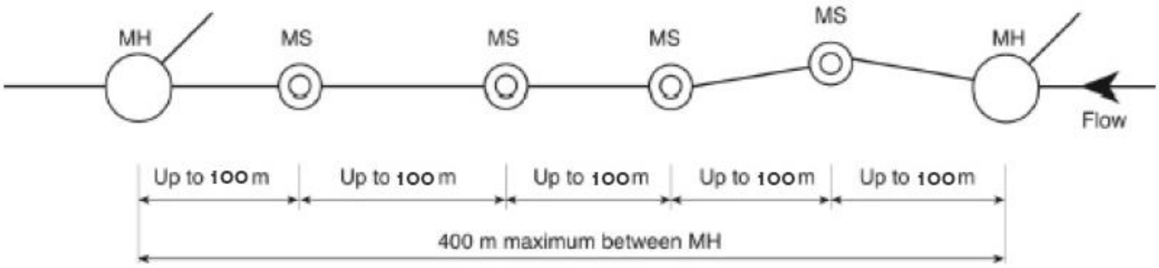


Figure 5.2 – Multiple MSs between consecutive MHs

5.3.8.4.3 Allowable deflection through MHs

A maximum allowable deflection through a MH shall comply with table 5.8.

5.3.8.4.4 Internal falls through MHs

The minimum internal fall through a MH shall comply with table 5.9.

Where the outlet diameter at a MH is greater than the inlet diameter, the minimum fall through the MH shall be not less than the difference in diameter of the two pipes, in which case the pipes shall be aligned soffit to soffit.

On pipes where the internal fall across the base of the MH is not achievable due to a large difference between the levels of incoming and outgoing pipes (see Appendix B Drawing B1-5 and Drawing B1-6;), then internal or external drops shall be provided (see Drawing B1-7).

Table 5.8 – Maximum allowable deflections through MHs

Pipe size DN	**Maximum deflection** Degrees (°)
150 – 300	Up to 120° for internal fall along MH channel – see table 5.9
150 – 300	Up to 150° where there is a large fall at MH using an internal or external drop structure

Table 5.9 – Minimum internal fall through MH joining pipes of same diameter

Deflection angle at MH Degrees (°)	**Minimum internal fall** (mm)
0 to 30	30
>30 to 60	50
>60 to 120	80

5.3.8.4.5 Effect of steep grades on MHs

Where a pipe of grade >7% drains to a MH, the following precautions shall be taken if the topography and the connection pipes allow for:

(a) No change of grade is permitted at inlet to a MH;

(b) Depth of MH is to exceed 1.5 m to invert for DN 150, DN 200, and DN 225 pipes;

(c) Depth of MH is to exceed 2.0 m deep for DN 300 pipes;

(d) Change of direction at the MH is not to exceed 45^{o};

(e) No drop junctions or verticals are to be incorporated in the MH;

(f) Inside radius of channel inside the MH is to be greater than 6 times the pipe diameter; and

(g) Benching is to be taken 150 mm above the top of the inlet pipe.

To avoid excessively deep channels within MHs, steep grades (>7%) shall be 'graded-out' at the design phase where practicable.

Grading the channel of the MH shall be limited to falls through MHs of up to 0.15 m. Where the depth of the channel within the MH would be greater than 2 x pipe diameter, then an internal or external drop structure shall be provided.

C5.3.8.4.5

For further guidance on handling steep grades, refer to WSA 02.

5.3.8.4.6 Flotation

In areas of high water table, all MHs shall be designed to provide a factor of safety against flotation of 1.25.

5.3.8.4.7 Covers

Watertight MH covers with a minimum clear opening of 600 mm in diameter, complying with AS 3996, shall be used, unless the TA has an alternative standard. AS 3996 gives direction for the class of cover for particular locations and applications.

5.3.8.4.8 Bolt-down covers

Where required by the TA, bolt-down metal access covers (watertight type) shall be specified on MHs:

(a) In systems where the possibility of surcharge exists; and

(b) Along creeks subject to flooding above the level of the cover, in tidal areas, or in any location where surface waters could inundate the top of a MH.

Sealed entry holes with restricted access should be used in geothermal conditions and for deep manholes.

MHs should, where practicable, be located on ground that is at least 300 mm above the 1% AEP flood level. Where this is not practicable, bolt-down access covers may be specified by the TA. It will also be necessary to specify the tying together of MH components where bolt-down covers are specified and precast components are used.

5.3.8.4.9 Size of manholes

The standard internal diameter of circular MHs is 1050 mm and preferred nominal internal diameters are 1050 mm, 1200 mm, and 1500 mm.

When considering the appropriate MH diameter, consideration shall be given by the designer to the base layout to ensure hydraulic efficiency and adequate working space in the chamber (as detailed in 5.3.8.4.2). Where the effective working space is reduced by internal drop pipes, a larger diameter may be required. Where there are several inlets, consultation with the TA on the layout of the chamber is recommended.

The base layout of MHs shall comply with Drawing B1-5

5.3.8.5 Maintenance shafts

Where maintenance shafts (MSs) have been approved by the TA, and where it is expected that human access below ground will not be required, MSs can be used on DN 150, DN 200, and DN 225 pipes as an alternative to MHs, providing 5.3.8.5.1 and 5.3.8.5.2 are satisfied. See Appendix B SNZ Drawings B7-10, B7-11, and B7-12.

Typical MS configurations are:

(a) Straight through MSs; and Appendix B Drawing B7-10 to B7-12.

(b) Angled MSs – see 5.3.8.5.2(a).

MSs can also be used in conjunction with a TMS (see 5.3.8.6).

5.3.8.5.1 Limiting conditions

The following conditions apply to the use of MSs:

(a) MSs shall only be used on DN 150, DN 200, and DN 225 pipes;

(b) MSs shall not be used instead of MHs at junctions;

(c) Depth of MSs shall:

  (i) Be within the allowable depth limit for the particular pipeline system

  (ii) Not exceed the MS manufacturer's stated allowable depth limit, and

  (iii) Be within the depth limit imposed by the TA;

(d) MSs shall be restricted to pipeline gradients and depths where the deviation from vertical of the MS riser shaft (that is, projected centre line of base to centre line at surface) is a maximum of 0.3 m measured at the surface;

(e) MSs shall not be used at discharge points of pumping mains.

5.3.8.5.2 Design parameters

MSs shall only be used at the design locations detailed in figures 5.1 and 5.2. The following requirements shall apply:

(a) Directional and gradient changes at MSs shall be achieved by using either:
   (i) Close-coupled horizontal or vertical manufactured bends immediately adjacent to the MS (maximum horizontal deviation of 33°), or
   (ii) MS units specially manufactured with internal horizontal or vertical angles to suit design requirements (maximum horizontal deviation of 90°);

(b) MSs at changes of grade shall be located on the pipe with the lesser of the two gradients to minimise the deviation from the vertical of the riser shaft;

(c) Straight through type and angled MSs can incorporate up to two higher level property connections discharging directly into the riser shaft.

For construction details see Appendix B and Drawing B7-11 and B7-12.

5.3.8.6 Terminal maintenance shafts

Where terminal maintenance shafts (TMSs) have been authorised by the TA and where it is expected that human access below ground will not be required, TMSs may be used on DN 150, DN 200, and DN 225 pipes as an alternative to MHs, providing the conditions detailed in this Code of Practice are satisfied.

5.3.8.6.1 Design parameters

A TMS may only be used as a terminating structure under the following conditions:

(a) At the permanent end of a wastewater pipe;

(b) On DN 150, DN 200, and DN 225 pipes;

(c) After the last MH (with no intermediate MS) provided it is spaced no further than 120 m from that MH, as shown in figure 5.1;

(d) After an intermediate MS, as shown in figure 5.2;

(e) Subject to the limiting conditions detailed in 5.3.8.5.1.

5.3.8.6.2 Property connections into a permanent end

TMSs may incorporate a maximum of two higher level property connection branches discharging directly into the riser shaft. Where a property connection is required directly ahead of the permanent end of the pipe (for example, a connection at the end of a no-exit road), a MS may be used instead of a TMS to accommodate the straight through connection. In such a case, a DN 100 connection will require a reducer immediately adjacent to the MS.

5.3.8.6.3 Dead ends

Pipes need not terminate at a MH, MS, or TMS if the pipe is to be extended in the future.

5.3.9 Venting

In urban developments, pipes will normally be adequately ventilated within private property. However, there are some situations where vent shafts will be required such as:

(a) At pumping stations;

(b) At MHs where pumping stations discharge to a gravity pipe; and

(c) At entrances and exits to inverted siphons.

In such situations vent shafts shall be installed as per the requirements of WSA 02 and WSA 04.

5.3.10 Connections

Connections link private systems to the public system or other approved outlet point. Private systems extend through to the public system, except where the TA accepts responsibility for that part of the pipe outside private property.

5.3.10.1 General considerations

The property connection should be designed to suit the existing situation and any future development. Each connection shall be capable of serving the entire building area of the property (unless specific approval is obtained from the TA).

5.3.10.2 Requirements of design

The design shall specify the requirements for the property connections including:

(a) Plan location and lot contours;

(b) Invert level at property boundary or junction with the main as applicable.

5.3.10.3 Number of connections

It is normal practice to provide one connection per lot. Provision of additional connections shall be subject to justification by the developer and approval by the TA.

For multiple occupancies (unit title, cross lease, or company lease), service of the whole property is normally achieved by providing a single point of connection to a TA system. Connection of the individual units is by joint service pipes owned and maintained by the body corporate, tenants in common or the company as the case may require. In this instance the whole of the multiple occupancy shall be regarded as a single lot.

Alternatively, if authorised by the TA, developers have the option of providing wastewater facilities to the individual titles or tenements in new developments by:

(a) Constructing individual connections which shall be owned and maintained by the body corporate, tenants in common or the company; or

(b) Extending the public line into the lot and providing a separate connection to each unit.

5.3.10.4 Location of connection

The connection shall be located to service the lowest practical point on the property and where possible:

(a) Be clear of obstructions, such as trees, tree roots, paved areas;

(b) Be easily accessible for future maintenance;

(c) Be clear of any known future developments, such as swimming pools or driveways;

(d) Avoid unnecessarily deep excavation >1.5 m where practicable;

(e) Be within or on the property boundary.

5.3.10.5 Connection depth

Connection depths shall be set to drain the whole serviced area recognising the following factors:

(a) Surface level at plumbing fixtures of buildings (existing or proposed);

(b) Depth to invert of pipe at plumbing fixture or intermediate points;

(c) Minimum depth of cover over connection for mechanical protection;

(d) Invert of public main at junction point;

(e) Allowance for crossing other services (for clearances see table 5.6);

(f) Provision for basements;

(g) Allowance for head loss in traps and fittings;

(h) Allowance for any soffit depth set by the TA.

The designed invert level at the end of the connection shall be not higher than the lowest calculated level consistent with these factors.

Where an approved connection to Council's reticulation is from a private sewer pressure main, Council requires an approved boundary kit for each connection to be located within the road reserve at the property boundary.

5.3.10.6 Location and marking of laterals

A red painted glued cap shall be installed at the end of the foul sewer laterals. The foul sewer lateral shall be located on the left hand side of the stormwater lateral (viewed from the road reserve looking into the property).

5.3.10.7 Permanent disconnection of wastewater lateral

Where existing property connections are to be disconnected, they shall be disconnected and capped off at least 200mm outside the property boundary. The location of the capped end shall be fixed as per as built specifications and included in the as-built data.

5.3.11 Pumping stations and pressure mains

Pressure mains shall be designed and installed in accordance with the standards of the TA. If the TA has no applicable standards, then they shall be designed in accordance with Sewage Pumping Station Standard WSA 04.

Wastewater and public toilets with pump stations or septic tanks shall be designed in accordance with Appendix G – Sewer Pump Station. Design of electrical systems shall be in accordance with the QLDC Electrical & SCADA Standard Network Flowmeters Standard (2010).

Surge analysis and protection against surge pressures will be also required for wastewater pump/ pumping main system. Deviations from the CoP may be considered at the Council's discretion.

All products and components including pumps shall be approved by the Council prior to submitting a design for acceptance.

All pressure main pipework shall be PE100.

Tracer wire shall be included on all pressure mains. Refer to section 6.5.3.4 for detail of form of wire and testing. For pressure wastewater mains, the tracer wire shall run continuously between valves. At each valve the wire shall be ducted to the surface level through a length of polyethylene pipe ending immediately below the lid. The tracer wire shall be long enough to extend 600mm minimum above ground level when uncoiled. The excess length shall be neatly coiled in the valve box.

5.3.12 Pressure sewers and vacuum sewers

Pressure sewers shall be designed and installed in accordance with the standards of the TA, with consideration in the design for cyclic dynamic stresses. Refer to the PIPA design guidelines (http://www.pipa.com.au). If the TA has no applicable standards, then they shall be designed in accordance with WSA 02 and WSA 07.

Vacuum sewers shall be designed and installed in accordance with the standards of the TA. If the TA has no applicable standards, then they shall be designed in accordance with WSA 06.

5.3.13 On-site wastewater treatment and disposal

On-site wastewater treatment and disposal shall be designed and installed in accordance with the standards of the TA. If the TA has no applicable standards, then they shall be designed in accordance with AS/NZS 1546.1 and AS/NZS 1547.

5.3.14 Building over Council Infrastructure

No building shall be constructed over any wastewater drain, nor shall any structure foundation be located within a line extending at 45º from 150mm below the pipe invert to the ground surface, or within 1.5m either side of the pipe, without the specific approval of the Council.

The Council will only give approval to construct a building over a wastewater drain if;

i. It is impractical to construct a new main clear of the zone of influence;
and
ii. A manhole is installed within 10m of both sides of the building;
and
iii. The pipe runs in a straight line both vertically and horizontally between manholes;
and
iv. There are no connections under the building;
and
v. The condition of the pipe is checked by closed circuit television survey prior to construction at the applicant's cost and the pipe condition is approved as acceptable by Council;
and
vi. Structures straddling or founded within the above zone are designed by a Chartered Professional Engineer such that there is no loading from the building applied to the wastewater pipe;
and
vii. Easement to be revised at the applicants expense and in accordance with the conditions of any specific approval.

5.4 Approval of proposed infrastructure

5.4.1 Approval process

Wastewater infrastructure requires approval from the TA.

5.4.2 Information to be provided

Applications for design approval shall include the information outlined in 1.8 of this Code of Practice. In addition, the following information shall be provided:

(a) A plan showing the proposed location of existing and proposed wastewater infrastructure;

(b) Detailed long sections showing the levels and grades of proposed wastewater pipelines in terms of datum;

(c) Long sections shall include full details of pipe and manhole materials and sizes;

(d) Details and calculations prepared which demonstrate that agreed levels of service will be maintained;

(e) Details and calculations prepared which clearly indicate any impact on adjacent area or catchment that the proposed infrastructure may have; and

(f) Appropriate operating manuals, pump information, and instructions for pump stations and pressure systems if proposed.

5.5 Construction

5.5.1 Pipeline construction

The construction of pipelines shall be carried out in accordance with the requirements of AS/NZS 2032 (PVC), AS/NZS 2033 (PE), AS/NZS 2566 Part 1 and 2 (all buried flexible pipelines), AS/NZS 3725 (concrete pipes), or AS 1741 or BS EN 295 (VC).

5.5.2 Trenching

See Appendix B Drawing B1-1 to Drawing B1-4 for guidance.

Where a pipeline is to be constructed through areas with unsuitable foundations such material shall be removed and replaced with other approved material or alternatively, other methods of construction shall be carried out to the approval of the TA to provide an adequate foundation and side support if required for the pipeline.

5.5.3 Reinstatement

Areas where construction has taken place shall be reinstated to a condition as required by the TA.

5.5.4 Inspection and acceptance

Pipeline inspection and recording by closed circuit television (CCTV) shall be carried out prior to acceptance by the TA.

CCTV inspections and deliverables shall be in accordance with *New Zealand pipe inspection manual* and the requirements of the TA.

Inspection to reference assets as per provided as builts, and shall reference the Resource Consent Number.

Acceptance will only be for pipe of Grade 1.

5.5.5 Leakage testing of gravity pipelines

Before a new pipeline is connected to the existing system, a successful field test shall be completed. The test shall be carried out as specified in Appendix C.

5.5.6 Leakage testing of pressurised sewers

Requirements for field testing of pressurised sewers are given in Appendix C.

5.5.7 Connection to existing systems

Connection to existing wastewater mains will only be undertaken by Queenstown Lakes District Council, or its authorised agents, at the cost of the applicant.

6 WATER SUPPLY

6.1 Scope

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development.

This section sets out requirements for the design and construction of drinking water supply systems for land development and subdivision. It covers the design of both the localised reticulation system and the larger distribution network.

Water reticulation design is generally described in ‘performance based’ terms combined with ‘deemed to comply’ solutions. Individual TAs may specify additional or varying requirements. The designer is responsible for all aspects of the water system design, excepting those aspects nominated and provided to the designer by the TA.

If the scope of the development is large and includes its own water source, treatment or reservoirs, reference should be made to WSA 03.

Detailed plans and design calculations (where appropriate) shall be submitted to the TA. In addition, the requirements outlined in section 1 of this Code of Practice shall be met.

6.2 General requirements

The designer shall agree the approach to be taken for water supply with the Council prior to commencing any work.

6.2.1 Objectives

The objectives are to ensure that the water reticulation system is functional, the required quality and quantity of water is supplied to all customers within the TA’s designated water supply area, and the TA’s requirements are satisfied.

The design shall ensure an acceptable water supply for each property including fire flows, depending on TA policies by providing either:

(a) A water main allowing an appropriate point of supply to each property;

and

(b) A service connection from the main for each property.

The designer shall consider:

(c) The TA’s policies, customer charters, and contracts;

(d) The hydraulic adequacy of the system;

(e) The ability of the water system to maintain acceptable water quality;

(f) The structural strength of water system components to resist applied loads;

(g) The requirements of SNZ PAS 4509;

(h) Environmental requirements;

(i) The environmental and community impact of the works;

(j) The ‘fit-for-purpose’ service life for the system;

(k) Optimising the ‘whole-of-life’ cost; and

(l) Each component’s resistance to internal and external corrosion or degradation.

6.2.2 Referenced documents and relevant guidelines

Relevant legislation is listed in the Referenced Documents section of this Code of Practice.

Water designs shall incorporate all the special requirements of the TA and shall be in accordance with the most appropriate Standards, codes, and guidelines including those set out in Referenced Documents, the Civil Defence Emergency Management Act 2002, and *Drinking-water standards for New Zealand 2005* (Revised 2008). Related Documents lists additional material that may be useful.

6.3 Design

6.3.1 Design life

All water supply systems shall be designed and constructed for an asset life of at least 100 years. Some components such as pumps, metering, control valves, and control equipment may require earlier renovation or replacement. Refer to WSA 03 for the classification of life expectancy for various components of water supply systems.

6.3.2 Structure plan

The TA may provide a structure plan setting out certain information to be used in design, such as flows, sizing, upstream controls, recommended pipe layout, or particular requirements of the TA. Where a structure plan is not provided, the designer shall determine this information by investigation using this Code of Practice and engineering principles.

6.3.3 Future development

Unless agreed in writing by the Council, where further subdivision or development is allowed for within the current district plan adjacent to the one under consideration the council shall require infrastructure to be constructed to the extents of the subdivision/development to allow for future connections.

The assessment of required capacity shall be on the basis of full development to the extent defined in the current district plan. Where infrastructure may service adjacent land then the full development to the extent defined in the current district plan of all the land that may be serviced by the infrastructure shall be included in the capacity calculations.

Where the new infrastructure being installed is required by Council to service future development then that infrastructure will be designed and constructed on the basis of full development to the extent defined in the current district plan.

The cost of increased infrastructure to service adjacent future development will be agreed in writing with the Council's Strategy and Asset Planning Team prior to commencing work.

6.3.4 System design

Water mains shall be designed with sufficient capacity to cater for all existing and predicted development within the area to be served and to meet the requirements of SNZ PAS 4509.

The designer shall be responsible for checking with Council that the network is adequate to accommodate the proposed subdivision/development.
The water demand allowance in the subdivision design shall include provision for:

(a) Population targets;

(b) The area to be serviced; or

(c) Individual properties proposed by the developer.

Adjustment may be required to cater for the known performance (demand-based flows) of the existing parts of the water system.

6.3.5 Design criteria

6.3.5.1 Hydraulic design

The diameter, material type(s), and class of the water main shall be selected to ensure that:

(a) The main has sufficient capacity to meet peak demands while maintaining minimum pressure;

(b) All consumers connected to the main receive at all times an adequate water supply and pressure; and

(c) The appropriate firefighting flows and pressures can be achieved.

6.3.5.2 Network analysis

Where required by the TA, a network analysis of the system shall be undertaken. The system shall be analysed using a mathematical model of the network to ensure adequate water supply is available to all consumers connected to the system for all defined modes of operation. The analysis shall include all elements within the system and shall address all demand periods including peak demand, low demand flows, and fire flows.

6.3.5.3 Peak flows

Clause deleted

6.3.5.4 Head losses

The head loss through pipe and fittings at the design flow rate shall be less than:

(a) 5 m/km for DN ≤150;

(b) 3 m/km for DN ≥200.

Head loss can be calculated using one of a number of standard hydraulic formulae. Some TAs have a preferred procedure and, where appropriate, this procedure should be used.

6.3.5.4.1 Hydraulic roughness values

The hydraulic roughness values considered in the analysis shall take account of the pipe material proposed, all fittings and other secondary head losses, and the expected increase in roughness over the life of the pipe. The designer should check with the TA to ascertain if it has any requirements to use a specific formula and or roughness coefficients. If there are no specific requirements then it is recommended that the Colebrook-White formula is used (see table 6.1). If the designer uses the Manning formula the coefficients in table 6.1 are recommended.

Table 6.1 – Hydraulic roughness values

Material	**Colebrook-White Coefficient k** (mm)	**Manning roughness Coefficient** (n)
PVC	0.003 – 0.015	0.008 – 0.009
PE	0.003 – 0.015	0.008 – 0.009
Ductile iron cement mortar lined	0.01 – 0.06	0.006 – 0.011
Mild steel cement mortar lined	0.01 – 0.06	0.006 – 0.011
GRP	0.003 – 0.015	0.008 – 0.009
NOTE – The values show a range of roughness coefficients. The lower value in the range represents the expected value for clean, new pipes laid straight. The higher value in the range represents the typical maximum expected for the product. It cannot be an absolute maximum, as the factors detailed in AS 2200 can lead to even higher roughness values in some circumstances. Recommendations on the appropriate roughness coefficient for a particular fluid may be obtained from the pipe supplier. Refer also to AS 2200 table 2 and notes.		

6.3.5.5 Minimum flows

The minimum flow shall be the greater of:

(a) 25 L/min for normal residential sites;

(b) Fire flows as specified in SNZ PAS 4509.

6.3.5.6 Minimum water demand

Following receipt of validated modelling data, the daily consumption has been amended to

(a) Daily consumption of 700 L/person/day (occupancy per residence = 3 people);

(b) Peak hour factor of up to 4.0 (Queenstown), 6.6 (Rest of District);

(c) Firefighting demands as specified in SNZ PAS 4509;

(d) The network should be designed to maintain appropriate nominated pressures for both peak demand (average daily demand in L/s x peak hour factor) and firefighting demand scenarios. These figures should be applied to mains of 100 mm diameter or greater. Mains less than 100 mm in diameter can be sized using the multiple dwellings provisions of AS/NZS 3500.1 table 3.3.

When supported by alternative modelling/metering data that has been approved by Council the following minimum water demand figures may be used at the sole discretion of the Council.

(a) Daily consumption of 250 L/p/day;

(b) Peak hour factor of up to 4.0 (Queenstown), 6.6 (Rest of District);

(c) Firefighting demands as specified in SNZ PAS 4509;

(d) The network should be designed to maintain appropriate nominated pressures for both peak demand (average daily demand in L/s x peak hour factor) and firefighting demand scenarios. These figures should be applied to mains of 100 mm diameter or greater. Mains less than 100 mm in diameter can be sized using the multiple dwellings provisions of AS/NZS 3500.1

table 3.3.

6.3.5.7 Sizing of mains

Tables 6.2 and 6.3 may be used as a guide for sizing mains.

Table 6.2 – Empirical guide for principal main sizing

Nominal diameter of main DN	**Capacity of main (single direction feed only)**			
	Residential (lots)	**Rural Residential** (lots)	**General/light Industrial** (ha)	**High usage Industrial** (ha)
100	40	10	–	–
150	160	125	23	–
200	400	290	52	10
225	550	370	66	18
250	650	470	84	24
300	1000	670	120	35
375	1600	1070	195	55

Table 6.3 – Empirical guide for sizing rider mains

DN 50 Rider mains		
Pressure	**Maximum number of dwelling units**	
	One end supply	**Two end supply**
High > 600 kPa	20	40
Medium 400 – 600 kPa	15	30
Low < 400 kPa	7	15

6.3.5.8 Pressure zones

TAs may have maximum acceptable pressure requirements in any pressure zone. In some cases, a 'PRV zone' may be used to control the pressure delivered to an area. In these cases, the designer shall consult with the TA to confirm pressure requirements.

6.3.5.9 Maximum pressure requirements

An output of the hydraulic design of a pipeline is the specification of the maximum pressure that may be imposed on the pipeline during operation.

Inputs to the design process include:

(a) Static head of supply;

(b) The range of pressure and flows required to provide an acceptable level of service to the end-user (minimum pressure) and to avoid water leakage (maximum pressure).

The outputs of water main hydraulic design shall include:

(c) Size of mains;

(d) Maximum and minimum design pressure;

(e) The pressure class/rating of pipeline system components;

(f) Surge analysis results;

(g) Hydraulic loss functions;

(h) Specification of the maximum allowable operating pressure;

(i) Flow and pressure compliance with peak demand and firefighting demand scenarios.

6.3.5.10 Design pressure

The design pressures are the limiting pressures for operation of a pipeline system including any allowance for variation of usage in the future.

The minimum design pressure is either the minimum pressure defined by the TA or some higher pressure selected to control (minimise) the range of pressures experienced over the normal diurnal variation in the system.

The design pressure shall be between 300 kPa and 900 kPa (30 m to 90 m).

A minimum pressure rating of each pipeline component is to be provided to the TA with the as-built details.

C6.3.5.10

A design pressure of 300 kPa to 900 kPa is set as this provides for approximately 200 kPa for two-storey dwellings at the upper floor and less than excessive pressures for dwellings constructed on lots below the position of the main. Specific additional consideration to these pressures may be needed in areas of significant contour.

6.3.5.10.1 Operating pressure/working pressure

The maximum allowable operating pressure in mains of 100mm dia and greater shall not exceed 900kPa without the specific approval of Council’s Chief Engineer.

The maximum allowable operating pressure of ridermains and service connections shall not exceed 900kPa.

6.3.5.11 District Metered Area infrastructure

In the event a development crosses or incorporates a District Metered Area or areas, then the appropriate infrastructure is required to be installed. This would include water meters, valving, housing and associated communication requirements.

6.3.6 Water quality

A number of factors in a network can adversely affect the quality of the water in the system. The network design shall ensure that the water quality at each property complies with the *Drinking-water standards for New Zealand 2005* (Revised 2008). The requirement to protect water supplies from the risk of backflow is stated in the Health (Drinking Water) Amendment Act s. 69ZZZ and this shall be adhered to.

6.3.6.1 Materials

All parts of the water supply system in contact with drinking water shall be designed using components and materials that comply with AS/NZS 4020.

All pipes shall be HD PE100. Unless otherwise agreed in writing by the Council. Acceptance of design documentation without separate written approval shall not constitute acceptance of an alternative material.

Refer to clause 3.1.8 - Council Approved Materials List.

6.3.6.2 Prevention of backflow

Drinking water supply systems shall be designed and equipped to prevent backflow. The location and operation of hydrants, air valves, and scours shall ensure no external water enters the system through negative pressure from normal operation.

Council prefers that backflow preventors should be located above ground, where possible. If it is not possible (e.g. where required to be located in a basement), the location is to be agreed by Council, and drainage for servicing or failure discharge must be provided in underground locations. If using an RPZ backflow preventer, it shall be installed above ground.

NOTE – Some TAs require appropriate backflow prevention at the point of supply for all connections.

6.3.6.3 Water age

Drinking water supply systems shall be designed to minimise water age to ensure no unacceptable deterioration of water quality. This shall include:

(a) Mains with dead ends should be avoided by the provision of linked mains or looped mains. Particular care shall be taken at the boundaries between supply zones where dead ends shall be minimised;

(b) Mains for short runs shall be reduced in size or looped, for example no-exit roads (see figure 6.5);

(c) Provision of large diameter mains capacity shall be staged by the initial provision of a smaller main, followed by additional mains as the demand increases. Discussions should be held with the TA on staging, as multiple mains may not be desirable and larger mains with a scouring programme may be preferred instead.

6.3.7 Flow velocities

In practice it is desirable to avoid unduly high or low flow velocities. Pipelines shall be designed for flow velocities within the range of 0.5 to 2.0 m/s. In special circumstances, velocities of up to 3.0 m/s may be acceptable.

For pumping mains an economic appraisal may be required to determine the most economical diameter of pumping main to minimise the combined capital and discounted pumping cost. The resulting velocity will normally lie in the range 0.8 m/s to 3.0 m/s.

The following factors shall be considered in determining flow velocity:

(a) Stagnation;

(b) Turbidity (large fluctuations in flow rates can dislodge the biological slime or stir up settled solids in pipelines);

(c) Pressure;

(d) Surge;

(e) Pumping facilities;

(f) Pressure reducing devices;

(g) Pipe lining materials.

6.3.7.1 Surge analysis

A surge analysis shall be undertaken for any pipeline within a pumped system or system containing automated valves. The source of any significant pressure surges or high-pressure areas shall be identified and remedial measures to minimise pressure surges designed and specified.

6.3.8 System layout

6.3.8.1 General

Locating infrastructure to be vested on private land will not be acceptable unless specifically agreed with the TA. Water mains are usually located in the road. The location shall be specified by the TA, within the road or space allocation nominated by the road controlling authority. Where approved by the TA water mains may be located in private property or public reserve, and in this case easements shall be required.

Water mains should:

(a) Be aligned parallel to property boundaries;

(b) Should not traverse steep gradients; and

(c) Should be located to maintain adequate clearance from structures and other infrastructure.

(d) Where practicable water mains shall be laid in the road berm outside of the carriageway and any associated drainage features.

(e) All water mains shall be laid within legal public road reserves where practicable. Easements shall be provided for all water supply systems that are to be vested in Council or the system owner where they cross any private land. Pipes shall be generally centrally located within an easement. An easement shall be 3 m wide or to the full extent of the zone of influence, whichever is greater, or unless otherwise agreed by Council.

6.3.8.2 Reticulation layout

A principal water main of not less than nominal internal diameter (DN) 100, fitted with fire hydrants, shall be laid on one side of all public roads and no-exit roads in every residential development. A DN 50 rider main shall be laid along the road frontage of all lots not fronted by the principal main. A DN 50 rider main shall also be provided for service connections where the principal main is DN 250 or larger. The principal mains serving commercial and industrial areas shall be at least DN 150 laid on both sides of the road. This requirement may be relaxed in short no-exit roads as long as adequate firefighting coverage is available.

6.3.8.3 Mains layout

In determining the general layout of mains, the following factors shall be considered:

(a) Main location to allow easy access for repairs and maintenance;
(b) Whether system security, maintenance of water quality, and ability to clean mains meet operational requirements;
(c) Location of valves for shut-off areas and zone boundaries (see 6.3.14);
(d) Avoidance of dead ends by use of looped mains or rider mains;
(e) Provision of dual or alternate feeds to minimise service risk.

6.3.8.4 Water mains in private property

Water mains located within private property will require an appropriately sized and registered easement in accordance with the TA's requirements.

C6.3.8.4

For some TAs, an easement over private property is not the preferred option and may only be used as a temporary solution for landlocked subdivisions pending future permanent supply within a road. A typical situation where the TA may approve water mains in easements is a fire main in a right of way.

6.3.8.5 Types of system configuration

Network layouts shall be established in accordance with TA practice. Interconnected ring systems should be provided when feasible. Refer to WSA 03 for further information.

6.3.8.6 Water mains near trees

Locating water mains within the root zone of trees should be avoided if possible. Where this is not practicable, careful attention to pipe material selection is necessary to minimise risk of pipe failure due to root growth.

6.3.8.7 Shared trenching

Where shared trenching is approved by the TA and utility service owners, a detailed design shall be submitted for approval by those parties and shall include:

(a) Relative location of services (horizontal and vertical) in the trench;
(b) Clearances from other services;
(c) Pipe support and trench fill material specifications;
(d) Embedment and trench fill compactions;

(e) Trench markings;

(f) Services' location from property boundaries;

(g) Any limitations on future maintenance; and

(h) Special anchoring requirements, such as for bends and tees.

Where approved by the TA and utility service owners, shared trenching may also be used for property service connections.

6.3.8.8 Rider mains and duplicate mains

A rider main shall be laid along the road frontage of all lots not fronted by a principal main.

Duplicate mains are required to provide adequate fire protection in the following cases:

(a) Arterial roads or roads with a central dividing island;

(b) Roads with split elevation;

(c) Roads with rail or tram lines;

(d) Urban centres;

(e) Parallel to large distribution mains that are not available for service connections;

(f) Commercial and industrial areas nominated by the TA;

(g) Where required by SNZ PAS 4509.

6.3.8.9 Crossings

Water main crossings of roads, railway lines, and underground services shall, as far as practicable, be at right angles. Mains should be located and designed to minimise maintenance and crossing restoration. The TA may require extra mechanical protection for the pipes or different pipe materials to minimise the need for future maintenance.

6.3.8.10 Crossings of waterways or reserves

All crossings of waterways or reserves shall be specific designs to suit the TA's requirement.

Crossings shall, as far as practicable, be at right angles to the waterway or reserve. Reference should be made to the TA to establish whether it prefers elevated crossings or below waterway invert crossings. When the pipeline is placed under the invert level of a waterway it may require mechanical protection by concrete encasement or steel or other acceptable pipe duct. Different pipeline materials may need to be used for the crossing.

6.3.8.11 Location marking of valves and hydrants

The location marking of stop valves, service valves, and fire hydrants shall be to SNZ PAS 4509.

6.3.9 Clearances

6.3.9.1 Clearance from underground services

Where a pipe is designed in a road the location of the pipe from other services shall comply with the Code as defined in 8.2.2, unless the TA has its own requirements.

For normal trenching and trenchless technology installation, clearance from other service utility assets shall not be less than the minimum vertical and horizontal clearances shown in table 6.4. Written agreement on reduced clearances and clearances for shared trenching shall be obtained from the TA and the relevant service owner prior to the commencement of construction.

Table 6.4 – Clearances between water mains and underground services

Utility (Existing service)	**Minimum horizontal clearance** (mm) — **New main size** — **DN ≤200**	**DN >200**	**Minimum vertical clearance**[1] (mm)
Water mains DN >375	600	600	500
Water mains DN ≤375	300[2]	600	150
Gas mains	300[2]	600	150
Telecommunications conduits and cables	300[2]	600	150
Electricity conduits and cables	500	1000	225
Public stormwater mains	300[2]	600	150[3]
Wastewater pipes	1000/600[4]	1000/600[4]	500[3]
Kerbs	150	600[5]	150 (where possible)

NOTE –

(1) Vertical clearances apply when water mains cross another utility service, except in the case of wastewater when a vertical separation shall always be maintained, even when the main and wastewater pipe are parallel. The main should always be located above the wastewater pipe to minimise the possibility of backflow contamination in the event of a main break.

(2) Clearances can be further reduced to 150 mm for distances up to 2 m when passing installations such as poles, pits, and small structures, providing the structure is not destabilised in the process.

(3) Water mains should always cross over wastewater and stormwater drains.

(4) When the wastewater pipe is at the minimum vertical clearance below the water main (500 mm), maintain a minimum horizontal clearance of 1000 mm. This minimum horizontal clearance can be progressively reduced to 600 mm as the vertical clearance is increased to 750 mm.

(5) Clearance from kerb and channel shall be measured from the nearest edge of the concrete. For water mains ≤375 clearances can be progressively reduced until the minimum of 150 mm is reached for mains DN ≤200.

(6) Where a main crosses other services, it shall cross at an angle as near as possible to 90°.

6.3.9.2 Clearance from structures

Pipes adjacent to existing buildings and structures shall be located clear of the 'zone of influence' of the building foundations. If this is not possible, a specific design shall be undertaken to cover the following:

(a) Protection of the pipeline;

(b) Long term maintenance access for the pipeline; and

(c) Protection of the existing structure or building.

The protection shall be specified by the designer for evaluation and acceptance by the TA.

Sufficient clearance for laying and access for maintenance is also required. Table 6.5 may be used as a guide for minimum clearances for mains laid in public streets.

Table 6.5 – Minimum clearance from structures

Pipe diameter DN	**Clearance to wall or building** (mm)
<100	600
100 – 150	1000
200 – 300	1500
375	2000
NOTE – These clearances should be increased for mains in private property (even with easements) as access is often more difficult and damage risk greater.	

6.3.9.3 Clearance from high voltage transmission facilities

Water mains constructed from metallic materials shall generally not be located close to high voltage transmission lines and other facilities. Special design shall be undertaken if it is necessary to locate such mains close to such facilities.

6.3.9.4 Deviation of mains around structures

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

6.3.10 Pipe selection

The selection of the appropriate pipe material, sizes, and classes shall be based on system demands.

6.3.10.1 Standard pipe sizes

The principal main shall be as per manufacturers standard sizes that are readily available in New Zealand, and specifically the Otago region.

6.3.10.2 Minimum pipe sizes

The minimum pipe and fittings PN to be used for water reticulation mains shall be PN 12.5 (see clause 3.1.8 - Council Approved Materials List).

(a) DN 50 for rider mains in residential zones;

(b) DN 100 for residential zones;

(c) DN 150 for industrial or commercial zones.

The TA may also specify minimum pipe diameters for other identified areas such as CBDs.

6.3.10.3 Pipe PN class (pressure rating)

Pipe PN class is selected on the basis of the design pressure (head) calculated for the various sections of the reticulation network. This may be varied by specific operational requirements specified by the TA.

6.3.10.3.1 Design pressure

The design pressure (head) for the mains to be installed shall be based on the following:

Design pressure, (m)	=	Maximum Supply Pressure, (m above the level datum used for the ground level)
	+	Surge Allowance, (m) (see 6.3.7.1)
	–	Lowest Ground Level (GL) of the proposed main, (m above datum).

The design pressure (m head) shall be used for:

(a) Selection of pipe materials and classes;

(b) Selection of pipe fitting types and classes.

6.3.10.3.2 Minimum pipe PN

The minimum pipe and fittings PN to be used for water reticulation mains shall be PN 12.5 (see clause 3.1.8 - Council Approved Materials List). Designers shall verify the TA's minimum requirement before specifying the required pipe PN.

6.3.10.3.3 Nominated pipe PN

Some TAs may nominate a pipe PN (such as PN 12) for pressure pipes and fittings to standardise on a limited number of pipe PNs, or to allow future operational flexibility within their system. Where this is the case, the design pressure used as the basis for system design, anchorage, and pressure testing shall not exceed the TA's specified operating pressure limit associated with the pipe PN.

6.3.10.3.4 Pumped mains

For water mains in pumped systems, a detailed surge analysis shall be conducted unless otherwise directed by the TA to ensure:

(a) The appropriate surge pressure is included in the calculated design head;

(b) Surge control devices are included in the system design, where identified by the detailed analysis, to protect the network or control pressure fluctuations in the supply to customers, or both.

NOTE – Surge can also be managed by soft starts on pump motors, variable speed drives, and speed controls on valve closures, for example.

6.3.10.4 Pipe materials

For acceptable pipe materials and Standards see Appendix A.

6.3.11 Fire flow

The water reticulation system shall be designed to comply with SNZ PAS 4509.

6.3.11.1 Fire protection services

Many commercial and industrial developments require installation of special fire protection services. While it is the responsibility of the site owner to provide these fire services, the developer shall design the water reticulation system to meet the required demands, where these are known in advance.

6.3.12 Structural design

6.3.12.1 General

For installation conditions beyond those shown on the drawings, the pipeline installation shall be specifically designed to resist structural failure. The design shall be in accordance with AS/NZS 2566.1 including the structural design commentary AS/NZS 2566.1 Supplement 1. Details of the final design requirements shall be shown on the drawings.

6.3.12.2 Seismic design

All pipes and structures shall be designed with adequate flexibility and special provisions to minimise risk of damage during earthquake. Historical experience in New Zealand earthquake events suggest that suitable pipe options, in seismically active areas, may include rubber ring joint PVC pipes, or PE pipes. Specially designed flexible joints shall be provided at all junctions between pipes and rigid structures (such as reservoirs, pump stations, bridges and buildings) in natural or made ground or as agreed with TA.

In developments where liquefaction has been identified, provisions to create resilient services must be considered and implemented where practicable. Relevant information can be found in the document *Underground Utilities – Seismic Assessment and Design Guidelines* Edition 1 March 2017.

6.3.12.3 Structural consideration

Pipelines shall be designed to withstand all the forces and load combinations to which they may be exposed including internal forces, external forces, temperature effects, settlement, and combined stresses. The water main design shall include the selection of the pipeline material, the pipe class, and selection of appropriate bedding material to suit site conditions.

6.3.12.4 Internal forces

Pipelines shall be designed for the range of expected pressures, including transient conditions (surge and fatigue) and maximum static head conditions. In the case of transient conditions the amplitude and frequency shall be estimated. The allowance for surge included in the maximum design pressure shall not be less than 200 kPa. Transfer and distribution mains subject to negative pressure shall be designed to withstand a transient pressure of at least 80 kPa below atmospheric pressure. A surge safety factor of 2 may be applied to the normal operating pressure to estimate the surge pressure in lieu of a detailed surge analysis.

6.3.12.5 External forces

The external forces to be taken into account shall include:

(a) Trench fill loadings (vertical and horizontal forces due to earth loadings);

(b) Surcharge;

(c) Groundwater;

(d) Dead weight of the pipe and the contained water;

(e) Other forces arising during installation;

(f) Traffic loads;

(g) Temperature (expansion/contraction).

The consequences of external forces on local supports of pipelines shall also be considered.

6.3.12.6 Geotechnical investigations

The designer should take into account any geotechnical requirements determined under section 2 of this Code of Practice.

Where required, standard special foundation conditions shall be referenced on the drawings.

6.3.12.7 Pipe selection for special conditions

Pipeline materials and jointing systems shall be selected and specified to ensure:

(a) Structural adequacy considering ground conditions and water temperature;

(b) Water quality considering lining material;

(c) Compatibility with aggressive or contaminated ground;

(d) Suitability for the geotechnical conditions;

(e) Compliance with the TA’s requirements.

6.3.12.8 Above-ground water mains

The design of above-ground water mains shall include the design of pipeline supports, maintenance and access requirements, control of unbalanced thrusts, and shall address exposure conditions, such as corrosion protection, UV protection, freezing of water mains, and temperature derating.

In such situations the pipe materials, support, and restraint for the pipes and fittings shall be detailed on the drawings.

6.3.12.9 Trenchless technology

Trenchless technology may be used as appropriate for alignments passing through or under:

(a) Environmentally sensitive areas;

(b) Built-up or congested areas to minimise disruption and reinstatement;

(c) Railway and major road crossings;

(d) Significant vegetation;

(e) Vehicle crossings.

Pressure pipes used for trenchless installation shall have suitable mechanically restrained joints, specifically designed for trenchless application, which may include integral restraint seal systems, or heat fusion welded joints. Any pipes installed using trenchless technology under roads shall be sleeved.

For information on trenchless installation methods see 5.3.6.8.

C6.3.12.9

Further information on trenchless technologies may be found in 'Trenchless technology for installation of cables and pipelines' (Stein), 'Trenchless technology – Pipeline and utility design, construction, and renewal' (Najafi), and 'Guidelines for horizontal directional drilling, pipe bursting, microtunnelling and pipe jacking' (Australasian Society for Trenchless Technology).

6.3.12.10 Embedment

6.3.12.10.1 Minimum pipe cover

Pipelines shall have minimum cover in accordance with the TA or utility owner's requirements. Where the TA does not have specific requirements, the minimum covers as described in AS/NZS 2566.2 may be used.

Within carriageways, trafficable footpaths, and crossings, water mains are to have a minimum of 1.0 m cover unless structural calculations to the appropriate standards have been provided and approved by Council. Laterals can have the cover reduced to 0.6 m within these areas. Cover outside of the carriageway, footpaths, crossings or other trafficable areas shall be no less than 0.6m.

Water pipes in trafficable areas with less than 1.0 m cover shall be concrete capped as per Appendix B Drawing B4-2. Water pipes with less 0.6 mm cover shall be concrete encased. The concrete encasement shall be reinforced concrete and structurally designed for required design load by a Structural Engineer.

6.3.12.10.2 Minimum trench width

Pipe trench width design considerations shall be based on the minimum side clearances detailed in Appendix B Drawing B7-1.

6.3.12.11 Pipeline restraint

Anchorage shall be provided at bends, tees, reducers, valves, and dead ends where necessary.

> ***C6.3.12.11***
>
> *In-line valves, especially those DN 100 or larger, should be anchored to ensure stability under operational conditions. See Appendix B2 drawings.*

6.3.12.11.1 Thrust blocks

The design of thrust blocks shall be based on the maximum test pressure.

Thrust blocks shall be designed to resist the total unbalanced thrust and transmit all load to the adjacent ground. Calculation of the unbalanced thrust shall be based on the maximum design pressure, or as otherwise specified by the TA.

Restraint joint systems, specifically designed to resist the total unbalanced thrust, and support all thrust load, may be used, instead of thrust blocks. These may include mechanical restraint coupling joints, or integral restraint seal systems.

Typical contact areas for selected soil conditions and pipe sizes are shown in Appendix B Drawing B2-5 and Drawing B7-7.

Thrust blocks for temporary infrastructure shall be designed to the requirements for permanent thrust blocks.

6.3.12.11.2 Anchor blocks

Anchor blocks are designed to prevent movement of pipe bends in a vertical direction. They consist of sufficient mass concrete to prevent pipe movement (Appendix B Drawing B2-5 and Drawing B7-7).

6.3.12.11.3 Restrained joint water mains

Commercially available mechanically restrained jointing systems may be used to avoid the need for thrust and anchor blocks subject to the approval of the TA. However many TAs will still require the use of thrust and anchor blocks.

6.3.13 Reservoirs and pumping stations

Where reservoirs or pumping stations are required, reference shall be made to the TA for its specific requirements.

WSA 03 contains design criteria for pumping stations and reservoirs.

6.3.14 Valves

6.3.14.1 General

All valve types, materials and manufactures shall be approved by the Council's Strategy and Asset Planning Team prior to a design being submitted for acceptance.

Valves are used to:

(a) Isolate reticulation mains from distribution mains;

(b) Isolate smaller reticulation mains from larger reticulation mains;

(c) Isolate planning zone boundaries, for example, industrial, residential, or commercial.

Valves shall be provided:

(d) Each side of freeways, arterial roads, and railway and tram crossings;

(e) Adjacent to street intersections (for ease of location);

(f) In the footway, clear of roadway, where possible.

(g) A valve shall be located on all legs of a junction and positioned no further than 20m from the junction unless otherwise agreed with the Council.

Subject to these considerations, valve numbers shall be minimised.

The TA should be consulted to establish the local requirement for connection type (flange or socket), as well as any other issues such as valve anchoring requirements.

6.3.14.2 Siting of valves

The siting of valves shall take a holistic view of the existing infrastructure and proposed additions. General principles to be considered shall include:

(a) Valves shall be sited to provide the control (such as flow, pressure, isolation, and diversion) required by the TA;

(b) Ready access to valves to enable their safe operation. Account shall be taken of traffic and other site peculiarities;

(c) Minimisation of inconvenience to the public by avoiding clustering of surface fittings in the footpath at intersections;

(d) Optimisation of the number and location of valves to meet the TA's operation and maintenance requirements, safe working, and to minimise the effect of a shutdown on the TA's customers.

6.3.14.3 Gate valves

Valves shall have anti-clockwise rotation of the input spindle for closure, unless otherwise specified by the TA. Gate valves DN ≤50 (commonly called peet valves) shall be clockwise closing unless otherwise specified by the TA.

Buried gate valves shall be operated from above ground and shall be designed to facilitate the use of a standard key and bar. An extension spindle shall be incorporated as necessary to ensure the top of the spindle is 350 mm below the FSL.

Valves DN ≥80 shall be gate valves. In-line valves shall be the same diameter as the reticulation main.

6.3.14.3.1 Gate valve spacing criteria

The number of property service connections in a shut-off area shall be in accordance with table 6.6. When assessing property service numbers, unit title and strata title properties such as apartment buildings and multi-unit developments shall be counted as multiple connections. All connections having an alternative supply may be excluded when assessing property service numbers. The overriding maximum spacing between in-line valves shall be in accordance with table 6.6.

Table 6.6 – Valve spacing criteria

Water main size DN	**Number of property service connections (nominal)**	**Maximum spacing** (m)
≤150	40	300*
200-300	100	750
375	150	1000
* In rural areas, the maximum spacing is 500 m.		

6.3.14.3.2 Branch mains

Stop valves shall be located on branch mains adjacent to the through water main. The type of joint to be used (Soc-Soc, FI-Soc or FI-FI) shall be based on the required security of the water mains. For transfer mains or reticulation mains (≥ DN 300, a tee with a flanged branch, and a flanged valve shall be used (see figure 6.1 and Appendix B B7-4 and B7-5.

Where a road crossing is necessary immediately after the tee branch and there is no space available adjacent to the tee, a stop valve shall be installed on the opposite side of the road (see figure 6.1 and Appendix B B7-4 and B7-5).

6.3.14.3.3 Pressure zone dividing valves

Pressure zone dividing valves and hydrants shall be installed in one of the following arrangements (see figure 6.2):

(a) Valves in a paired configuration with a standard fire hydrant located between them. Installation in this manner permits the valves to be checked for leakage. The valve on the low pressure side of the pair will normally be closed in order for the fire hydrant to be used for firefighting purposes with the supply from the higher pressure zone;

(b) A valve with a standard fire hydrant on each side.

6.3.14.3. 4 Secure service connections

Additional stop valves may be provided at a service connection to a customer requiring a greater security of supply such as hospitals and large industrial or commercial developments. Figure 6.3 illustrates typical arrangements to facilitate partial isolation of the main while maintaining supply to the customer.

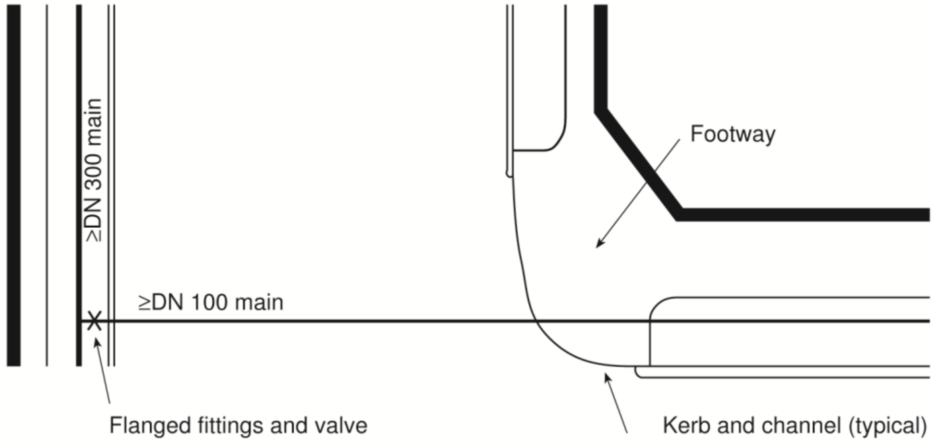


Figure 6.1 – Branch valve adjacent to main

Figure 6.2 – Valve and hydrant combinations for pressure zone dividing valves

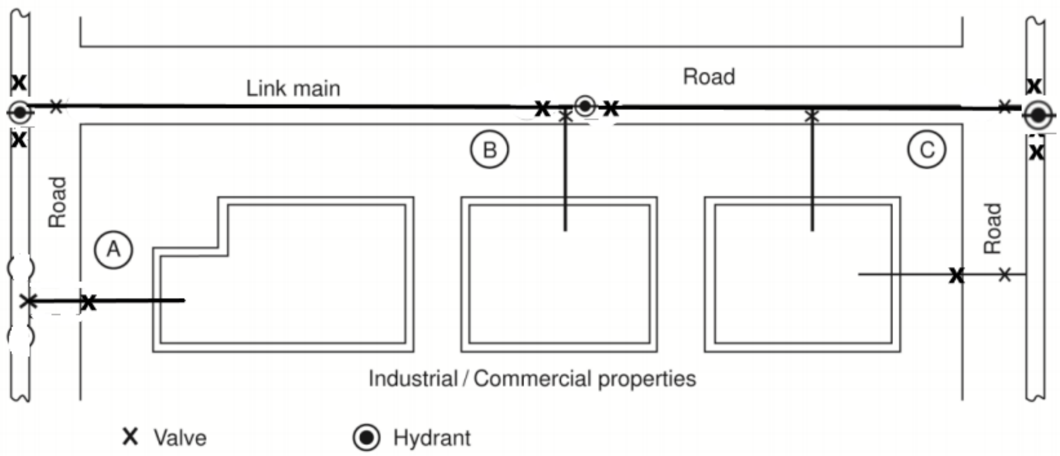


Figure 6.3 – Secure connection

NOTE –

(1) Example A – feed from two directions off a large diameter water main. The arrangement is more complicated than Example B, but is justified by the cost of an additional large diameter stop valve which would be required if using Example B.

(2) Example B – feed from two directions off a smaller diameter main. This is a simpler arrangement than Example A, but requires two valves on the main.

(3) Example C – feed from two separate mains.

6.3.14.4 Butterfly valves

Butterfly valves shall only be used with the approval of the TA.

_C6.3.14.4_

Butterfly valves are not normally used in reticulation mains as they hinder swabbing operations, and the quick closing action can induce high surge pressures.

6.3.14.5 Pressure reducing valves

Pressure reducing valves (PRV) are outside the scope of this Code of Practice. Refer to WSA 03.

_C6.3.14.5_

A PRV is used to reduce the pressure upstream of the PRV to a desired lower downstream pressure. The PRV works automatically to maintain the desired downstream pressure. Refer to WSA 03 for design criteria.

6.3.14.6 Air valves

6.3.14.6.1 Installation design criteria

Investigation into the need for air valves (AVs) shall be made for all high points on mains, particularly at points more than 2 m higher than the lower end of the section of water main and particularly if the main has a steep downward slope on the downstream side.

Where the hydraulic head is less than 10 m, special consideration shall be given to the type of AV to prevent water leakage from the valve. AVs shall be installed with an isolating valve to permit servicing or replacement without having to shut down the main.

Combination AVs, that is (dual) AVs incorporating an AV (large orifice) and an air release valve (small orifice) in a single unit, are generally the preferred type for distribution and transfer mains, and where required on reticulation mains.

The nominal size of the large orifice of air valves shall be DN 80 for installation on mains. This size has an exhaust capacity of approximately 0.3 m^3/s.

_C6.3.14.6.1_

Water mains with only a few service connections or a configuration that leads to air accumulation may require combination air valves to automatically remove accumulated air that may otherwise cause operational problems in the water system.

The configuration of the distribution network for both the change in elevation and the slope of the water main governs the number and location of air valves required.

6.3.14.6.2 Air valves location

Air valves shall not be located in major roadways or in areas subject to flooding. When required, air valves shall be located:

(a) At summits (high points);

(b) At intervals of not more than 800 m on long horizontal, ascending, and descending sectors;

(c) At every increase in downward slope;

(d) At every reduction in upward slope;

(e) On the downstream side of PRVs;

(f) On the downhill side of major isolating valves;

(g) At blank ends.

Where the air valve is in a valve chamber, the design shall ensure adequate venting for effective operation and drainage to prevent backflow contamination.

6.3.14.7 Scours and pump-out branches

Scours and pump-out branches are provided in the distribution network for maintenance purposes. They are designed to allow draining of water from the mains by gravity or use of a mobile pump.

Hydrants may be used for flushing and draining on water mains DN <300.

> ***C6.3.14.7***
>
> *On mains DN ≥300, scours are more effective in draining and provide greater flushing velocities than hydrants.*

Scours and pump-out branches shall incorporate appropriate measures to prevent back siphonage into the water supply system.

There shall be adequate drainage facilities to receive the flow resulting from flushing and draining operations.

Scours shall:

(a) Drain the water main by gravity or have provision for pump-out within a period of 1 hour, or both;

(b) Have a diffuser fitted at the discharge point if there is a likelihood of environmental or asset damage; and

(c) Not be subject to inundation.

6.3.14.7.1 Scour sizes

Scours shall be sized in accordance with table 6.7.

Table 6.7 – Minimum scour size

Main size DN	**Scour size** DN
DN ≤200	80
DN >200 – DN ≤300	100
DN >300 – DN ≤375	150

6.3.14.7.2 Scour locations

Scours shall be located at:

(a) Low points at the ends of water mains; and

(b) Low points between in-line stop valves.

Scours shall drain to a point where the discharge is readily visible to prevent the scour valve inadvertently being left open.

Typical discharge locations include:

(c) An approved pit that is to be pumped out each time the scour is operated (called a pump scour);

(d) A kerb and channel;

(e) An open-grated street drainage sump;

(f) A natural water course (with energy dissipater).

Scours shall not:

(g) Cause damage when operated;

(h) Discharge to closed stormwater structures;

(i) Discharge across roadways;

(j) Discharge directly to waterways, unless in compliance with the appropriate consent requirements.

6.3.14.8 Flushing points

Flushing points shall be installed at the end of DN 50 rider mains (see Appendix B Drawing B7-5).

6.3.15 Hydrants

6.3.15.1 General

Hydrants are installed on reticulation mains for firefighting or operational purposes. Operational purposes include mains flushing, chlorination, to allow the escape of air during charging, and the release of water during dewatering of the water main, where air valves and scours are not installed.

6.3.15.2 Hydrants for firefighting

The spacing of hydrants for firefighting shall be in accordance with SNZ PAS 4509.

6.3.15.3 Hydrant installation

Fire hydrants shall not be fitted to reticulation mains DN <100 or to distribution or transfer mains without the prior written approval of the TA.

6.3.15.4 Hydrants for reticulation system operational requirements

Additional to firefighting requirements, hydrants shall be provided at:

(a) High points on reticulation mains to release air during charging, to allow air to enter the main when dewatering, and for manual release of any build-up of air, as required, where automatic combination AVs are not installed;

(b) Localised low points on water mains to drain the water main where scours are not installed.

Adequate drainage facilities shall be provided to receive the hydrant flows from dewatering and flushing operations.

> ***C6.3.15.4***
>
> *AVs are not normally required on reticulation mains in residential areas where the configuration of mains and service connections will usually eliminate small amounts of air accumulated during operation; hydrants should be placed as close as possible to stop valves to facilitate maintenance activities such as cleaning of water mains.*

6.3.15.5 Hydrants at ends of mains

If a scour is not provided, a hydrant shall be installed as close as possible to the end of every main DN ≥100.

> ***C6.3.15.5***
>
> *Apart from the firefighting function, a hydrant also allows the section of dead end main to be flushed regularly to ensure acceptable on-going water quality. This is particularly important in new subdivisions where only a small number of properties may be connected initially and where the main has been laid in a larger than required size with the expectation that it will be extended at a future date.*

6.3.16 Connections

6.3.16.1 Connection of new mains to existing mains

In specifying connection detail the designer shall consider:

(a) Pipe materials, especially potential for corrosion;

(b) Relative depth of mains;

(c) Standard fittings;

(d) Pipe restraint and anchorage;

(e) Limitations on shutting down major mains to enable connections; and

(f) Existing cathodic protection systems.

Connections from the end of an existing main shall be designed to address any differing requirements for the pipes being connected, particularly restraint, spigot/socket joint limitations, and corrosion protection. The designer shall consider the potential for insufficiently restrained/ anchored stop valves near the connection.

All connections to the existing reticulation shall be made by a contractor approved the TA.

6.3.16.2 Property service connections

Each Residential Unit shall be provided with a 20mm (ID) dia connection. The connection to each Residential Unit shall include a 20mm (ID) dia Acuflo Manifold including internal backflow prevention located within an Acuflo manifold box on the property boundary within the road reserve.

For Multi-unit developments and multiple rears lots that exceed 5 lots or units then a suitably designed rider main can be installed with the toby valves located within the ROW adjacent to the individual properties or units.

Where it is not practical to install all the meters within the road reserve (i.e. multiple dwellings of three levels or greater), QLDC may at its sole discretion, consent to remote water meters being installed within the property, where they are readily accessible for reading, maintenance or replacement. In addition to separate meters within the property, multi-unit developments must also have a single property meter located on QLDC's side of the point of supply.

The Acuflo manifold box shall be extended and the Acuflo manifolds shall be located with 550-650mm cover to ground level for all 20mm connections. The toby valve for all other service connections shall be located with 550-650mm cover to ground level within a standard valve box.

Valves shall be located clear of vehicle manoeuvring areas, where practicable. Where this cannot be achieved, the valve shall be protected within a pre-approved trafficable valve box.

Where the District Plan permits two or more Residential Units to be constructed on a single Lot, individual 20mm (ID) dia service connections shall be provided to each Residential Unit or one 25mm (ID) dia service connection for a maximum of two Residential Units. Each service connection shall be connected to the nearest trunk water main or rider water main. 25mm dia water connections shall be divided and reduced to a 20mm dia water connection to each Residential Unit served.

Tapping saddle fittings used with polyethylene pipe must comply with AS/NZS 4129. All other tapping bands should be in accordance with AS/NZS 4793. Mechanical saddles are acceptable for pipe sizes between DN63 and DN180. Electrofusion saddles are acceptable for pipe sizes between DN63 to DN315. A Tee shall be installed on pipe sizes over 315 mm diameter. Gunmetal tapping bands on polyethylene pipe is not permitted.

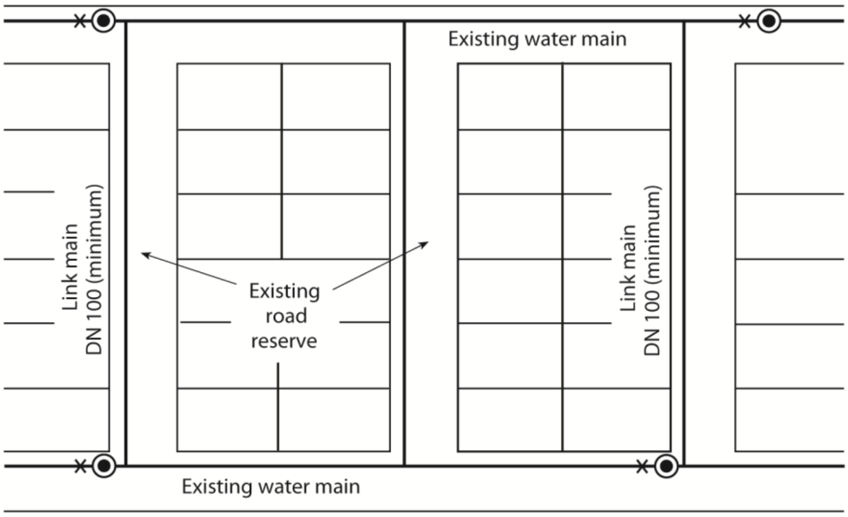
6.3.16.3 Permanent disconnection of water lateral

Permanent disconnection will disable the connection to the extent it will not be possible to restore service through the pipe.

This will require the water connection to the main (whether in the verge or road carriageway) being disconnected and capped off at the main.

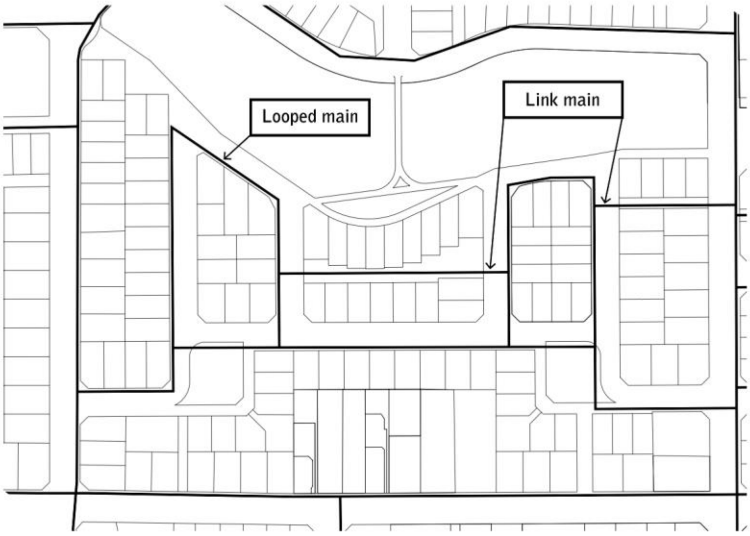
6.3.17 Termination points

Termination points or dead ends should be avoided to prevent poor water quality. Alternative configurations such as a continuous network, link mains, looped mains, and the use of reticulation mains smaller than DN 100, particularly in no-exit roads, should be considered (see figures 6.4 and 6.5).



NOTE – Rider mains are not shown.

Figure 6.4 – Elimination of termination points



Note - Rider mains are not shown

Figure 6.5 – Looped and link principal mains

6.3.17.1 Permanent ends of water mains

Rider mains, DN <100, may be used to supply the furthest properties beyond the water main. The DN 100 main shall be laid to a point where all properties are provided with the fire protection required by SNZ PAS 4509.

A method of flushing shall be provided at the end of the rider main and water main, which shall be suitably anchored (see Appendix B Drawing B7-5).

6.3.17.2 Temporary ends of water mains

Water mains shall be laid to within 1 m of the boundary of a subdivision where the main is to be extended in the future.

Temporary dead-end mains shall terminate with a hydrant followed by a gate valve. The valve and hydrant shall be suitably anchored so that the future extension can be carried out without the need to disrupt services to existing customers.

Where a development is staged mains shall be constructed to terminate approximately 2 m beyond the finished road construction to ensure that future construction does not cause disruption to finished installations.

6.3.18 Water Meters and Backflow Prevention

Water meters shall be installed by the developer at all points of supply on the property boundary and must be accessible to pedestrians. Once installed and following 224c certification the meters are owned and maintained by QLDC.

All meters shall be in accordance with QLDC's water metering policy or as agreed in writing by QLDC's Asset Planning and Strategy and Asset Planning teams.

6.3.19 Building over Council Infrastructure

No building shall be constructed over any water supply pipe, nor shall any structure foundation be located within a line extending at 45º from 150mm below the pipe invert to the ground surface, without the specific approval of the Council.

The Council will only give approval to construct a building/structure over a water main if;

i. It is impractical to construct a new main clear of the zone of influence;
   and
ii. A valve is installed within 10m of both sides of the building;
   and
iii. The pipe runs in a straight line both vertically and horizontally between valves and shall be PE100;
iv. There are no connections under the building;
   and
v. The condition of the pipe is checked pot holes every 10m prior to construction at the applicant's cost and the pipe condition is approved as acceptable by Council;
   and
vi. Structures straddling or founded within the above zone are designed by a Chartered Professional Engineer such that there is no loading from the building applied to the water main;
   and
vii. Easement to be revised at the applicant's expense and in accordance with the conditions of any specific approval.

6.4 Approval of proposed infrastructure

6.4.1 Approval process

Water supply infrastructure requires approval from the TA.

6.4.2 Information to be provided

Design drawings compatible with the TA's concept plan and the design parameters included in this Code of Practice shall be provided to the TA for approval. Designers shall ensure the following aspects have been considered and where appropriate included in the design:

(a) The size (or sizes) of pipework throughout the proposed reticulation system;
(b) Selection of appropriate pipeline material type/s and class;
(c) Mains layouts and alignments including:
    (i) Route selection
    (ii) Topographical and environmental aspects
    (iii) Easements
    (iv) Foundation and geotechnical aspects
    (v) Clearances, shared trenching requirements
    (vi) Provision for future extensions;
(d) Hydraulic adequacy including:
    (i) Compliance with the required maximum and minimum operating (working) pressure
    (ii) Acceptable flow velocities, and
    (iii) Compliance with the estimated water demand, including firefighting;
(e) Property service connection locations and sizes;
(f) Types and locations of appurtenances, including:
    (i) Stop valves
    (ii) Pressure reducing valves (PRVs)
    (iii) Hydrants and fire services
    (iv) Scours and pump-out branches and
    (v) Termination details;
(g) Locations and details of thrust blocks and anchors, see Appendix B Drawing B7-7.
(h) Preparation of final design drawings, plans (and specifications if applicable).

6.5 Construction

6.5.1 Excavation

Excavation of existing carriageways shall conform to the TA's road opening procedures where these exist. Excavation in existing carriageways shall be carried out in a safe manner with the minimum disruption to traffic and pedestrians.

6.5.2 Embedment

Pipes and fitting shall be surrounded with a suitable bedding material in accordance with Appendix B Drawing B1-2 to DrawingB1-4).

6.5.3 Backfilling and reinstatement

6.5.3.1 Carriageways

Backfilling shall be in accordance with the requirements of the TA.

Pipe trenches within a carriageway shall be backfilled using an approved hardfill placed immediately above the pipe embedment and compacted in layers not exceeding 200 mm in loose depth, as per Appendix Drawing B1-2 and Drawing B1-3

In existing sealed roads, the top section of the trench shall be backfilled as specified by 3.4.2.3. The depth of base course and type of finishing coat seal shall conform to the standard of the existing road construction.

6.5.3.2 Berms

Pipe trenches under grass berms and footpaths shall be backfilled in accordance with the requirements of Appendix B Drawing B1-4.

6.5.3.3 Detector tape

Open trenching – backfill shall be placed to 100 mm below existing ground level. At this point, where required by the TA, the contractor shall provide and lay metallic 'detector' tape coloured blue, stipulating 'Danger – Water Main Below' (or similar). See Appendix B Drawing B1-1.

6.5.3.4 Tracer wire

Tracer wire in the form of a continuous 4 mm^2 multi strand (minimum 4) polythene sleeved copper cable, shall be installed with all non-metallic pipes to allow detection. The wire shall be strapped to the pipe wall by means of a minimum of two complete wraps of heavy duty adhesive tape, at a maximum of 3.0 m intervals. The wire shall have some slack to allow for bends in laying and for future installation of tapping saddles.

The tracer wire shall run continuously between valves and hydrants. At each valve or hydrant the wire shall be ducted to surface level through a length of polyethylene pipe ending immediately below the lid, The tracer wire shall be long enough to extend 600 mm minimum above ground level when uncoiled. The excess length shall be neatly coiled in the valve or hydrant box.

The tracer wire shall be tested for continuity between surface boxes using an electronically generated tone and detector probe or alternative approved method.

NOTE tracer wire is not required on water laterals.

6.5.4 Pressure testing of water mains

Before a new water main is connected to the existing reticulation, a successful pressure test shall be completed. The system test pressure is applied to test the integrity of construction of the pipeline system. The system test pressure generally exceeds the actual design pressure of the system (maximum 1.25 times the maximum rated operating pressure of the lowest rated component in the system). See Appendix C for the appropriate testing procedure.

6.5.5 Disinfection of water mains

Disinfection of the water mains shall be carried out following successful pressure testing and backfilling as specified in Appendix D. The disinfection solution shall be collected and disposed of in an appropriate manner.

6.5.6 Discharge of testing water

Discharge of testing or chlorinated water from pipelines may require a resource consent from the regional council.

6.5.7 Water sampling

The TA may require water samples to be taken for water quality compliance purposes.

7 LANDSCAPE

7.1 Scope

Where community specific guidelines are available these shall be taken into consideration throughout the design and construction of subdivisions and development.

This section sets out requirements for the design and construction of landscape and planting for land development and subdivision. Section 7 applies to all landscape areas requiring planting and revegetation whether in road reserves, swales, rain gardens, ponds/wetlands, recreation reserves, or other public reserves, and private land.

Design and construction shall be undertaken in accordance with the requirements of Part 7, Landscape of NZS 4404:2010 except as amended and extended for Queenstown Lakes District Council requirements in the clauses below, and any Queenstown Lakes District Council guidelines and specifications relating to landscape and reserves Developments shall comply with Section 7 Landscape of NZS 4404:2010 except as modified by this document.

Throughout the section where the QLDC or Council Operations [Parks] Department is referred to, this should be taken as the QLDC or Council Parks and Open Space Planning team.

7.2 General

Consultation with Queenstown Lakes District Council's Operations [Parks] department is required on all landscape matters in potential reserves prior to the design phase and development plan approvals. This includes consulting on the potential to create new reserve land and/or improve existing reserves. Public land for reserves shall only be created and vested in Council where there is an identified need in consultation with Council's Operations [Parks] department.

All landscaping and built assets in reserves and road reserves to be vested to Council shall be maintained by the developer for a minimum period of 3 years from the time of receiving 224c certification. A developer's agreement shall be provided to Parks and Open Space Planning team outlining how the reserves will be maintained within this period and the condition they shall be in at the end of this period".

7.2.1 Approval

Consultation with the Council on landscape design and construction at an early stage, and prior to submission of any engineering designs for acceptance, is required. New planting plans are to be signed off by the Parks and Open Spaces Planning Manager prior to planting or establishment of planting areas.

Each TA may have specific landscape guidelines which will be detailed in district plans or codes of practice and some areas may be subject to special landscape requirements which will need assessment through a resource consent process. These may be subject to specific design consideration and approval by the TA. Stormwater systems including secondary flow paths shall be considered when landscape designs are determined, so as to avoid conflict or failure of these systems.

7.2.2 Environmentally-responsive design

Landscape design has application throughout the subdivision and development process. Landscape design should be considered in the early stages of a development and at this initial concept stage it is important to establish objectives for overall landscape design involving the appropriate professionals to assess the natural systems, vegetation, and landscape features. This includes consideration of protecting, maintaining, and restoring existing natural ecosystems, vegetation, and landscape features; responding to the surrounding landscape character and context; and cultural and heritage elements; and contributing to ecological and habitat biodiversity. Provision of amenity open space and access is required to make open space connections, access to and location of watercourses, and provision of reserves and streetscape to provide a framework of coherence and amenity.

7.2.3 Reserves and land protection covenants

Queenstown Lakes District Council's requirements for new reserve provisions should be determined prior to the initial design stage through consultation with the Operations [Parks] department.

When assessing reserve provision and development proposals the Council will consider:

- Filling existing gaps in reserve provisions
- Encouraging improvement of existing reserves
- Development designs that are sympathetic to the existing landscape character of the area
- Development designs that will provide recreational benefit to the community and/or District
- Preserving existing lookout and observation points
- Protecting heritage features and sites
- Protecting and enhancing sites of ecological importance
- Securing reserve land at the subdivision stage(s) of development.

Council may request recreation, landscape, heritage or ecological assessments for consideration.

If new reserve land is considered appropriate, layout plans showing proposed location of reserves are required to be approved by Queenstown Lakes District Council's Operations [Parks] department prior to an application for an outline development plan, a plan change, a resource or building consent or a connection to Council services being lodged.

All reserve provision and development proposals should be approved in principle by Queenstown Lakes District Council's Operations [Parks] department prior to any public consultation.

Detailed development plans for all future reserves shall be submitted with applications for subdivision consent, and no work is to be carried out on site before approval of the development plans from Council's Operations [Parks] department. No work is to be carried out until development contributions have been calculated and agreed with Council. Council agreements relating to individual stages of development will allow work to commence on those stages.

All reserve development shall be completed in accordance with the plans acceptable to Queenstown Lakes District Council's Operations [Parks] department. 'As-built' plans shall be provided for all reserves. Development may include earthworks, drainage, irrigation, planting, paths, structures (such as seating, tables, lighting, rubbish bins, fencing, barriers, signs, and play equipment) and facilities (such as toilets and changing sheds) as agreed with Council's Operations [Parks] department.

Unless a license to occupy is agreed by QLDC, gardens in road reserves shall only be provided in areas that are adjacent to commercial or community uses i.e. shops, hospitality, parks, schools or community facilities. In all residential areas, the expected level of service for road reserves is trees and lawn unless a license to occupy the road reserve that ensures maintenance of the garden(s) by the licensee is agreed by QLDC.

If gardens are provided for in road reserves (in accordance with the above clause and not covered by a license to occupy) the developer shall maintain the garden areas for a period of one year from the time the road is vested. All trees planted in road reserves shall also be maintained by the developer for a period of one year. A developers agreement shall be provided detailing the maintenance specifications for trees and garden areas in road reserves. At the end of the one year period all trees and planting is to be shown to be of good health and free of structural defects otherwise term will start again - after tree or plants has been replanted.

7.2.4 Ecological, functional, and aesthetic opportunities

Planting provides a range of ecological, functional, and aesthetic opportunities for environmental enhancement:

(a) Ecological:
- (i) Provides, protects, and maintains terrestrial biodiversity and habitat
- (ii) Reduces the amount of sediment and pollutants entering waterways
- (iii) Maintains and enhances water quality and habitat
- (iv) Reduces surface water flooding
- (v) Increases stability and contributes to erosion control
- (vi) Supports carbon sequestration
- (vii) Supports ecosystem functioning including nutrient recycling, water retention, purification, and sediment control
- (viii) Provides wildlife habitat value;

(b) Functional:
- (i) Defines space
- (ii) Provides shade, shelter, and privacy
- (iii) Screens unsightly outlooks and provides visual barriers
- (iv) Ameliorates sound and reduces pollution
- (v) Assists driver recognition of road link and place context
- (vi) Reduces glare and reflection and provides urban cooling
- (vii) Assists in the control of erosion
- (viii) Creates physical barriers
- (ix) Provides recreation and amenity value
- (x) Provides edible species
- (xi) Provides opportunities for enhancing health, and should not be detrimental to it;

(c) Aesthetic:

(i) Frames views

(ii) Emphasises landform and landscape features

(iii) Provides visual unity in the environment

(iv) Reduces the visual impact of the roadway

(v) Softens hard surfaces and bleak areas

(vi) Provides colour, form, and texture

(vii) Provides visual lineage within and between regions

(viii) Provides identity and environment.

7.2.5 Landscape and planting opportunities

Opportunities for landscaping are diverse, ranging from specimen tree planting to planting associated with existing indigenous vegetation, traffic management devices, riparian margins, wetlands, swales, rain gardens, ponds, reserves, and specific landscape features in the development.

7.3 Design

Planting and other landscaping shall be appropriate to and compatible with the local environment. The design layout and plant species selection shall be based on the consideration of the following:

(i) Ability of plants to thrive on the site
(ii) Height of plants at time of maturity and future shading impacts
(iii) Size of planting areas, including road berms, to be compatible with plant species
(iv) To be sympathetic to the existing landscape character of the area
(v) Provide for long-term sustainable management.

Planting and other landscaping features shall be easily maintainable and minimise overall life cycle costs inclusive of establishment, irrigation, maintenance and replacement.

7.3.1 Location

Landscaping and planting should be designed to respond to the overall environmental context such as vegetation and water bodies, cultural and heritage elements, local road geometry, stormwater and reserve design, and utilities placement. Planting may include specimen trees, edible gardens, rain gardens, swales, and other amenity garden features. Refer to the Queenstown Lakes District Council Street Tree Planting Guidelines.

Infrastructural services should be planned at the same time as the landscape design so that tree and garden planting location does not compromise the integrity and efficient operation of services. If particular landscape conditions or objectives are required for a subdivision or development then these will need to be taken into account prior to undertaking detailed engineering design.

Detailed development plans showing distances of trees from paths, structures and underground services shall be provided for the approval of Queenstown Lakes District Council's Operations [Parks] department so as to reduce the potential for future conflicts between trees and infrastructure. All trees and vegetation planted near high voltage transmission lines must comply (including when maturity is reached) with the Electrical (Hazards from Trees) Regulations 2003.

All new trees in reserves and road reserves require the approval of the QLDC Arborist unless tress are approved species from QLDC Street Tree Planting Guidelines Appendix I. If a license to occupy has not been granted, and garden assets are proposed to lie within the road corridor in areas of 50 km/hr and above, approval by QLDC's Parks and Opens Spaces Manager is required. This will be assessed based on appropriate levels of service and traffic management requirements in addition to the above criteria.

7.3.2 Reserve location and layout

Reserve location and layout design shall take into account adjoining land uses and areas to ensure there is an appropriate provision of recreation assets and landscaping in accordance with TA's plans and policies. The design of access routes into and through a reserve should ensure linkages with existing networks, consider future developments both of the reserve and adjoining areas, take into account topography, and shall follow CPTED principles.

7.3.3 Existing vegetation and trees

Where there is existing vegetation and/or trees in an area proposed as reserve, Queenstown Lakes District Council's Operations [Parks] department shall decide whether they are to be removed or retained prior to development and Arboricultural and/or Ecological assessments shall be provided on Council's request to inform this decision. Vegetation and/or trees to be removed or retained shall be identified on the development plans.

All existing vegetation and trees to be retained shall be cordoned off to protect the root zone and vegetation, prior to the commencement of construction and the cordon shall remain in place until completion of construction.

Existing trees to be retained are to be protected by temporary fencing in a circle with a radius equal to the maximum crown extension (drip line). A qualified person shall be used to determine the protected area and supervise construction. At no time shall anything be deposited in the root zones of protected vegetation and trees. If installation is required under existing vegetation trenchless technology should be considered, if this is not practicable advice from a suitably qualified person should be sought to minimise damage to the vegetation.

A tree or vegetation plan and construction methodology shall be supplied to the TA including:

(a) Position and design of temporary protective fencing or other methods of protection;

(b) Arboricultural maintenance required;

(c) Methods of protection of the tree and root zone where construction is to occur near the root zone and tree canopy;

(d) Maintenance required for long term health and stability of the tree or vegetation.

7.3.4 New trees and road geometry

Separation and sight distances should be considered when planting on roads. Alternative location and design proposals shall also be considered, such as provision of trees in a dedicated area or 'non-services' berm in the road reserve. Tree planting in groups can help accentuate road perception (see 3.3.5). Strategically placed, grouped plantings of trees are often of greater benefit and impact than individual trees placed linearly in a roadside berm.

7.3.5 Planted grass areas, berms, swales, or rain gardens

Berms, swales, or rain gardens shall be of sufficient width to allow for adequate growth of the plants and ease of maintenance. Narrow grass strips should be avoided. It is important to provide adequate means for tree growth and ongoing tree health at the same time as allowing for infiltration of water.

7.3.6 Species selection

In selecting species for planting, take into account the overall composition, low maintenance, and longevity, as well as the need to comply with the TA's planting policies. All new trees in reserves and road reserves require the approval of the QLDC Arborist unless tress are approved species from QLDC Street Tree Planting Guidelines Appendix L. Refer Appendix I for QLDC Street Tree Planting Guidelines.

Fruit trees and native tree species suitable to the environment shall be promoted in reserves, where appropriate.

The spacing of trees and plants should ensure a coherent design. The following matters shall be considered:

(a) Suitability of eco-sourced native plants for revegetation planting of the ecological region to protect the local biodiversity;

(b) Suitability to environmental conditions, for example climate, ground moisture, wind, and shade;

(c) Tolerance to high foot traffic use where appropriate;

(d) Pest and disease resistance, invasive or recognised as a pest plant under the National Pest Plant Accord (refer to http://www.biosecurity.govt.nz/nppa);

(e) Non-suckering habit;

(f) Final height, form, and longevity;

(g) Maintenance requirements;

(h) Safety such as toxicity of leaves, flowers, seeds, and bark in areas likely to be used by young children, and impairments to pedestrians;

Plant species on the road should be selected to avoid interfering with sight lines inconsistent with the target operating speed. The mature size of any tree or garden planting is to be assessed for each planting location and relative to the surrounding street environment.

7.3.7 Quality control

All plants shall be sound, healthy, vigorous, and free of any defects which may be detrimental to plant growth and development. In addition plants should have vigorous root and branch systems and plants supplied in pots should not be root bound. To ensure that plants adapt and thrive once planted they should be 'hardened off' prior to planting. Only species adapted to the site conditions shall be planted. Biodegradable plant protectors/guards are only to be used (no plastic).

7.3.8 Landscaping structures

7.3.8.1

Landscaping structures include (but are not limited to) sculptures, walls, fences, screens, bollards, tree cages, entranceways, and posts. The materials should be robust to suit their purpose and ideally reflect the local character. The design of the landscape structure shall be considered as an integral part of the development and surroundings to fulfil both functional and aesthetic requirements. Durability and maintenance requirements shall be considered. Structures shall not:

(a) Inappropriately limit safe sight lines;

(b) Be a hazard to pedestrians, people with disabilities, cyclists, or vehicle traffic.

7.3.8.2

Entranceway wall structures shall be located fully on private land unless TA approval is obtained. Any other immovable landscape structure (for example boulders) shall be located to prevent obstructing access to underground services.

7.3.8.3

Structures shall be designed to safely withstand appropriate loadings. Structures not exempt under the Building Act shall only be constructed on receipt of a building consent.

Design for access and mobility of buildings and associated facilities shall comply with NZS 4121.

All retaining walls including those not requiring a building consent should be constructed to resist lateral earth pressures and those from any surcharge loading that may be present.

7.3.9 Fencing of reserves

The permanent fencing of common boundaries of any reserve including esplanade, reserve accessways, and road boundaries, may be required. Standards and requirements shall be in accordance with the TA's fencing policy at the time. The TA may specify that one or both of the following options apply:

(a) A fencing covenant is registered on all titles of properties with a common boundary to reserve land, indemnifying the TA against all costs of erection and maintenance of fences on common boundaries;

(b) There is a specific fencing design for the reserve or boundary type.

7.3.10 Planting period and irrigation

Planting programmes where possible shall occur in the season that optimises growing conditions for plants and trees and maximises plant establishment.

Depending on the location and season of planting, Queenstown Lakes District Council's Operations [Parks] department may require provision for temporary irrigation of native gardens, grass areas or revegetation planting. Provision for watering during the establishment of plants or lawn may be required for these areas if not otherwise irrigated. Grass areas in reserves in CBDs or shopping precincts, sports field turf and all specimen trees and exotic gardens shall be permanently irrigated and irrigation plans shall be supplied for approval by Council's Operations [Parks] department.

All other reserves, including berms in the road reserve, shall not be irrigated unless with the written agreement of QLDC Parks and Open Space Planning team.

Irrigation shall be designed in accordance with the design standards and specifications included in Appendix F.

7.3.11 Trails and Tracks

All new trails and tracks shall be developed in accordance with the QLDC 2018 Trail Design Standards & Specifications Appendix J.

7.3.12 Playgrounds

New playground designs are to be signed off by the Parks and Open Spaces Planning Manager before resource consent is issued. As-builts for all new assets are to be received by Council before 224c is approved. New playground design and equipment shall comply with NZS 5828 and SNZ HB 5828.1.

7.3.13 Sports field facility development

New playground designs are to be signed off by the Parks and Open Spaces Planning Manager. It is strongly advised this is done before resource consent is issued. Design shall be in accordance with the *Guidance Document for Sports Field Development, 2019.*

7.3.14 Public toilets

New public toilet design shall comply with NZS 4241. All public toilets with pump stations or septic tanks shall be designed in accordance with Appendix G – Sewer Pump Station

7.4 Construction and maintenance

7.4.1 Introduction

There are minimum construction and maintenance standards and recommended procedures to be followed to ensure that all landscaping is to an acceptable standard prior to final inspection and release of the bond, if a bond is required.

It is the developer's responsibility to ensure that the landscaping meets the required standards at the termination of the maintenance period. The developer is responsible (and may be bonded) for the routine maintenance and replacement of the planting including dead wooding, weed control, mulching, replacing dead trees, shrubs, and plants, and watering for a defined period from the time of acceptance of as-built landscape plans by the TA or issue of a s. 224 completion certificate under the Resource Management Act.

Sign-off for practical completion shall be obtained from the Queenstown Lakes District Council's Operations [Parks] department at the end of the maintenance period. Maintenance and plant replacement shall be undertaken until sign-off. Prior to sign-off, grass and planting areas shall have a fully established sward of grass or planting coverage without any visible gaps. There should be no weeds present in the planting areas, and weed species should consist of no more than 5% of grass areas. All trees should be in good health, structure, form and be free of disease.

7.4.2 Soil and fertility

The developer shall be responsible for the supply and spreading of soil. Topsoil should be correctly stored and handled when stripped and respread. A soil test shall be undertaken to determine the composition and type of fertiliser to be applied to the area being developed. A proprietary fertiliser or soil ameliorant suited to the species shall be applied where the existing soil is deficient in minerals and nutrients, plants are showing signs of lack of fertility, or to ensure maximum health and vigour.

Application rates and type of fertiliser or soil ameliorant should be selected according to species and soil fertility.

7.4.3 Weeds and litter control

At the end of the maintenance period there shall generally be no weeds within 2 m of any tree planting or in garden beds. Weeds should be controlled in an appropriate manner. When hoeing/pulling weeds care shall be taken to avoid damage to plants and their roots. The soil shall not be mixed with mulch when removing weeds. Any spraying should be kept to a minimum near swales, rain gardens, ponds, riparian margins, and adjacent properties.

All areas once established shall be kept free of litter and debris, including paper, plastic, stones, bricks, bottles, glass, cans, and other forms of inorganic matter.

7.4.4 Planting grass areas

7.4.4.1

Grass areas and berms shall be formed after all other construction has been completed. The grass areas and berms shall incorporate not less than 100 mm compacted thickness of friable weed and stone free topsoil (generally made up of a compositions of approximately 1 – 5% sand, 7 – 16% humus or organic material, and no more that 30% weight in clay) placed over a base material capable of allowing root penetration and sustaining growth. The maximum slope for grass areas intended to be mown is 1:5.

7.4.4.2

Stormwater reserve grassed areas that are to be mown shall have a high endophyte certified seed. A Fescue/Browntop blend is suggested with a composition of 50% Winter Active Rygrass, 15% Chewing Fescue, 15% Creeping Red Fescue, 18% Tall Fescue, and 2% Browntop.

7.4.4.3

Heavily compacted soils shall be ripped to a depth of 300 mm with rip lines 1 m apart, and rolled, before any laying of topsoil. The ground profile shall be smooth and free of ruts and depressions prior to grassing. Ripping to decompact soils should not be undertaken within the dripline of trees to be retained. Grass areas and berms shall be graded to edges (for example, pavement or footpath) allowing for approximately 15 mm of settlement.

7.4.4.4

All grass areas within a road corridor that has a speed limit in excess of 50km/h are to be planted with high fescue grass on screened soil.

7.4.4.5

Rural berms shall be topsoiled to the same standards as urban berms unless they make use of already grassed undisturbed ground.

7.4.4.6

The area for grass seeding shall be free of all weed species. Grass seed mix shall be in accordance with the Queenstown Lakes District Council Turf Reinstatement Specifications, January 2007.

7.4.4.7

A sward coverage of not less than 90% shall be achieved within 1 month of sowing, and before completion documentation shall be provided for processing by the TA. All established grass shall be mown to a range specified by the TA. A common mowing height range is a minimum height of 50 mm and maximum height of 100 mm. All grass edges shall be maintained in a neat and tidy manner.

7.4.5 Mulch

7.4.5.1

Mulch shall be applied to tree and garden areas to conserve moisture and reduce weed growth, except in riparian margins. Typically mulch will be cambium grade bark mulch, clean, free of sawdust and dirt, and with individual pieces no larger than 100 mm; mulched trees/branches that have no viable seeds; or stone mulches. Mulch for planting beds shall be a uniform 100 mm in final depth.

Where deemed required, robust timber edging to be included on gardens and mulched areas in order to prevent mulch/soil loss/creep onto walkways etc. Mulched areas timber edging to be maintained at 100 mm minimum. Assessment to be made by Parks Planner or Parks Officer.

Before mulching soil should be damp to a depth of 300 mm. Mulching should be carried out on an ongoing basis to all garden beds and juvenile trees to maintain specified depth at end of maintenance period.

7.4.5.2

Mulch shall only be spread after the soil surface is levelled off to remove bumps and hollows. Weeds and grass are to be removed prior to mulching. Plants shall not be damaged or buried during the mulching process. Where it is known that bark mulch affects certain species or will be lost due to wind, slope of the land, or for some other reason, alternative mulches shall be considered and used.

7.4.5.3

Mulch shall be evenly spread at the base of the trunk and shall not be stacked into a volcano shape.

7.4.5.4

Mulch should be free of all contamination including non-organic debris, pest plants, noxious (as specified under the Otago Regional Council Regional Pest Management plan 2019), contaminants, stumps, branches, and construction debris

7.4.6 Specimen tree planting

7.4.6.1

Specimen trees are defined as trees with a trunk diameter of 25 mm to 100 mm when measured at 1400 mm above ground level. Larger trees can be used with the approval of the TA.

Those contractors involved in specimen tree planting and maintenance should be competent horticultural/ arboricultural practitioners and therefore follow accepted industry standard procedures for tree planting. Establishment and initial maintenance are critical to the long-term viability of the specimen tree.

7.4.6.2

Specimen trees shall be sound, healthy, vigorous, and free of any defects (relative to the species). Specimen trees are to be a minimum of PB 95 (planter bag of 95 pint capacity approximately 54 L) grade when planted. A recommended minimum height for specimen trees is 2.5 m at the time of planting to aid early establishment unless the local conditions of a site require consideration of alternatives, for example, an exposed site may require small, well-hardened trees. Specimen trees between 1.5 – 2.5 m may be allowed with the approval of the TA.

7.4.6.3

Given the generally modified nature of soil in subdivisions it is essential that a suitable tree planting pit be prepared. The approach shall be to have:

(a) Ground free from debris and rubbish;

(b) Ground cultivated to a depth of 1 m and a width of 1 m to break up any compaction, fracture subsoil, and afford drainage to hard rock areas;

(c) Sides of planting holes crumbled and not smooth;

(d) Topsoil incorporated into the upper level of planting holes;

(e) Each tree fertilised with an appropriate amount of slow release fertiliser, as per the manufacturer's recommendations;

(f) Final planted depth consistent with finished ground level;

(g) Each tree adequately staked to withstand movement in natural wind conditions and to meet TA standards;

(h) Trees secured with expandable ties at approximately 1/3 of their height or as high as required to support the tree (to be checked every 6 months) or anchored below ground with a root ball anchor;

(i) Soil firmed sufficiently to force any air pockets from planting holes;

(j) Trees watered immediately following planting;

(k) Trees radially mulched to a distance of 500 mm or to drip line, whichever is the greater area and a depth of 100 mm; and

(l) Staking uniformly low and visually consistent throughout the subdivision stage. Ground-treated timber stakes should only be used if the stakes are to be removed once the trees are stable, that is at the end of a maintenance period.

(m) Unless specifically agreed otherwise by Council, new verges that incorporate street tree planting shall be no less than 1.8m in width in order to provide the new trees with a suitable rooting environment and increase their likelihood of becoming successfully established without disrupting the surrounding infrastructure. Appropriate alternative methods should be used in cases where less room is available and street trees would provide amenity.

7.4.6.4

The onus is on the developer to ensure that trees are protected during the further development of the subdivision (that is, the construction of dwellings/buildings) and during the defined maintenance period.

7.4.6.5

Newly planted trees, where appropriate, shall incorporate a suitable and sustainable form of physical support. This support can consist of below ground anchor systems (preferred when planting large grade trees in very high profile situations) or wooden stakes. If wooden stakes are employed, the local climatic conditions shall be assessed and this will determine the dimensions of the supports, though as a guide tree stakes should not exceed 1/3rd of the height of the tree being planted. Options for tree staking include a single stake positioned on the windward side of the tree (only to be used in relatively sheltered areas) two opposing stakes or three stakes in a triangle formation (to be used on large grade trees).

The newly planted tree shall be attached to the wooden stakes using a suitable tie which shall be at least 50mm in width and of a semi-permanent webbing construction made from a biodegradable product such as hessian or an acceptable equivalent. Each tie should be taut, but should not pull the tree towards the stake. The intention is to keep the tree in place while permitting the top to move freely, such crown movement will encourage increases in stem diameter and root development.

7.4.6.6

Providing a suitable rooting environment is crucial to successful tree establishment. Ensuring a newly-planted tree has sufficient good quality, uncompacted soil increases the trees likelihood of becoming successfully established without disrupting the surrounding infrastructure. Certain specialist design features may reduce the soil volumes required within the pit itself, such as interconnected pits, or incorporation of root paths to nearby uncompacted soil.

Achieving sufficient soil volume on sites where the planting area is subjected to loading such as car parking, footpaths, roads above tree roots requires a system of below ground support. Two of the most commonly used methods are structural soils and below-ground, pre-engineered cells. Structural soils are appropriate where other, non-structural soil is also readily available to the tree. For example, trees planted within a parking area adjacent to a soft landscape area, where tree roots can grow freely beneath the hard surfacing, but have access to adjacent uncompacted soil. Pre-engineered cells filled with suitable soil may be necessary in more urban areas where tree roots have fewer opportunities to access soil beyond the tree pit. The use of either approach requires specialist knowledge and advice should be sought from the manufacturer/supplier before being included in the tree pit design.

7.4.7 General amenity planting

Before topsoil is added all stripped and graded ground intended for planting should be cultivated to a depth appropriate to the plant species including a sufficient depth to break up any compaction. There should be friable topsoil for shrubs and ground cover appropriate to the depth of the root ball.

7.4.8 Revegetation planting and existing vegetation

Revegetation planting shall be a minimum grade of PB3 (planter bag) or root trainers and shall be planted at a density and size of plant that achieves a coverage ratio specified by the TA or appropriate to form the desired canopy density. Plants shall be spaced unevenly in the planting layout to encourage a natural appearance and setting.

Assisted natural revegetation is a technique using native seedling establishment complemented with weeding, thinning, and mulching and is an option that may be considered.

Edges of existing vegetation, to be retained where appropriate, shall be planted to mitigate the effects of wind funnelling. Mulches can be used in these areas to minimise the establishment of weed species.

7.4.9 Swales, rain gardens, wetlands, and riparian margins planting

Swales, rain gardens, wetlands, and riparian margins should have site specific planting plans prepared by a suitably qualified person and submitted to the TA for approval of designs. Access shall be provided if future removal and maintenance is required.

7.4.10 Pruning

7.4.10.1

Trees should be selected and located to minimise ongoing pruning costs and requirements. All pruning of street trees shall be undertaken by a suitably qualified arborist. All pruning shall be undertaken to recognised arboricultural practices. Pruning of amenity trees shall comply with AS 4373.

Pruning should be carried out on shrubs to maintain a high standard of presentation, display, and plant vigour. Paths, roads, and all other accessways should be kept clear of excess growth. Pruning may also be necessary to ensure signs are not obscured. Where appropriate pruning should allow for adequate sight visibility to ensure the safety of road users. However there are situations where planting should be used to restrict visibility and slow traffic or frame views.

7.4.10.2

All weak, dead, diseased, and damaged growth should be removed, and pruning carried out to maintain the desired shape and size. Pruning should not be carried out during leaf burst or leaf fall. The following pruning techniques (for shrubs) should be employed where appropriate:

(a) Tips to be pinched or purged as appropriate for species to give desired shape and size;

(b) Form pruning of young plants to ensure compact form and shape;

(c) Undercutting of groundcovers at edges generally;

(d) Plants are to be pruned so that they do not smother neighbouring plants.

7.4.11 Maintenance

7.4.11.1 Planting period and irrigation

Landscape plans shall ensure that future maintenance requirements have been considered so that ongoing costs are minimised. The maintenance period will vary depending on the nature type of planting and should be covered in specifications and as required by the TA.

The developer shall:

(a) Remove from the area all temporary services, machinery, and surplus materials that have been used for the construction, and leave the site in a tidy condition;

(b) Clean all paths and surrounding areas;

(c) Remove all plant labels;

(d) Clear and weed all channels;

(e) Ensure that all damaged, vandalised, stolen, or dead plants are replaced to maintain numbers and unity of display;

(f) Ensure that amenity planting beds are cleaned to remove prunings, dead or damaged leaves, and any other object or material, including retail attachments such as labels. The edges of the beds shall be left evenly shaped and sloped.

Land to be vested for reserves purposes shall as a minimum meet the following general requirements:

(g) The land is to be free of noxious weeds (Old Man's beard, Broom, Hemlock, Gorse, all Contoneaster species, all Buddleia species, Briar Rose, Darwin's Barberry, Blackberry, Grey Willow, Cracked Willow, Contorta Pine, Ragword, all Thistle species, Spanish Heath, Tree

Lupin, Hawthorn, Sycamore, Silver Birch and all other plants as listed and updated on the Otago Regional Councils website for Pest Plant control), tree stumps (above ground) and other specified vegetation identified.

(h) All previous fences, farm utilities, building remains, and rubbish are to be removed or disposed of to the satisfaction of the TA;

(i) Land to be mown shall be accessible to suitable mowing equipment, and is to have an established turf type seed grass cover;

(j) Drainage reserves, ponds, lakes, channels, and streams requiring maintenance shall have suitable access for machinery;

(k) All boundaries are to be surveyed and clearly pegged or fenced where required;

(l) Any rights of way or easements are to be formalised at no cost to the TA;

(m) Any proposed landscape planting or furniture/structures shall be completed.

7.4.11.2 Maintenance period

Generally, the maintenance period for new reserves shall be minimum three years from receiving section 224c certification, but to be approved by Parks and Open Spaces Planning Manager. The maintenance required during this period shall be outlined in a Maintenance Agreement between the developer and QLDC Parks and Open Space Manager that shall be established prior to obtaining section 224c certification. The Maintenance Agreement shall ensure that all new reserve and road reserve areas are managed in accordance with QLDC maintenance standards. At a minimum, the maintenance period shall include the following requirements:

(a) all new assets, including irrigation, shall be kept in good working order and be free of defects or disrepair.

(b) turf, specimen trees and vegetation shall be maintained to an acceptable standard as specified by QLDC Parks and Open Space Planning team.

(c) the reserves shall be kept in a tidy condition and to not have any loose litter or collections of refuse.

(d) health and safety plans shall be provided for all contractors undertaking maintenance in the reserves or road reserves.

7.5.1 Asset register and plans

At practical completion and prior to section 224c certification, all new reserve and road reserves asset information should be submitted electronically with spatial attributes as outlined in Schedule 1D.

8 NETWORK UTILITY SERVICES

8.1 Scope

This section sets out requirements for the provision of stormwater, wastewater, and water supply systems, power, telecommunications and gas, and their locations in the road. The scope of these provisions applies to both future and existing roads and applies equally to all network utility services.

NOTE – Network utility services in roads are subject to the Utilities Access Act 2010 and the Infrastructure (Amendments Relating to Utilities Access) Act 2010.

8.2 General

8.2.1 Legislation

Referenced legislation and documents are listed in the Referenced Documents section of this Code of Practice.

8.2.2 Definitions

For the purpose of section 8 the following definitions shall apply:

Code Means the national Code of Practice approved in accordance with the Utilities Access Act 2010

Corridor manager Has the same meaning given to it by the Utilities Access Act 2010

8.2.3 Context

The developer is required to make all arrangements with the appropriate network utility operators for the supply and installation of stormwater, wastewater, water supply, and electric power and to the extent applicable for the provision of telecommunication and gas reticulation.

The developer shall provide satisfactory evidence to the TA corridor manager that the network utility operators are prepared to reticulate the subdivision and that agreement on the financial arrangements for the installation of each supply has been reached. The following applies to each utility:

(a) Stormwater, wastewater, and water supply. Where water supply and wastewater pipes, and stormwater systems are in the road reserve, they shall be installed at the time of road construction to the requirements of the TA corridor manager and the water supply authority for water pipes, or the TA for wastewater pipes and stormwater systems;

(b) Electric power. The supply of electric power will generally be by means of an underground system. Ducts shall be installed at the time of road construction to the requirements of the electrical supply authority and the TA corridor manager. Where the developer is intending to provide electric power other than by underground system, the developer shall provide alternative supply arrangements for approval of the TA;

(c) Telecommunications. Arrangements shall be made with the telecommunication supplier for the reticulation of telecommunication facilities. Where only part of this reticulation is being supplied initially the arrangements shall include the requisite space being maintained for the installation of the remainder of the reticulation at a later date. Ducts will be supplied to the subdividing developer at the time of road construction for installation in the carriageway formation to the requirements of the telecommunications supplier and the TA corridor manager;

(d) Gas. Where an existing gas supply is available or likely to be available to serve a subdivision, the developer may make appropriate arrangements with the gas supply authority and the TA corridor manager, and at the time of road construction, install such ducts/pipes as may be required.

The developer shall follow the requirements of the Code to the extent that they apply to the utility installation for the development.

8.3 Design

8.3.1 Plans

Copies of the plans of the development/subdivision shall be forwarded by the developer to all of the affected network utility operators at an early date to facilitate the design of the reticulation.

> ***C8.3.1***
>
> *It is important that all of the affected network utility operators are advised by the developer of any amendments to the development plan. Information when available on the type of dwellings and likelihood of more than one dwelling on any lot, will be valuable for design purposes.*

8.3.1.1

In preparing the engineering plans consideration shall be given to the requirements of the network utility operators and the TA corridor manager for:

(a) Minimum cover to cables and pipes;

(b) The network utility operator's desired position for the cable and piping within the road berm as agreed with the TA corridor manager;

(c) The minimum separation distances between power or telecommunication cables, and gas or water mains;

(d) The width of berm which shall be clear of other services and obstructions to enable efficient cable-laying operations.

> ***C8.3.1.1***
>
> *Reference should be made to each network utility operator and the TA corridor manager for their specific requirements. Refer to the Code for further information.*

8.3.2 Utilities above ground

Utilities should preferably be sited within the road berm or on land which will legally become part of the road but which is set back outside the normal road line. Alternatively separate lots (public utility reserves) or easements over private property may be used. If there are any concerns raised about the safety of above ground structures, the risk should be assessed in accordance with the requirements of the Code and any significant risks mitigated.

8.4 Construction

8.4.1 Underground cabling

Underground cable laying shall be achieved by the most appropriate method considering the nature of subsoil and potential damage to infrastructures and shall be to the approval of the TA corridor manager.

> ***C8.4.1***
>
> *The trenchless method is preferred in existing urban areas for underground cabling. Refer to the Code for further information.*

8.4.2 Materials

Materials and sizes of ducts and pipes shall comply with the requirements of the network utility operators and the colours should be in accordance with the Department of Labour's *Guide for safety with underground services.*

8.4.3 Conversion to underground on existing roads

Where a proposed subdivision fronts on to an existing road, the conversion of overhead reticulation to underground will in some instances be desirable. Agreement on the feasibility and benefit shall first be agreed between the network utility operator and the TA.

8.4.4 Commercial and industrial subdivisions

The servicing requirements for commercial and industrial areas are often indeterminate. Close liaison between the developer and the network utility operator is advisable, particularly immediately before cabling is installed so that changes can be incorporated to accommodate extra sites or the requirements of a particular industry.

8.4.5 Location of services

8.4.5.1 Position in the road

Position and depth shall be agreed with the appropriate network utility operator and the TA corridor manager in accordance with the provisions of the Code.

8.4.5.2 Recording of underground services

TAs shall maintain a procedure for recording the location of their underground services on plans which are readily available to the public at the TA office. It is unlikely that the TA will be able to provide a service for utility services other than those for which it is immediately responsible. These will usually be stormwater, wastewater, and water supply. Other authorities or network utility operators are required to maintain similar records of the existence and detailed location of their services for ready reference.

8.4.5.3 Accuracy and tolerance

It is essential that all services be laid to predictable lines if there is to be a reasonable opportunity of laying new services in existing systems. In addition to specifying the location of any service in the road berm, there should also be a tolerance which shall on no account be exceeded without proper measurement and recording on the detailed record plan. Tolerance of ±300 mm in the horizontal and ±100 mm in the vertical is a practicable requirement.

8.4.6 Trenches

8.4.6.1

When new subdivision construction is undertaken the backfilling and compaction of trenches to a state of stability consistent with the future of the surface shall be carried out in accordance with the Code and to the satisfaction of the TA corridor manager.

8.4.6.2

Where underground services are laid after the initial construction of the subdivision or where they are extended from an existing area into a new one, special attention shall be given to the opening and reinstatement of trenches in accordance with the Code and to the satisfaction of the TA corridor manager.

C8.4.6

TAs are recommended to prepare standard specifications for the opening of trenches and the restoration of surfaces. Network utility operators are in turn recommended to comply with the requirements of such specifications.

Refer to the Code for further guidance.

8.4.7 Completion of Work

Following completion of the works and prior to issuing a 224c certificate the developer shall provide written confirmation from the Network Utility Service providers that the installation has been completed to their standards and that they are satisfied with access provisions allowing for maintenance and future upgrading of their network.

Appendix A – Acceptable Pipe and Fitting Materials

(Informative)

Table A1 and table A2 give information on acceptable pipe and fitting materials. The information is sourced with permission from the Water Services Association of Australia. Refer also to WSA 02 (Sewerage Code of Australia) and WSA 03 (Water Supply Code of Australia) for further information.

For ALL PE pipes dimensions shall be provided for Outside Diameter (OD), Inside Diameter (ID) and Nominal Diameter (ND)

Table A1 – Acceptable pipe materials and Standards

Note: PVC only used if specifically agreed with TA

NOTE – Refer also to WSA 02 (Sewerage Code of Australia) and WSA 03 (Water Supply Code of Australia)

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
PVC-U	AS/NZS 1260 (Class SN 4, 8, or 16 as required by TA)	✓	–	✓	–	Gravity applications only. Well established methods of repair. Suitable for aggressive groundwater, anaerobic conditions and tidal zones. Can be used for trenchless installation with suitable end load resistant joints.
PVC-U	AS/NZS 1254 (Class SN 4, or 8, as required by TA)	✓	–	–	–	Gravity stormwater applications only.
PVC-O	AS/NZS 4441 (Series 1 or Series 2, as required by the TA)	–	✓	–	✓	Improved fracture toughness compared with PVC-U. Improved fatigue resistance compared with PVC-U and PVC-M. NOTE – Use only DI fittings in pumped mains to achieve full fatigue resistance. Has increased hydraulic capacity compared with PVC-U and PVC-M. Suitable for aggressive groundwater, anaerobic conditions, and tidal zones. Specific design for dynamic stresses (fatigue) required for pressure sewer applications.
PVC-U	AS/NZS 1477 (Series 1 or Series 2, as required by the TA)	–	✓	–	✓	Well established methods of repair. Alternative installation techniques possible, for example slip lining. Suitable for aggressive groundwater, anaerobic conditions, and tidal zones. Can be used for trenchless installation with suitable end load resistant joints. Specific design for dynamic stresses (fatigue) required for pressure sewer applications.

Table A1 – Acceptable pipe materials and Standards (continued)

Note: PVC only used if specifically agreed with TA

Pipe materials	**Standard applicable**	**Stormwater (Gravity)**	**Wastewater (Pressure sewer/ rising main)**	**Wastewater (Gravity)**	**Water supply (Pressure)**	**Notes**
PVC-M	AS/NZS 4765 (Series 1 or Series 2, as required by the TA)	–	✓	–	✓	Improved fracture toughness compared with PVC-U. Has increased hydraulic capacity compared with PVC-U. Inferior fatigue resistance compared with PVC-U and PVC-O. Suitable for aggressive groundwater, anaerobic conditions and tidal zones. Specific design for dynamic stresses (fatigue) required for pressure sewer applications.
PE (PE 80B or PE 100 as required by the TA)	AS/NZS 4130	–	✓	–	✓	Generally for pressure applications. Can be easily curved to eliminate the need for bends. Alternative installation techniques possible, for example pipe cracking, direction drilling, and slip lining. Can be welded to form an end load resistant system. Compression couplings and end load resistant fittings are available in smaller diameters. Pipe longitudinal flexibility accommodates large differential ground settlement. Fusion jointing requires skilled installers and special equipment. Retrospective installation of fittings/repair complicated. Specific design for dynamic stresses (fatigue) required for pressure sewer applications. ≤ DN 125 available in long coiled lengths for fewer joints. Suitable for aggressive groundwater, anaerobic conditions or tidal zones. Suitable for ground with high subsidence potential, for example fill or mining areas.

Table A1 – Acceptable pipe materials and Standards (continued)

Note: PVC only used if specifically agreed with TA

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
PE (Stiffness Class SN 4, 8, 10, or 16 as required by the TA)	AS/NZS 5065	✓	–	✓	–	Only for gravity applications. Can be easily curved. Alternative installation techniques possible, for example pipe cracking and slip lining. Can be welded to form an end load resistant system. Fusion jointing requires skilled installers and special equipment. Retrospective installation of fittings/repair complicated. Smaller diameters available in long coiled lengths for fewer joints. Suitable for aggressive groundwater, anaerobic conditions, or tidal zones.
PP (Stiffness Class SN 4, 8, 10, or 16 as required by the TA)	AS/NZS 5065	✓	–	✓	–	Only for gravity applications.
GRP	AS 3571.1	✓	✓	✓	–	Alternative installation techniques possible, for example slip lining. UV resistant (special product). Custom made fittings can be manufactured. Suitable for use without additional corrosion protection in areas where stray electrical currents occur. Low impact resistance and ease of damage to thermosetting resin, makes GRP susceptible to damage during transportation, and installation, in above ground installations, from vandalism, or when damaged as a consequence of nearby excavation. Suitable for aggressive groundwater, anaerobic conditions or tidal zones.

Table A1 – Acceptable pipe materials and Standards (continued)

Note: PVC only used if specifically agreed with TA

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
GRP	AS 3571.2	–	–	–	✓	Alternative installation techniques possible, for example slip lining. UV resistant (special product). Custom made fittings can be manufactured. Suitable for use without additional corrosion protection in areas where stray electrical currents occur. Low impact resistance and ease of damage to thermosetting resin, makes GRP susceptible to damage during transportation, and installation, in above ground installations, from vandalism, or when damaged as a consequence of nearby excavation. Suitable for aggressive groundwater, anaerobic conditions, or tidal zones.
VC	BS EN 295	✓	–	✓	–	Gravity applications only. Has benefits for particularly aggressive industrial wastes. Not recommended for active seismic (earthquake) zones, or unstable ground.
RRRC (rubber ring joint reinforced concrete)	AS/NZS 4058	✓	–	✓	–	Requires protection from hydrogen sulphide attack in sewer applications, by plastic lining or selection of appropriate cement additives.

Table A1 – Acceptable pipe materials and Standards (continued)

Note: PVC only used if specifically agreed with TA

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
CLS (SCL) (concrete lined welded steel)	NZS 4442 AS 1579	–	✓	–	✓	Cement mortar lined, PE coating below ground or heavy duty coating above ground High mechanical strength and toughness. Available in long lengths. RRJ and welded joints available. Custom made, specially configured steel fittings can be made to order. Can be welded to form a system that will resist end load and joint permeation. UV resistant/vandal proof/impact resistant (where PE coated). Cathodic protection (CP) can be applied to electrically continuous pipelines to provide enhanced corrosion protection. PE lined and coated – RRJ As above for CLS (SCL). Suitable for conveying soft water. Corrosion resistant under all conditions. General notes Standard Portland cement mortar not resistant to H^2S attack, at any high points or discharge points in the main. High alumina cement has improved resistance. Welded joints require skilled installers and special equipment. Welded joints require reinstatement of protection systems on site. Special design required for welded installations parallel, and adjacent to high voltage (> 66 kV) transmission lines. Cathodic protection requires regular monitoring and maintenance. Seal coating may be required over cement mortar linings, when conveying soft water, or in low flow extremities of reticulation mains, to prevent potentially high PH. Suitable for high load applications such as railway crossings and major roads. Large diameters are available. Suitable for aerial or suspended pipeline applications.

Table A1 – Acceptable pipe materials and Standards (continued)

Note: PVC only used if specifically agreed with TA

Pipe materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main)	Wastewater (Gravity)	Water supply (Pressure)	Notes
DI (ductile iron pipe)	AS/NZS 2280 AS 3681	–	✓	–	✓	Fatigue analysis not normally required (pressure sewer applications). High mechanical strength and toughness. Ease of jointing. UV resistant/vandal proof/impact resistant. Well established methods of repair. Suitable for high pressure and above ground pipelines. Restrained joint systems available. Sufficient ring stiffness to not rely on side support, for structural adequacy for the usual water supply installation depths. Elevated PH may occur when conveying soft water, or in low flow extremities of reticulation mains. PE sleeving is required, and must be carefully applied and repaired when damaged. Standard Portland cement mortar not resistant to H2S attack, at any high points or discharge points in the main. (Wastewater applications. High alumina cement has improved resistance.) Not suitable for aggressive groundwater, anaerobic conditions, or tidal zones.
Corrugated aluminium pipe	AS/NZS 2041	✓	–	–	–	Generally of short length (for culverts and so on). Joints need consideration in fine soils with high water tables. Invert may need lining to extend life.
Corrugated steel pipe	AS/NZS 2041 NZS 4405 NZS 4406	✓	–	–	–	Generally only for short length (culverts and so on). Joints need consideration in fine soils and high water tables. Invert may need lining to extend life.
ABS	AS/NZS 3518 AS/NZS 3690 AS/NZS 3879	–	✓	–	✓	Specific design for dynamic stresses (fatigue required for pressure sewer applications).
PVC-U	AS/NZS 1260		–		–	Gravity applications only.

Pipe materials	**Standard applicable**	**Stormwater (Gravity)**	**Wastewater (Pressure sewer/ rising main)**	**Wastewater (Gravity)**	**Water supply (Pressure)**	**Notes**
PVC-U	AS/NZS 1254		–	–	–	Gravity stormwater applications only.

Table A2 – Acceptable fitting materials and Standards

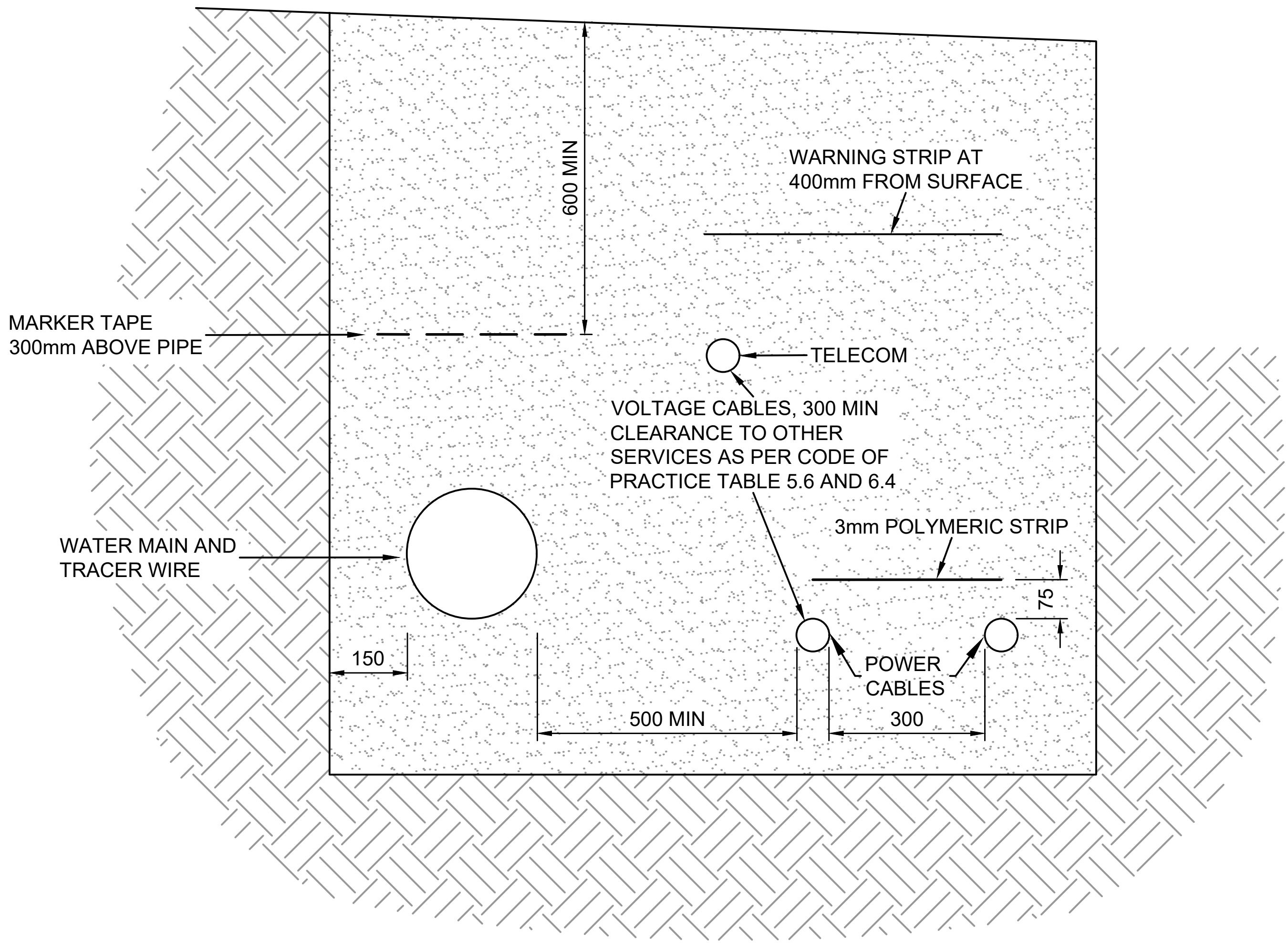
Fittings Materials	Standard applicable	Stormwater (Gravity)	Wastewater (Pressure sewer/ rising main	Wastewater (Gravity)	Water supply (Pressure)	Notes
PVC-U	AS/NZS 1254	✓	–	–	–	Gravity stormwater applications only.
PE	AS/NZS 4129	✓	✓	✓	✓	PE pressure fittings, including mechanical compression, butt fusion or electrofusion, as approved by the TA.
Access covers and grates	AS 3996	✓	–	✓	–	
Ductile iron	AS/NZS 2280	–	✓	–	✓	Generally for pressure applications. Shall be coated with a polymeric coating, applied in accordance with AS/NZS 4158.
Ductile iron unrestrained mechanical couplings	AS/NZS 4998	–	✓	–	✓	Generally for pressure applications. Shall be coated with a polymeric coating, applied in accordance with AS/NZS 4158.
Plastic or metallic tapping bands	AS/NZS 4793	–	✓	–	✓	Generally for pressure applications. Tapping bands used on flexible pipes shall be AS/NZS 4793 Type F – that is, 'full circle design'. Ductile iron tapping bands shall be coated with a polymeric coating, applied in accordance with AS/NZS 4158.
Fire hydrants	NZS/BS 750	–	✓	–	✓	Generally pressure applications.
Resilient seated gate valves	AS 2638.2	–	✓	–	✓	Generally pressure applications.
PE (Stiffness Class SN 4, 8, 10 or 16 as required by the TA)	AS/NZS 5065	✓	–	✓	–	Gravity applications only.
PP (Stiffness Class SN 4, 8, 10 or 16 as required by the TA)	AS/NZS 5065	✓	–	✓	–	Gravity applications only.

Appendix B - Standard Construction Drawings

QLDC Land Development and Subdivision Code of Practice - 2020

Normative

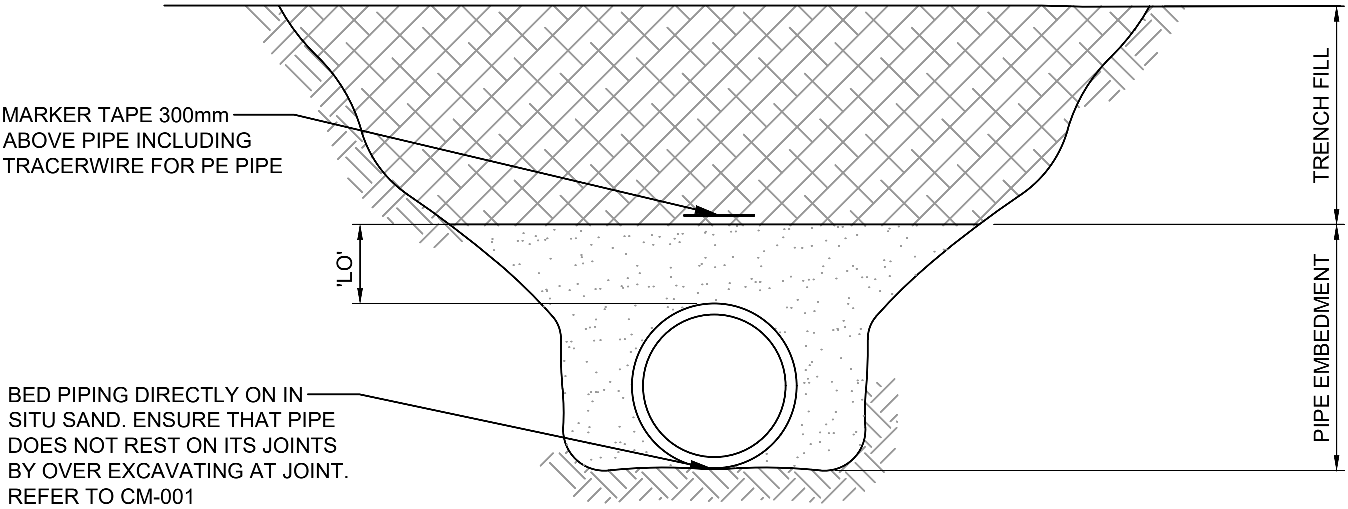
TABLE OF CONTENTS



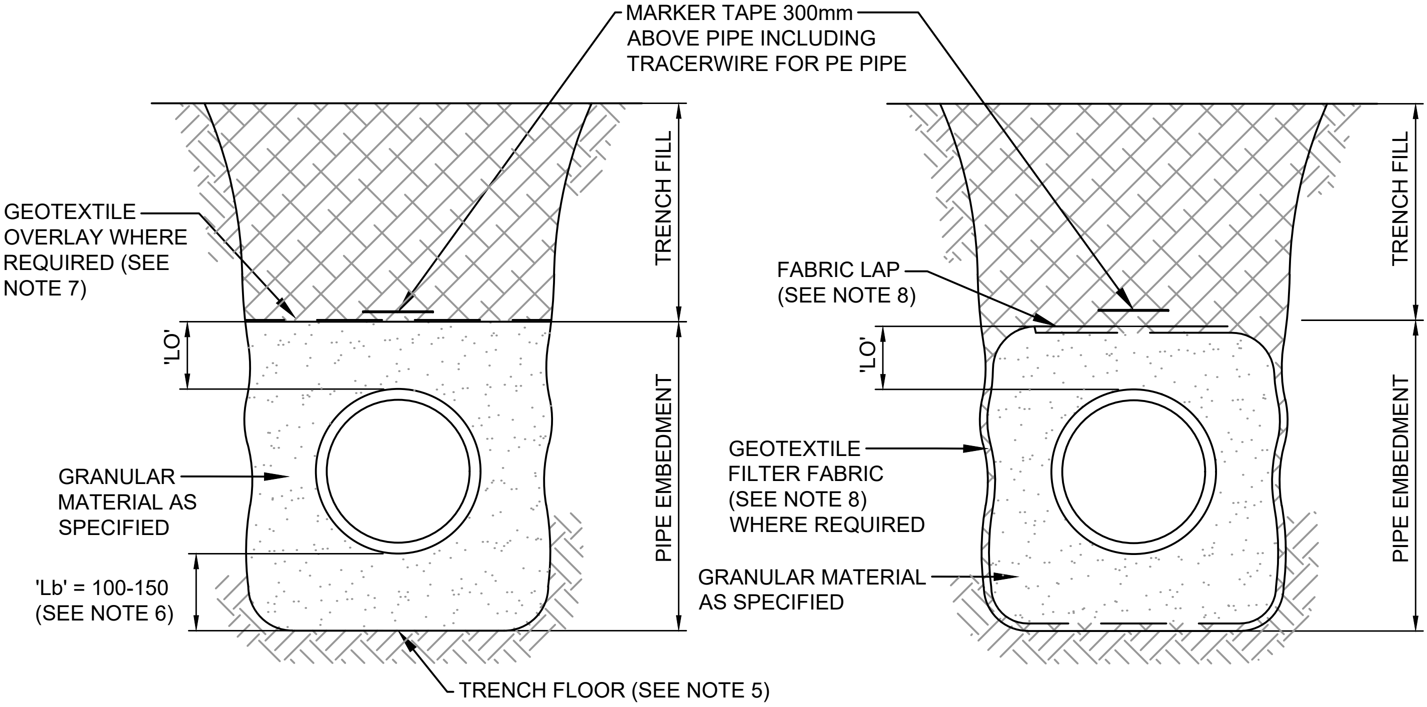
TRENCH DETAILS & UNDERGROUND UTILITIES IN VERGE

NOTE
SEPARATION FROM WATERMAIN DEFINED IN COP TABLE 6.4 (VARIES WITH PIPE SIZE)

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Typical Combined Service Trench Detail	NOT TO SCALE Drawing No. B1-1



TRENCH IN SAND STRATA



TYPE 3 SUPPORT

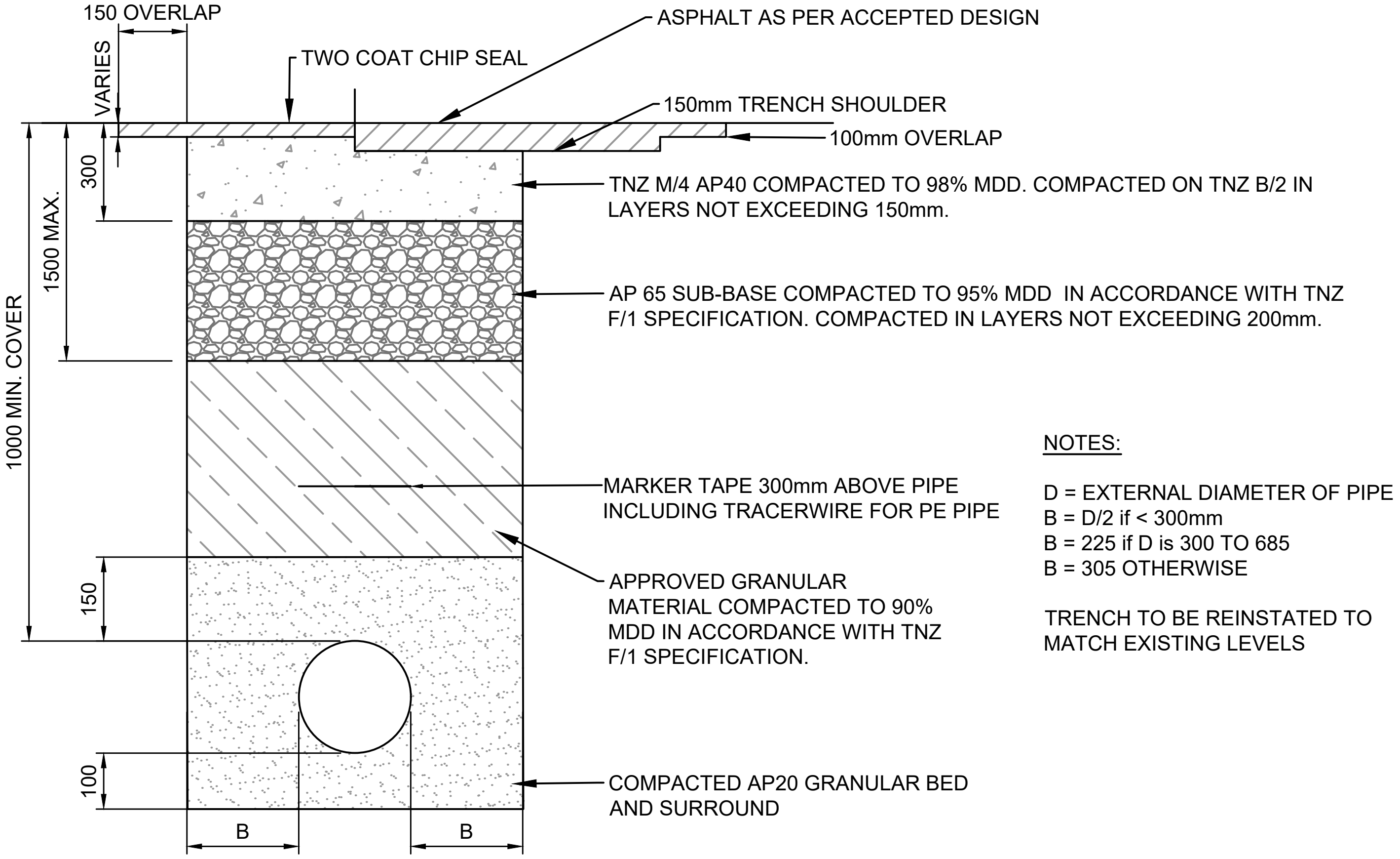
FOR FLEXIBLE AND RIGID PIPES (SEE NOTE 3)

TYPE 4 SUPPORT

WITH GEOTEXTILE FOR FLEXIBLE AND RIGID PIPES (SEE NOTE 3)

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH CM-001
3. PIPE CLASSIFICATION
   a. RIGID PIPES: VC, RC, STEEL AND CL
   b. FLEXIBLE PIPES: PVC, GRP AND PE
4. PLACEMENT OF EMBEDMENT, TRENCH FILL AND COMPACTION TO MEET THE REQUIREMENTS OF DRAWINGS AND SPECIFICATION.
5. EXCAVATE OR COMPACT TRENCH FLOOR TO PROVIDE A FLAT FIRM BASE TO SUPPORT BEDDING MATERIAL AND MINIMISE PIPE SETTLEMENT. WHEN EXCAVATED, REPLACE WITH GRANULAR MATERIAL AS SPECIFIED FOR BEDDING OR ADOPT TYPE 1,2,3 OR 4 SUPPORT AS REQUIRED.
6. ENSURE BEDDING IS DEEP ENOUGH THAT PIPE JOINT PROJECTIONS (SOCKETS AND FLANGES) DO NOT TOUCH TRENCH FLOOR - SEE CM-001
7. TYPE 4 SUPPORT TO BE USED WHERE MIGRATORY NATIVE SOILS (SANDS AND CLAYS) ARE ENCOUNTERED ADJACENT TO THE EMBEDMENT ZONE AND SINGLE SIZED AGGREGATE IS USED.
8. GEOTEXTILE OVERLAY IS REQUIRED FOR COARSE AGGREGATE EMBEDMENT >5mm. LAY GEOTEXTILE FILTER FABRIC AGAINST TRENCH FLOOR AND WALLS SUCH THAT IT FULLY ENCASES THE EMBEDMENT
   - PRESS FILTER FABRIC INTO VOIDS BEFORE INSTALLING EMBEDMENT TO PREVENT FABRIC TEARING
   - PROVIDE A MINIMUM OF 250 OVERLAP AT ALL FILTER FABRIC JOINTS
9. IN SOME AREAS LOCAL PRACTICE MAY ALLOW USE OF SELECTED EXCAVATED MATERIAL AS PIPE EMBEDMENT.
10. IN UNSUITABLE GROUND CONDITIONS SPECIFIC DESIGN IS REQUIRED REFER TO WSA 03 & WSA 04 DRAWINGS FOR GUIDANCE.
11. CONCRETE PIPES SHOULD BE BASED ON FIGURES 11 TO 13 IN ASNZS 3725.

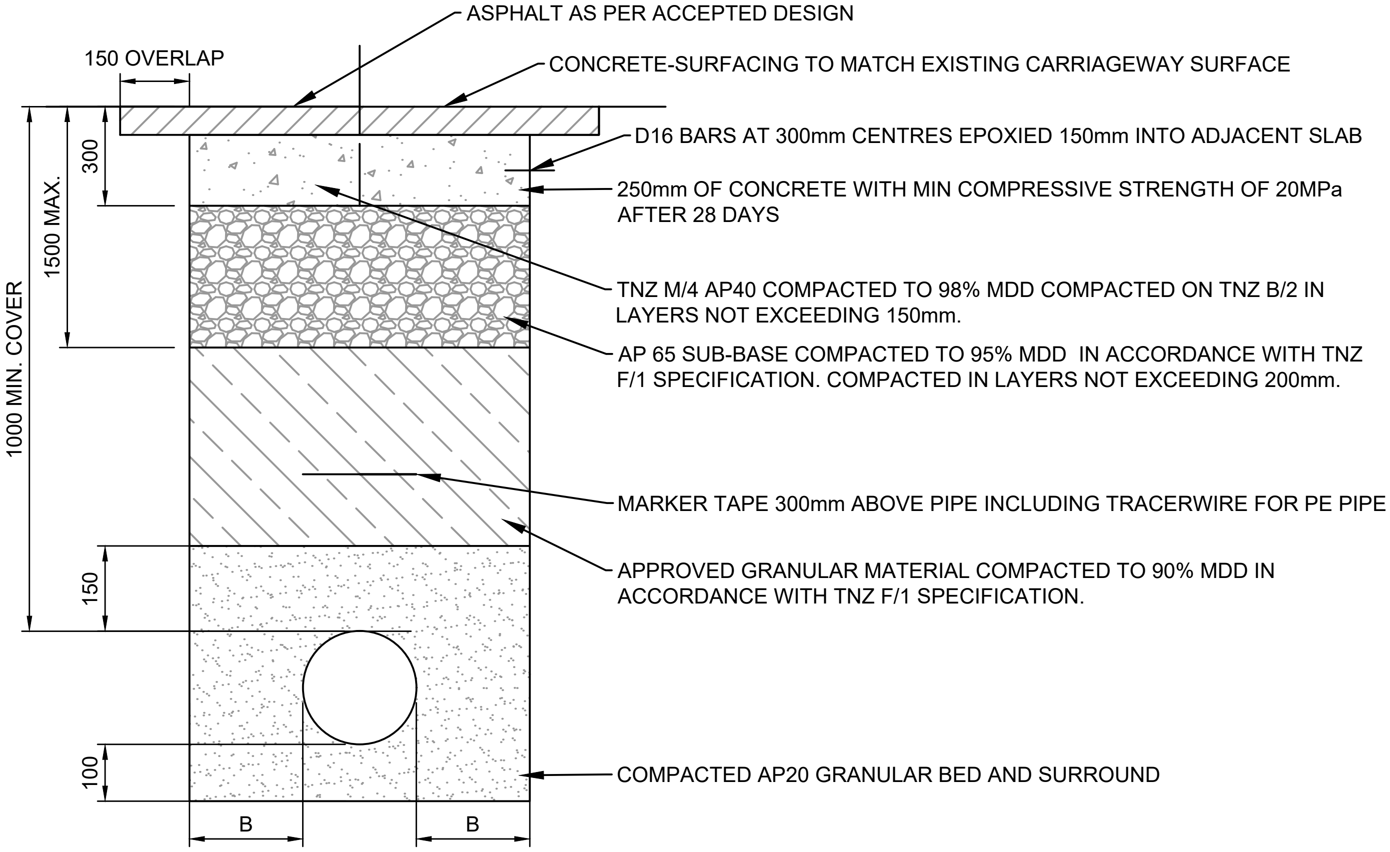


NOTES:

D = EXTERNAL DIAMETER OF PIPE
B = D/2 if < 300mm
B = 225 if D is 300 TO 685
B = 305 OTHERWISE

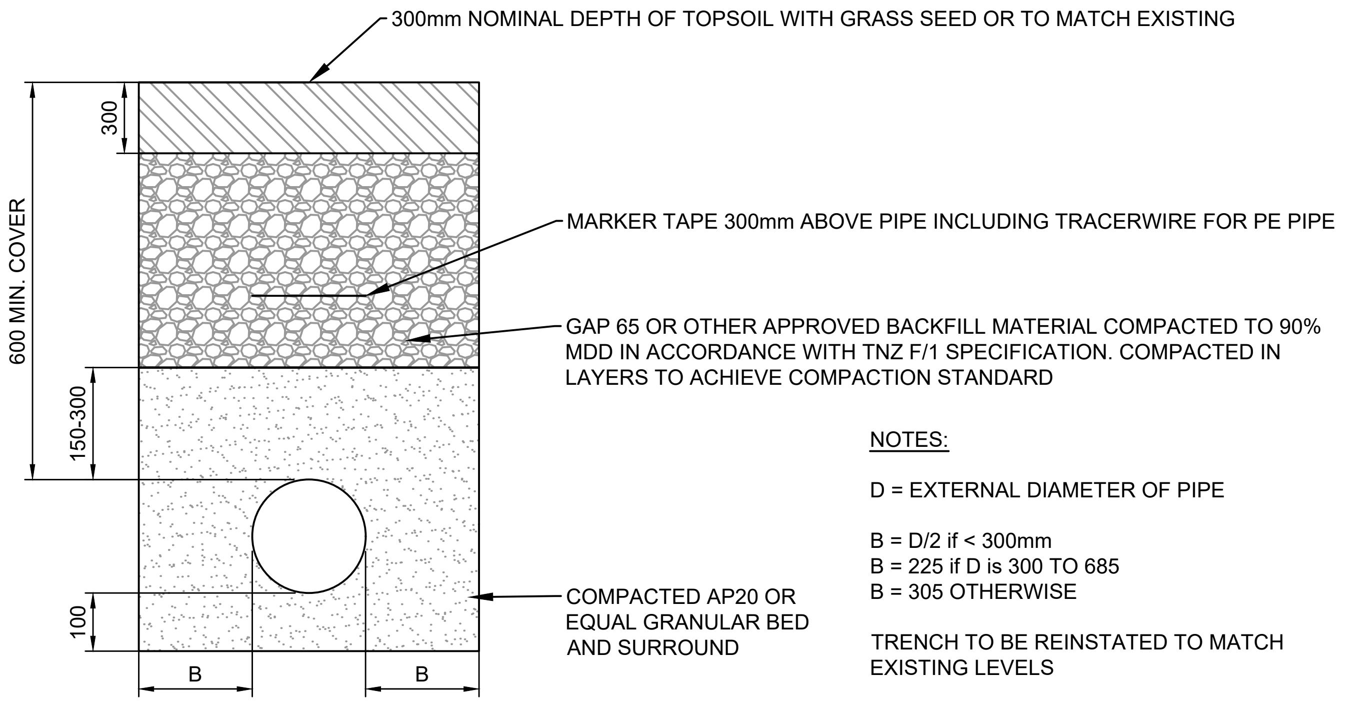
TRENCH TO BE REINSTATED TO MATCH EXISTING LEVELS

CHIPSEAL CARRIAGEWAY CROSS SECTION

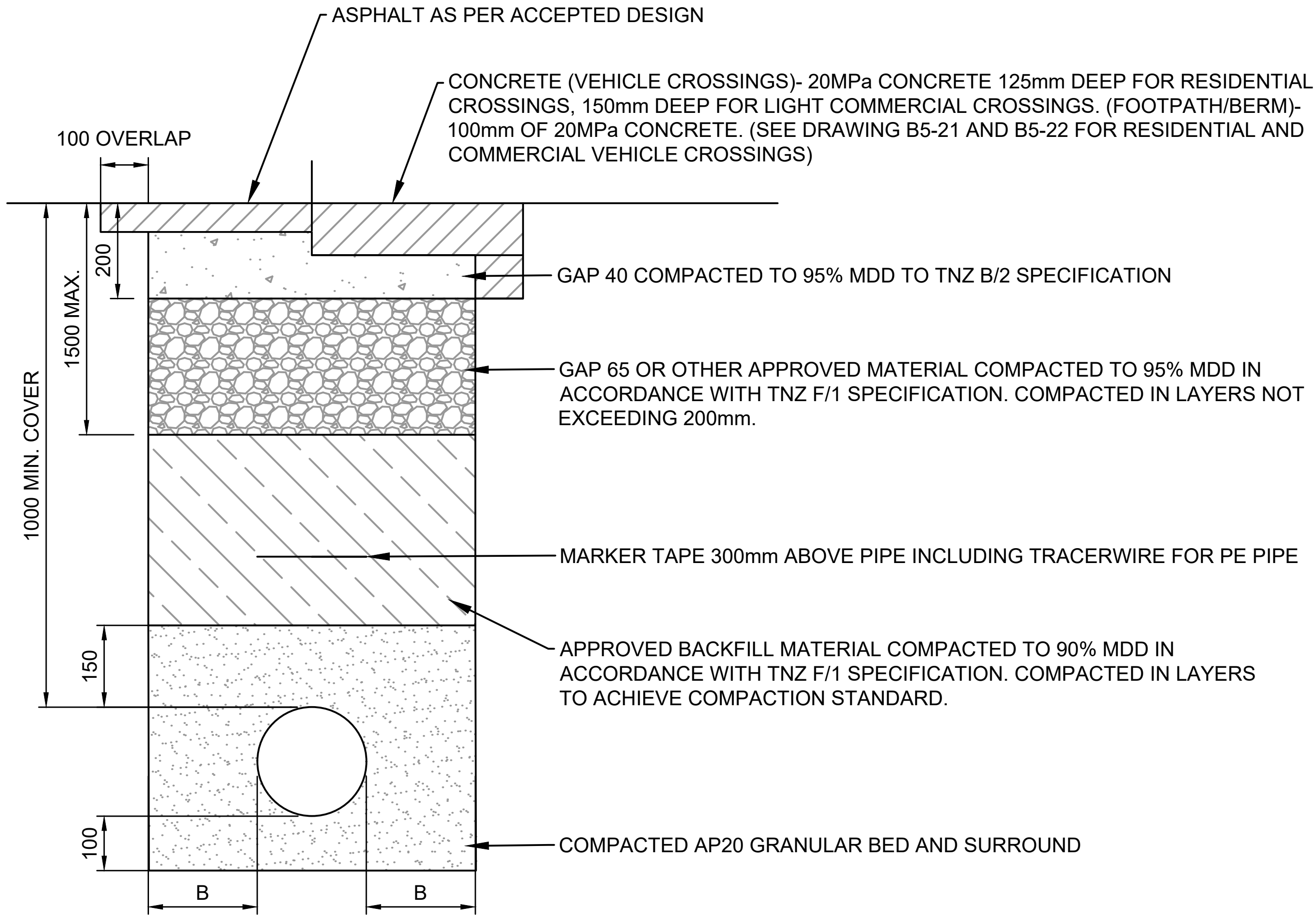


ASPHALT/CONCRETE CARRIAGEWAY CROSS SECTION

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Typical Pipe Bedding & Backfill for Carriageways	NOT TO SCALE Drawing No. B1-3

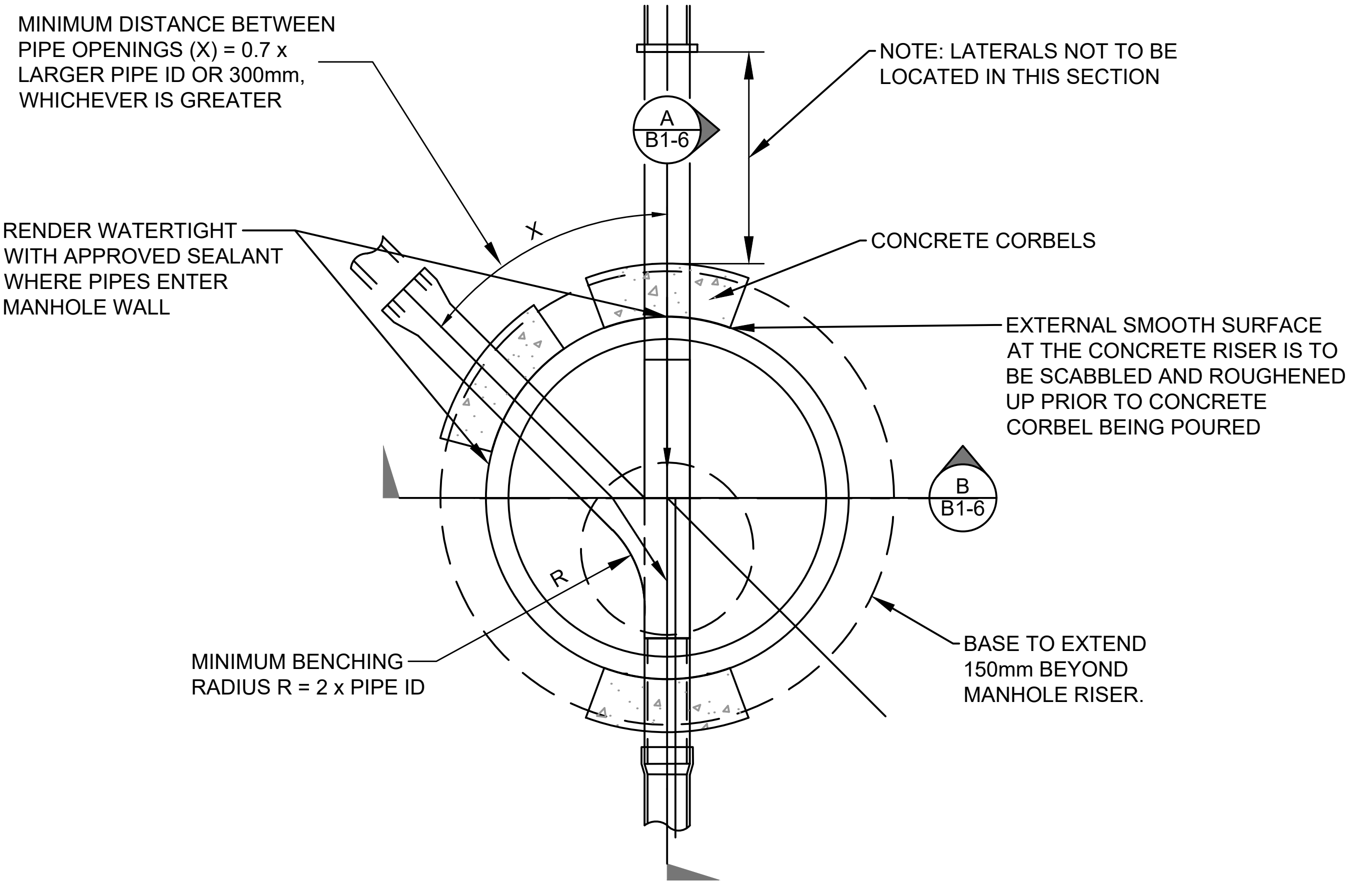


BERM/NON TRAFFICABLE CROSS SECTION



VEHICLE CROSSING CROSS SECTION

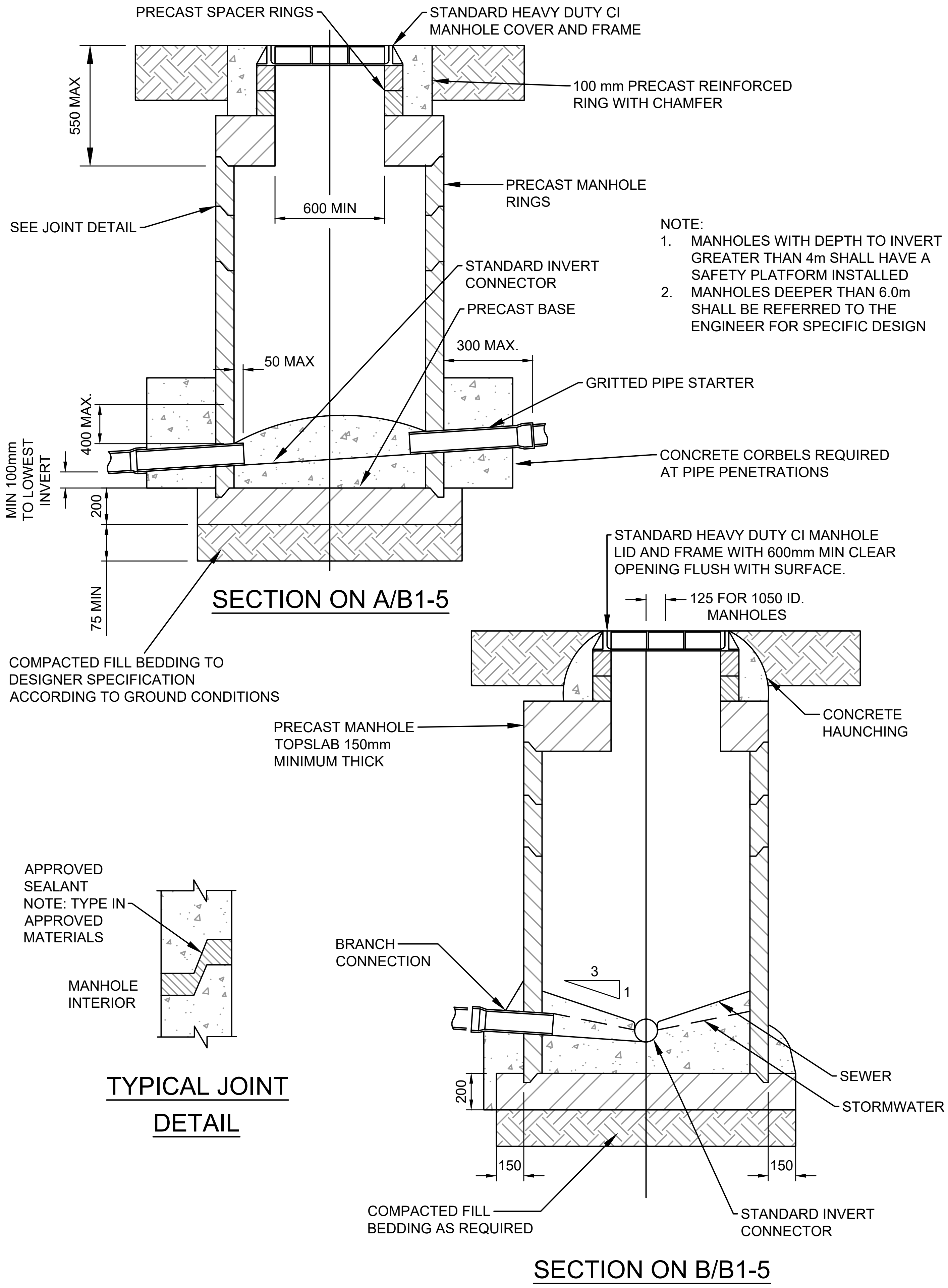
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Typical Pipe Bedding & Backfill for Vehicle Crossings & Non Trafficable	NOT TO SCALE Drawing No. B1-4



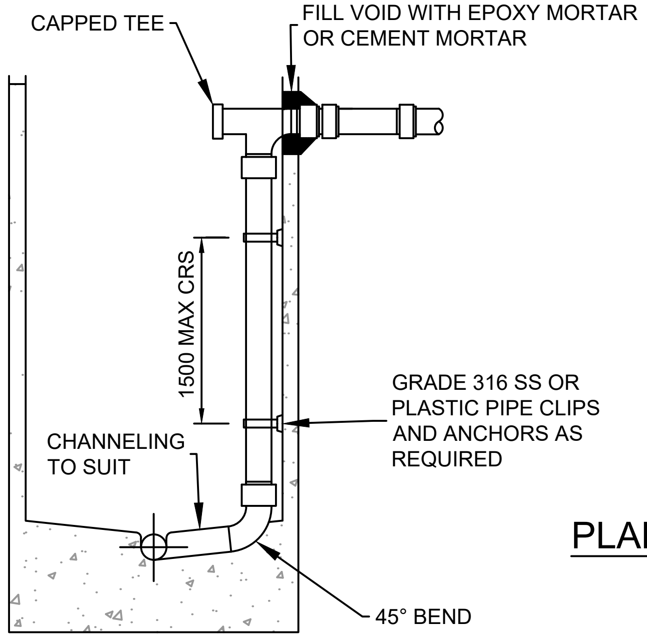
PLAN

NOTES
1. ALL IN SITU CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 20MPa @ 28 DAYS.
2. ALL PRECAST MANHOLE UNITS (SHOWN SHADED IN DRAWING B1-6) TO BE STANDARD MANUFACTURED UNITS. (IE. HUMES OR SIMILAR APPROVED)
3. ALL BRANCHES SHALL BE CONSTRUCTED SUCH THAT THEY CAN BE READILY ACCESSED BY CCTV CAMERA. THE CORBALS DETAIL (IE. CROSS SECTION) SHALL NOT BE COMPROMISED. IF REQUIRED, THE "STRAIGHT THROUGH" CHANNEL SHALL BE OFFSET FROM THE MANHOLE CENTRELINE AND THE BRANCH CHANNELLING LEFT STRAIGHT FOR A SUFFICIENT LENGTH TO ACHIEVE THE DESIRED RESULT.
4. ACCESS OPENING TO BE LOCATED OVER THE DOWNSTREAM SIDE OF THE MANHOLE.
5. IF A DEVIATION IS SOUGHT FROM THE REQUIREMENTS IN THE DETAIL ABOVE, JUSTIFIABLE CALCULATIONS MUST BE GIVEN AND BE TO COUNCIL'S SATISFACTION.
6. >75° DEFLECTION SHALL REQUIRE SPECIFIC DESIGN FOR MANHOLE RISERS FOR ANY DIAMETER OF PIPE >375mm.

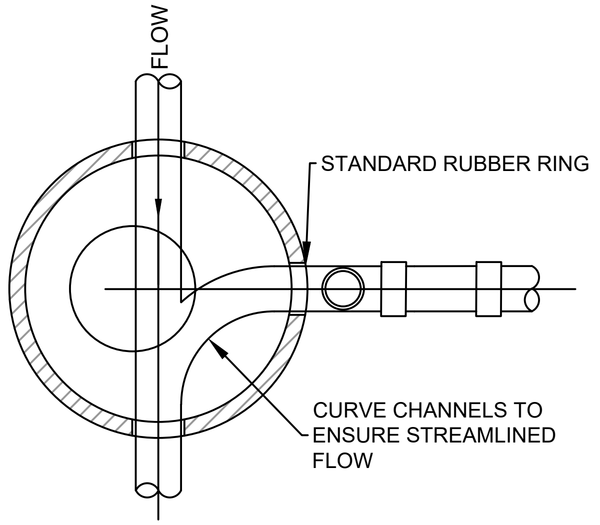
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Manhole Detail A - Typical Plan View	NOT TO SCALE Drawing No. B1-5



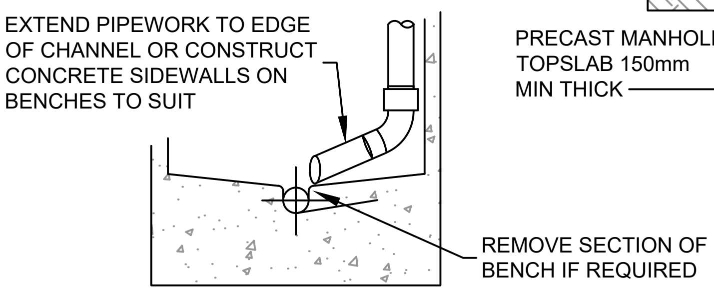
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Manhole Detail B - Typical Cross Section	NOT TO SCALE Drawing No. B1-6



SECTION - INTERNAL DROP MANHOLE

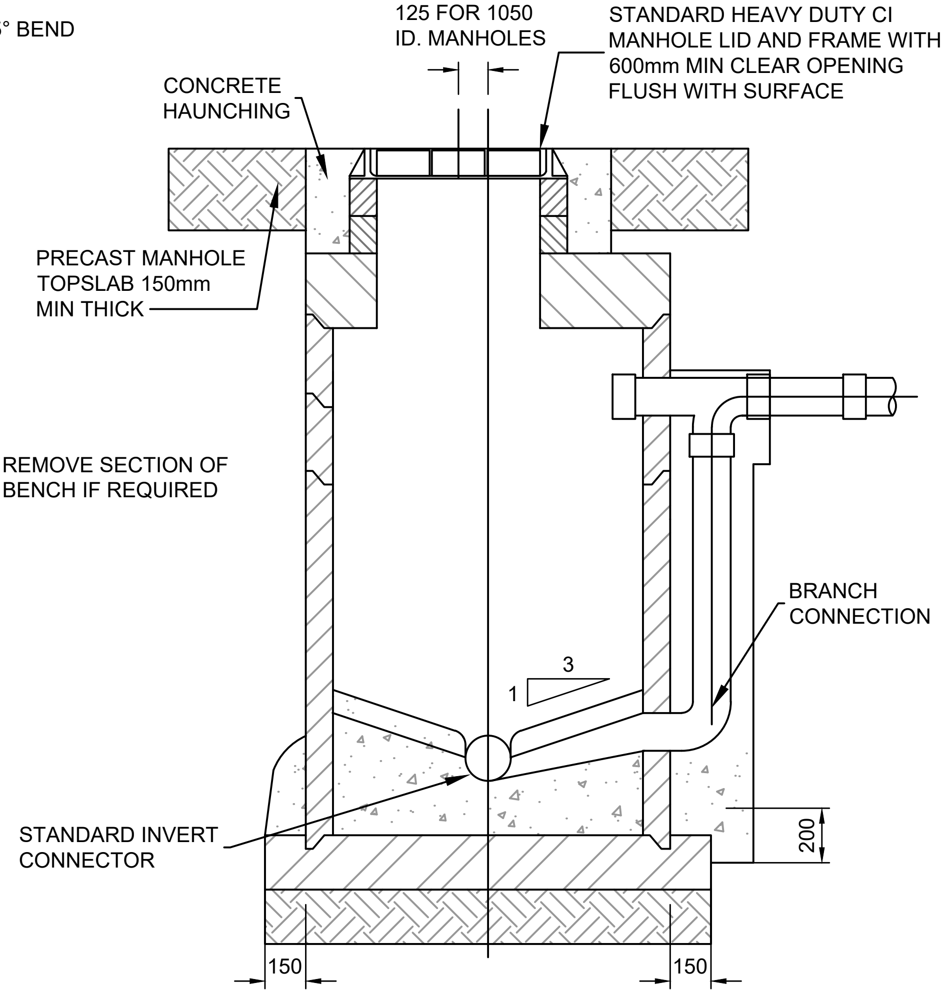


PLAN - EXTERNAL DROP MANHOLE

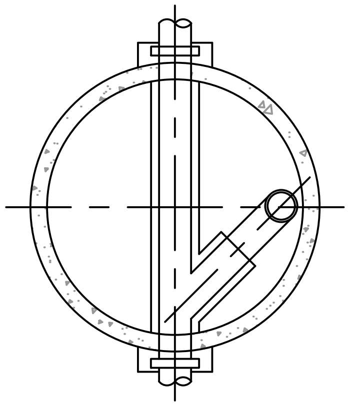


INTERNAL DROP POST CONSTRUCTION INSTALLATION DETAIL

(WHERE AUTHORISED BY TERRITORIAL AUTHORITY)



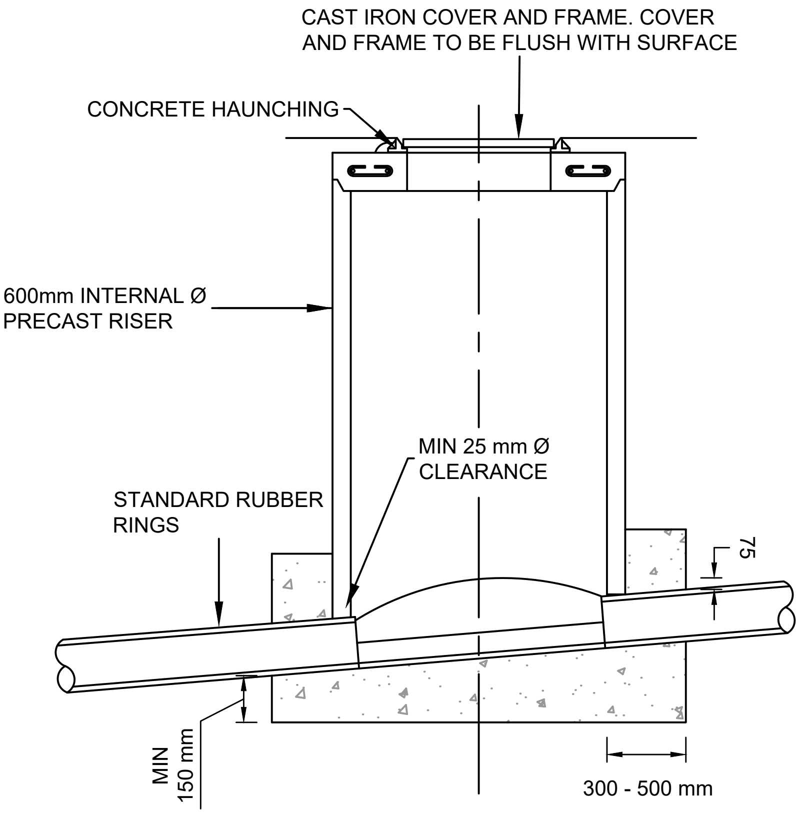
SECTION - EXTERNAL DROP MANHOLE



PLAN - TYPICAL INTERNAL DROP

SUITABLE FOR INSITU AND PRECAST MH (WHERE AUTHORISED BY TERRITORIAL AUTHORITY)

NOTES:
1. ALL DIMENSIONS IN MILLIMETRES.
2. MANHOLES WITH DEPTH TO INVERT GREATER THAN 4m SHALL HAVE A SAFETY PLATFORM INSTALLED.
3. MANHOLES DEEPER THAN 6.0m SHALL BE REFERRED TO THE ENGINEER FOR SPECIFIC DESIGN.
4. MINIMUM DN 1200 MH TO BE USED WITH INTERNAL DROP STRUCTURES.
5. INTERNAL DROP NOT NORMALLY USED IN STORMWATER APPLICATIONS.
6. ALL CAST IN-SITU BENCHING AND HAUNCHING TO BE 30MPa CONCRETE UNLESS OTHERWISE SPECIFIED BY TA.

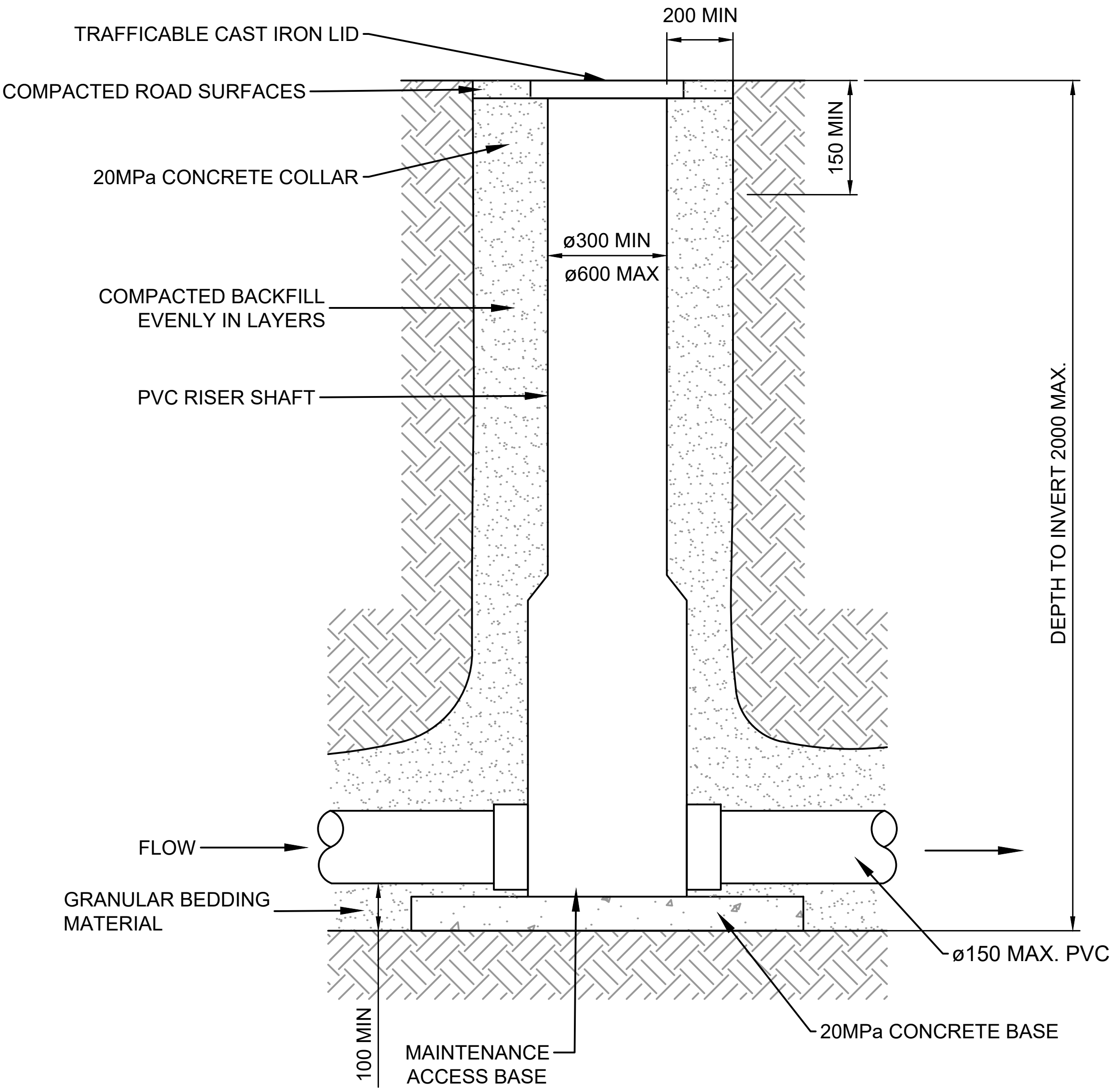


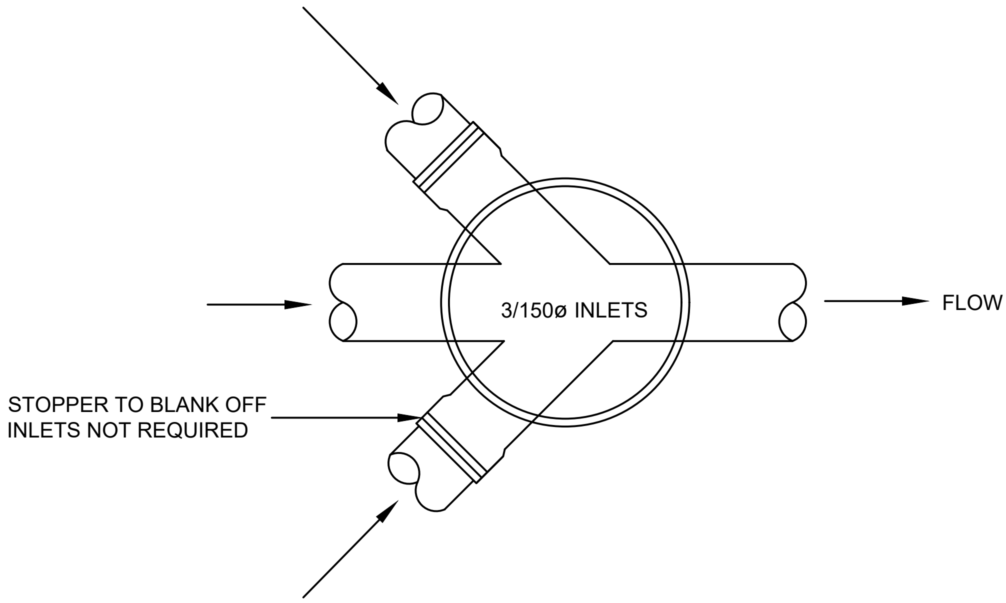
(DEPTH NOT TO EXCEED 1.2m)

MINI MANHOLE

NOTE:
1. ALL DIMENSIONS IN MILLIMETRES.
2. ALL CAST IN-SITU BENCHING AND HAUNCHING TO BE 30MPa CONCRETE UNLESS OTHERWISE SPECIFIED BY TA.

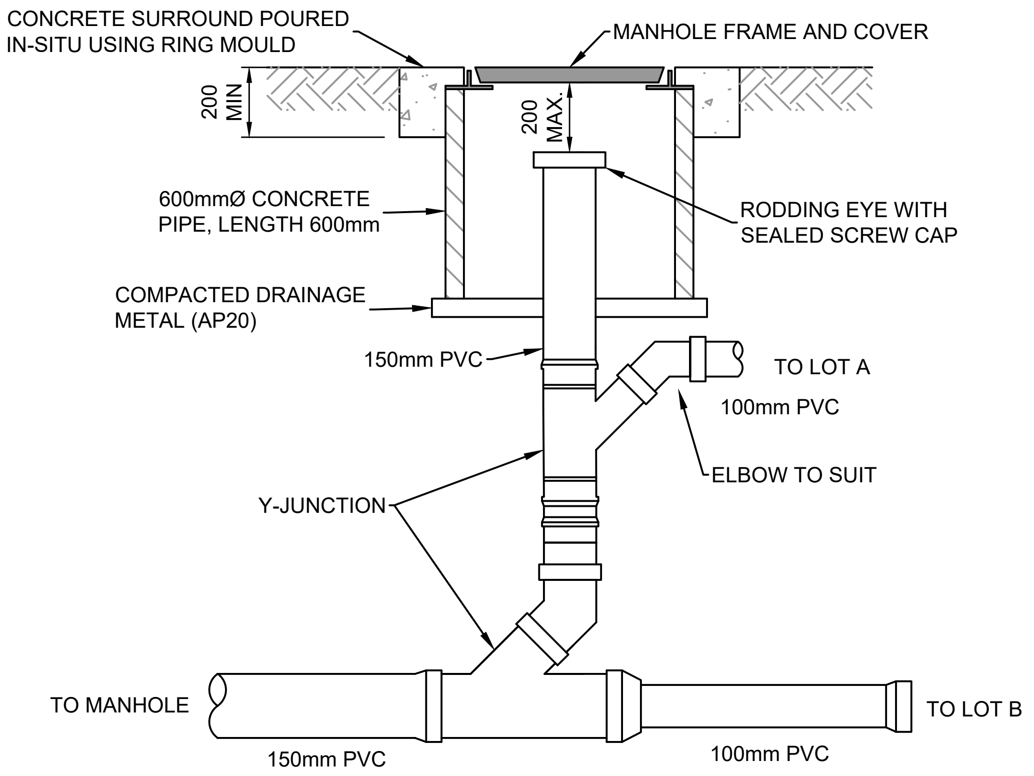
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Mini Manhole Detail	NOT TO SCALE Drawing No. B1-8



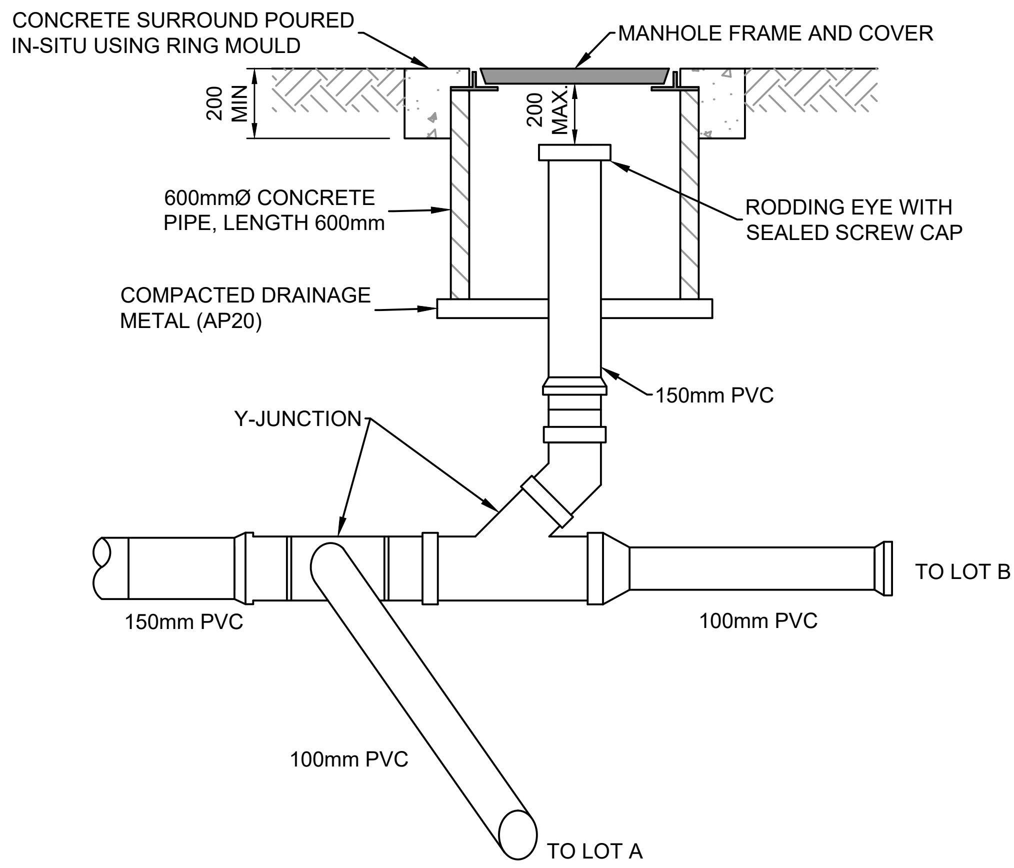


NOTE:
ONLY TO BE USED FOR THE TERMINATING MANHOLES IN COMMON EASEMENTS OR RIGHT OF WAY ACCESS FOR RESIDENTIAL SITES WITH A MAXIMUM OF THREE 100mmØ HOUSE CONNECTIONS, OR WHERE DIRECTED BY THE ENGINEER.

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: PVC Inspection Chamber (Residential Only)	NOT TO SCALE Drawing No. B1-9

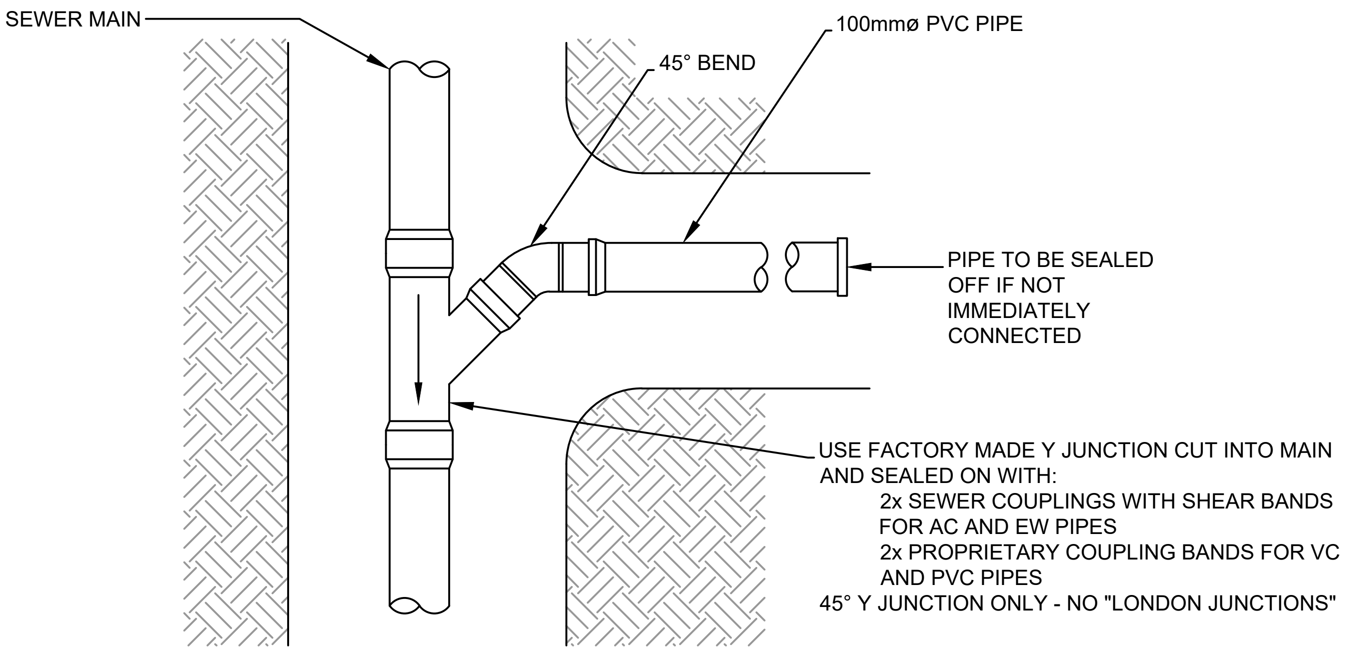


LATERAL OFF RODDING EYE STANDPIPE

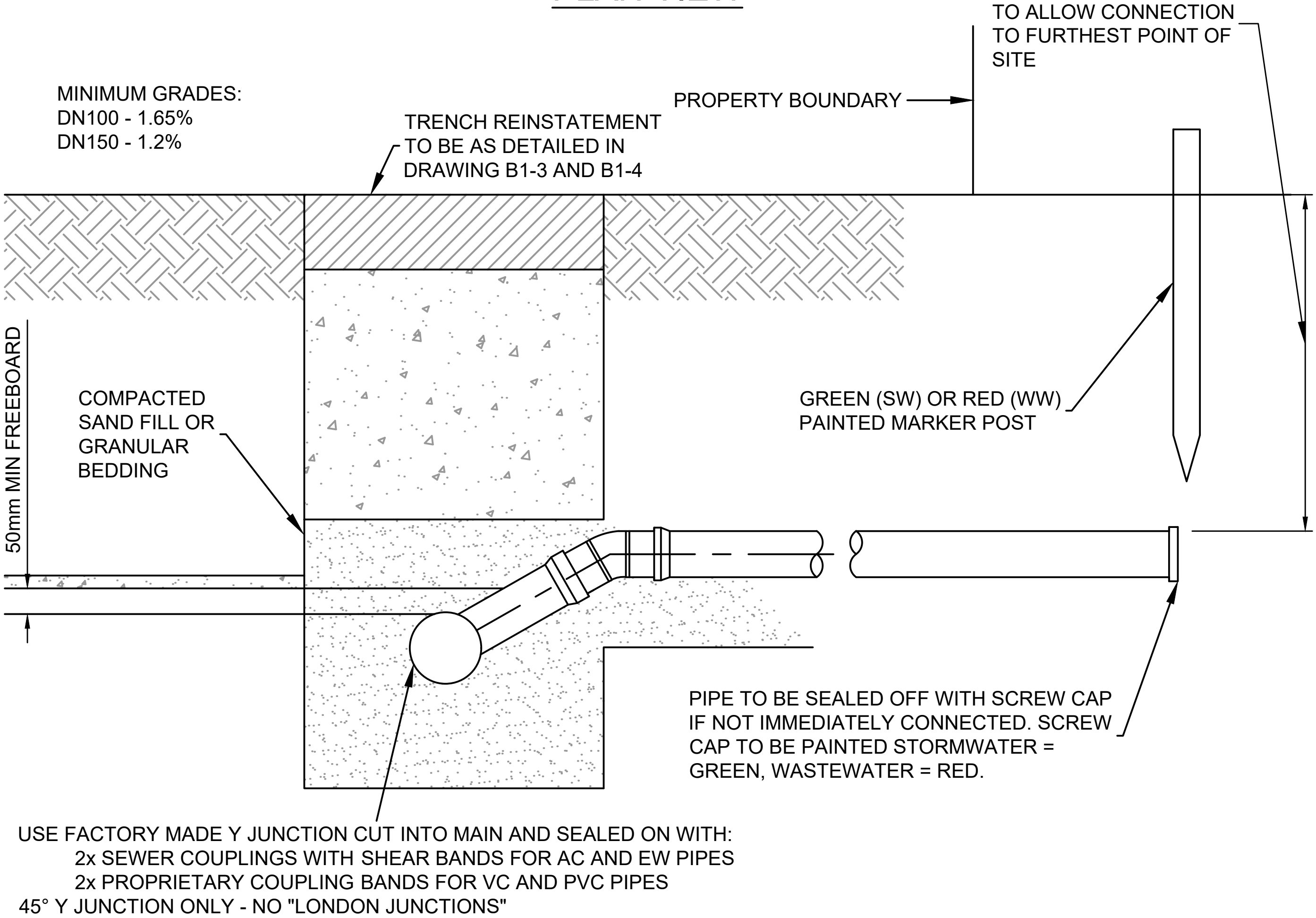


LATERAL OFF 150mm CONNECTION TO MANHOLE

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Lateral Connections For Two Properties	NOT TO SCALE Drawing No. B1-10



PLAN VIEW



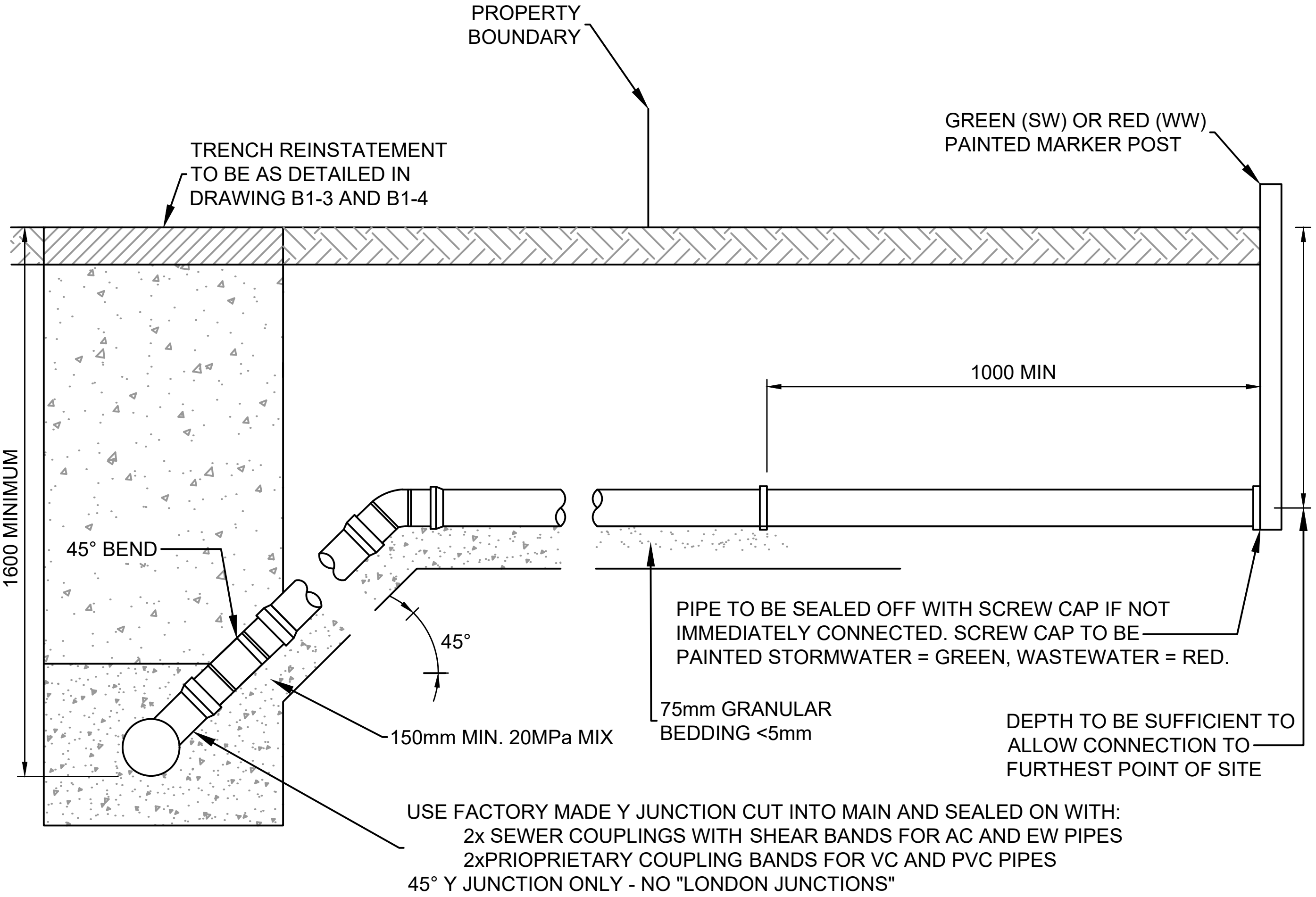
SHALLOW CONNECTION

DEPTH TO INVERT LESS THAN 1.2m

NOTES:

1. ALL CONNECTIONS SHALL HAVE NO ACCESS FITTINGS ON LINE, NO CHANGE OF DIRECTION, OR CHANGE OF GRADE WITHIN 3m OF MAIN CONNECTION.

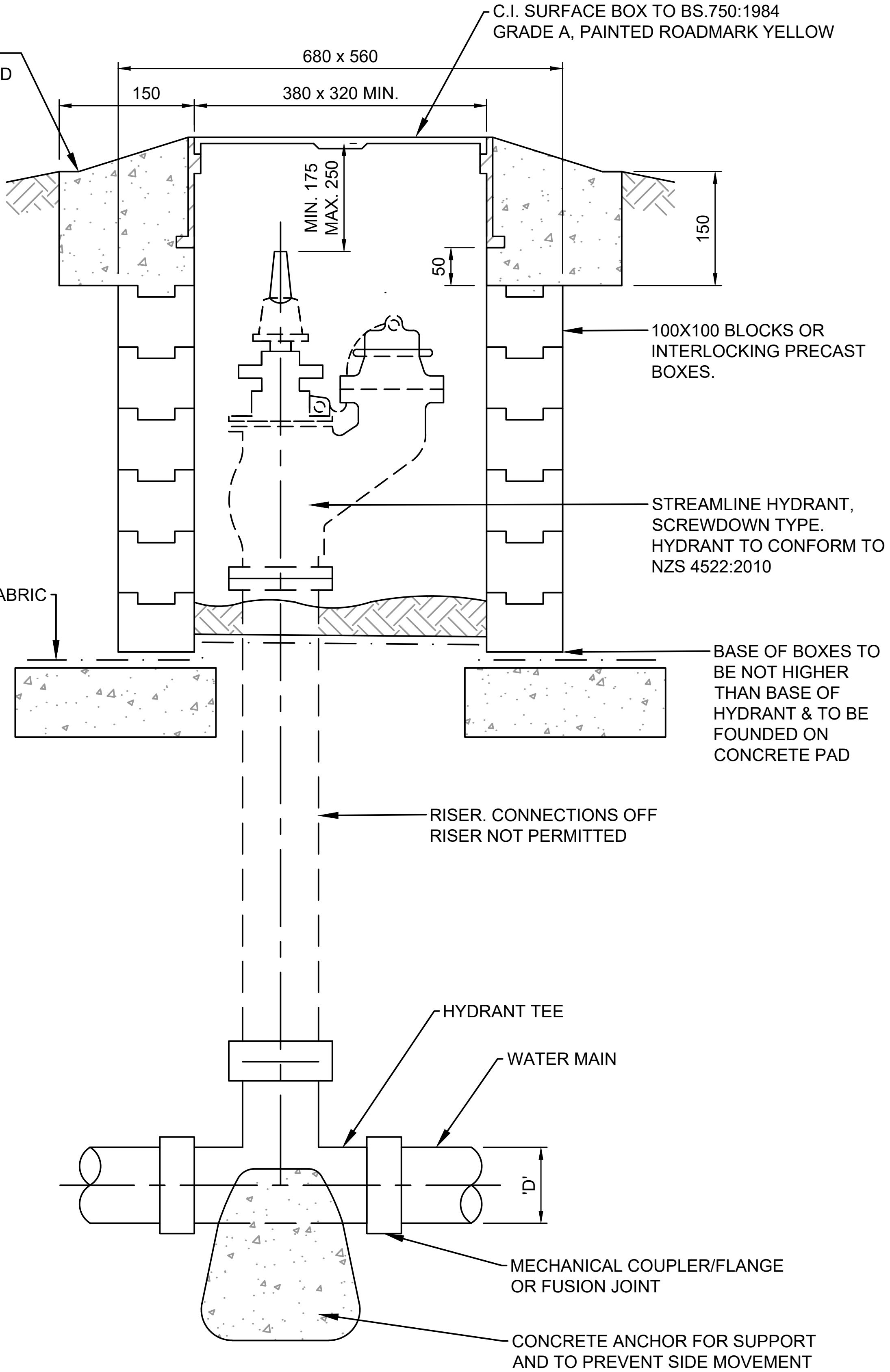
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Domestic Drainage (Shallow Connection) Detail	NOT TO SCALE Drawing No. B1-11



DEEP CONNECTION

DEPTH TO INVERT MORE THAN 1.2m

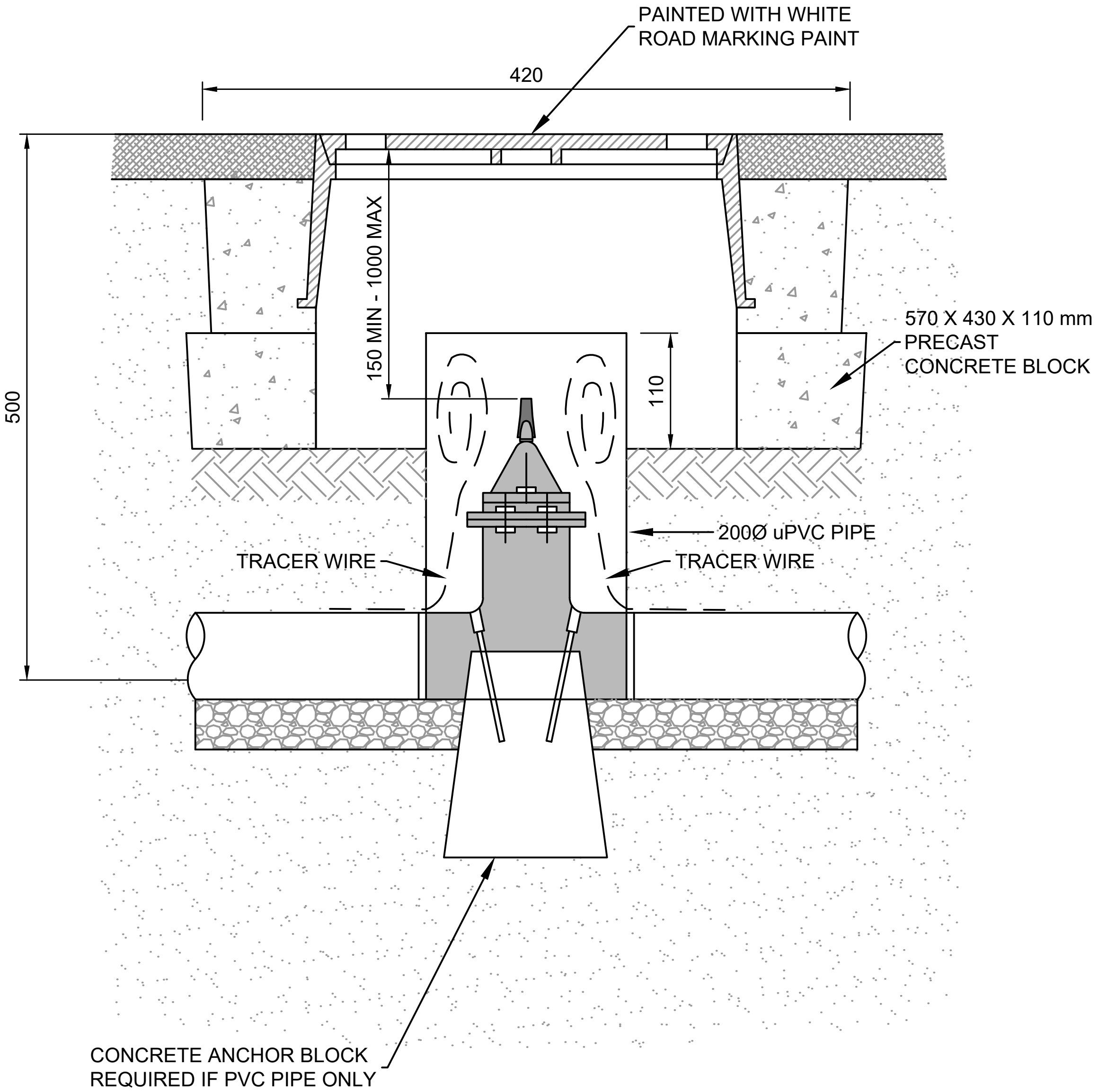
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Domestic Drainage (Deep Connection) Detail	NOT TO SCALE Drawing No. B1-12



NOTES:

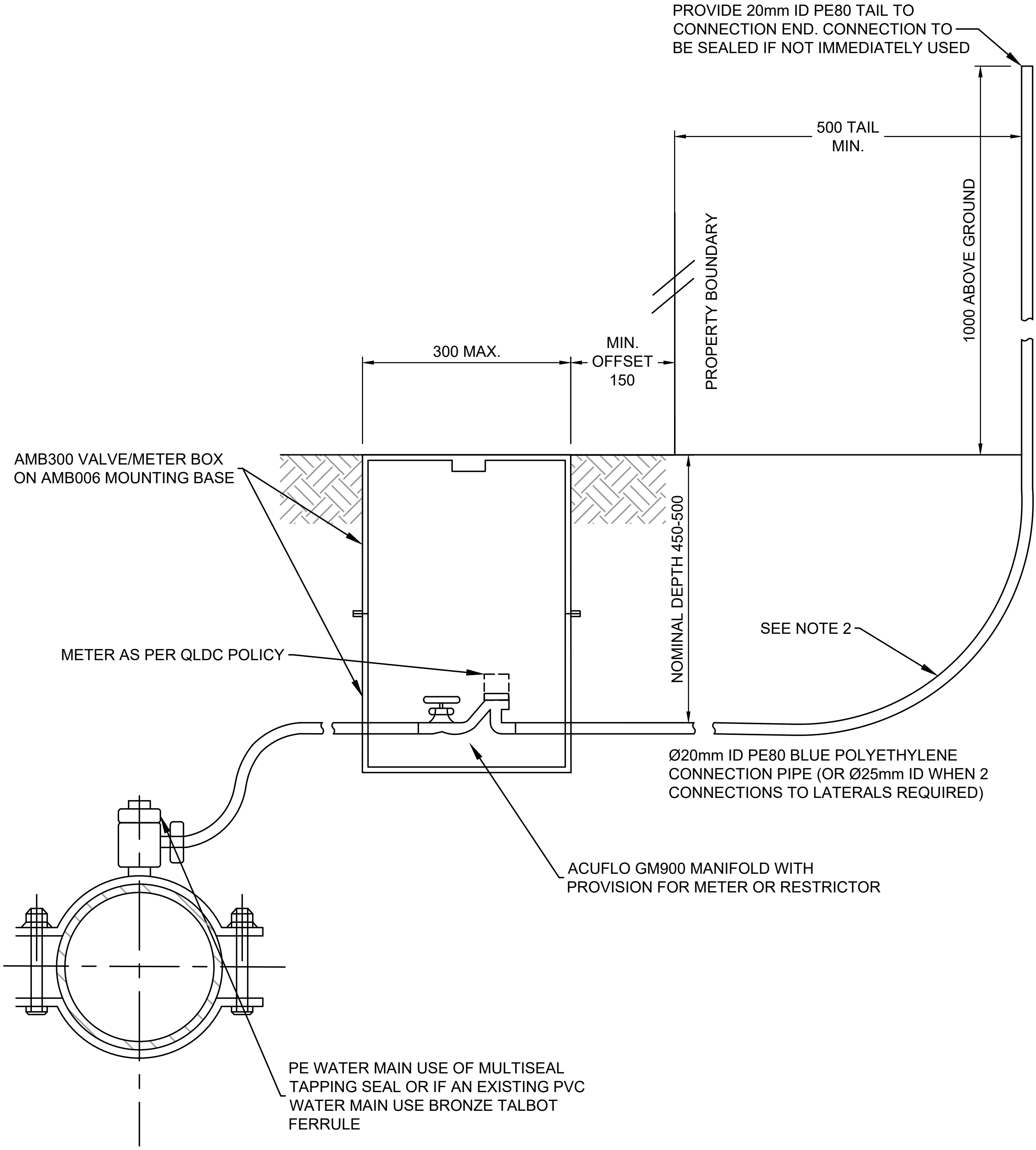
1. ALL DIMENSIONS IN MILLIMETRES.
2. WHERE MAINS ARE CONSTRUCTED IN PVC, USE STANDARD CAST IRON HYDRANT TEE AND STEP MECHANICAL COUPLER.
3. FROST PLUG TO BE INSTALLED.
4. ALL FIRE HYDRANTS SHALL BE INSTALLED ON SUPPLY PIPES THAT HAVE A MINIMUM COVER OF 1000mm TO ALLOW FOR SUITABLE CLEARANCES, IF REQUIRED LOCALISED LOWERING OF THE SUPPLY PIPES CAN BE ACHIEVED BY TAPERING DOWN FROM 5m EITHER SIDE OF THE FIRE HYDRANT.

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Fire Hydrant	NOT TO SCALE Drawing No. B2-1



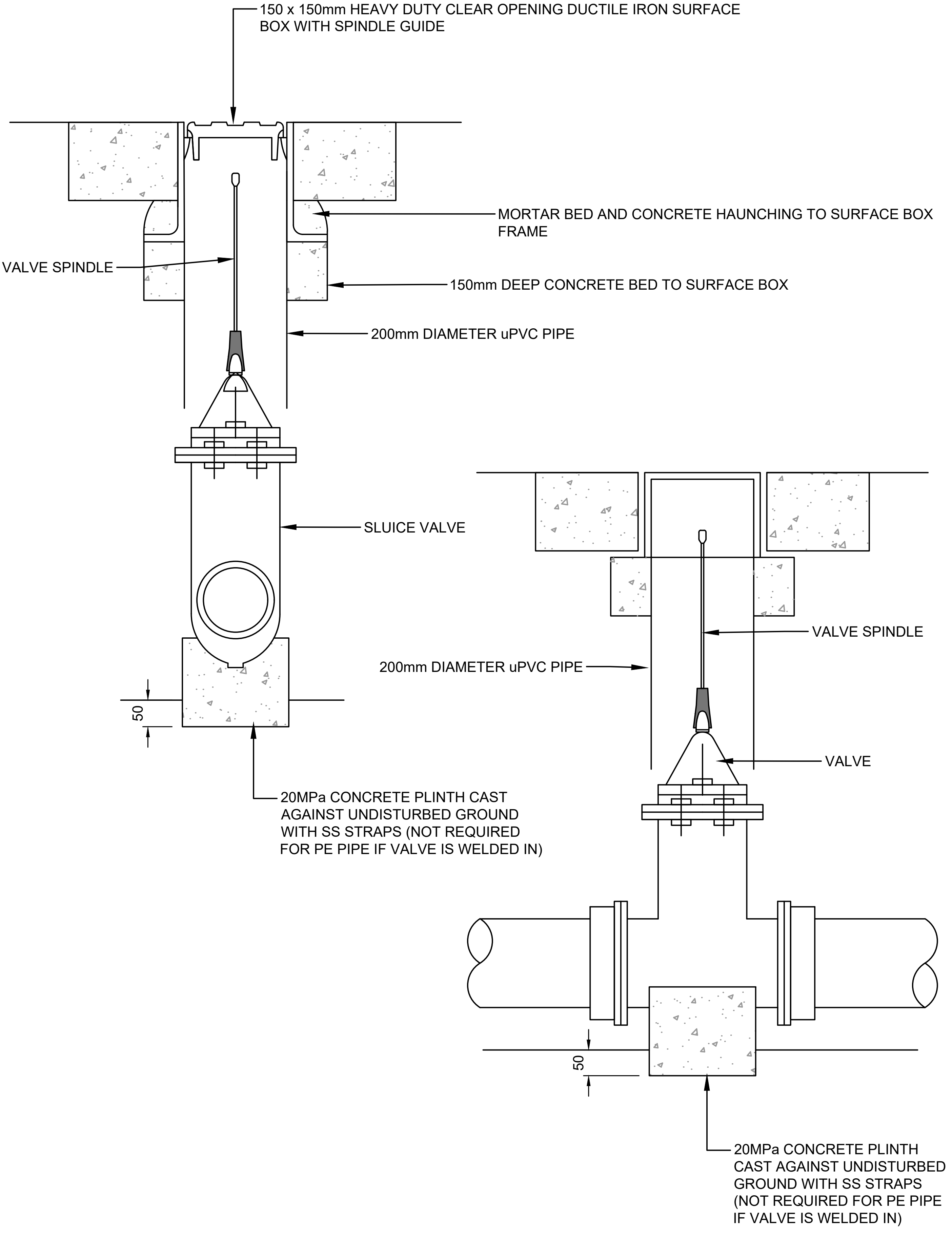
NOTES:

1. CONCRETE SURROUNDS 370x480x90H Ø200 HOLE FITS CAST IRON VALVE BOX 225x235
2. FIRE HYDRANT CONCRETE SURROUND 570x430x110H FITS 405x255 SV OR FH CAST IRON BOX

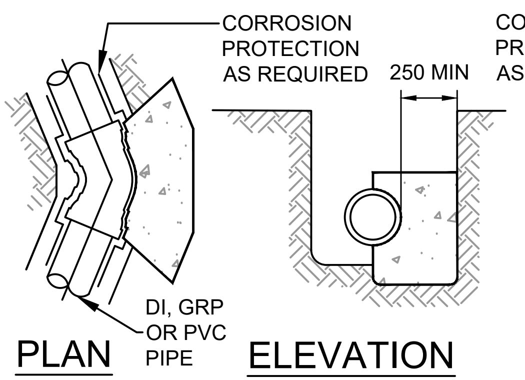


NOTES:
1. OPTION OF USING 50 mm BRASS TALBOT INSTEAD OF ELBOW OFF MAIN.
2. OPTION OF A CONTINUOUS PIPE LAID IN ACCORDANCE WITH MANUFACTURE MINIMUM BEND RADIUS, AND IF THIS CANNOT BE ACHIEVED THEN ELECTRO FUSION (EF) ELBOWS ARE TO BE USED.
3. WHEN THERE IS NO OPTION BUT TO INSTALL A TOBY BOX IN A TRAFFICABLE AREA THEN A TRAFFICABLE CAST BOX WITH CAST IRON LID IS REQUIRED.
4. 25mm ID CONNECTIONS REQUIRE 2 x ACUFLO BOXES OR 500mm JUMBO BOX WITH BASES.
5. AN ACUFLO GM900 MANIFOLD WITH BLANK CAP AND SCREW-IN DUAL CHECK VALVE SHALL BE INSTALLED ON EACH CONNECTION AND POSITIONED INSIDE AN AMB035 (LID-LESS BOX/BASE COMBINATION) WITH A AMB300 (300mm WITH LID) BOX POSITIONED ABOVE TO GIVE REQUIRED DEPTH (450mm) NEAR THE PROPERTY BOUNDARY AND ALSO BE CLEAR OF ANY VEHICULAR MOVEMENTS.

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Typical Service Connection	NOT TO SCALE Drawing No. B2-3

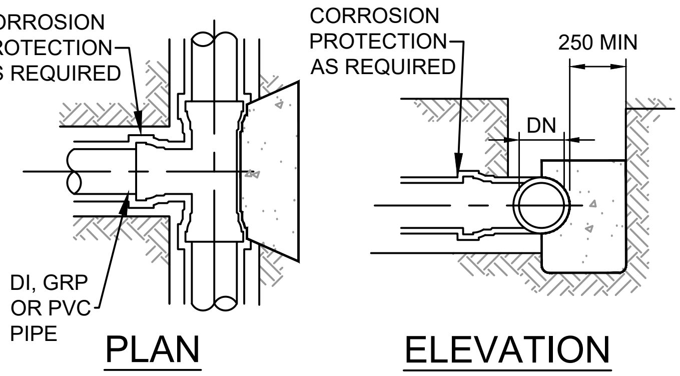


QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Sluice Valve Detail	NOT TO SCALE Drawing No. B2-4



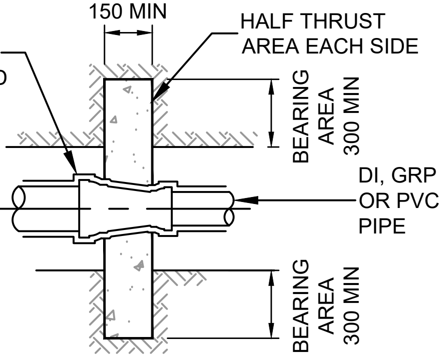
THRUST BLOCK FOR BENDS

(FOR HORIZONTAL THRUST)



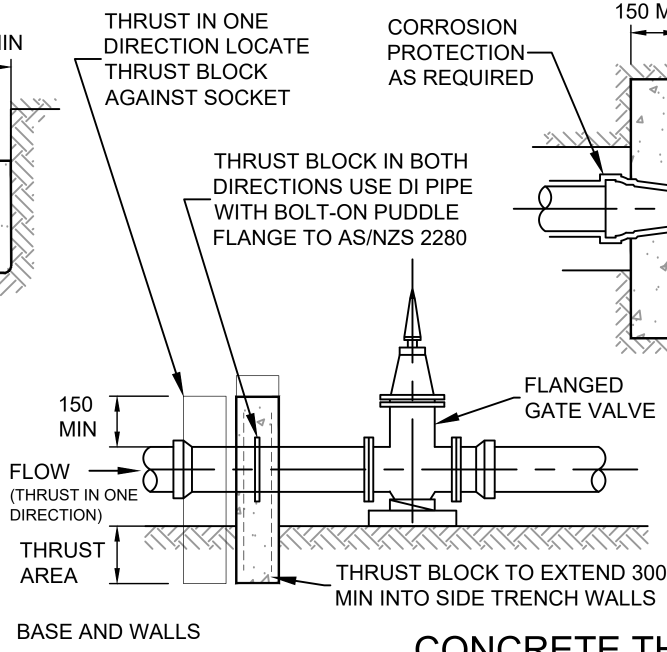
THRUST BLOCK FOR TEES

(FOR HORIZONTAL THRUST)



TAPER THRUST BLOCK

(FOR HORIZONTAL THRUST)



CONCRETE THRUST BLOCK FOR FLANGED VALVES

MINIMUM THRUST AREA FOR BLOCKS IN SQUARE METRES (m^2) DESIGN PRESSURE 1000 kPa (NOM. 100m HEAD)

NOMINAL DIAMETER OF FITTING (DN) / SOIL CLASSIFICATION AND ALLOWABLE HORIZONTAL BEARING PRESSURE OF GROUND. (SEE NOTE 1)	90° & 60° HORIZONTAL BENDS			45° & 30° HORIZONTAL BENDS			22.5° HORIZONTAL BENDS			11.25° HORIZONTAL BENDS			TEES AND DEAD ENDS		
FOR HORIZONTAL THRUST ON TRENCH WALLS WHERE THE COVER OVER PIPES IS 450 OR GREATER	STIFF CLAY MEDIUM DENSE CLEAN SAND	VERY STIFF CLAY DENSE SAND/GRAVEL DECOMPOSED ROCK	HARD CLAY SOUND ROCK	STIFF CLAY MEDIUM-DENSE CLEAN SAND	VERY STIFF CLAY DENSE SAND/GRAVEL DECOMPOSED ROCK	HARD CLAY SOUND ROCK	STIFF CLAY MEDIUM-DENSE CLEAN SAND	VERY STIFF CLAY DENSE SAND/GRAVEL DECOMPOSED ROCK	HARD CLAY SOUND ROCK	STIFF CLAY MEDIUM-DENSE CLEAN SAND	VERY STIFF CLAY DENSE SAND/GRAVEL DECOMPOSED ROCK	HARD CLAY SOUND ROCK	STIFF CLAY MEDIUM-DENSE CLEAN SAND	VERY STIFF CLAY DENSE SAND/GRAVEL DECOMPOSED ROCK	HARD CLAY SOUND ROCK
PBH kPa	50	100	200	50	100	200	50	100	200	50	100	200	50	100	200
100	0.32	N	N	N	N	N	N	N	N	N	N	N	.023	N	N
150	0.68	0.34	N	0.37	N	N	0.19	N	N	N	N	N	0.48	0.24	N
200	1.07	0.54	0.27	0.58	0.29	N	0.30	N	N	N	N	N	0.76	0.38	0.19
225	1.46	0.73	0.37	0.79	0.40	0.20	0.40	0.20	N	0.20	N	N	1.03	0.52	0.26
250	1.64	0.82	0.41	0.88	0.44	0.22	0.45	0.23	N	0.23	N	N	1.16	0.58	0.29
300	2.59	1.30	0.65	1.40	0.70	0.35	0.72	0.36	N	0.36	N	N	1.83	0.92	0.46
375	3.95	1.98	0.99	2.14	1.07	0.53	1.09	0.55	0.27	0.55	0.27	N	2.79	1.40	0.70
450	5.60	2.80	1.40	3.03	1.51	0.76	1.54	0.77	0.39	0.78	0.39	0.19	3.96	1.98	0.99
500	6.16	3.08	1.54	3.34	1.67	0.83	1.70	0.85	0.43	0.85	0.43	0.21	4.36	2.18	1.09
600	9.69	4.84	2.42	5.24	2.62	1.31	2.67	1.34	0.67	1.34	0.67	0.34	6.85	3.43	1.71
750	14.40	7.20	3.60	7.79	3.90	1.95	3.97	1.99	0.99	2.00	1.00	0.50	10.18	5.09	2.54

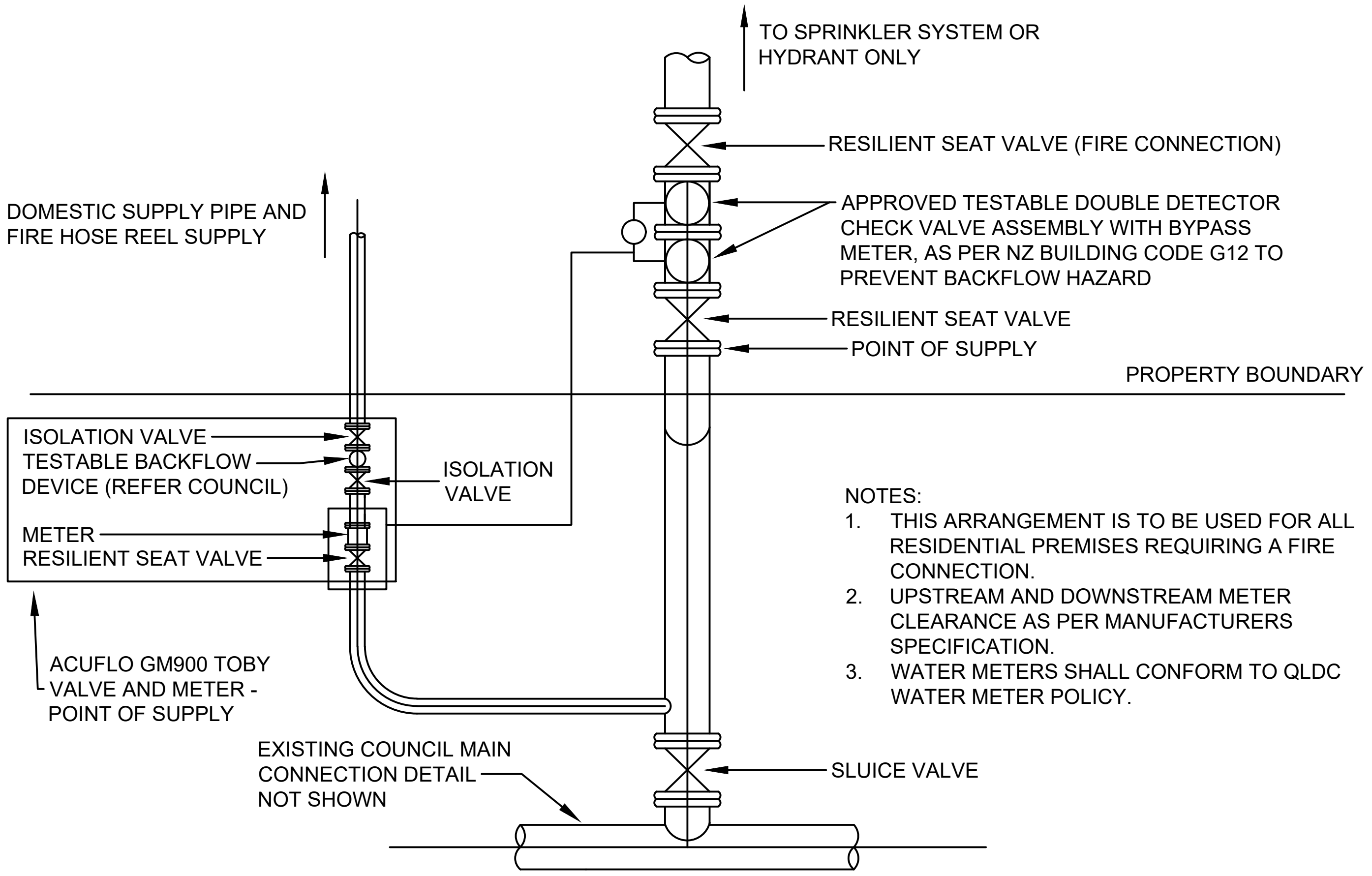
N' DENOTES NOMINAL THRUST AREA - (SEE NOTES 4 & 5)

PBH - ALLOWABLE HORIZONTAL BEARING PRESSURE

NOTES:

1. SOIL CLASSIFICATIONS USED IN THIS TABLE ARE EXPLAINED IN APPENDIX G OF WSA 03.
2. CAST THE THRUST AREA OF ALL THRUST BLOCKS AGAINST A CLEAN FACE OF UNDISTURBED NATURAL SOIL. THRUST BLOCKS NOT TO INTERFERE WITH OTHER SERVICES.
3. DO NOT USE STANDARD THRUST BLOCKS IN:
   - VERY SOFT, SOFT OR FIRM CLAY;
   - LOOSE CLEAN SAND;
   - UNCOMPACTED FILL OR REFUSE;

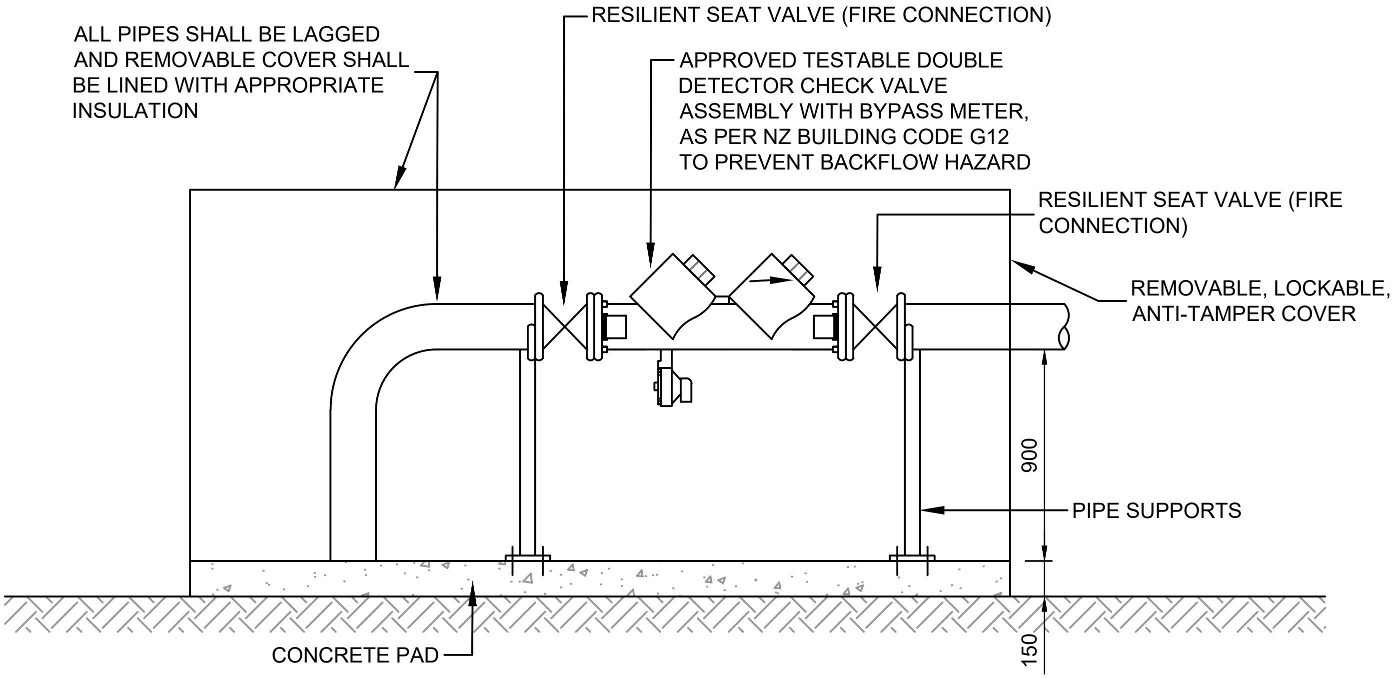
   A GEOTECHNICAL ASSESSMENT AND INDIVIDUAL DESIGN IS REQUIRED FOR THESE SOILS.
3. THE NOMINAL THRUST AREA 'N' TO BE ACHIEVED BY POURING CONCRETE THE FULL LENGTH OF THE FITTING AND EXTENDING FROM THE FLOOR OF THE TRENCH TO ABOVE THE FITTING (SEE NOTE 5).
4. FOR SYSTEM TEST PRESSURES OTHER THAN 1000 kPa REDUCE OR INCREASE THE MINIMUM THRUST AREA BY THE RATIO OF THE APPLICABLE PRESSURES EXCEPT WHERE:
   - THRUST AREA IS <0.18m^2, AND
   - 'N' APPEARS IN THE TABLE AND THE APPLICABLE PRESSURE IS ABOVE 1000 kPa CALCULATE THE AREA.
5. FINISH THRUST BLOCKS APPROXIMATELY 100 mm ABOVE THE TOP OF THE FITTING OR BEARING PAD AND EXTEND TO THE FLOOR OF THE TRENCH OR DEEPER IF NECESSARY TO ACHIEVE THE REQUIRED THRUST AREA. MAXIMUM ENCASEMENT TO BE 180°.
6. THE MINIMUM THRUST AREA FOR TAPER THRUST BLOCKS TO BE EQUAL TO THE DIFFERENCE BETWEEN THE THRUST AREAS FOR DEAD-ENDS OF EQUIVALENT DIAMETER TO THOSE EACH SIDE OF TAPER.
7. FOR DOWNWARD VERTICAL THRUST, THE ALLOWABLE BEARING PRESSURES FOR VARIOUS SOILS MAY BE TAKEN AS TWICE THAT FOR HORIZONTAL THRUST SHOWN.
8. WHEN POURING CONCRETE AGAINST FITTINGS PLACE A MEMBRANE OF POLYETHYLENE, PVC OR FELT BETWEEN THE FITTING AND CONCRETE TO PREVENT DAMAGE TO THE FITTING. JOINTS TO BE CLEAR OF CONCRETE.
9. CONCRETE TO BE KEPT CLEAR OF BOLTS & FLANGES OR GIBAULT JOINTS TO ALLOW FITTINGS TO BE REMOVED WITHOUT INTERFERING WITH ANCHOR BLOCK.
10. THE USE OF THRUST BLOCKS IS GENERALLY NOT REQUIRED FOR PE PIPE. THRUST BLOCKS MAY BE REQUIRED IN CASES WHERE SPECIAL GASKETED MECHANICAL FITTINGS ARE USED.



NOTES:

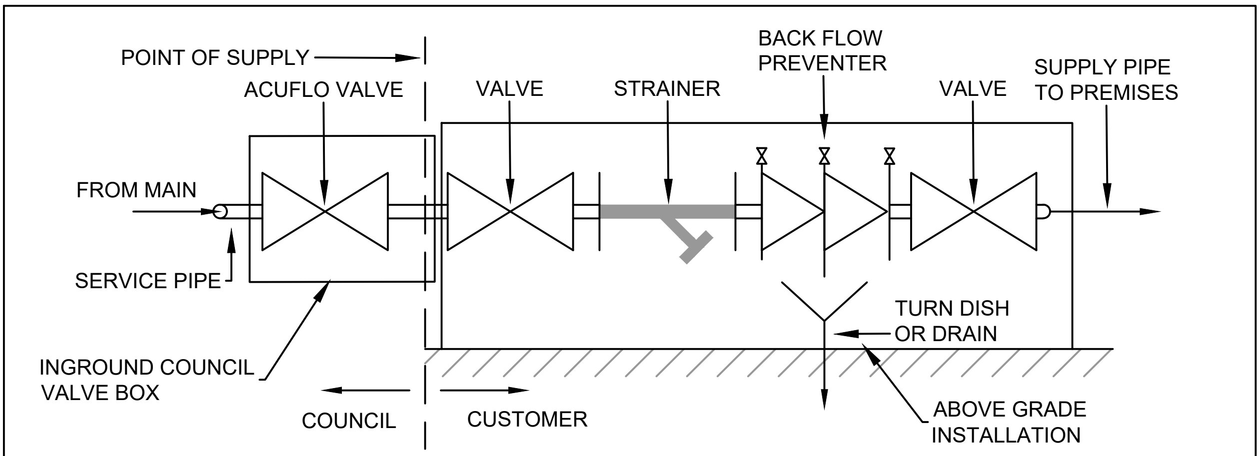
1. THIS ARRANGEMENT IS TO BE USED FOR ALL RESIDENTIAL PREMISES REQUIRING A FIRE CONNECTION.
2. UPSTREAM AND DOWNSTREAM METER CLEARANCE AS PER MANUFACTURERS SPECIFICATION.
3. WATER METERS SHALL CONFORM TO QLDC WATER METER POLICY.

PLAN

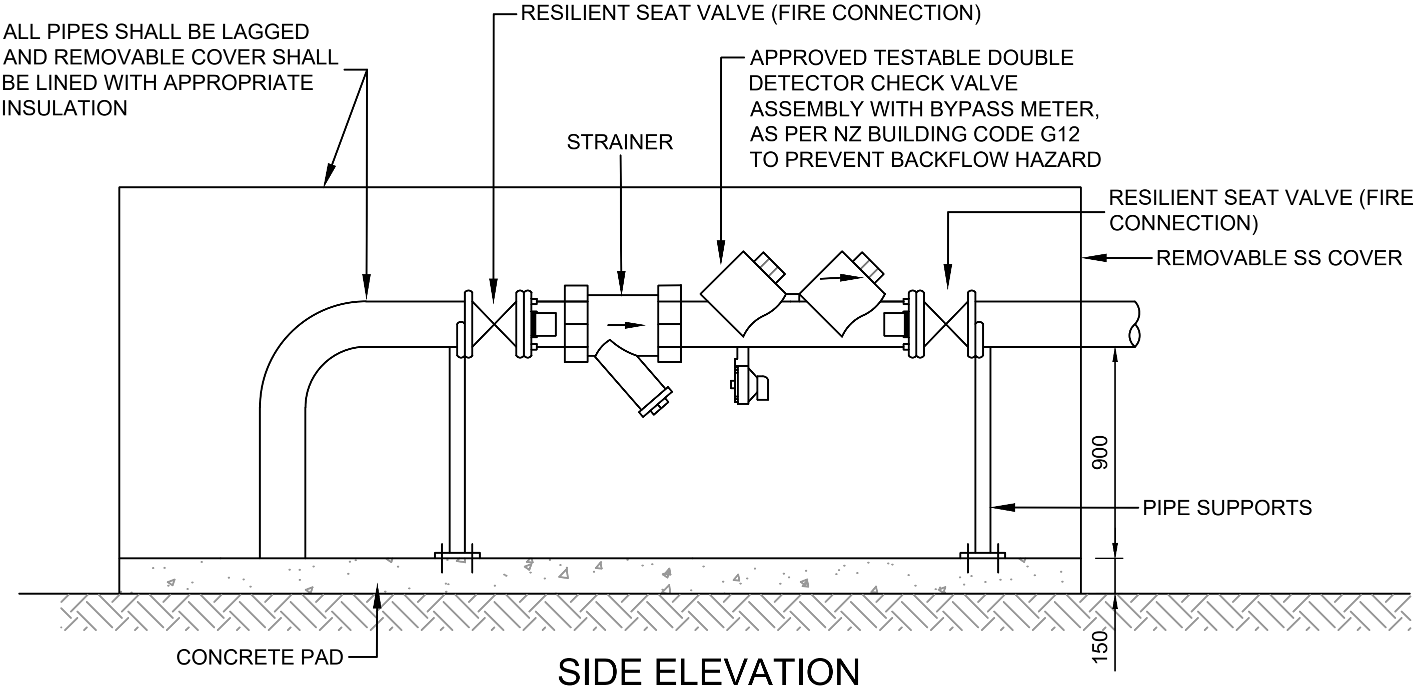


SIDE ELEVATION

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Residential Fire System Connection with Potable Supply	NOT TO SCALE Drawing No. B2-6



UNMETERED SUPPLY



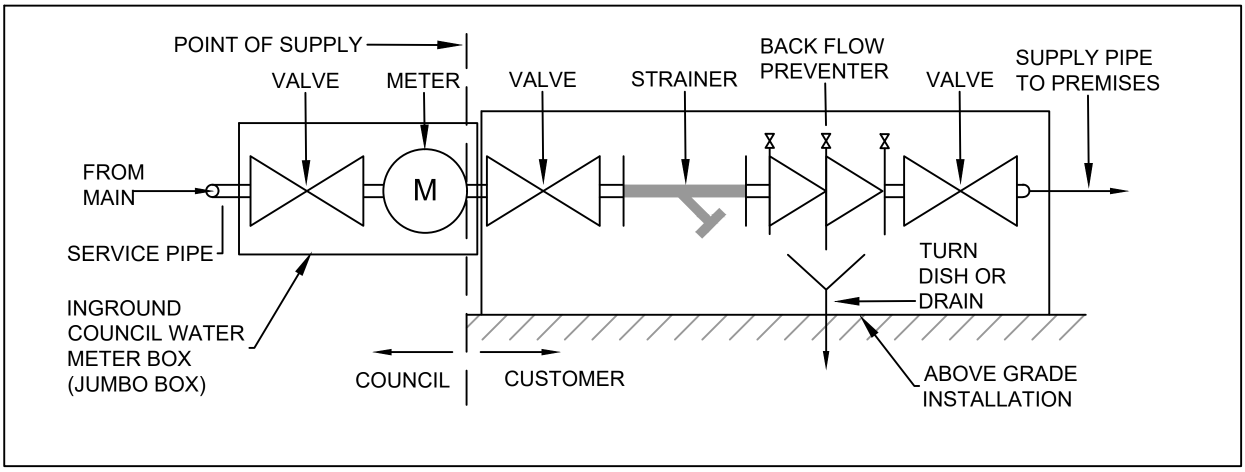
SIDE ELEVATION

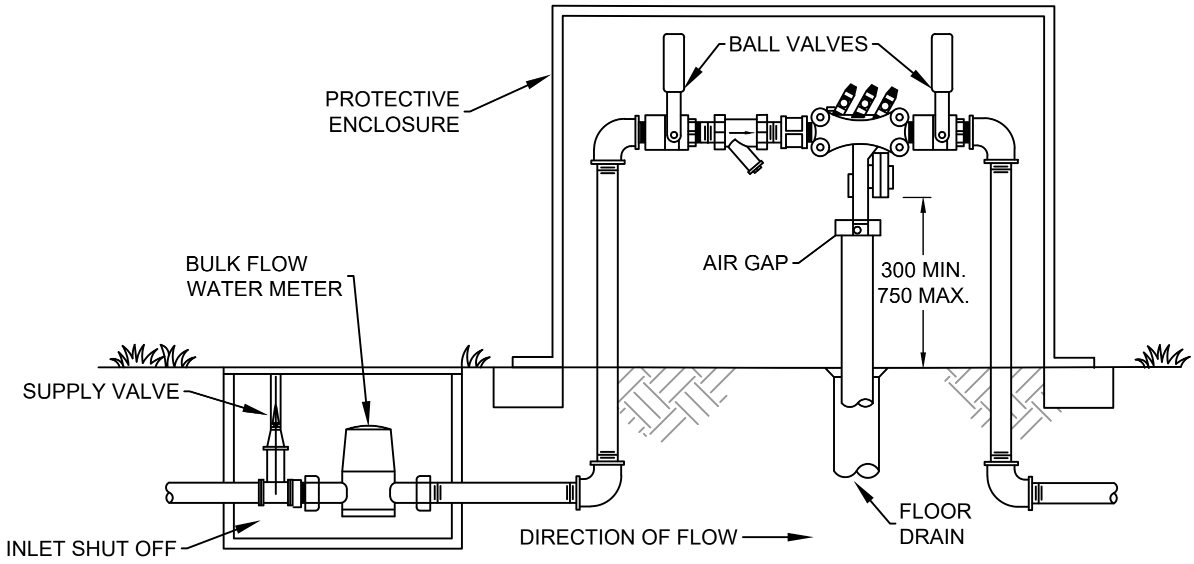
COMMERCIAL FIRE FIGHTING WATER CONNECTION

1. A STANDARD ACUFLO BOX AND MANIFOLD WILL NOT BE APPLICABLE TO THIS INSTALLATION. ACUFLO HARDWARE IS ONLY SUITABLE FOR UP TO 25mm PIPE CONNECTIONS. THIS INSTALLATION WILL NEED TO BE CONFIGURED SPECIFIC TO THE SITE. REFER TO ITEMS BELOW THAT ARE MANDATORY:
   - THE SERVICE PIPE SHALL HAVE A BLUE RESILIENT SEATED SERVICE VALVE IN ITS OWN VALVE BOX.
   - A REDUCED PRESSURE ZONE BFP SHALL BE INSTALLED INSIDE THE BOUNDARY OF THE PRIVATE PROPERTY. IF THE WATER SUPPLY IS PROPOSED TO BE DIVIDED INTO MULTIPLE LINES TO SERVICE DIFFERENT AREAS OF THE SITE, THE BFP SHALL BE LOCATED ON THE SINGLE INCOMING WATER SUPPLY LINE IN ADVANCE OF ANY SUCH DIVISION. A RPZ SHALL BE LOCATED ABOVE GROUND.
   - THIS BFP IS THE POS BFP DEVICE REQUIRED BY THE HEALTH AMENDMENT ACT 2007. THE DEVICE SHALL BE LOCATED IN AN ABOVE GROUND ENCLOSURE WHERE POSSIBLE.

LOCATING BACK FLOW PREVENTERS AND WATER METERS

2. BACK FLOW PREVENTERS SHALL BE LOCATED DIRECTLY WITHIN THE ROAD FRONTAGE BOUNDARY OF THE PROPERTY SERVED IN EVERY INSTANCE EXCEPT WHERE IN A CBD ENVIRONMENT WHERE THERE MAY BE NO SPACE WITHIN THE BUILDING FRONTAGE FOR AN ABOVE GROUND CABINET.
3. A BFP SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER RECOMMENDATIONS, AND THE APPROPRIATE BFP USED SHOULD BE DETERMINED BASED ON THE HAZARD. IF USING A RPZ BFP, IT SHALL BE INSTALLED ABOVE GROUND. ALL OTHER BFP'S SHOULD BE ABOVE GROUND WHERE POSSIBLE. THE BFP SHALL ALLOW ANY WATER DISCHARGED TO DRAIN TO GROUND IN AN OBVIOUS MANNER.
4. THE FIRST ISOLATION VALVE IS THE SUPPLY POINT; THIS IS THE BOUNDARY BETWEEN COUNCIL RESPONSIBILITY AND PRIVATE OWNER'S RESPONSIBILITY FOR SERVICE AND WATER QUALITY.
5. THE ISOLATION VALVE SHALL BE LOCATED ON THE ROAD RESERVE IN ALL INSTANCES AND SHALL NOT BE LOCATED ON A ROW OR EASEMENT.

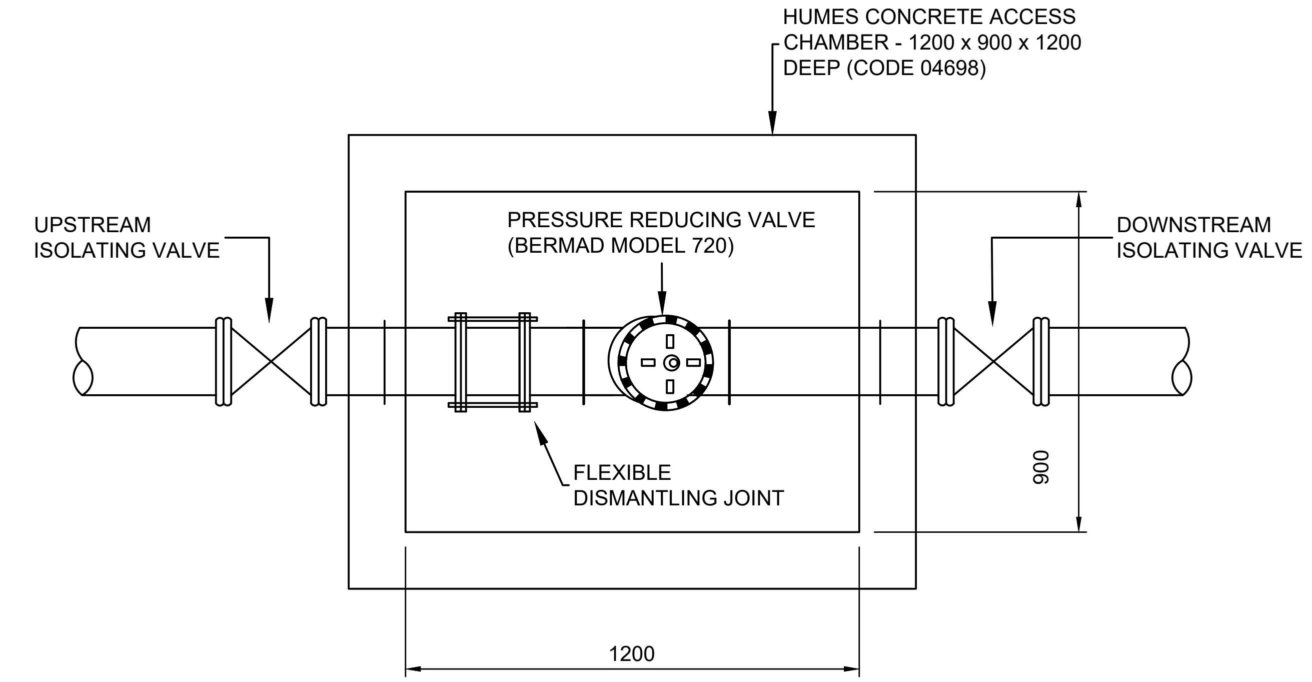




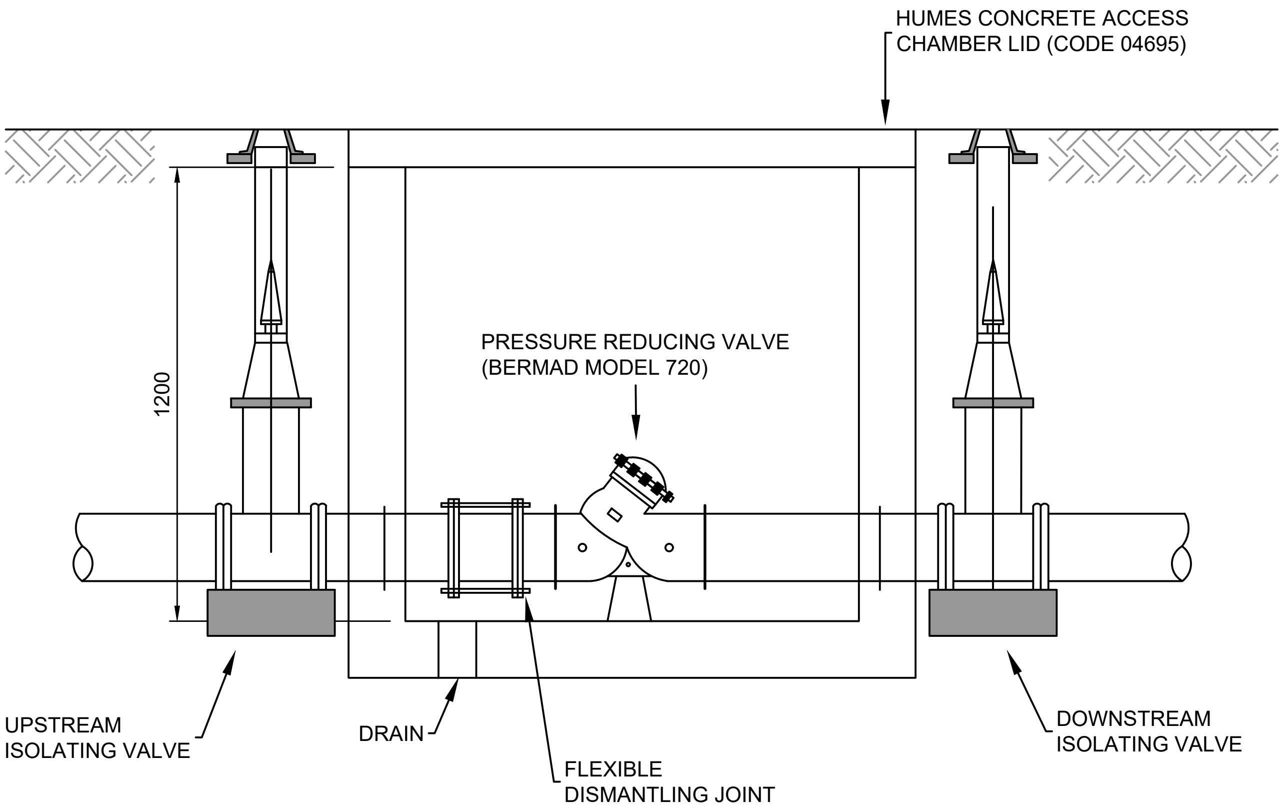
1. A STANDARD ACUFLO BOX AND MANIFOLD WILL NOT BE APPLICABLE TO THIS INSTALLATION. ACUFLO HARDWARE IS ONLY SUITABLE FOR UP TO 25mm PIPE CONNECTIONS. THIS INSTALLATION WILL NEED TO BE CONFIGURED SPECIFIC TO THE SITE. REFER TO ITEMS BELOW THAT ARE MANDATORY:
   - THE SERVICE PIPE SHALL HAVE A BLUE RESILIENT SEATED SERVICE VALVE IN ITS OWN VALVE BOX PRIOR TO A WATER METER BOX.
   - A WATER METER BOX SHALL BE LOCATED 300mm BEFORE THE PRIVATE PROPERTY BOUNDARY. THE BOX SHALL CONTAIN AN APPROVED WATER METER OF A SUITABLE SIZE. THE METER SHALL HAVE THREE REGISTERS OF THE SUB m³ VALUES. THIS IS COUNCIL'S POINT OF SUPPLY BOUNDARY AND IS LOCATED IN THE STREET PRIOR TO THE REQUIRED BFP.
   - A BFP DEVICE OF EITHER RA TESTABLE DOUBLE CHECK VALVE ASSEMBLY OR REDUCED PRESSURE ZONE BFP SHALL BE INSTALLED INSIDE THE BOUNDARY OF THE PRIVATE PROPERTY. IF THE WATER SUPPLY IS PROPOSED TO BE DIVIDED INTO MULTIPLE LINES TO SERVICE DIFFERENT AREAS OF THE SITE, THE BFP SHALL BE LOCATED ON THE SINGLE INCOMING WATER SUPPLY LINE IN ADVANCE OF ANY SUCH DIVISION.
   - THIS BFP IS THE POS BFP DEVICE REQUIRED BY THE HEALTH AMENDMENT ACT 2007. IF THIS DEVICE IS ASSESSED TO BE A RPZ THEN IT SHOULD BE LOCATED IN AN ABOVE GROUND ENCLOSURE.
   - AN **ELSTER HELIX 4000 OR C4000 / 4200 OR SENSUS MEITWIN; MEISTREAM; WP** WATER METER SHALL BE INSTALLED ON TO THE MANIFOLD.

LOCATING BACK FLOW PREVENTERS AND WATER METERS

2. BACK FLOW PREVENTERS SHALL BE LOCATED DIRECTLY WITHIN THE ROAD FRONTAGE BOUNDARY OF THE PROPERTY SERVED IN EVERY INSTANCE EXCEPT WHERE IN A CBD ENVIRONMENT WHERE THERE MAY BE NO SPACE WITHIN THE BUILDING FRONTAGE FOR AN ABOVE GROUND CABINET.
3. THE BFP SHALL BE ABOVE GROUND AND ALLOW ANY WATER DISCHARGED TO DRAIN TO GROUND IN AN OBVIOUS MANNER. WHERE DOUBLE CHECK VALVE DEVICES ARE INSTALLED IN AN UNDERGROUND CHAMBER, THE DESIGN MUST ALLOW FOR SERVICING BY TOP ENTRY AND THE CHAMBER MUST BE WELL DRAINED. FOR LARGER SIZED DOUBLE CHECK VALVE DEVICES IT IS GOOD PRACTICE TO INSTALL THESE ABOVE GROUND, FOR EASE OF ACCESS AND POSSIBLE FUTURE UPGRADING TO REDUCED PRESSURE ZONE DEVICES.
4. THE WATER METER IS THE SUPPLY POINT; THIS IS THE BOUNDARY BETWEEN COUNCIL RESPONSIBILITY AND PRIVATE OWNER'S RESPONSIBILITY FOR SERVICE AND WATER QUALITY.
5. THE WATER METER SHALL BE LOCATED ON THE ROAD IN ALL INSTANCES AND SHALL NOT BE LOCATED ON A ROW OR EASEMENT.
6. WATER METERS OF SIZES LARGER THAN 25mm WILL REQUIRE A JUMBO METER BOX AND A SEPARATE INDIVIDUAL TOBY VALVE WITH VALVE CHAMBER PRIOR TO THE WATER METER BOX.
7. THE WATER METER BOX SHALL HAVE THE WORDS "METER" AND/OR "WATER METER" VISIBLE UPON THE COVER.



PLAN

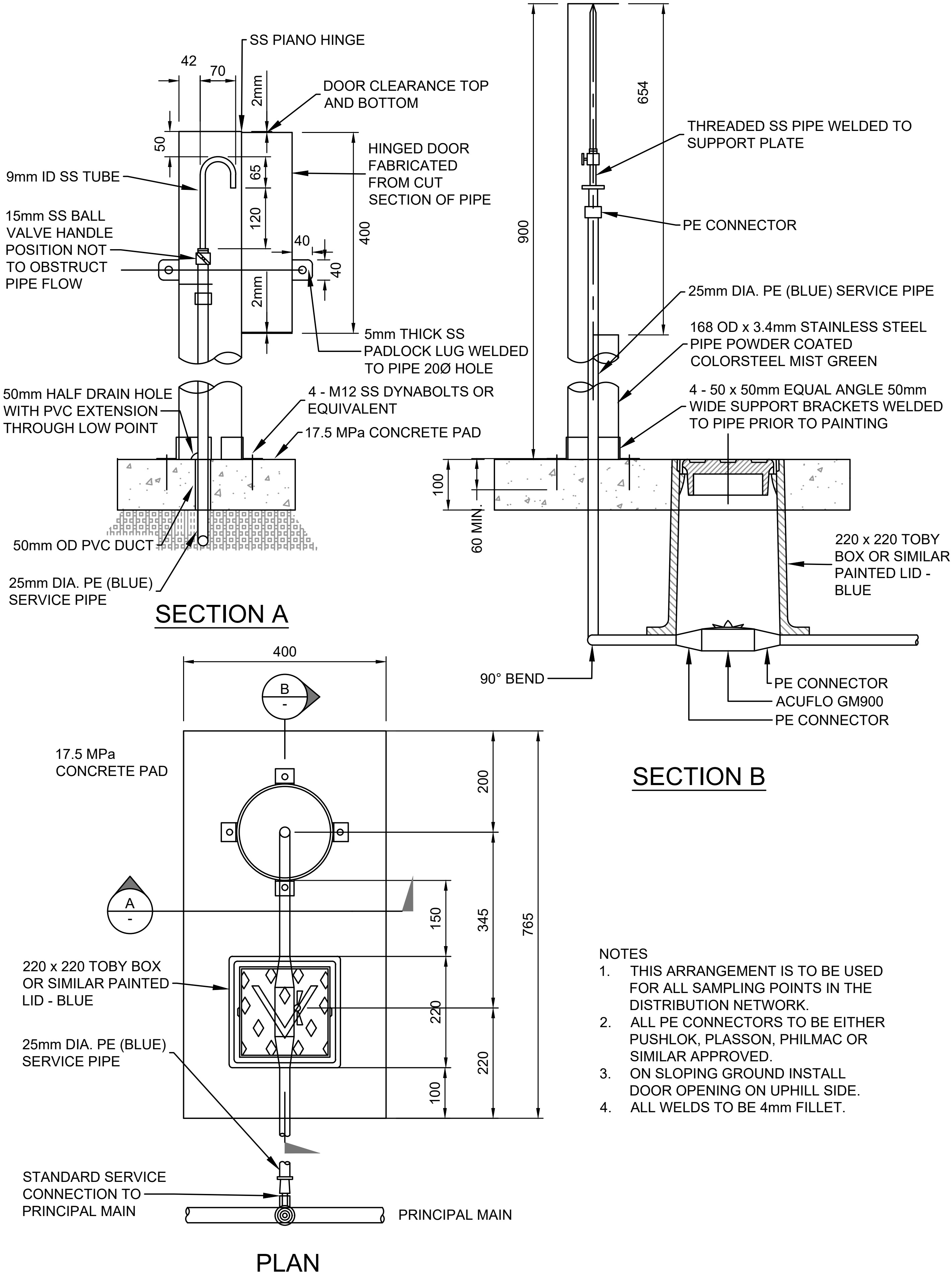


SECTION

NOTES:

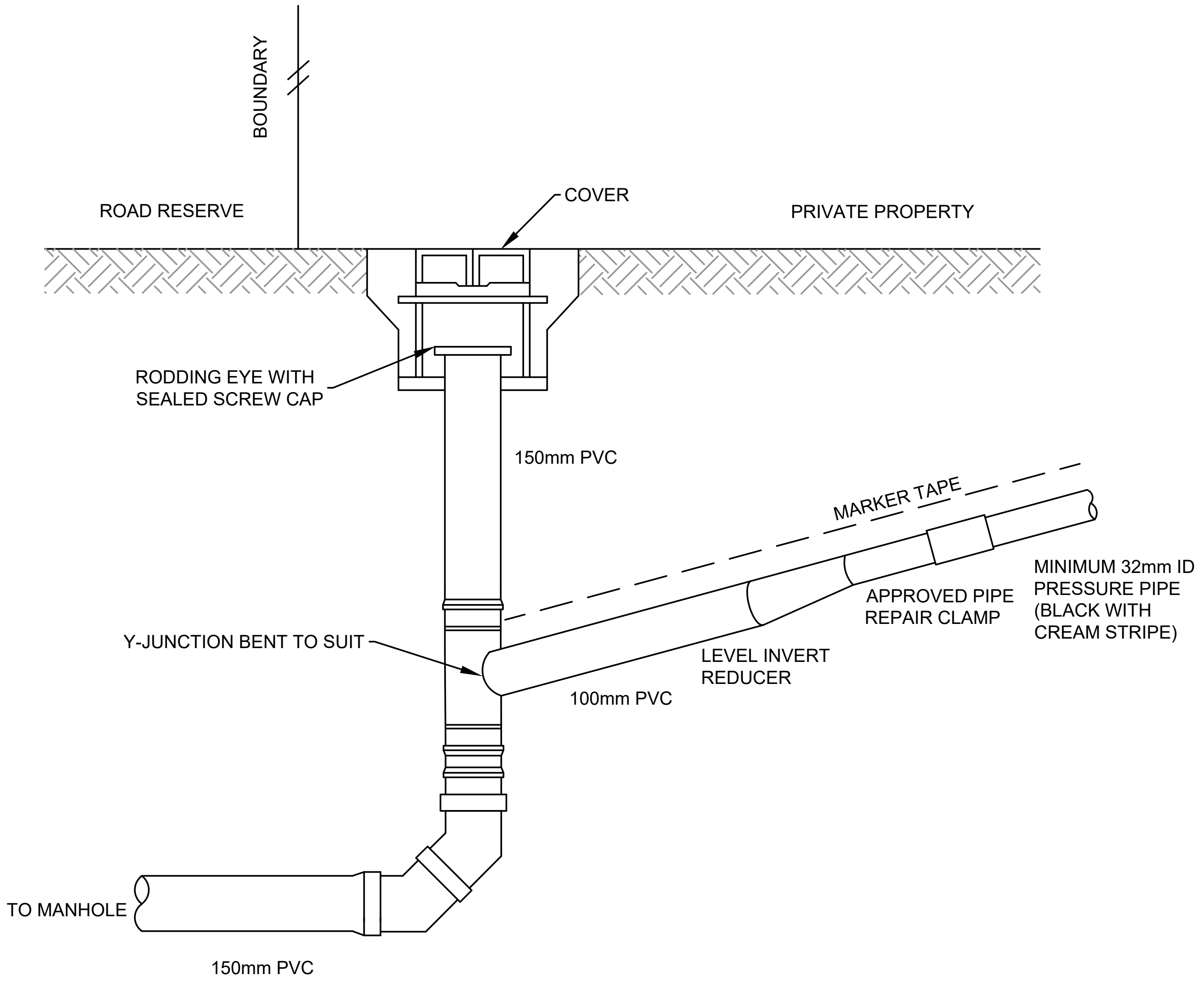
1. CONSIDERATION NEEDS TO BE GIVEN FOR UPSTREAM FILTER AND PRESSURE RELIEF VALVE WHEN DESIGNING THE INSTALLATION OF THESE VALVES.
2. CONSIDERATION NEEDS TO BE GIVEN FOR DRAINAGE WITHIN THE VALVE CHAMBER.

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: PRV Valve Chamber	NOT TO SCALE Drawing No. B2-9

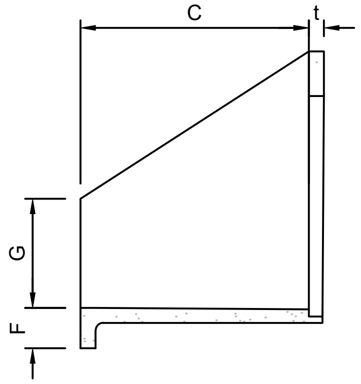


NOTES
1. THIS ARRANGEMENT IS TO BE USED FOR ALL SAMPLING POINTS IN THE DISTRIBUTION NETWORK.
2. ALL PE CONNECTORS TO BE EITHER PUSHLOK, PLASSON, PHILMAC OR SIMILAR APPROVED.
3. ON SLOPING GROUND INSTALL DOOR OPENING ON UPHILL SIDE.
4. ALL WELDS TO BE 4mm FILLET.

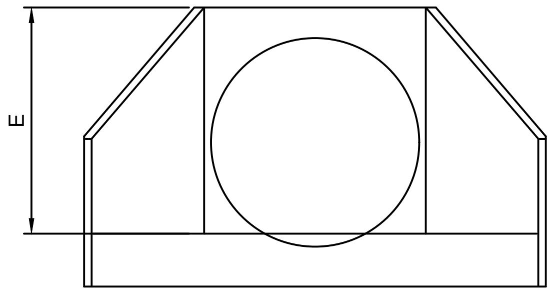
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Water Sampling Point	NOT TO SCALE Drawing No. B2-10



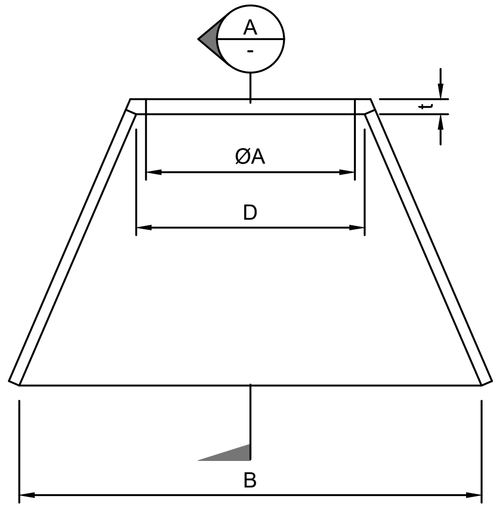
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Private Pressure Sewer Main Connection to Sewer Lateral	NOT TO SCALE Drawing No. B3-1



CROSS SECTION A



FRONT ELEVATION



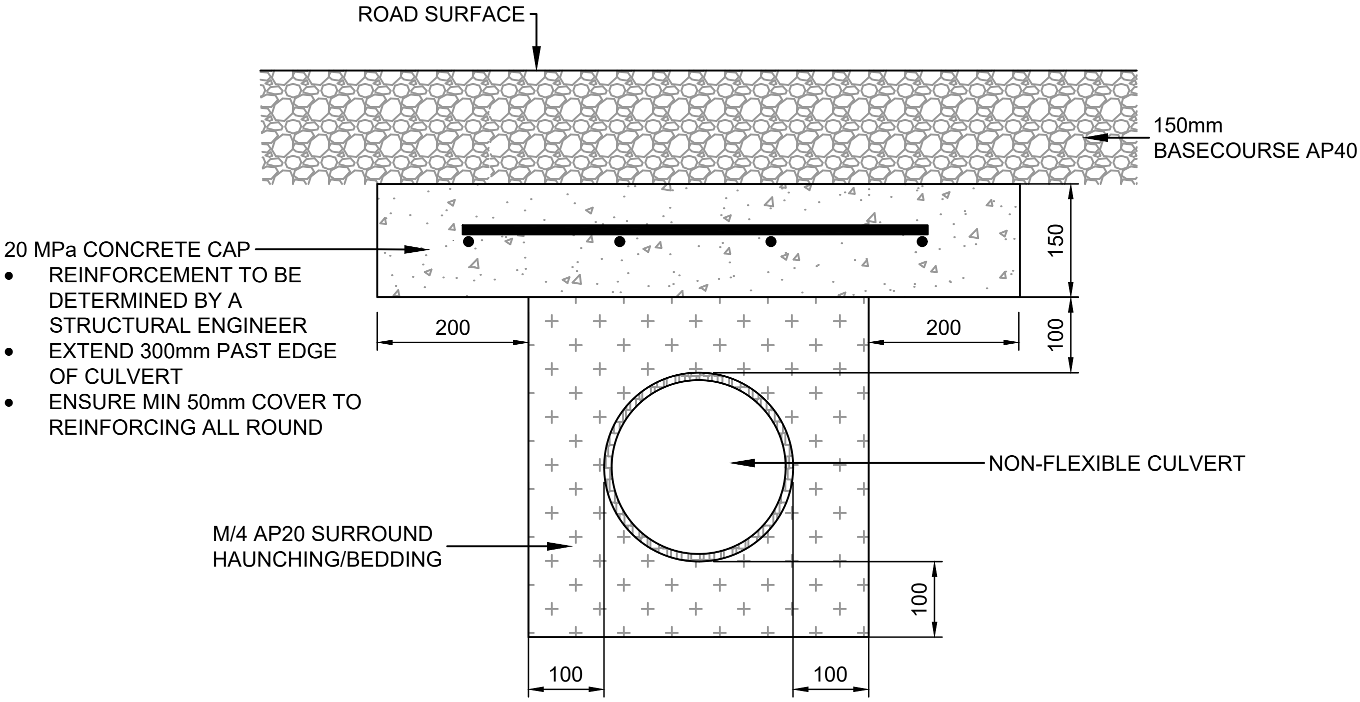
PLAN VIEW

TABLE 1

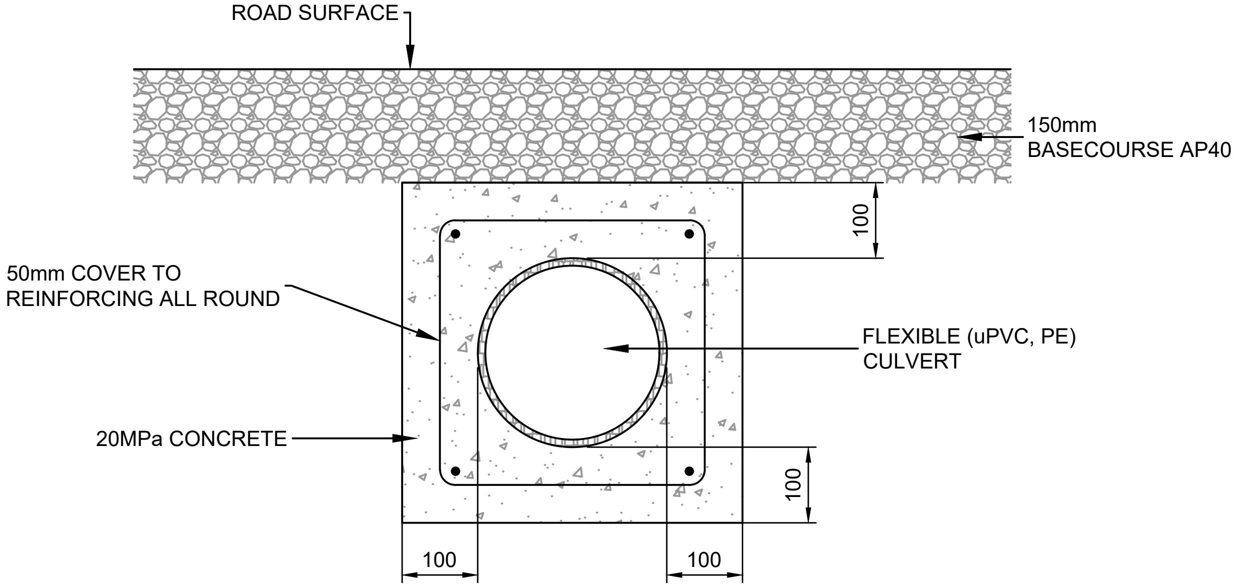
PIPE DIA.	PRINCIPAL DIMENSIONS (mm)							
	A	B	C	D	E	F	G	t
150-300	190-390	1000	600	460	520	200	160	50
300-600	370-700	1900	1100	750	900	280	500	80
600-1050	720-1225	3000	100	1270	1675	345	600	100
1200-1350	1380-1540	4100	2400	1600	1975	425	750	125
1600-1800	1727-2040	4900	2400	2150	2265	450	750	150

NOTES:

1. REINFORCED FLOOR AND WALLS WITH
   150 TO 375 - 665 MESH (668 OR SIMILAR)
   450 TO 600 - 663 MESH OR EQUIVALENT OR 10Ø RODS @ 250 CRS
   675 TO 900 - 12Ø RODS @ 250 CRS
   1050 TO 1350 - 12Ø RODS @ 150 CRS
2. ALL REINFORCEMENT SHALL BE PLACED CENTRAL IN WALLS & FLOOR AND SHALL BE CONTINUOUS BETWEEN WALL AND FLOOR.
3. LAPS IN STRUCTURAL GRADE BARS TO BE 300mm MINIMUM.
4. THERE SHALL BE AT LEAST TWO BARS WHETHER MESH OR MILD STEEL, OVER THE TOP OF THE PIPE.
5. CONCRETE COMPRESSIVE STRENGTH IS TO BE 20MPa @ 28 DAYS.
6. BAFFLES ARE TO BE CONSTRUCTED AS SHOWN WHEN OUTLET VELOCITIES AND SOIL CONDITIONS DICTATE. IN EXTREME CASES SPECIFIC DESIGN MAY BE REQUIRED.
7. INLETS EXCEEDING 450mmØ TO HAVE ANTI-VERMIN SCREENS FITTED, EXCEPT WHEN THE PIPE IS LESS THAN 20m LONG.
8. TABLE 1 IS FOR FORMING INLET AND OUTLET STRUCTURES OUTSIDE MANUFACTURERS SPECIFICATIONS.



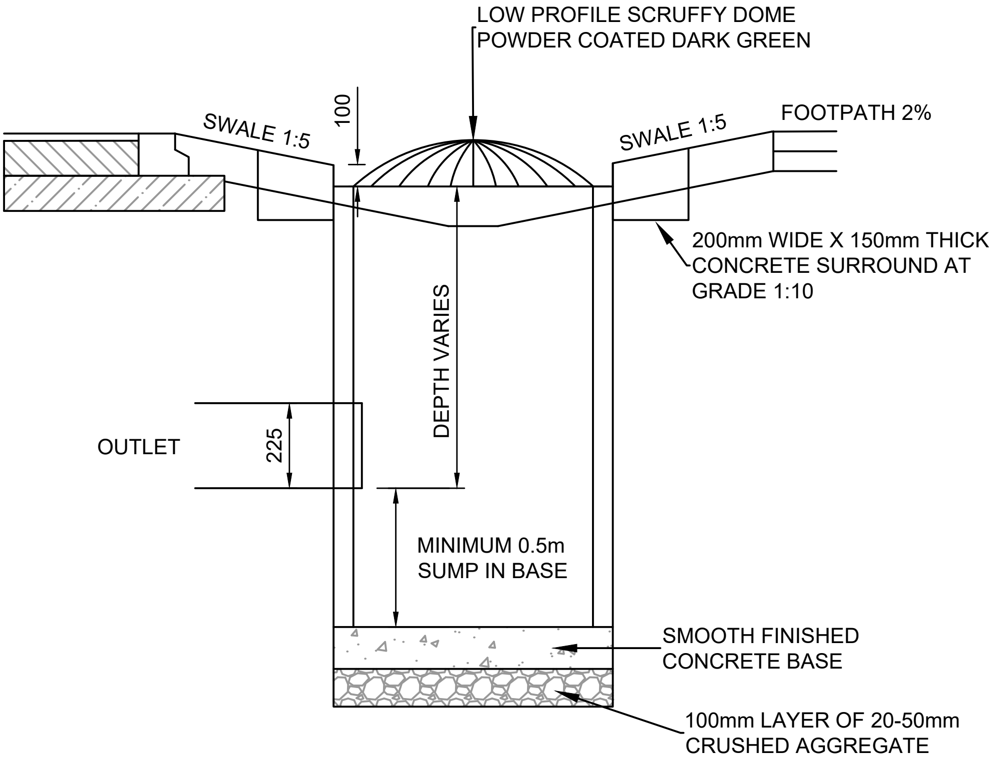
CONCRETE CAPPING DETAIL



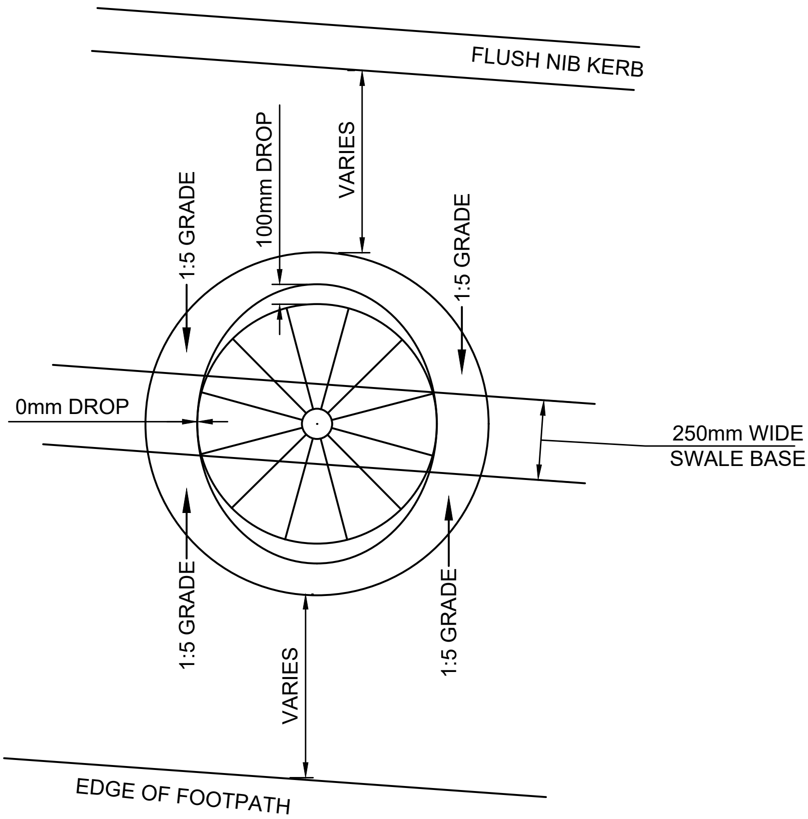
CONCRETE ENCASING DETAIL

NOTES:
1. FOR NON-FLEXIBLE PIPE DIAMETERS GREATER THAN 450mm OR FLEXIBLE PIPE DIAMETERS GREATER THAN 300mm SPECIAL DESIGN APPLIES.
2. WITH FLEXIBLE PIPES PROTECTION TO BE USED UNLESS OTHERWISE SPECIFIED.
3. PIPES IN TRAFFICABLE AREAS WITH LESS THAN 1.0 m COVER SHALL BE CONCRETE CAPPED, AND PIPES WITH LESS 0.6 m COVER SHALL BE CONCRETE ENCASED. THE CONCRETE ENCASEMENT SHALL BE REINFORCED CONCRETE AND STRUCTURALLY DESIGNED FOR REQUIRED DESIGN LOAD BY A STRUCTURAL ENGINEER.

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Concrete Capping Detail	NOT TO SCALE Drawing No. B4-2

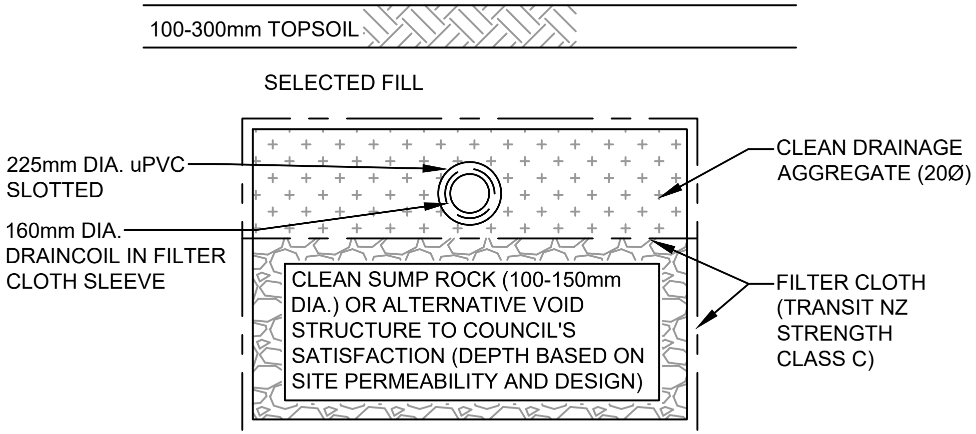


SIDE ELEVATION

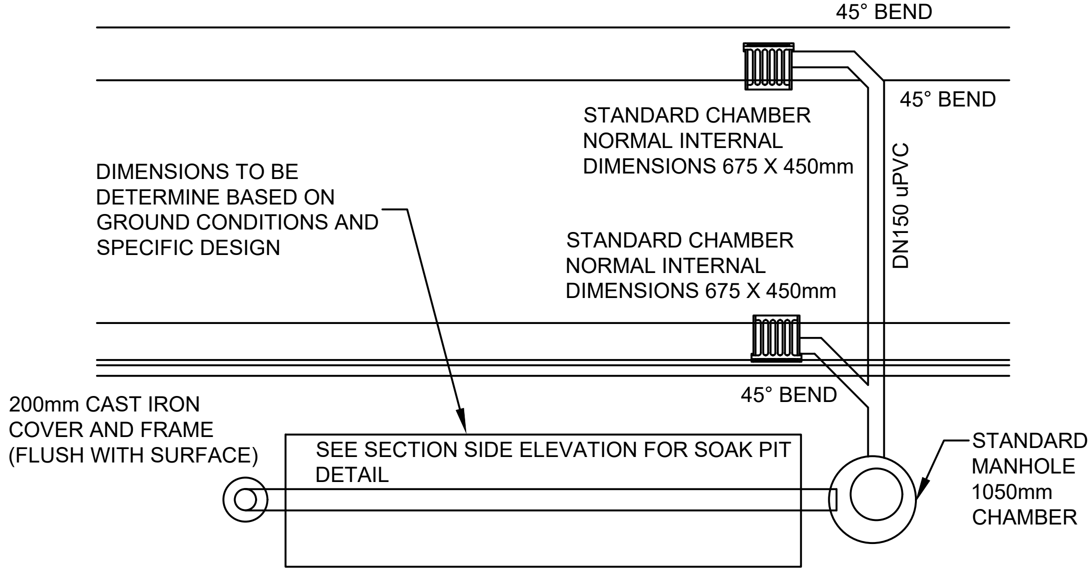


PLAN

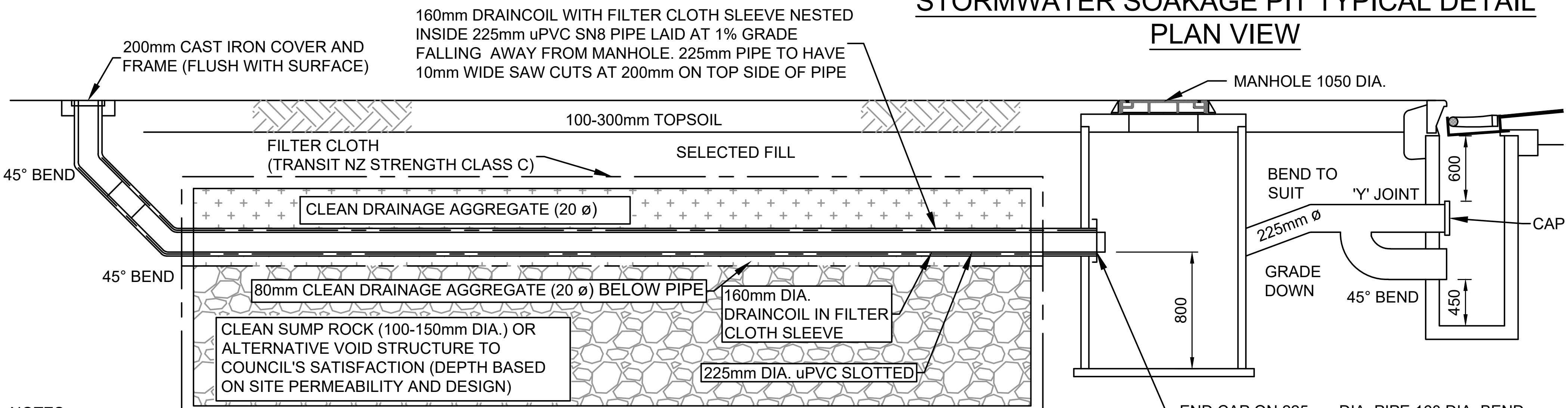
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Scruffy Dome Detail	NOT TO SCALE Drawing No. B4-3



STORMWATER SOAKAGE PIT TYPICAL SECTION END ELEVATION (ROAD CONNECTIONS)



STORMWATER SOAKAGE PIT TYPICAL DETAIL PLAN VIEW



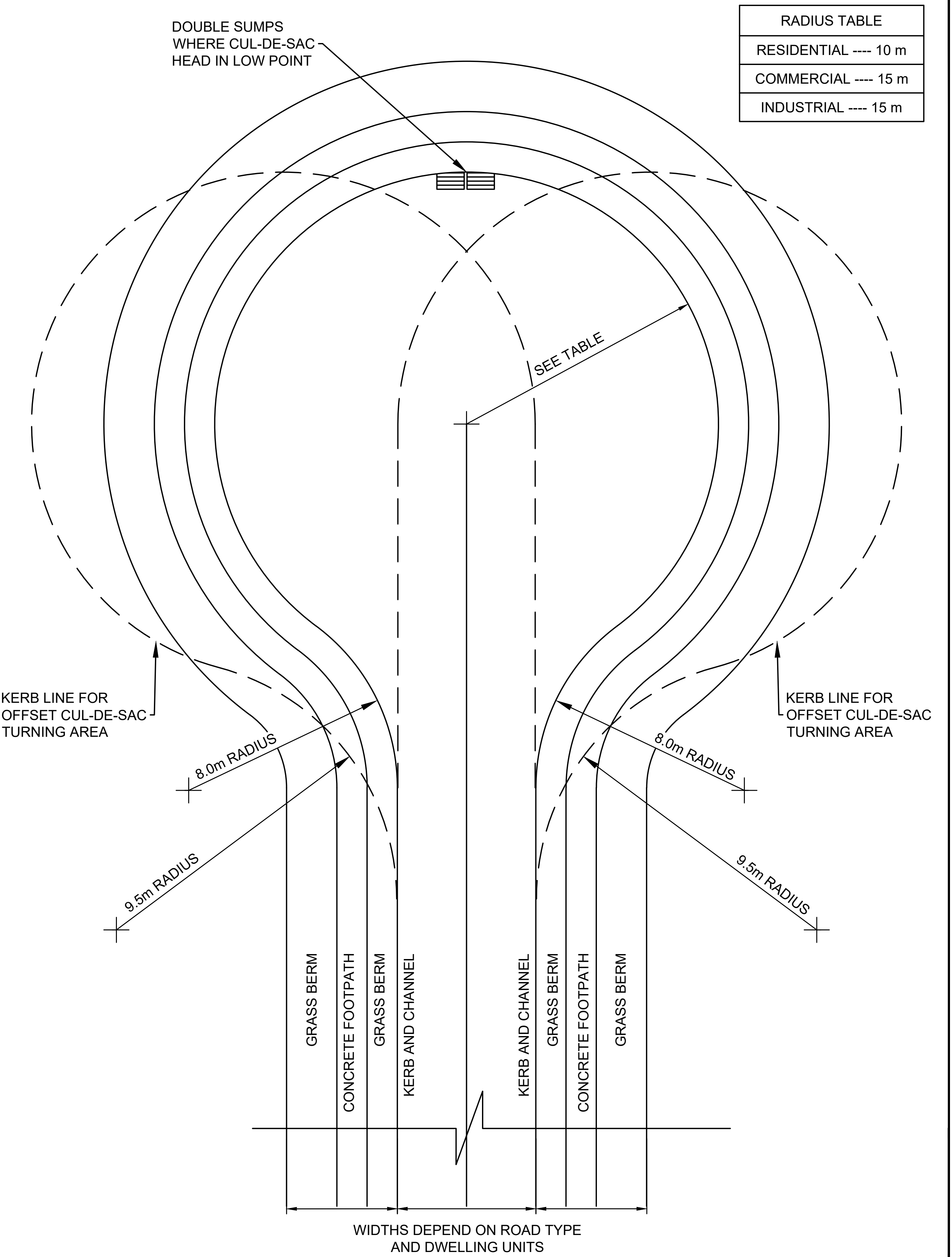
END CAP ON 225mm DIA. PIPE 160 DIA. BEND FIXED IN CAP WITH 50mm 90° BEND ABOVE IT

NOTES:

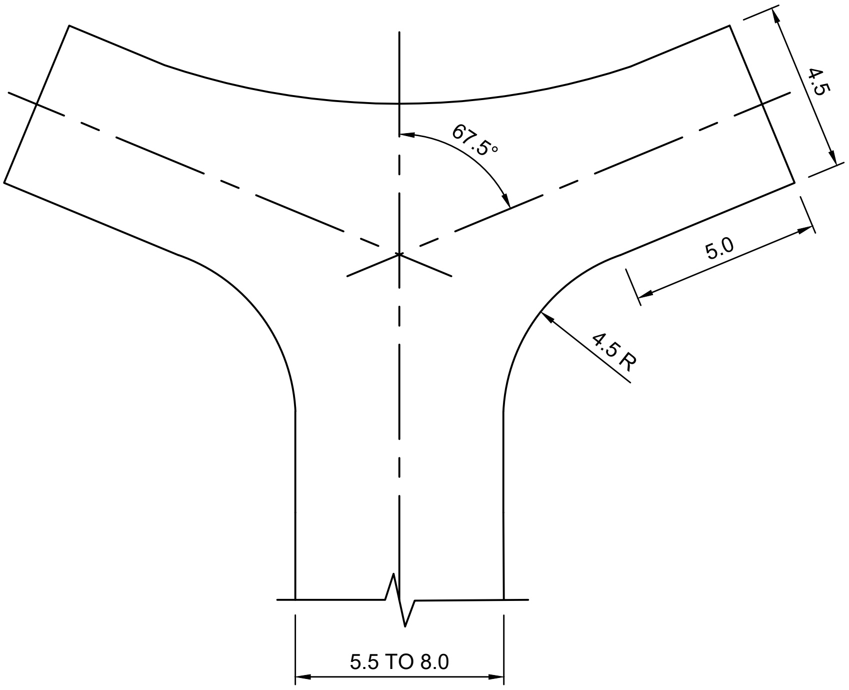
1. DRAINCOIL IS TO BE REMOVABLE FROM WITHIN THE 225mm PIPE, ENABLING CLEANING/REPLACEMENT OF THE PIPE AND FILTER SLEEVE AS REQUIRED. CLEANING EYE ALLOWS FOR FLUSHING FROM EITHER END OF THE SYSTEM.
2. SOAKPIT DIMENSIONS TO BE DETERMINED BASED ON GROUND CONDITIONS AND SPECIFIC DESIGN.

STORMWATER SOAKAGE PIT TYPICAL SECTION SIDE ELEVATION (ROAD CONNECTIONS)

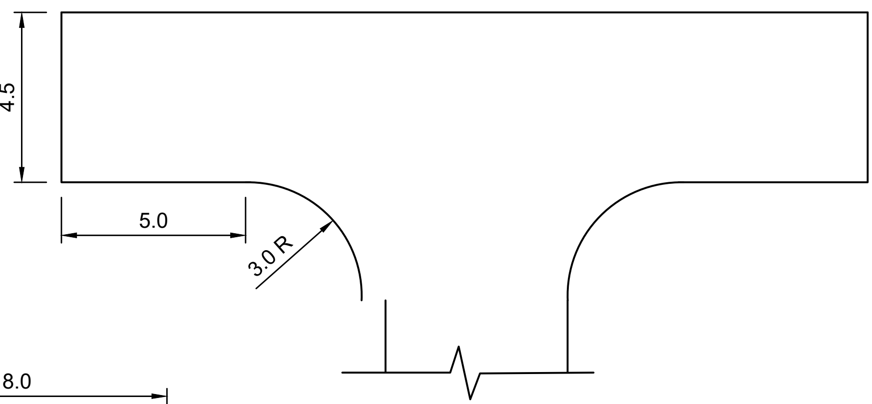
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Soak Pit	NOT TO SCALE Drawing No. B4-4



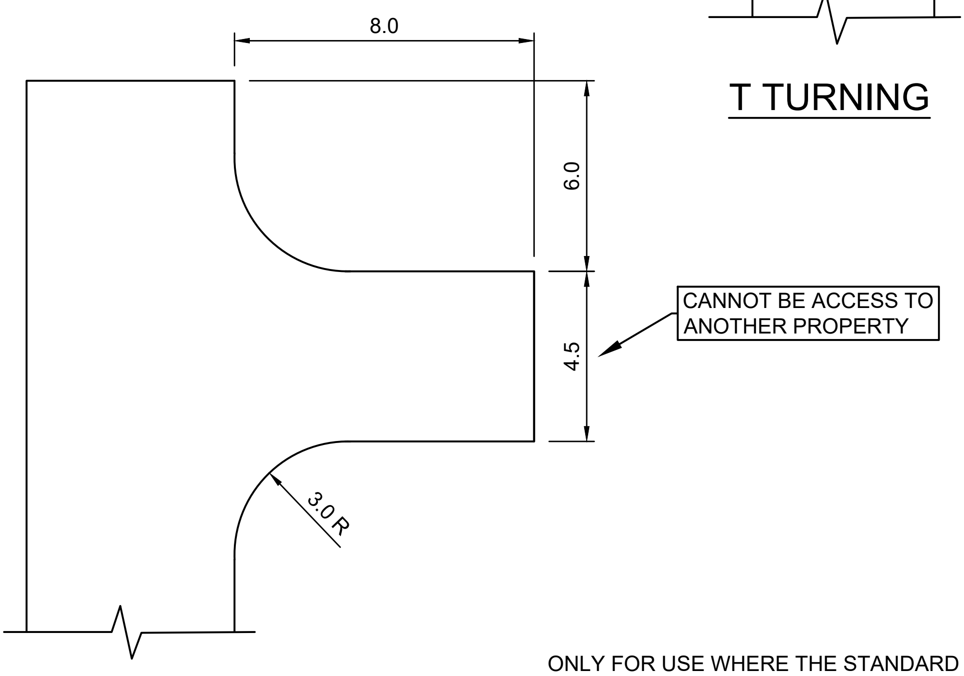
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Dimensions of No-Exit Road Turning Areas	NOT TO SCALE Drawing No. B5-1



Y TURNING



T TURNING

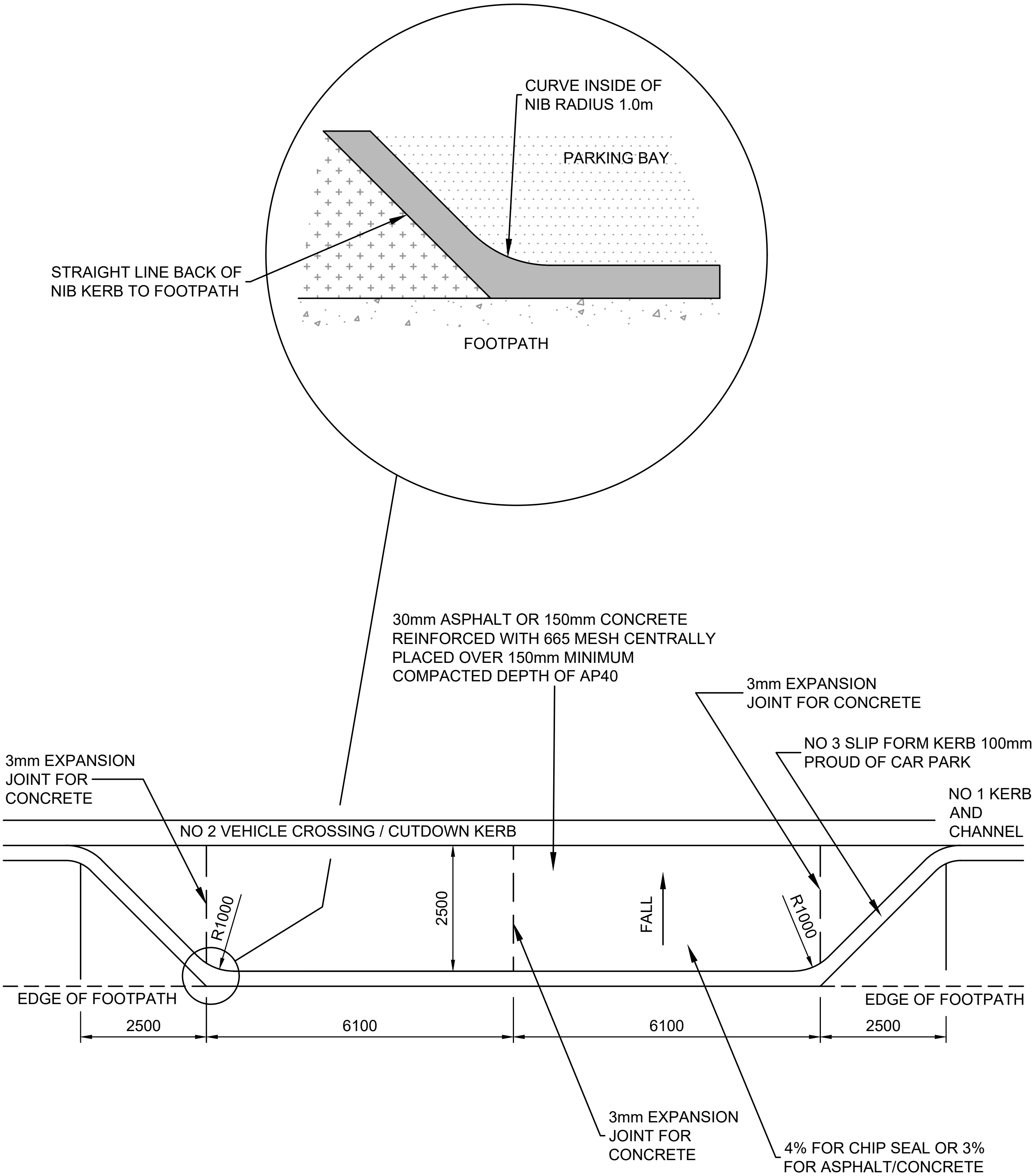


L TURNING

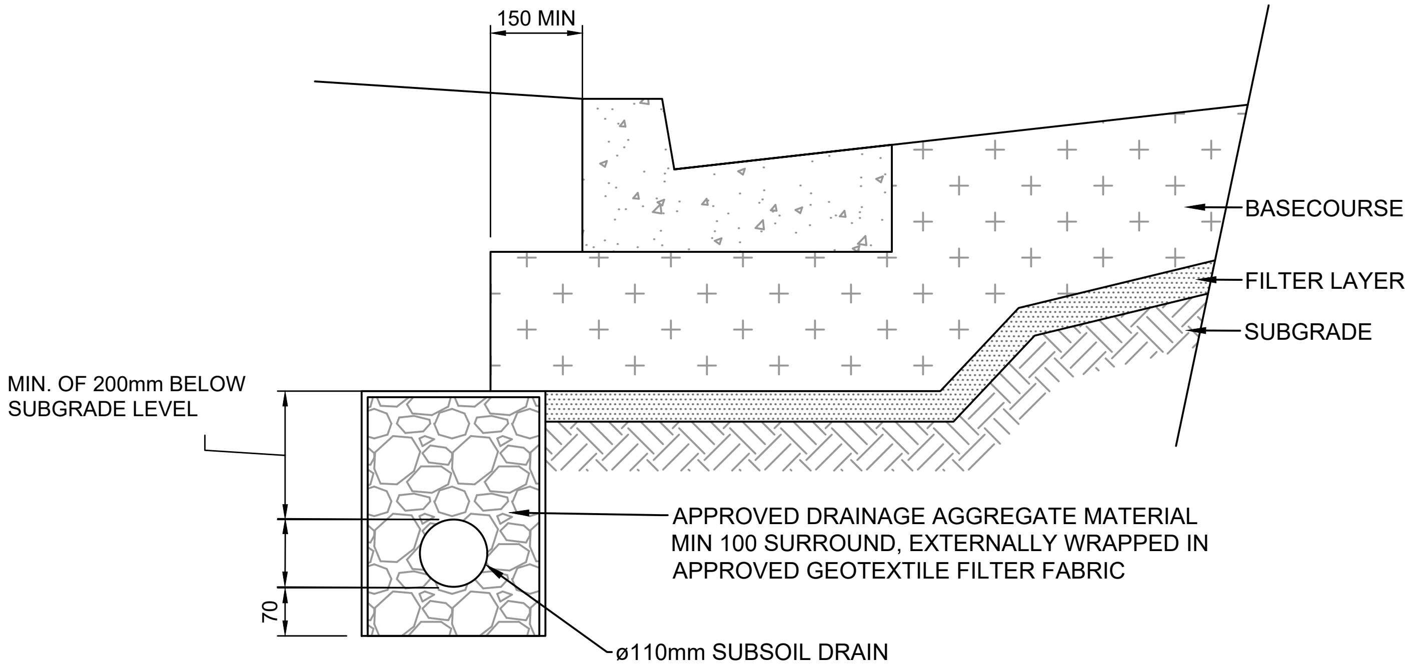
ONLY FOR USE WHERE THE STANDARD CIRCULAR HEAD IS UNSUITABLE OR WHERE APPROVED BY COUNCIL.

ALL DIMENSIONS ARE IN METRES.

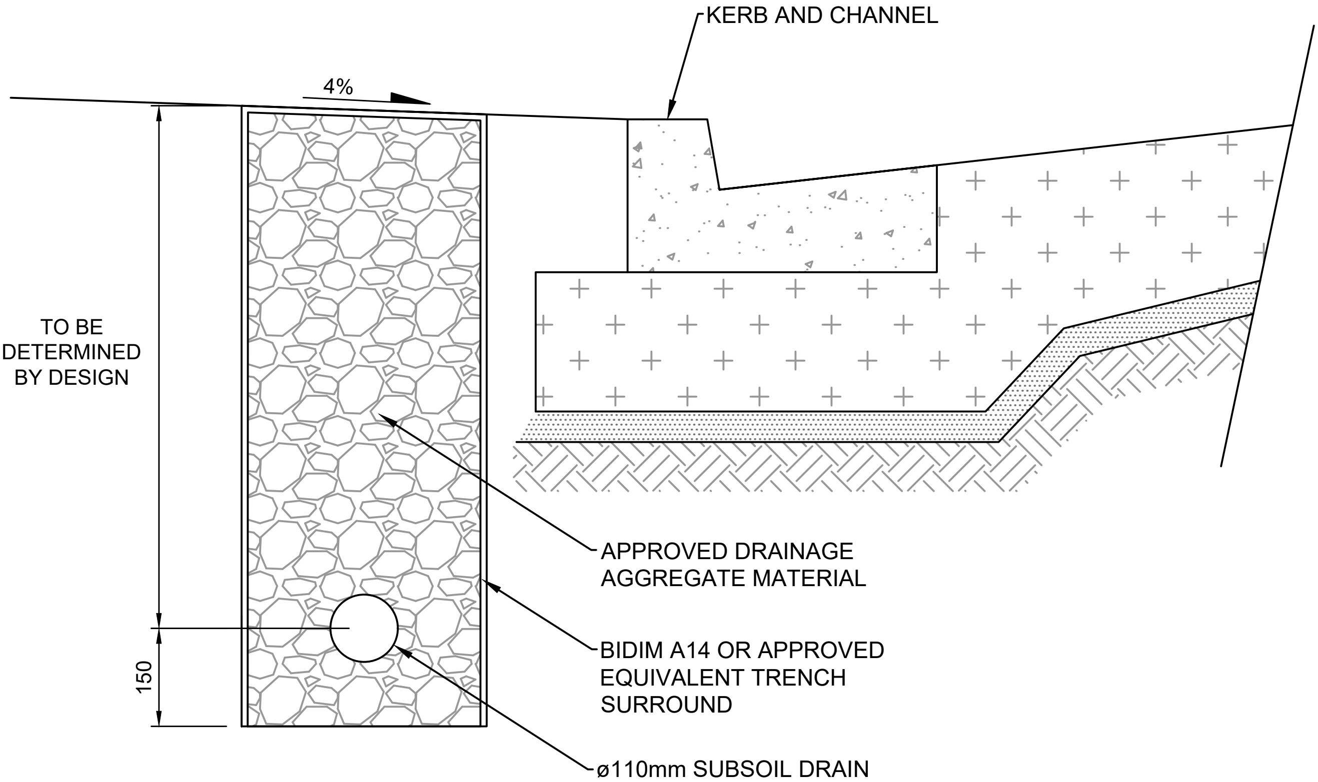
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Turning Areas for No-Exit Roads	NOT TO SCALE Drawing No. B5-2



QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Parking Bay	NOT TO SCALE Drawing No. B5-3



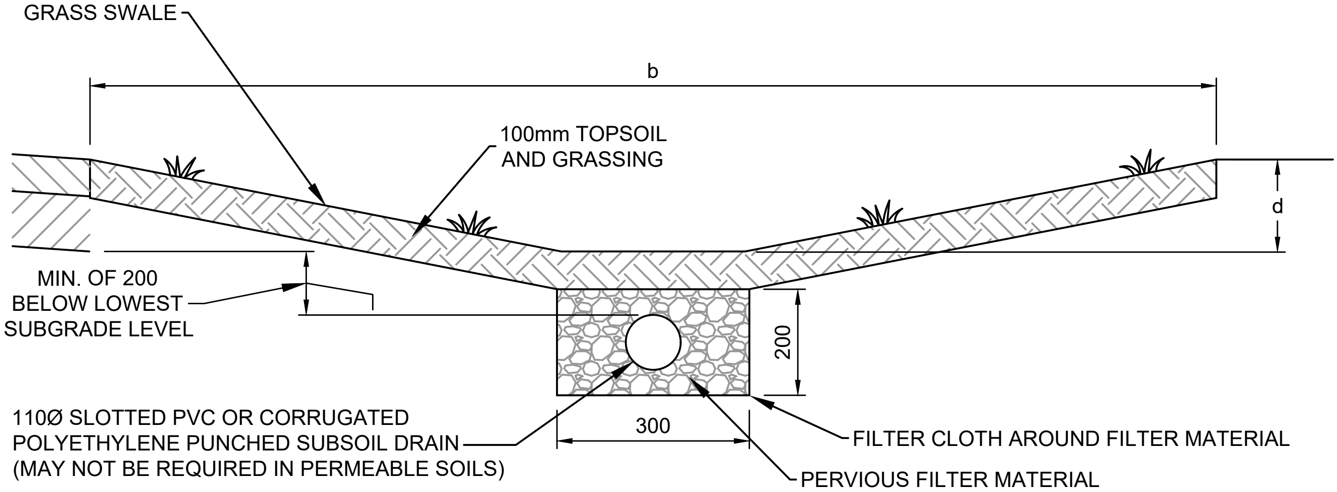
UNDER KERB DRAINAGE



SURFACE WATER CUT-OFF DRAIN

ALL DIMENSIONS ARE IN MILLIMETRES

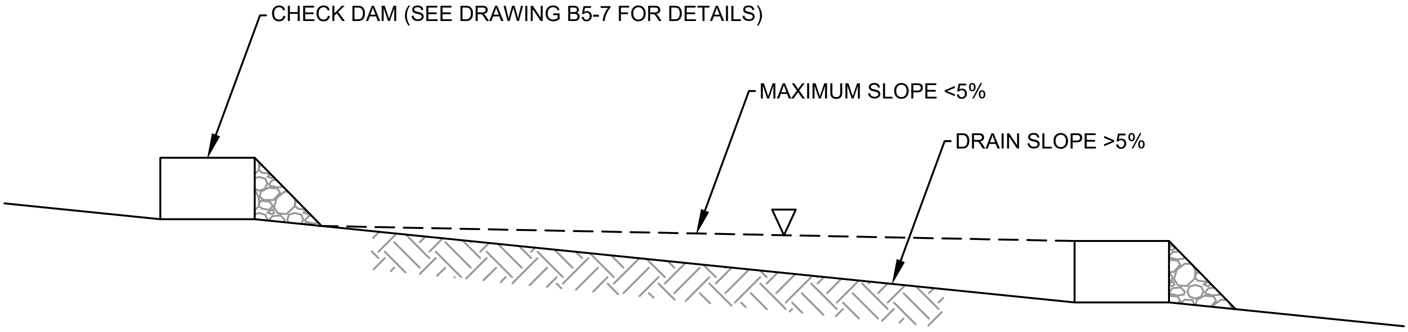
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Subsoil Drains - Roadside	NOT TO SCALE Drawing No. B5-4



SWALE CROSS SECTION

NOTES:
1. EFFECTIVE CATCHMENT AREA DRAINED = IMPERVIOUS AREA + 0.72 x PERVIOUS AREA.
2. MAXIMUM SWALE SLOPE UP TO 5%. STEEPER SWALES REQUIRE CHECK DAMS (SEE DRAWING B5-6 AND DRAWING B5-7).
3. DIMENSIONS 'b' AND 'd' TO BE SIZED FOR CONVEYANCE OF 5% AEP EVENT.
4. EXISTING GROUND IS REGRADED, COMPACTED, TOPSOILED (100mm DEPTH), AND GRASSED.
5. SIDE SLOPES NO STEEPER THAN 1v:4h IF PLANTED (NOT MOWN).
6. SIDE SLOPES NO STEEPER THAN 1v:5h IF GRASSED (MOWN).

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Typical Swale Detail	NOT TO SCALE Drawing No. B5-5



LOCATION OF CHECK DAMS IN SWALES

QLDC LDSC 2020
Standard Details

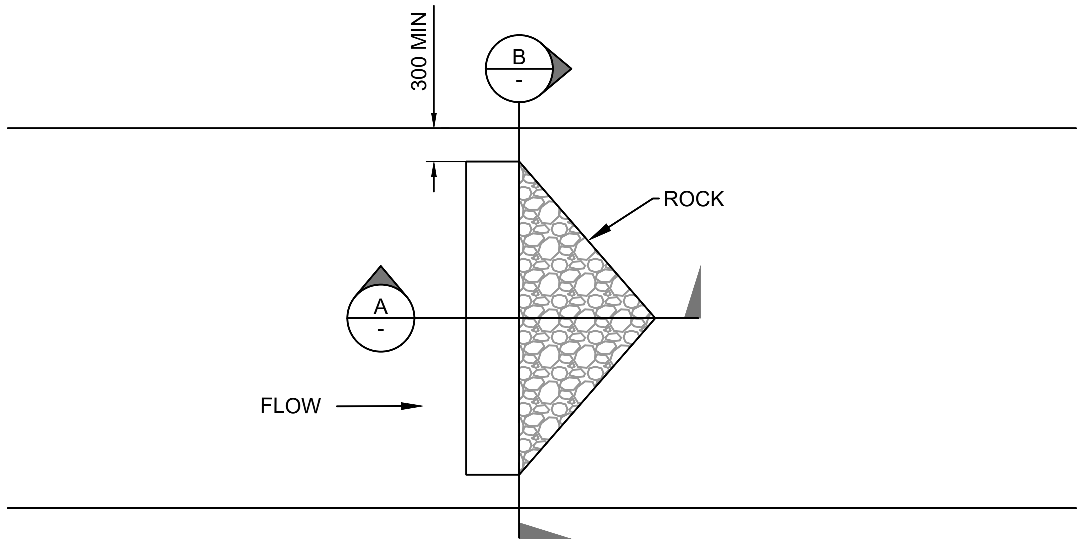
Revision:
Rev Date:

QUEENSTOWN LAKES DISTRICT COUNCIL

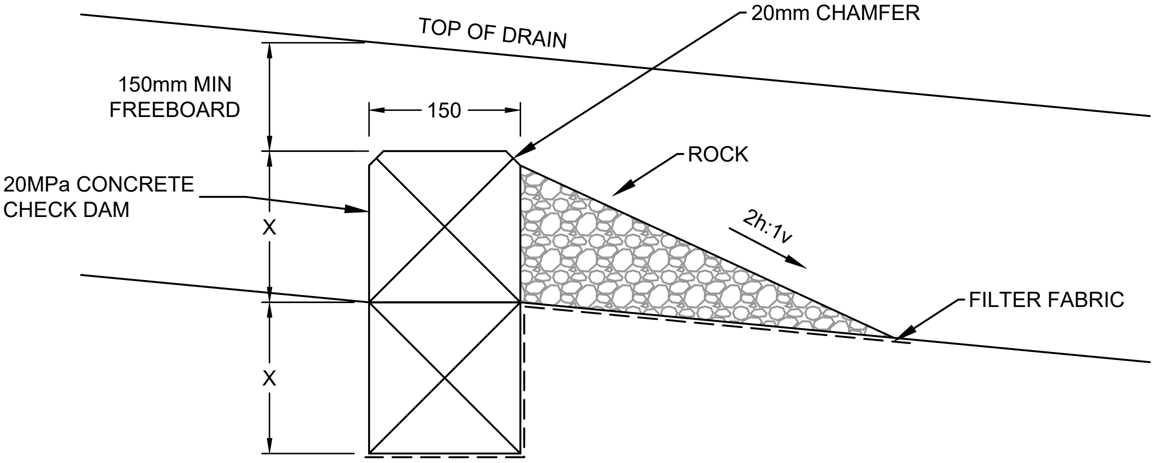
Drawing Title:
Typical Swale Detail (When Check Dams Required)

NOT TO SCALE

Drawing No.
B5-6

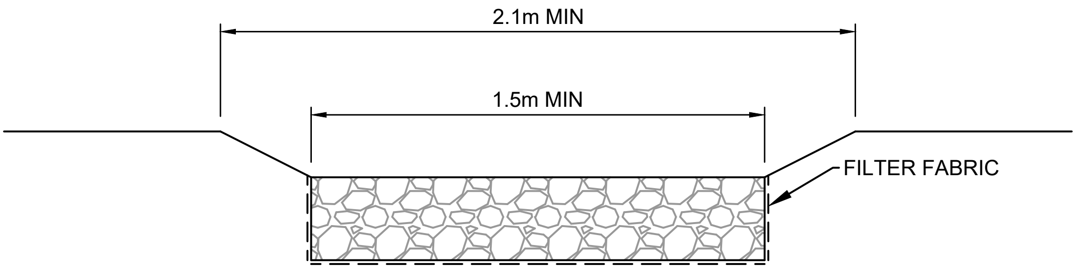


TYPICAL PLAN



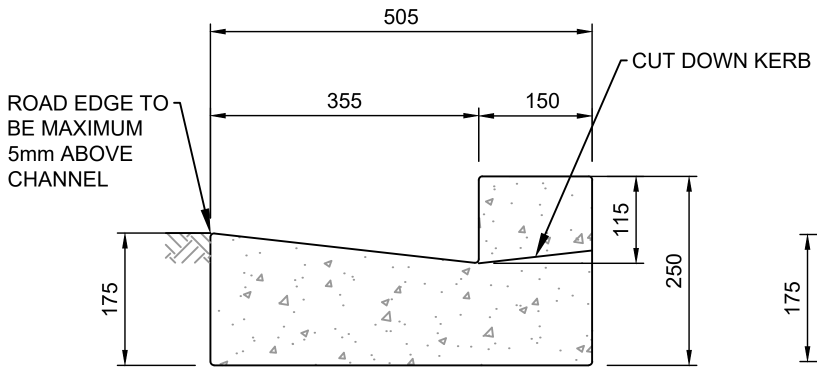
ELEVATION A

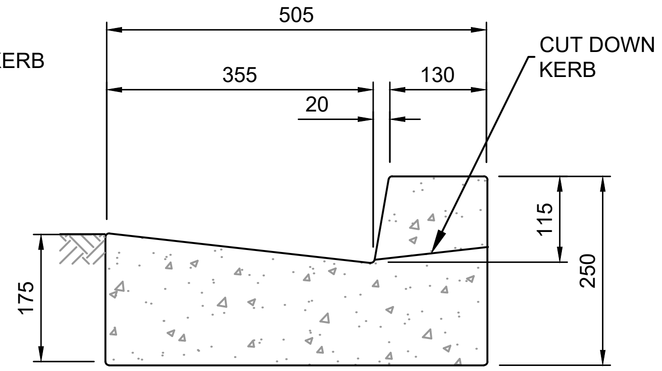
ROCK TO BE SCORIA GRADED CLEAN (SGC) 75-70 OR EQUIVALENT.
FILTER FABRIC TO BE BIDIM A14 OR EQUIVALENT.



ELEVATION B

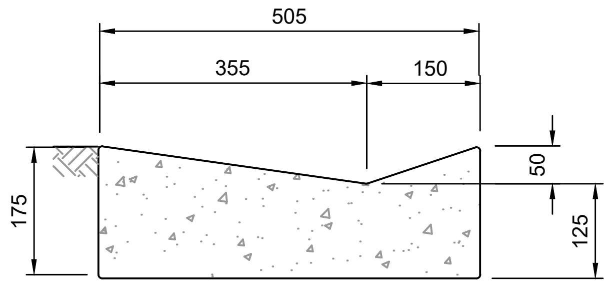
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Typical Check Dam Detail	NOT TO SCALE Drawing No. B5-7

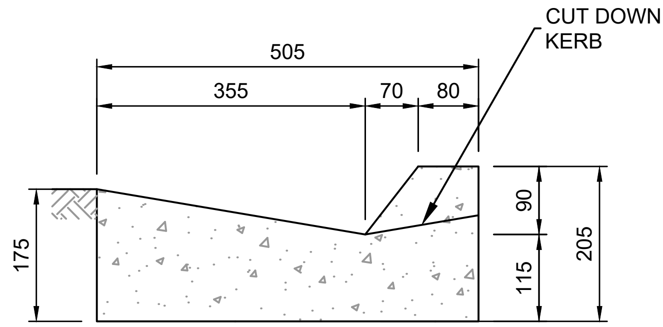




No. 1 KERB & CHANNEL

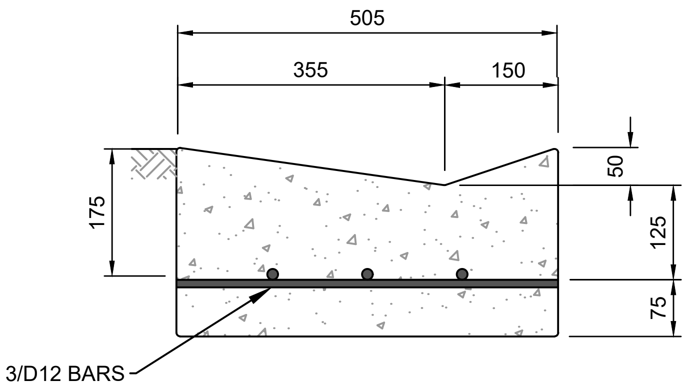
No. 1a KERB & CHANNEL

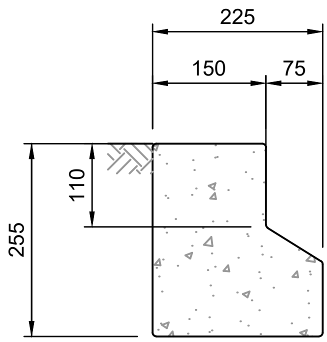




No. 2 VEHICLE CROSSING

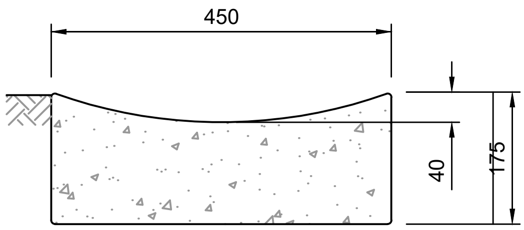
No. 8 MOUNTABLE KERB & CHANNEL

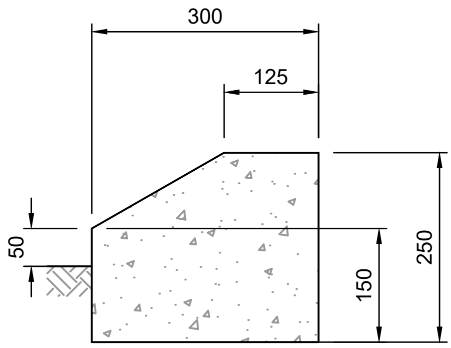




No. 2a COMMERCIAL VEHICLE CROSSING

No. 3 SLIP FORM KERB



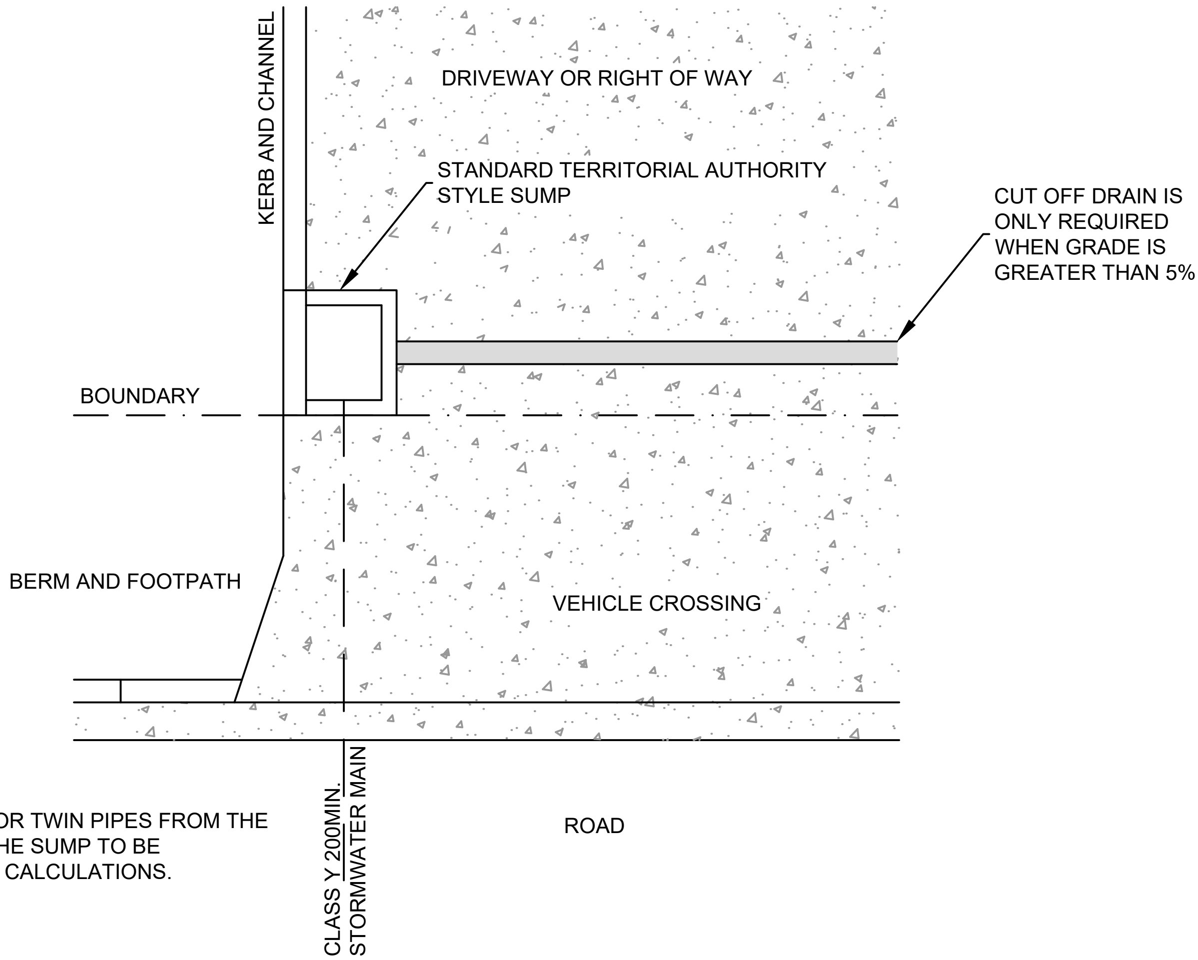


No. 16 DISH CHANNEL

No. 5 MOUNTABLE KERB

NOTE: KERB AND CHANNELS TO HAVE 200mm MIN. DEPTH OF COMPACTED AP40 BASECOURSE OR GAP65 SUBBASE UNDER THEM

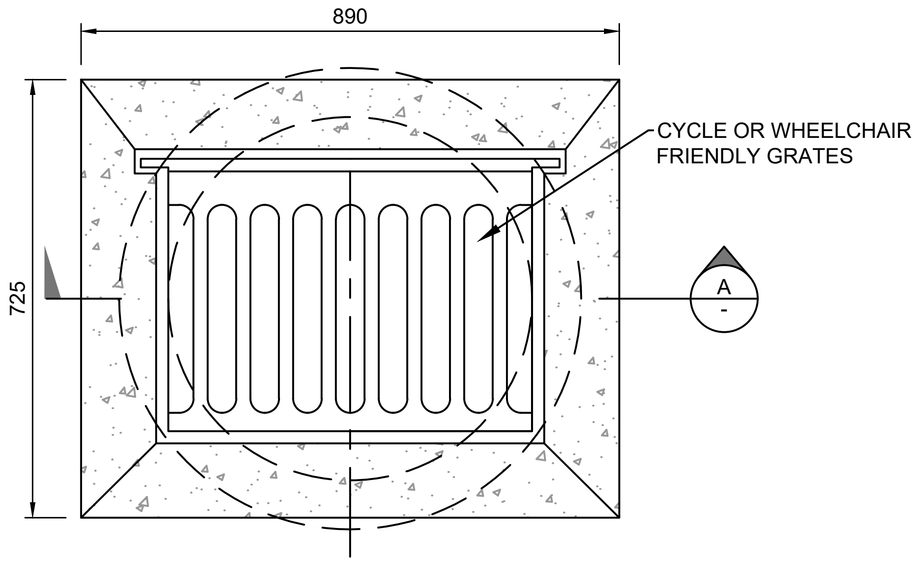
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Kerbs and Dished Channels	NOT TO SCALE Drawing No. B5-8



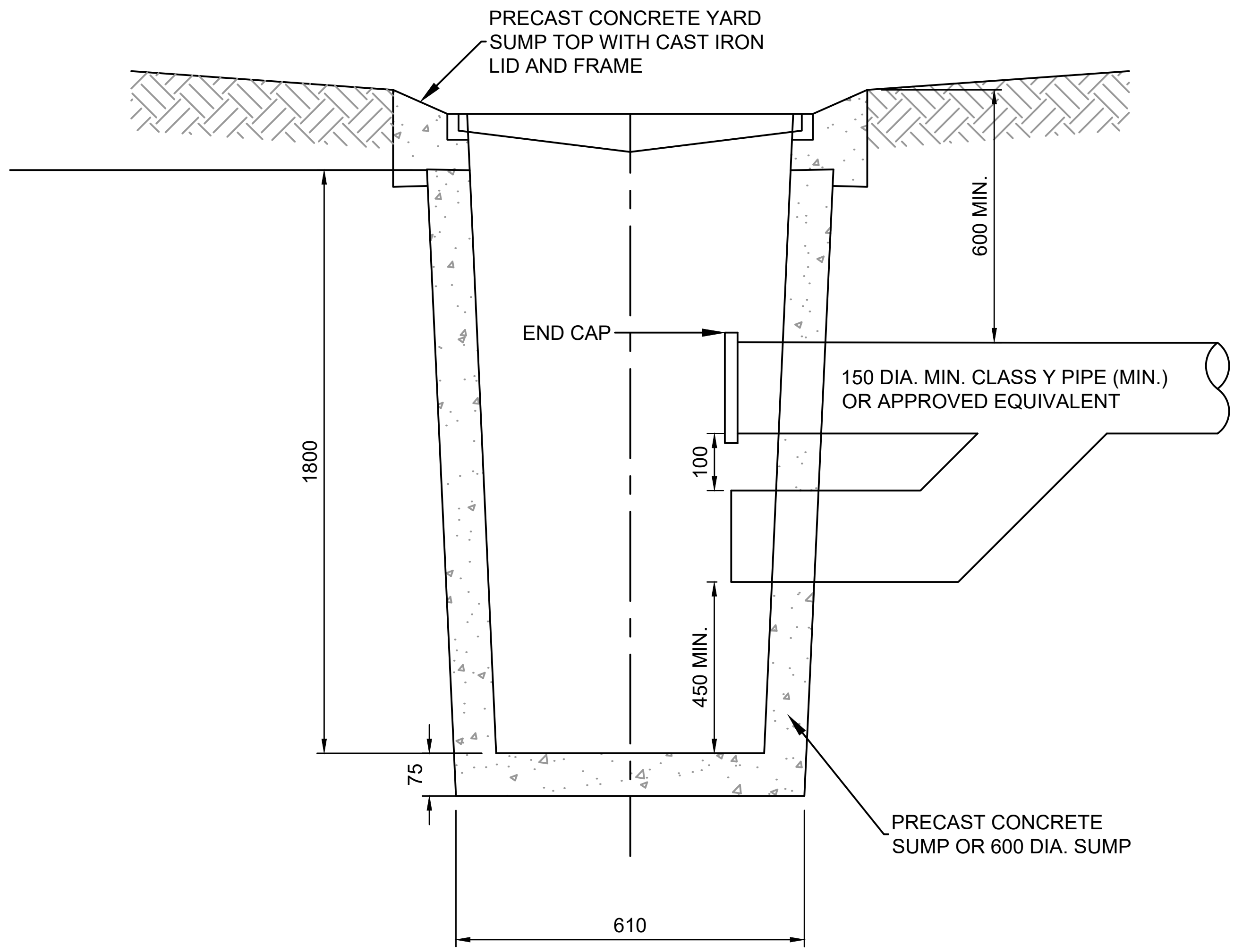
NOTES:

1. USE OF SINGLE OR TWIN PIPES FROM THE PROPERTY TO THE SUMP TO BE DETERMINED BY CALCULATIONS.

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Typical Sump to Driveway or Right of Way	NOT TO SCALE Drawing No. B5-9



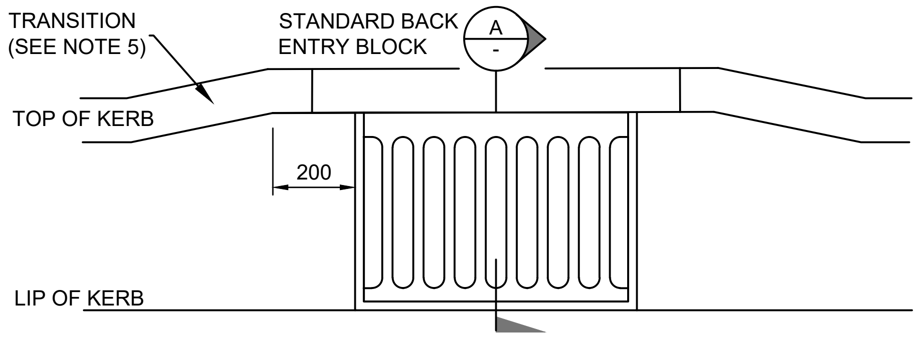
PLAN



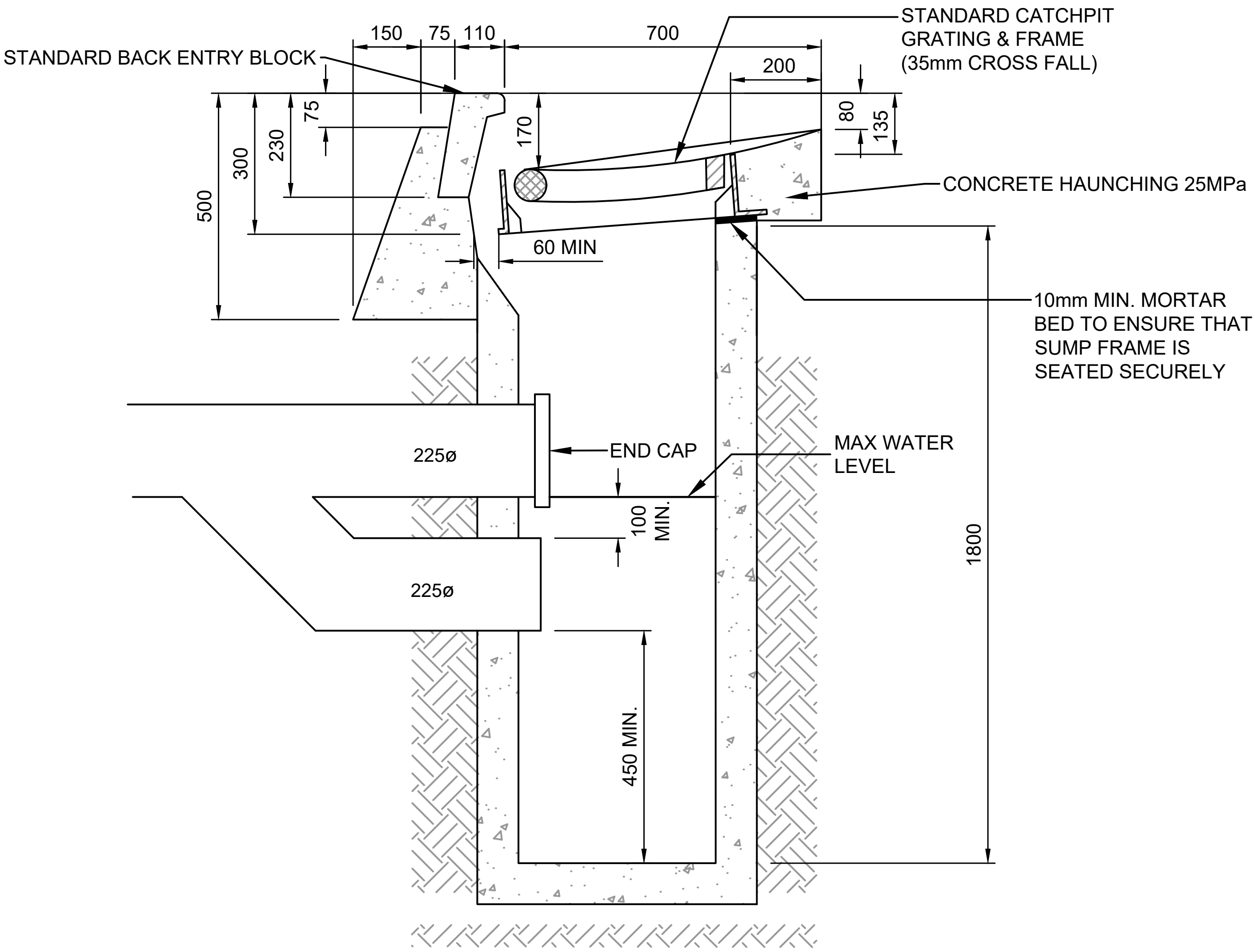
NOTE:
1. SUMP OUTLET MAY BE 150 DIA. IN PRIVATE PROPERTY
2. ALL DIMENSIONS ARE IN MILLIMETRES

SECTION A

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Flat Channel or Yard Sump - Private Only	NOT TO SCALE Drawing No. B5-10



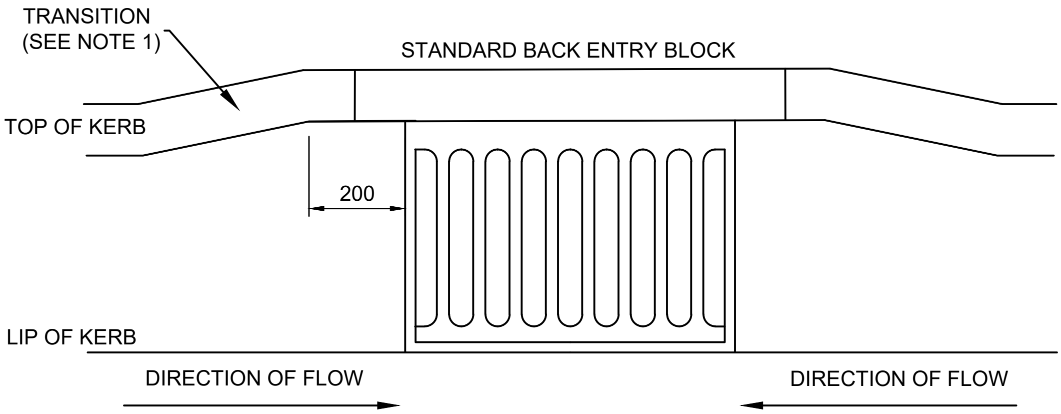
STANDARD SUMP IN CHANNEL



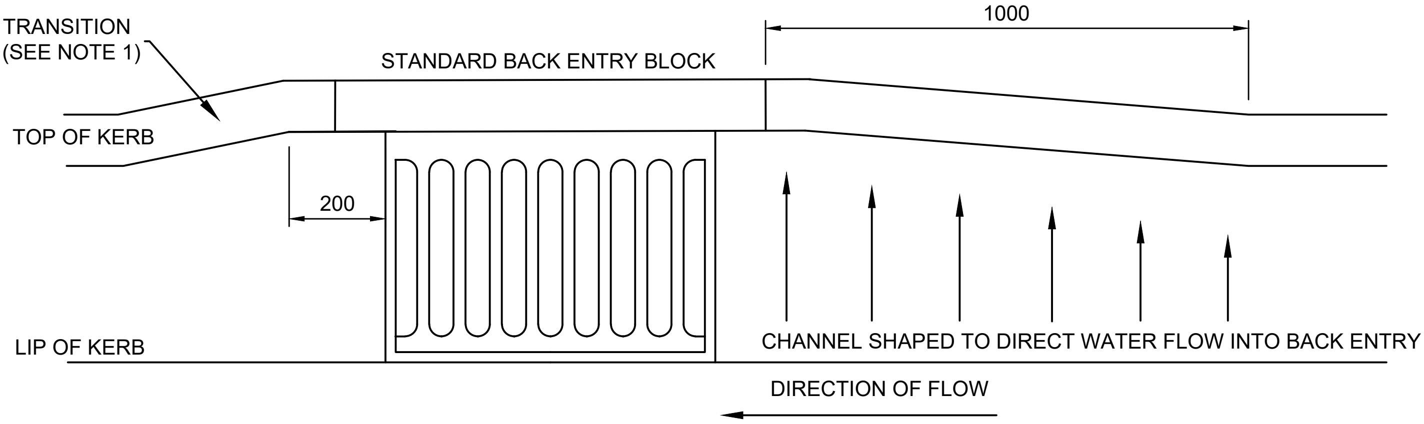
SECTION A

NOTE:

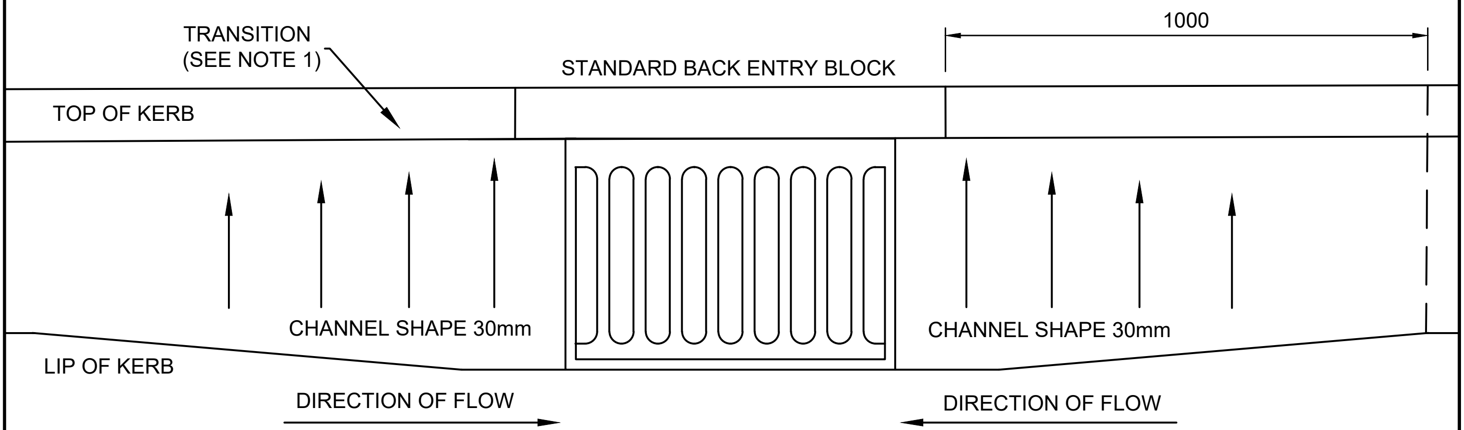
1. ROAD SUMPS TO BE PLACED AT 90m (MAX.) INTERVALS.
2. DOUBLE SUMPS TO BE INSTALLED IN PLACE OF SINGLE SUMPS:
   A. UNDER VERTICAL CURVES IN ROADS
   B. ON ALL ROADS WITH VERTICAL GRADIENTS EXCEEDING 10%. SPECIFIC DESIGN REQUIRED WHERE GRADIENT EXCEEDS 12%.
3. SUMP LEADS TO INTERSECT SIDE OR BACKWALL OF SUMP BOX AT 90°.
4. SITE-SPECIFIC DESIGN REQUIRED TO REDUCE SYPHON FROM 225ø DOWN TO 150ø.
5. WHERE GRADIENTS EXCEED 10%, CHANNEL TRANSITION INTO DOUBLE MUDTANK TO BE 800mm AND CHANNEL TO BE FORMED DIRECTLY INTO BACK ENTRY.
6. TO BE USED WHERE BACK OF KERB IS NOT DIRECTLY ADJACENT TO THE FOOTPATH.
7. ALL SUMPS SHOULD BE 1800mm DEPTH.
8. A MINIMUM SEDIMENT STORAGE DEPTH OF 450mm IS TO BE PROVIDED (TO INVERT OF PIPE).
9. REDUCED COVER WHERE THE LEADS LEAVE THE MUD SUMP IS ACCEPTABLE. THIS SHOULD NOT REDUCE BELOW A MINIMUM OF 600mm COVER TO PIPE.
10. THE LENGTH OF PIPE WITH REDUCED COVER SHOULD BE MINIMISED AND AVOID EXTENDING INTO THE WHEEL TRACKS AS FAR AS POSSIBLE.



STANDARD ROAD SUMP



ROAD SUMP IN HILLSIDE CHANNEL

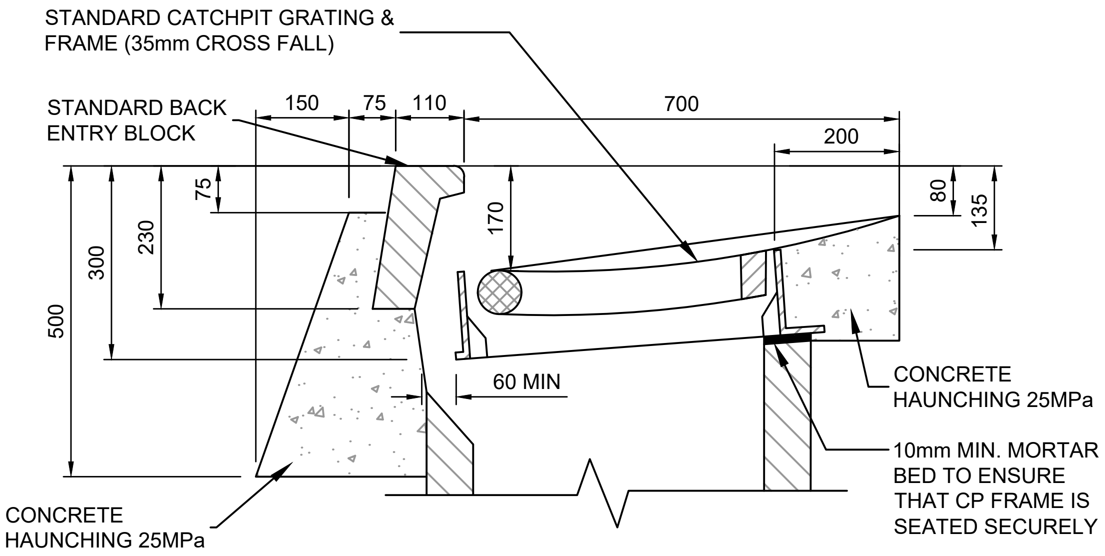


ROAD SUMP DETAIL WHERE NO VERGE

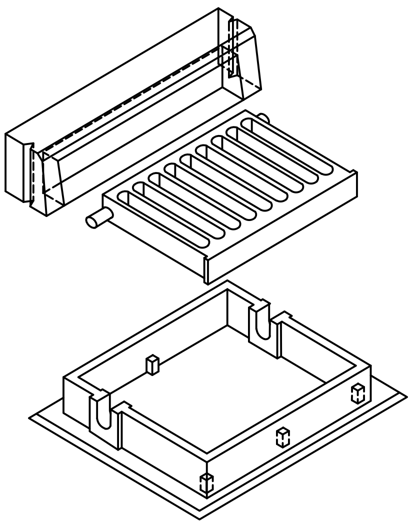
(BACK OF KERB AGAINST FOOTPATH)

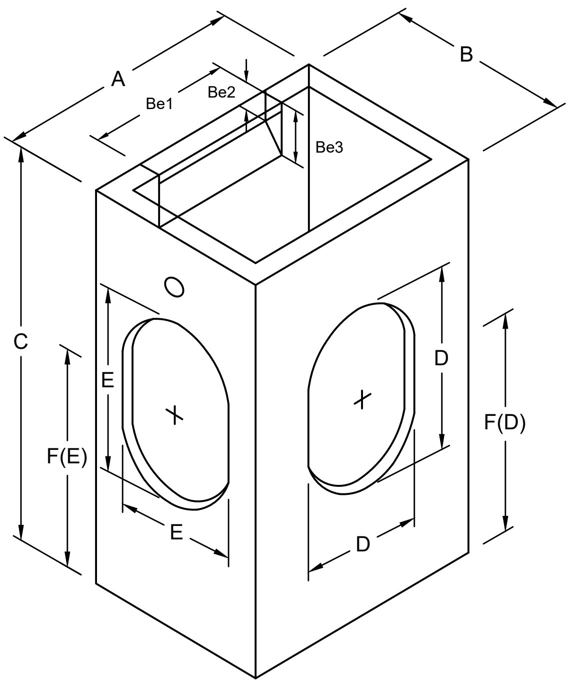
NOTE:

1. WHERE GRADIENTS EXCEED 10%, CHANNEL TRANSITION INTO DOUBLE MUDTANK TO BE 800MM AND CHANNEL TO BE FORMED DIRECTLY INTO BACK ENTRY.



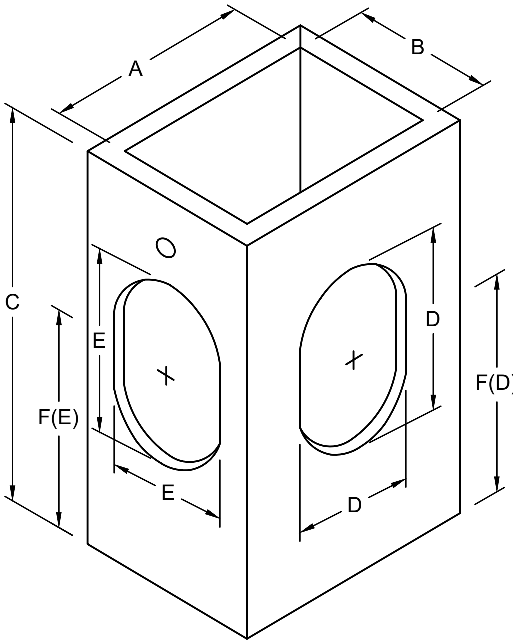
SECTION THROUGH GRATE





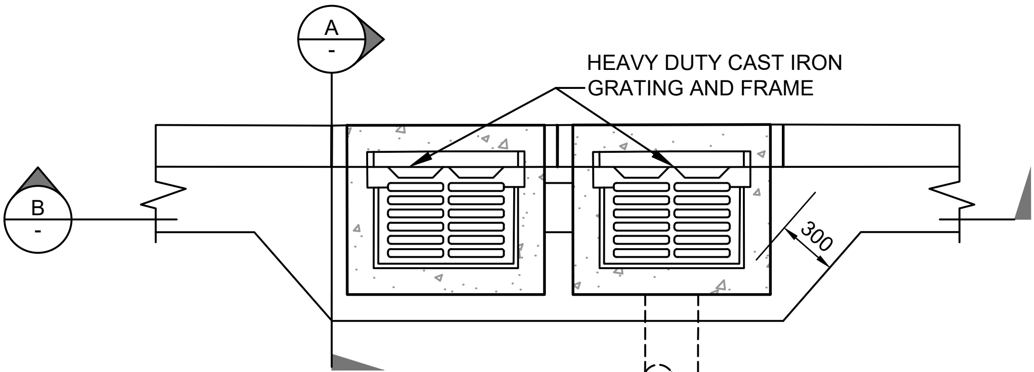
BACK ENTRY SUMP ISOMETRIC VIEW

NOTES:
1. DIMENSIONS PER MANUFACTURER'S SPECIFICATIONS.
2. ALL SUMPS SHALL BE A MINIMUM OF 1800 DEPTH.

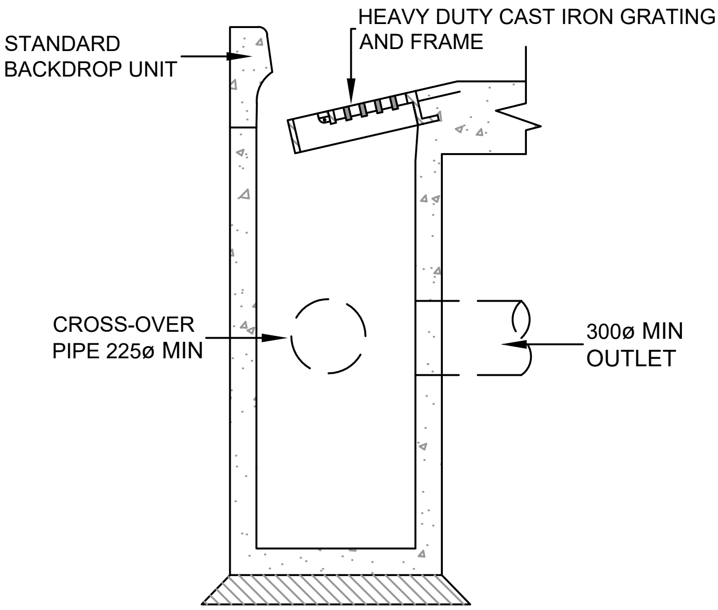


FLAT TOP SUMP ISOMETRIC VIEW

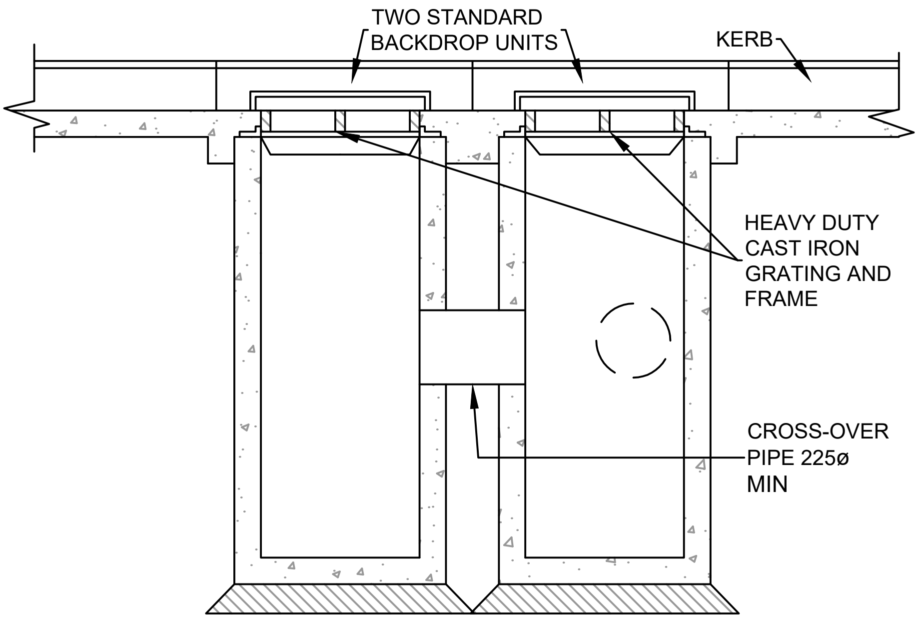
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Standard Flat Top and Back Entry Sump	NOT TO SCALE Drawing No. B5-13



PLAN

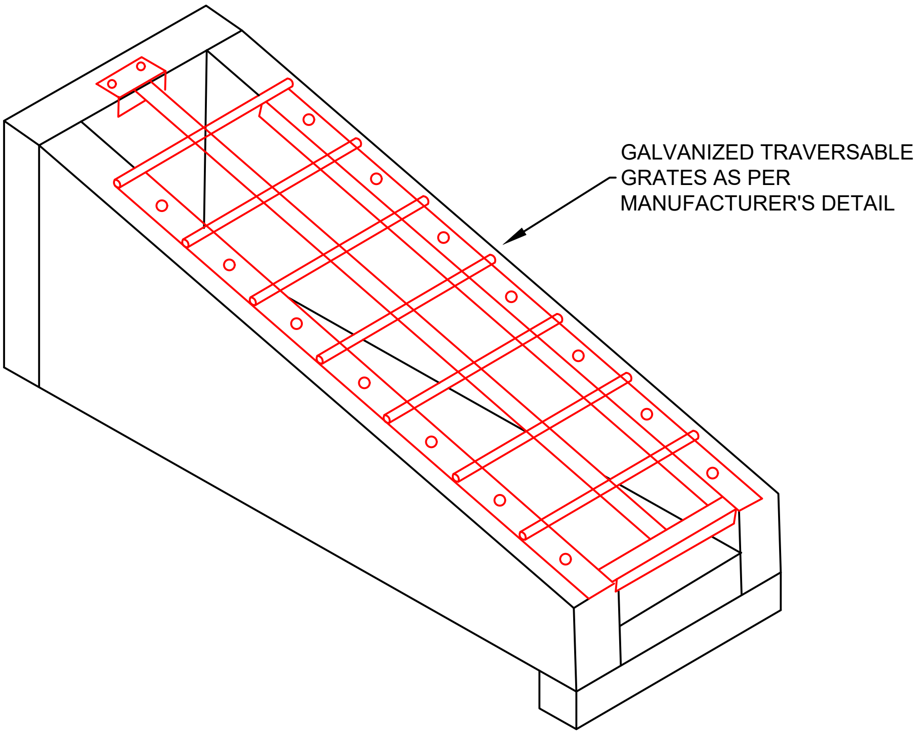


SECTION A



SECTION B

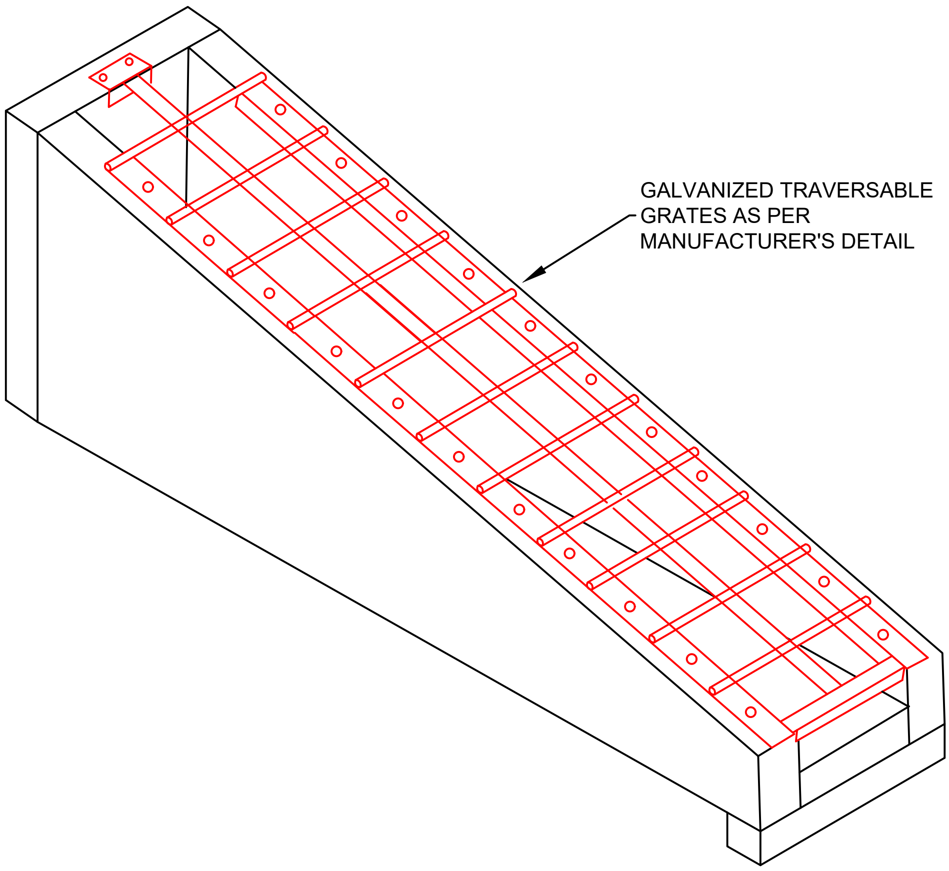
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Double Back-Entry Sump for Road Low Points and Alternative	NOT TO SCALE Drawing No. B5-14



ISOMETRIC VIEW

NOTES:
1. IT IS RECOMMENDED THAT THE GRATES ARE SOURCED FROM THE MANUFACTURER OF THE PRECAST CULVERT HEADWALL TO ENSURE THE GRATE AND HEADWALL ARE COMPATIBLE. OTHERWISE GUIDANCE SHOULD BE SOUGHT FROM THE MANUFACTURER OF THE PRECAST CULVERT HEADWALL ON THE REQUIRED DIMENSIONS FOR ANY GRATES NOT SUPPLIED BY THEM.
2. THE CLEAR WIDTH BETWEEN SIDE WALLS OF PRECAST CULVERT HEADWALLS SHALL NOT EXCEED 600mm WHEN USING THIS GRATE.
3. MATERIAL SPECIFICATIONS FOR THE FOLLOWING ITEMS:
   STEEL GALVANIZED ANGLES - AS/NZS 3679.1:1996 HOT ROLLED BARS AND SECTIONS REINFORCING BARS - AS/NZS 4671:2001
   STEEL REINFORCING MATERIALS GALVANIZING - AS/NZS 4680:2006 HOT DIP GALVANIZING (ZINC) COATINGS ON FABRICATED FERROUS ARTICLES

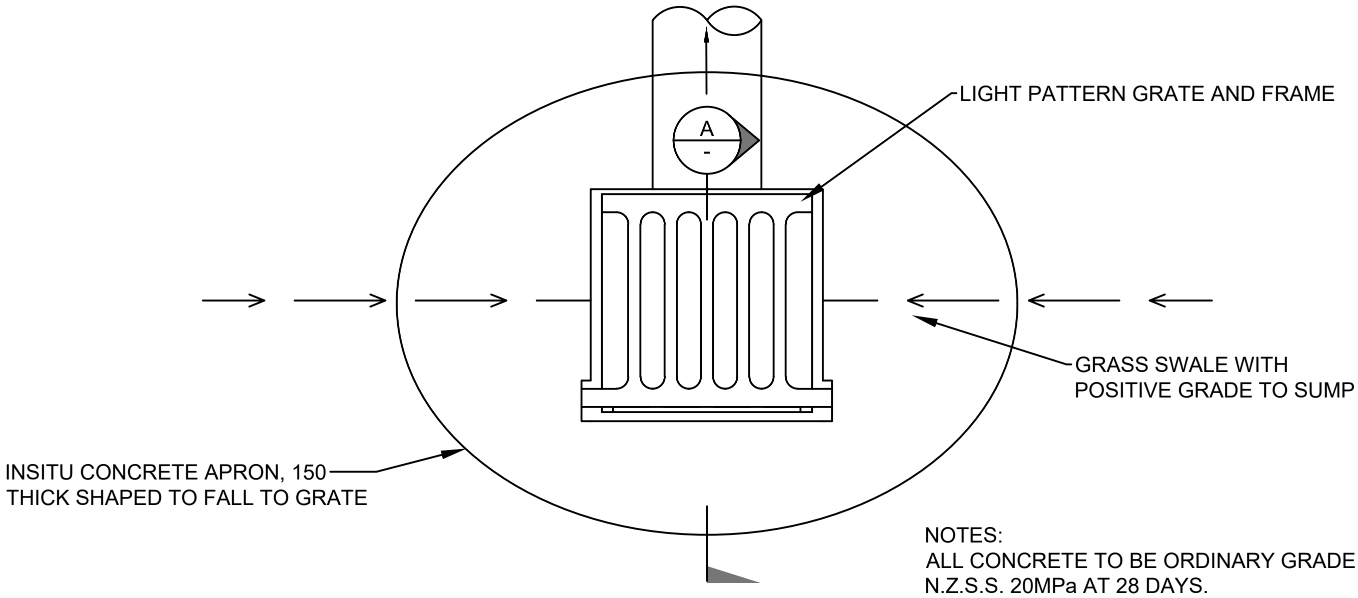
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Traversable Grates for Precast Headwalls 300mm to 450mm Culverts	NOT TO SCALE Drawing No. B5-15



ISOMETRIC VIEW

NOTES:
1. IT IS RECOMMENDED THAT THE GRATES ARE SOURCED FROM THE MANUFACTURER OF THE PRECAST CULVERT HEADWALL TO ENSURE THE GRATE AND HEADWALL ARE COMPATIBLE. OTHERWISE GUIDANCE SHOULD BE SOUGHT FROM THE MANUFACTURER OF THE PRECAST CULVERT HEADWALL ON THE REQUIRED DIMENSIONS FOR ANY GRATES NOT SUPPLIED BY THEM.
2. THE CLEAR WIDTH BETWEEN SIDE WALLS OF PRECAST CULVERT HEADWALLS SHALL NOT EXCEED 600mm WHEN USING THIS GRATE.
3. MATERIAL SPECIFICATIONS FOR THE FOLLOWING ITEMS:
STEEL GALVANIZING ANGLES - AS/NZS 3679.1:1996 HOT ROLLED BARS AND SECTIONS REINFORCING BARS - AS/NZS 4671:2001 STEEL REINFORCING MATERIALS GALVANIZING - AS/NZS 4680:2006 HOT DIP GALVANIZING (ZINC) COATINGS ON FABRICATED FERROUS ARTICLES.

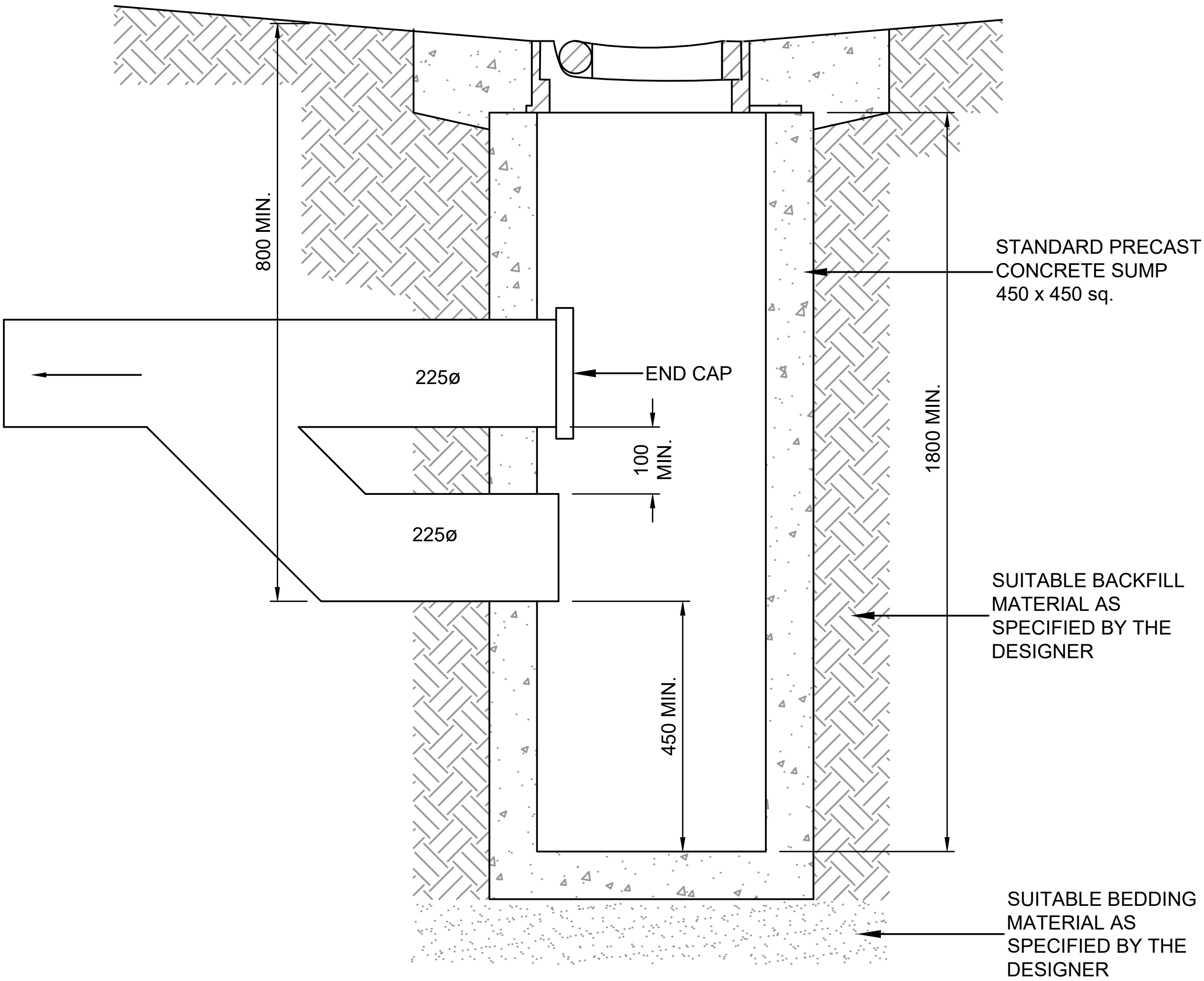
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Mountable Grates for Precast Headwalls 300mm to 450mm Culverts	NOT TO SCALE Drawing No. B5-16



PLAN

NOTES:
ALL CONCRETE TO BE ORDINARY GRADE N.Z.S.S. 20MPa AT 28 DAYS.

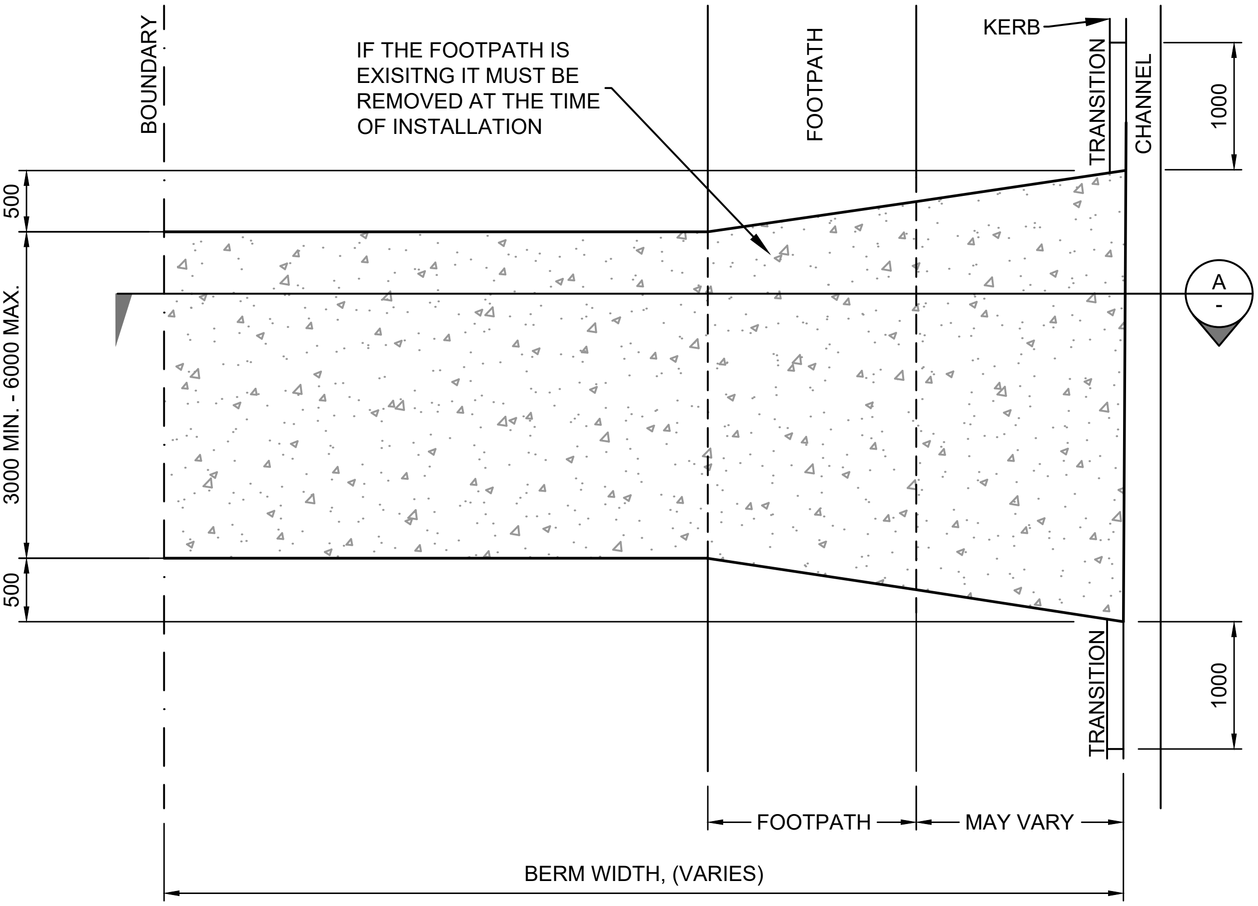
ALL PIPES TO BE FINISHED FLUSH WITH INSIDE WALL OF SUMP.



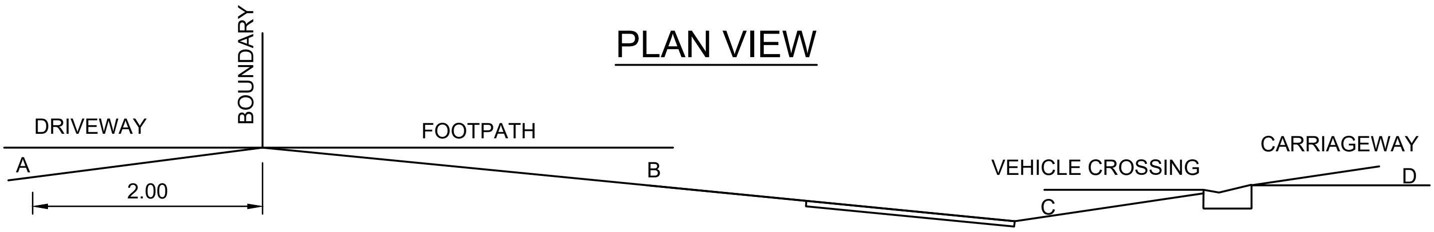
SECTION A

NOTES:
1. ALL SUMPS SHOULD BE 1800mm DEPTH.
2. A MINIMUM SEDIMENT STORAGE DEPTH OF 450mm IS TO BE PROVIDED (TO INVERT OF PIPE).

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Berm Sump Detail	NOT TO SCALE Drawing No. B5-17

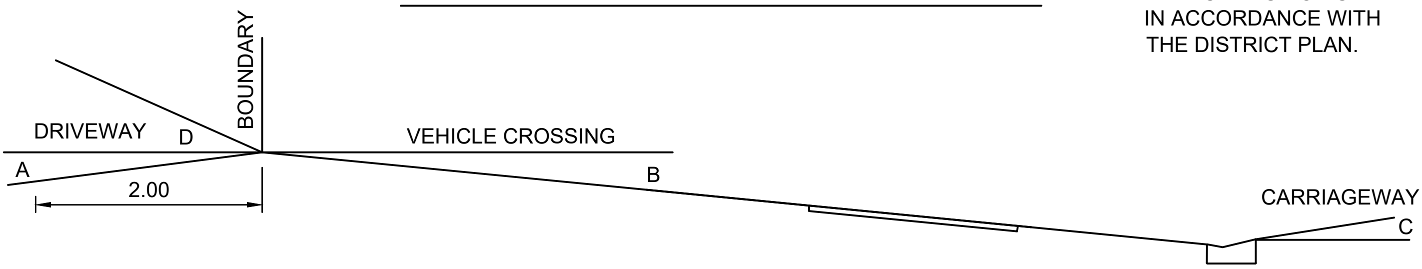


PLAN VIEW



SECTION A: LOW LEVEL FOOTPATH

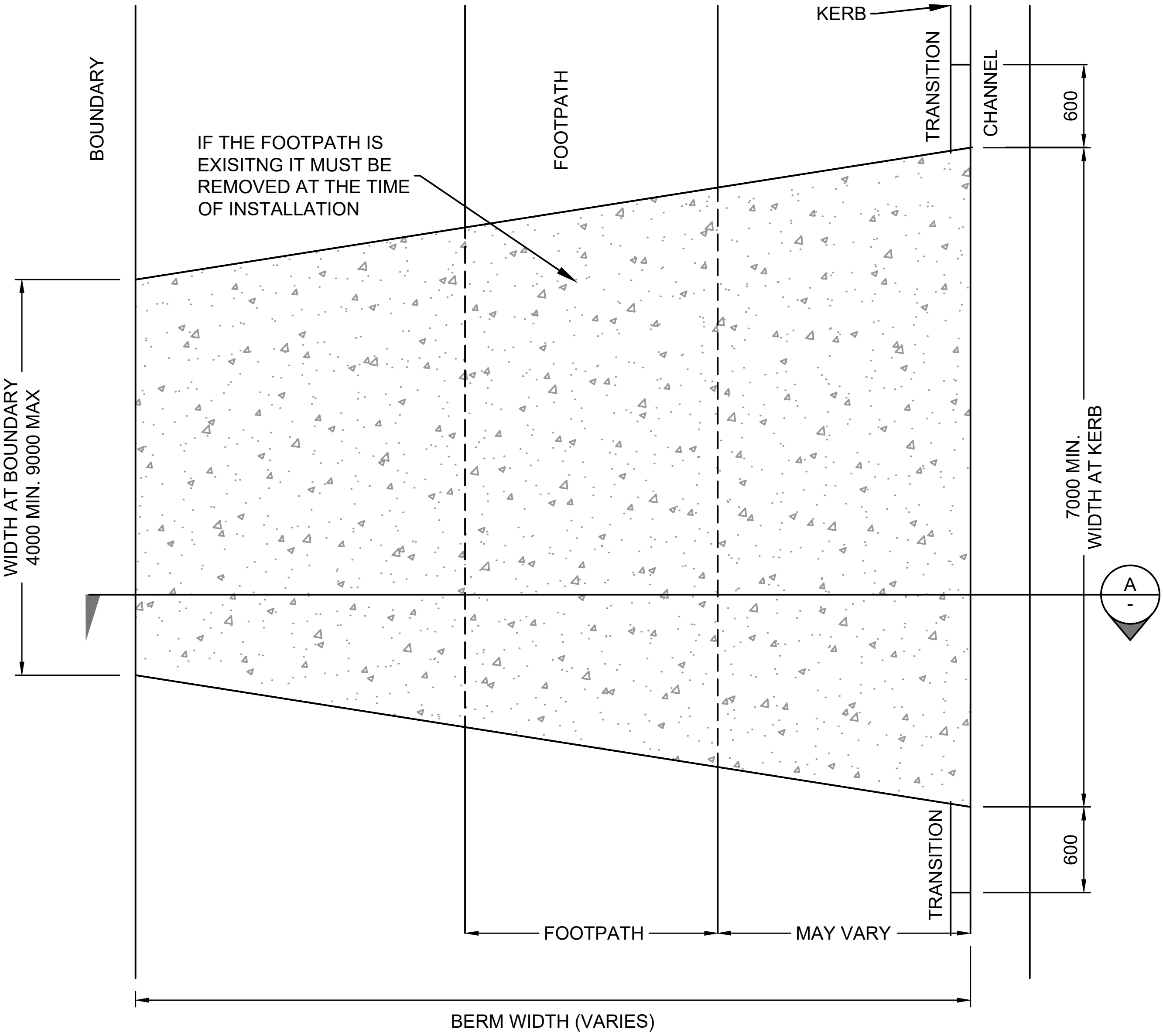
MAX. CHANGE OF GRADE IN ACCORDANCE WITH THE DISTRICT PLAN.



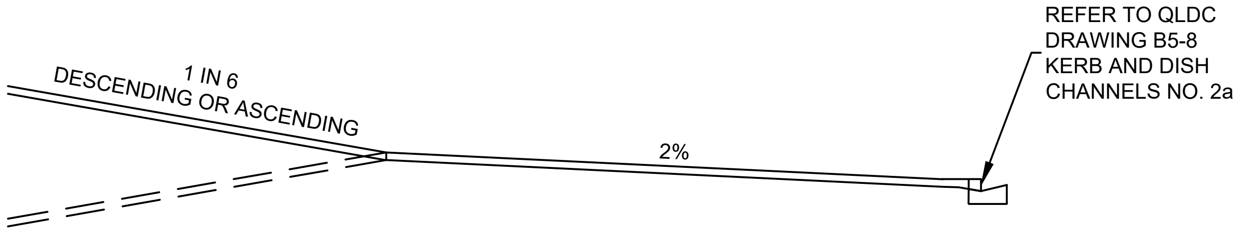
SECTION A: STANDARD FOOTPATH

NOTES:
1. DESIGN OF ALL RESIDENTIAL CROSSINGS TO COMPLY WITH DISTRICT PLAN REQUIREMENTS.
2. CROSSING CONCRETE TO BE 125mm THICK REINFORCED WITH STRUCTURAL MESH, CENTRALLY PLACED.
3. SURFACING TO BE CONCRETE WITH A MINIMUM CRUSHING STRENGTH OF 20MPa AT 28 DAYS, OR 30mm DG7 ASPHALT (NZTA M10 Notes TABLE N3.3), OR 2 COAT SEAL.
4. BASECOURSE TO BE A MINIMUM 150mm COMPACTED DEPTH OF M4 AP40 CRUSHED GRAVEL, OR 150mm M4 AP40 FOR 2 COAT SEAL.
5. SUBGRADE TO BE TRIMMED AND COMPACTED TO ACHIEVE A MINIMUM CBR VALUE = 7.
6. MAXIMUM LONGITUDINAL GRADIENTS SHALL BE IN ACCORDANCE WITH THE DISTRICT PLAN.
7. A, B, C AND D REFER TO THE GRADIENTS EXPRESSED EITHER AS A PERCENTAGE OR IN DEGREES.
8. LOW SLUNG CARS WITH GROUND EFFECT FEATURES MAY NOT MEET THE CRITERIA ASSUMED IN THIS DESIGN GUIDE.

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Vehicle Crossing - Residential	NOT TO SCALE Drawing No. B5-18

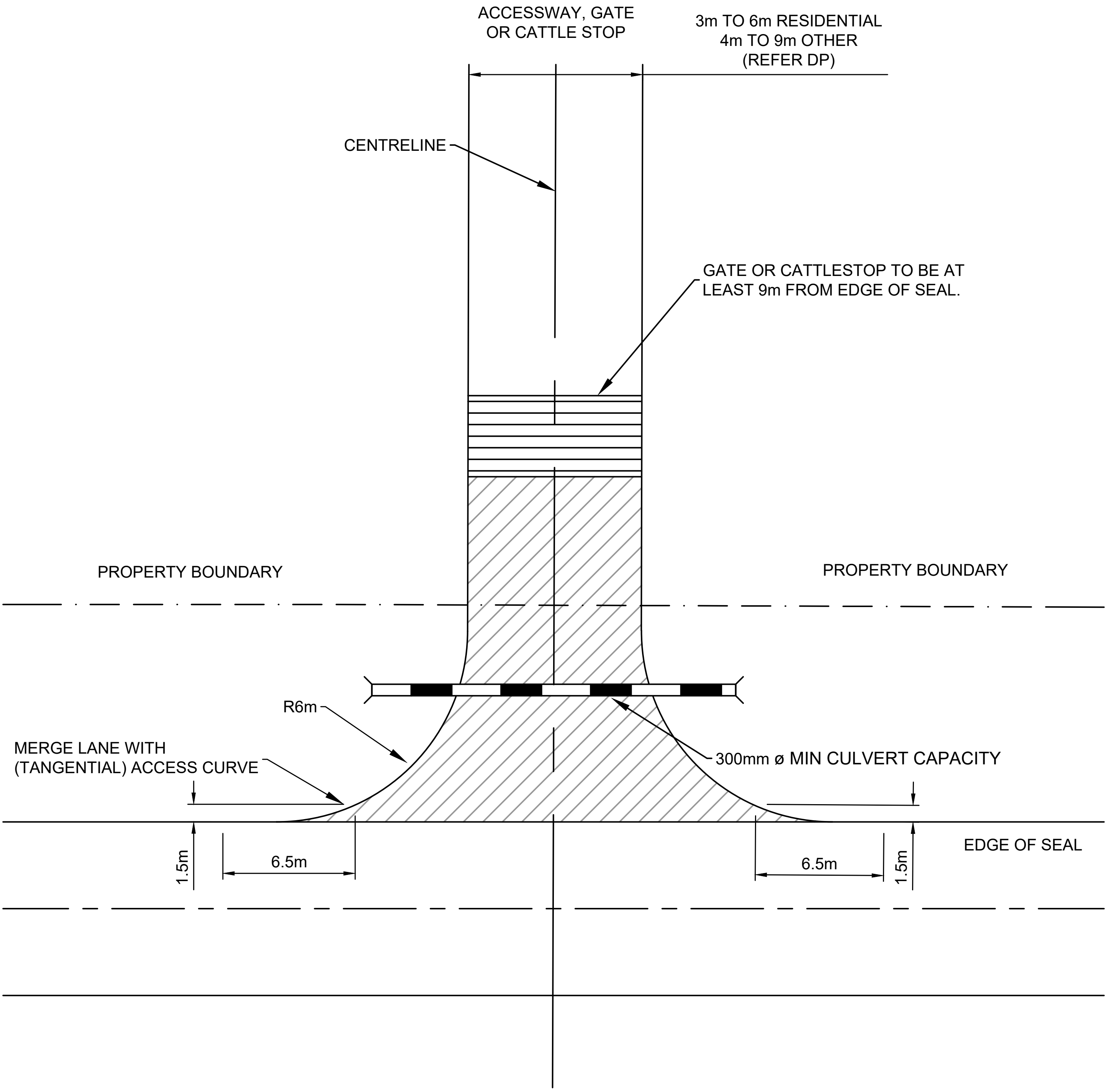


PLAN



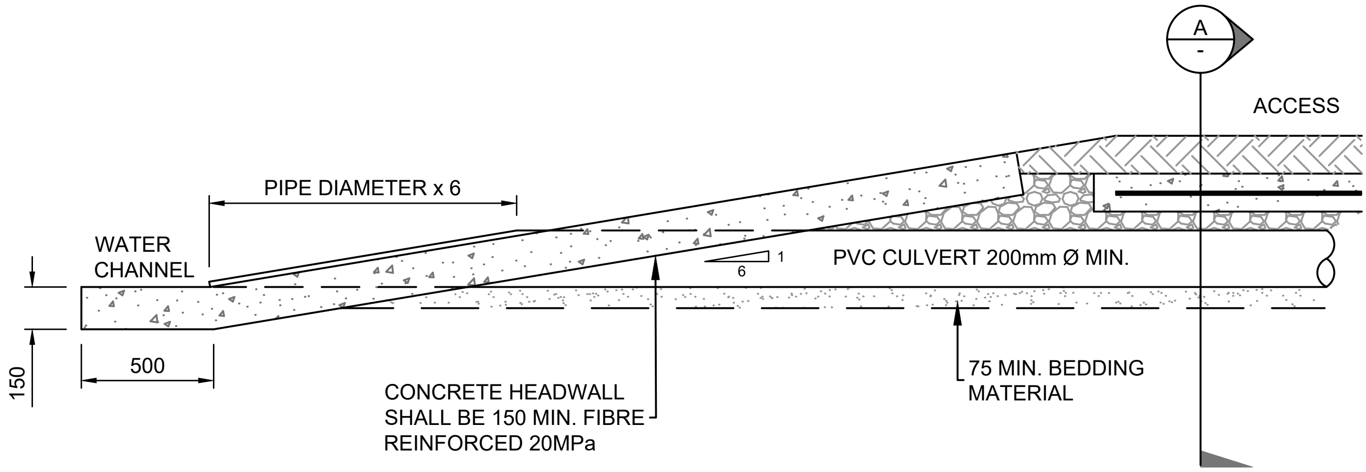
SECTION A

NOTES:
1. THE CONCRETE SHALL BE 150mm THICK AND REINFORCED WITH STRUCTURAL MESH, CENTRALLY PLACED.
2. THE CONCRETE SHALL HAVE A MINIMUM CRUSHING STRENGTH OF 20 MPa AT 28 DAYS AND SHALL COMPLY WITH NZS 3124.
3. CHANNEL CROSSING TO BE HEAVY DUTY, REINFORCED WITH 3 D12 BARS.
4. SUB-GRADE TO BE TRIMMED AND COMPACTED TO ACHIEVE A MIN. CBR VALUE OF > 7.
5. DESIGN OF ALL COMMERCIAL CROSSINGS TO COMPLY WITH THE DISTRICT PLAN.
6. MAXIMUM LONGITUDINAL GRADIENTS SHALL BE IN ACCORDANCE WITH THE DISTRICT PLAN.
7. ONLY CONCRETE IS PERMITTED (ASPHALT NOT PERMITTED).

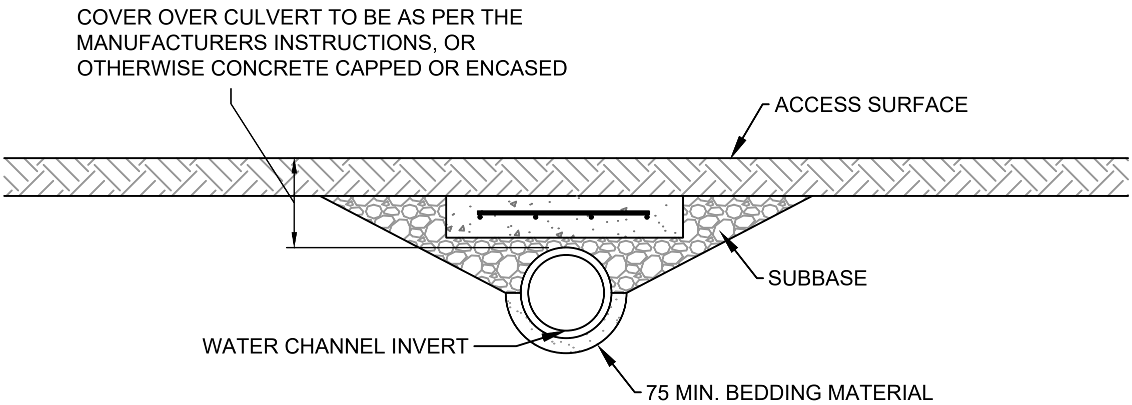


NOTES:

1. CROSSING TO BE MINIMUM 4.5m WIDE AT ENTRANCEWAY & INCORPORATE MIN. 6m RADIUS.
2. PAVEMENT CONSTRUCTION TO BE 150mm COMPACTED DEPTH M/4 AP40 BASECOURSE ON 200mm COMPACTED DEPTH OF AP65 SUBBASE ON COMPACTED SUB-GRADE WITH CBR > 7 (FOR ACCESSWAY INTERNAL TO SITE AS WELL AS LINKING SITE AND LEGAL ROAD).
3. WHERE THE CROSSING INTERCEPTS EXISTING SIDE DRAINAGE, A MIN. 300mm ø CULVERT IS TO BE INSTALLED.
4. IF THE APPLIED SURFACE IS CHIP SEAL A SECOND COAT SEAL IS REQUIRED TO BE PROGRAMMED AND CONSTRUCTED WITHIN 12 MONTHS FROM CONSTRUCTION OF THE FIRST COAT OR IN THE NEXT SUMMER SEASON, WHICHEVER COMES FIRST.
5. CULVERT TO BE FINISHED WITH CONCRETE HEADWALLS AS PER DRAWING B5-24: NON-PRECAST HEADWALL DETAIL OR DRAWING B5-16: TRAVERSABLE GRATES FOR PRECAST HEADWALLS 250mm TO 450mm CULVERTS.
6. MINIMUM DEPTH OF 450mm TO TOP OF CULVERT IS REQUIRED OR CONCRETE CAPPED/ENCASED IF THE ROAD DEPTH CANNOT BE ACHIEVED OR AS AGREED WITH THE T.A.



LONGITUDINAL ELEVATION: HEADWALL

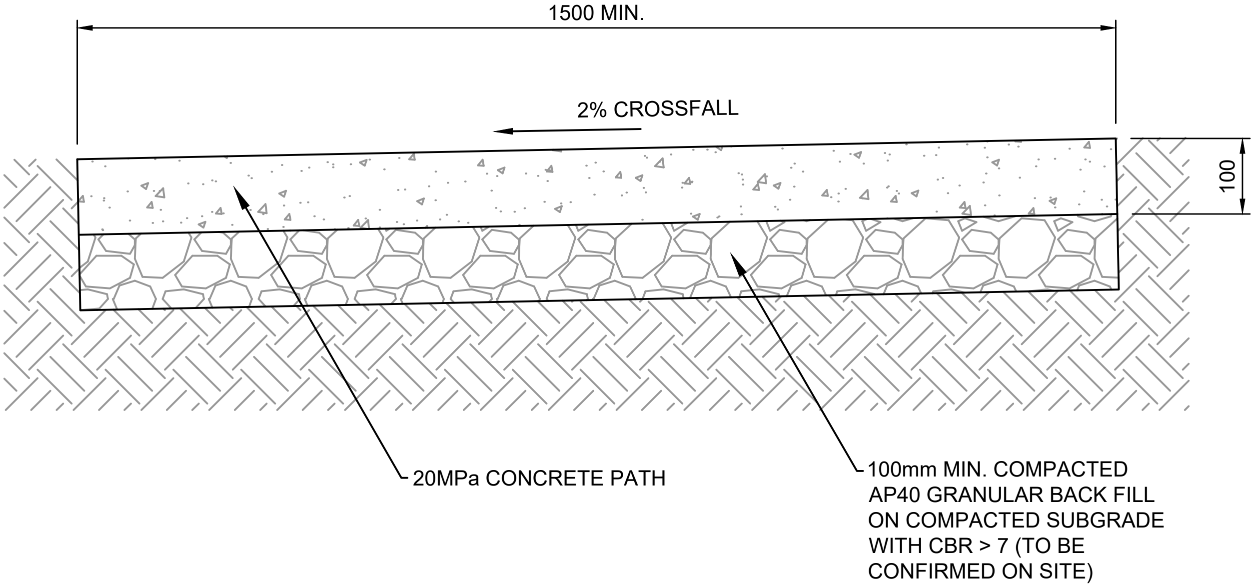


SECTION A: ACCESS PIPE BEDDING

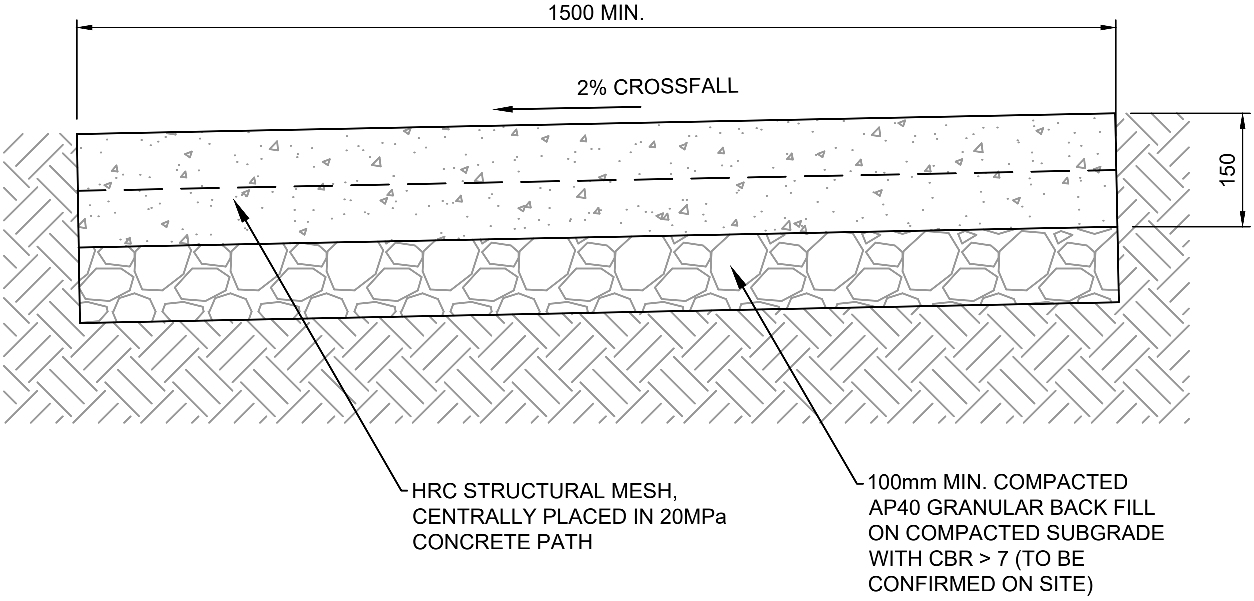
NOTES:

1. WHERE THE ACCESS INTERCEPTS EXISTING SIDE DRAINAGE / WATER TABLE, A 200mm MIN. DIAMETER (OR MIN. DIAMETER OF UPSTREM CULVERT, WHICHEVER IS THE GREATER) CULVERT IS TO BE INSTALLED.
2. PIPE TO SN8 PVC OR CONCRETE WITH APPROPRIATE BEDDING.
3. COVER OVER CULVERT TO BE AS PER THE MANUFACTURERS INSTRUCTIONS, OR OTHERWISE CONCRETE CAPPED OR ENCASED IF AN APPROPRIATE DEPTH CANNOT BE ACHIEVED.
4. CULVERT ENDS TO BE MITRED TO A GRADIENT OF 1V:6H.
5. CONSTRUCT CONCRETE HEADWALL AND APRON AROUND PIPE ENDS AND CHANNEL INVERT.

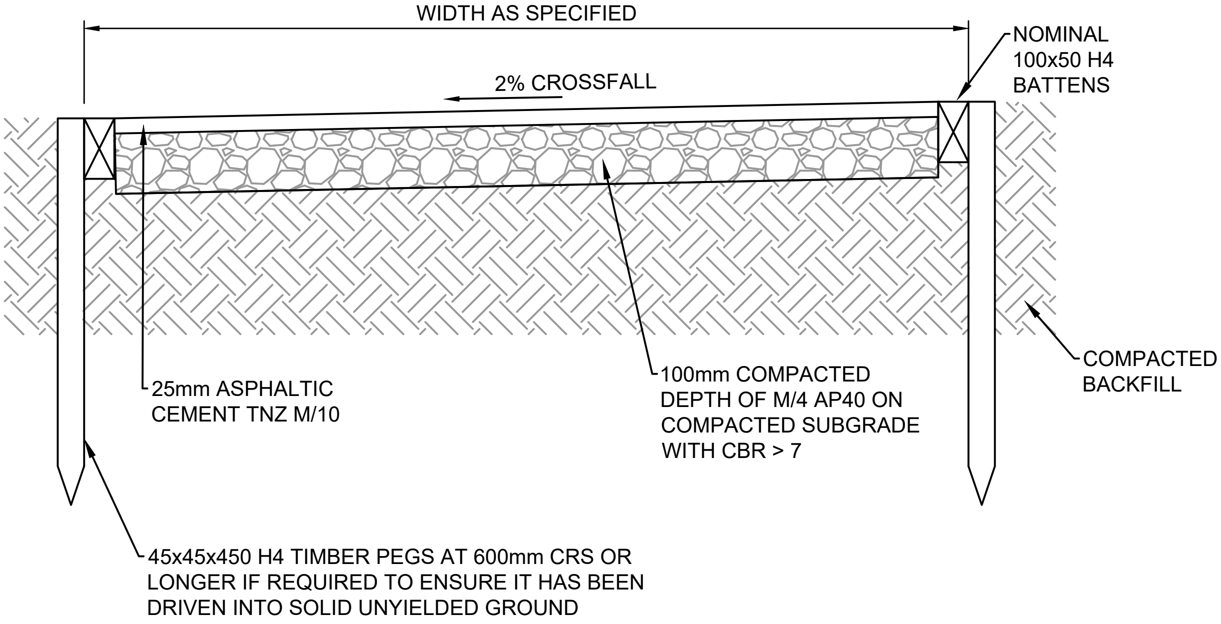
QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Non-Precast Headwall Detail for Culvert Under Access	NOT TO SCALE Drawing No. B5-21



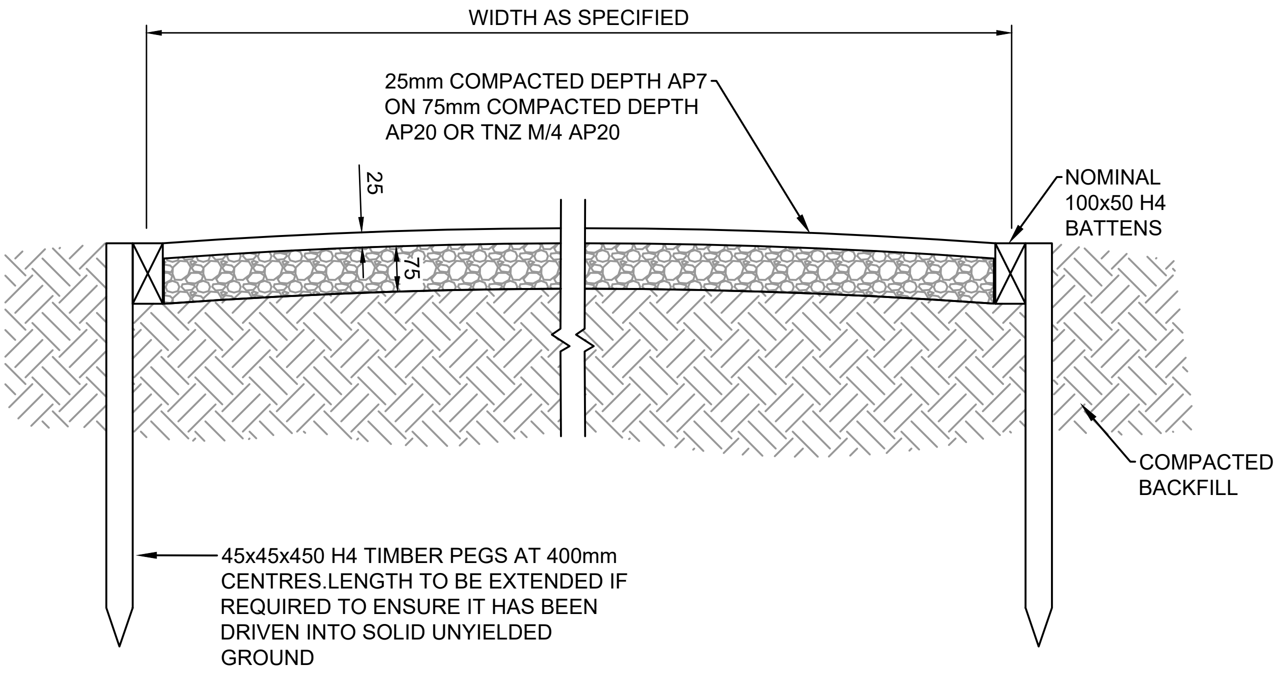
CONCRETE FOOTPATH



HEAVY DUTY CONCRETE FOOTPATH

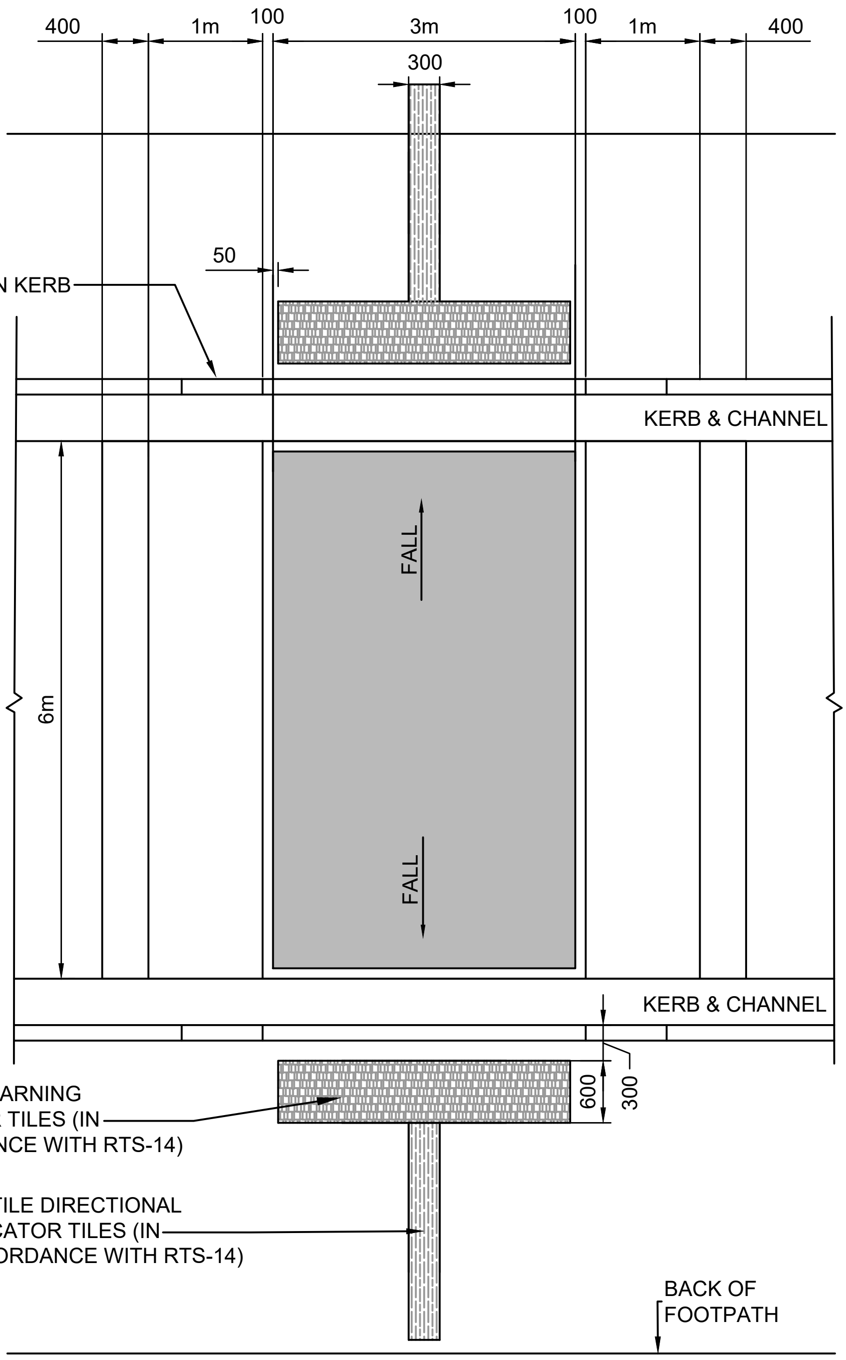


ASPHALT FOOTPATH

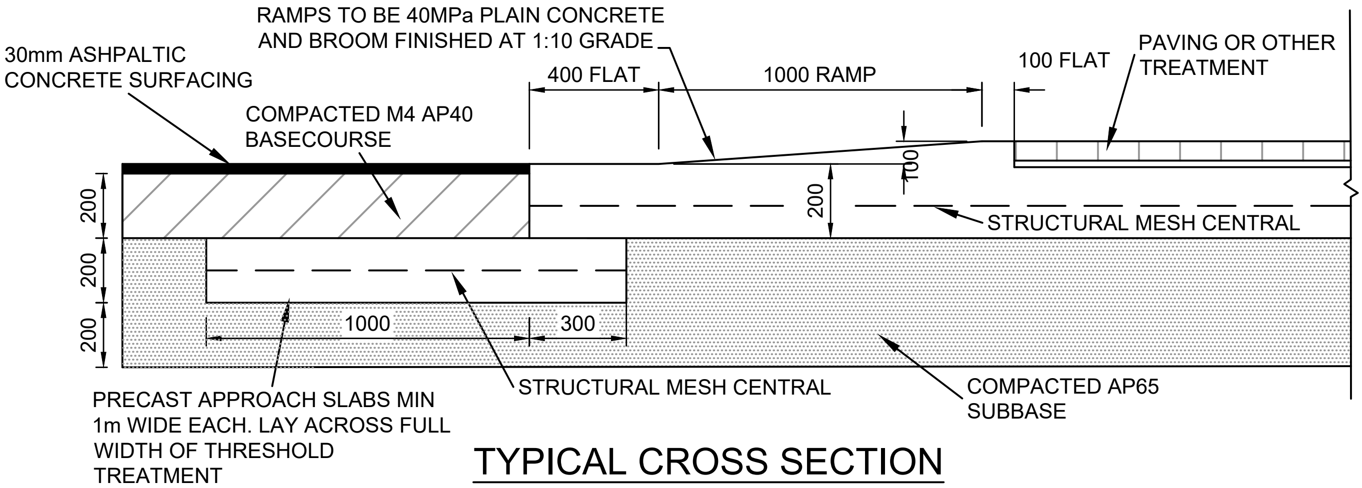


GRITTED FOOTPATH

NOTES:
1. RE. MIN. CBR OF 7 REQUIRED AND SUBBASE OF 75mm.
2. CROSSFALLS TO BE NOMINALLY 3% (CROWNED OR CONTINUOUS CROSSFALLS AS SPECIFIED).
3. SUBGRADE & METALCOURSE TO BE TREATED WITH APPROVED SOIL STERILANT.
4. PEGS CAN BE CUT OFF AT AN ANGLE, FLUSH WITH BOXING ON SIDE AND MINIMUM 5mm DOWN ON THE OTHER.
5. TRACKS AND TRAILS TO BE DESIGNED AND BUILT AS PER THE QLDC TRACKS AND TRAILS DESIGN GUIDE.



PLAN



TYPICAL CROSS SECTION

QLDC LDSC 2020
Standard Details

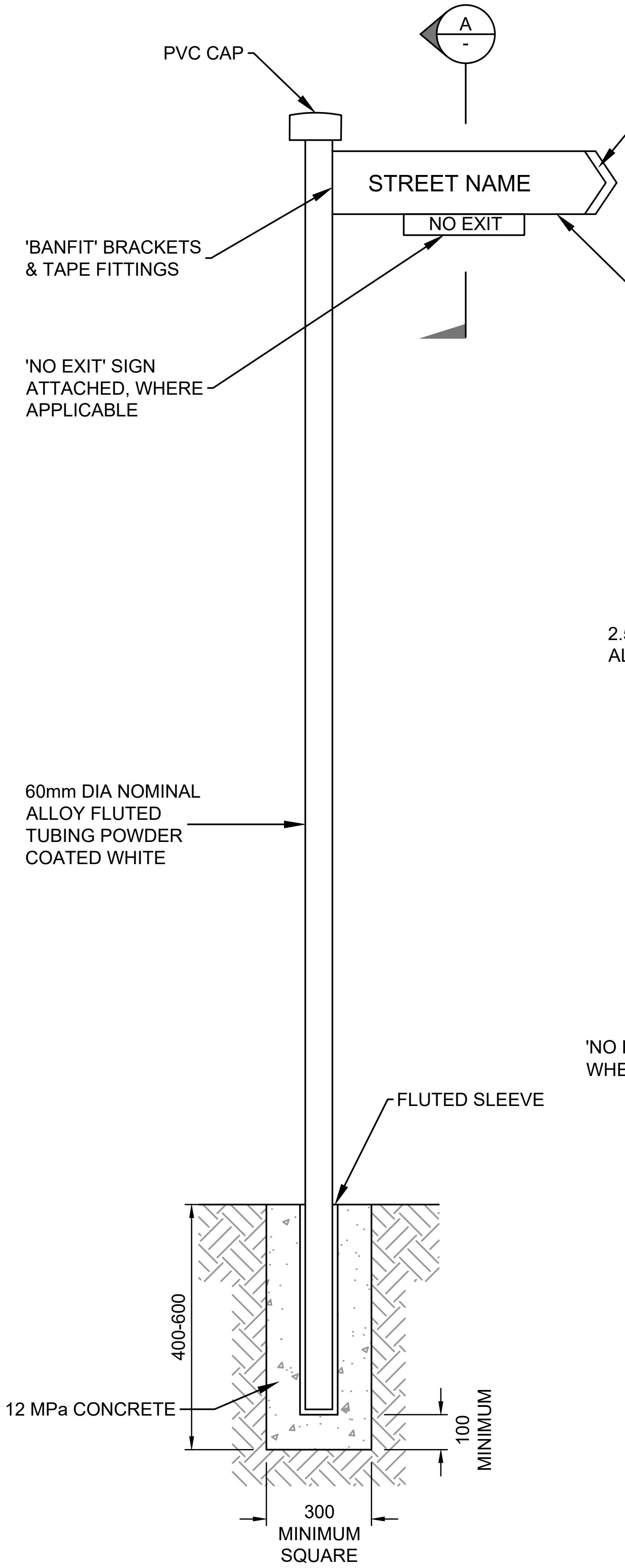
Revision:
Rev Date:

QUEENSTOWN LAKES DISTRICT COUNCIL

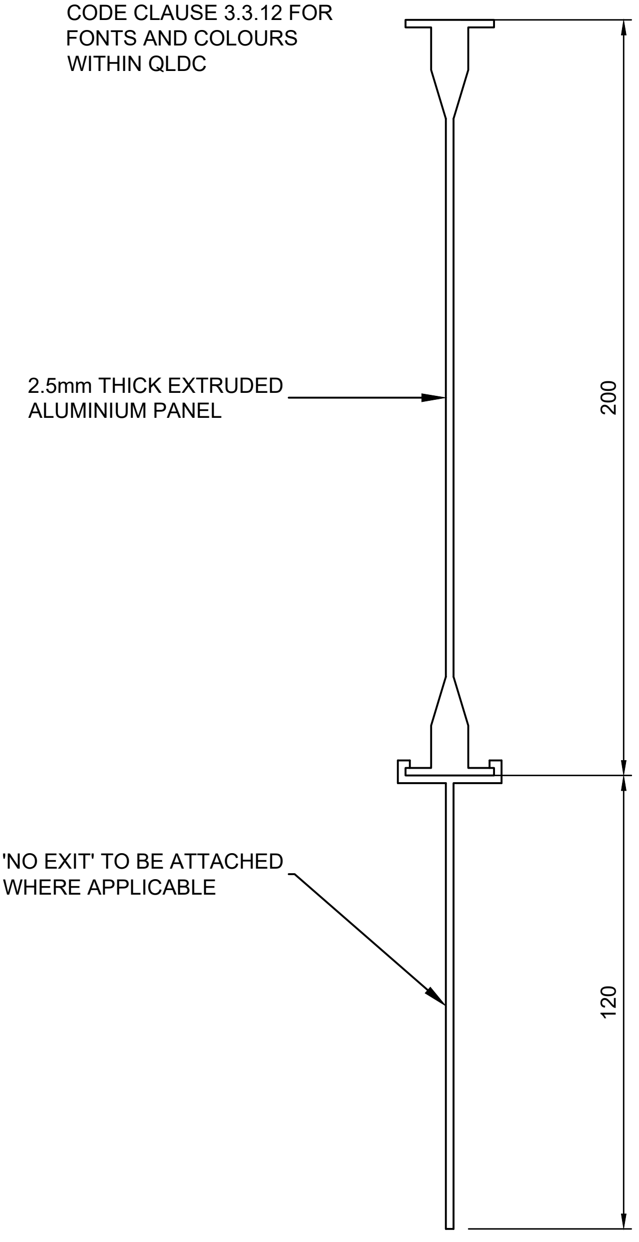
Drawing Title:
Pedestrian Crossing Detail

NOT TO SCALE

Drawing No.
B5-24



STREET NAME AND POST



SECTION A

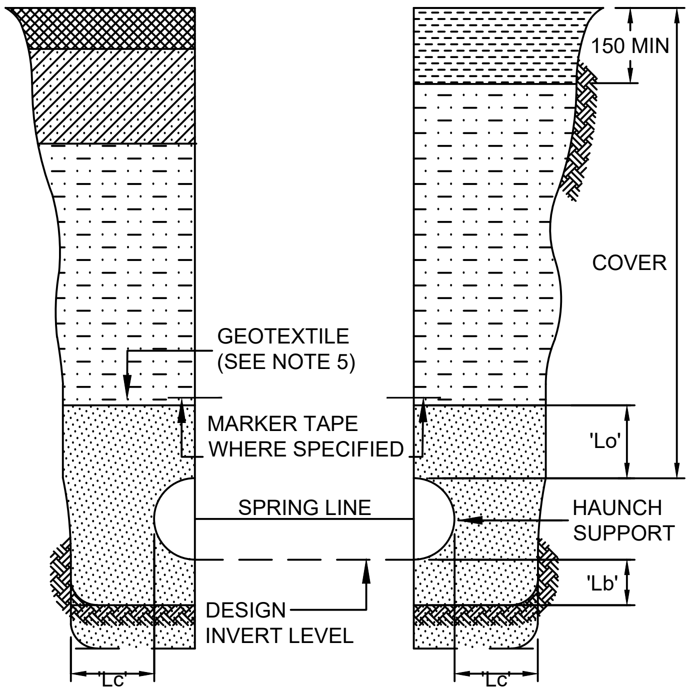
NOTE:
WHERE POLES ARE SUPPORTING MORE THAN 3 SIGNS, SPECIFIC APPROVAL OF BASE UNIT DESIGN IS REQUIRED.

QLDC LDSC 2020 Standard Details Revision: Rev Date:	QUEENSTOWN LAKES DISTRICT COUNCIL	Drawing Title: Street Sign: Pole Mount	NOT TO SCALE Drawing No. B6-1

MATERIAL		ZONE
ROAD SURFACE	NON ROAD SURFACES	
ROAD SURFACE LAYER	TO MATCH EXISTING	SURFACE COURSE
TO MATCH EXISTING ROAD BASE OR TO TERRITORIAL AUTHORITY REQUIREMENTS	TRENCH FILL MATERIALS TO BE SIMILAR WITH SNZ HB 2002 APPENDIX L OR TO TERRITORIAL AUTHORITY REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE	ROAD BASE
TRENCH FILL MATERIALS TO BE SIMILAR WITH SNZ HB 2002 APPENDIX L OR TO TERRITORIAL AUTHORITY REQUIREMENTS OR INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE		TRENCH FILL (AS SPECIFIED IN DESIGN DRAWINGS)
EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND TERRITORIAL AUTHORITY (SEE NOTE 4)		EMBEDMENT: OVERLAY
		EMBEDMENT: SIDE SUPPORT
BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING		EMBEDMENT: BEDDING
		OVER-EXCAVATION

VEHICULAR LOADING

'Lo' - 100 mm MIN. NON TRAFFICABLE
'Lb' - 300 mm MIN. TRAFFICABLE
- REFER TO CM - 002



SPRING LINE TRENCH CLEARANCE

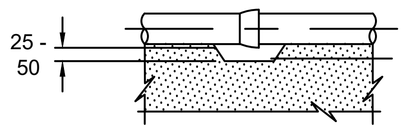
NOMINAL DIAMETER DN	MINIMUM CLEARANCE 'Lc'
≤150	100
>150 - ≤300	150
>300 - ≤450	200
>450 - ≤900	300
>900 - ≤1500	350

TRENCH WIDTH TO BE SUFFICIENT TO SAFELY LAY PIPE AND COMPACT THE SIDE SUPPORT ZONE

ZONE	MATERIAL
TOPSOIL OR PAVEMENT	ORIGINAL OR IMPORTED MATERIAL TO MATCH EXISTING
TRENCH FILL (AS SPECIFIED IN DESIGN DRAWINGS)	INORGANIC FILL MATERIAL WITH 75 MAXIMUM STONE SIZE
EMBEDMENT: OVERLAY	EMBEDMENT MATERIAL IN ACCORDANCE WITH DESIGN DRAWINGS AND TERRITORIAL AUTHORITY (SEE NOTE 4)
EMBEDMENT: SIDE SUPPORT	
EMBEDMENT: BEDDING	BEDDING MAY BE OMITTED IF TRENCH BASE IS GRANULAR SAND OR GRAVEL OF SUITABLE GRADING
OVER-EXCAVATION	

NO VEHICULAR LOADING

INCLUDES LOCATIONS WHERE OCCASIONAL VEHICLE LOADING OCCURS SUCH AS RESERVES AND FOOTWAYS



PROVIDE POCKETS IN BEDDING AT JOINTS PRIOR TO LAYING PIPES. FILL VOID DURING COMPLETION OF EMBEDMENT

PIPE JOINT BEDDING POCKETS

FOR JOINT PROJECTIONS (SOCKETS, FLANGES, AND SO ON)

NOTE:

1. ALL DIMENSIONS IN MILLIMETRES.
2. SPECIFY SPECIAL BEDDING TO SUIT THE CONDITIONS IF THE TRENCH FLOOR HAS:
   - IRREGULAR OUTCROPS OF ROCK OR
   - BEEN DISTURBED BY UNCONTROLLED GROUND WATER.
3. COMPACT AND EVENLY GRADE FINISHED TRENCH FLOOR.
4. EMBEDMENT, TRENCH FILL AND COMPACTION TO MEET THE REQUIREMENT OF DESIGN DRAWINGS OR SPECIFICATIONS.
5. USE GEOTEXTILE FILTER FABRIC WHERE SPECIFIED.
6. SIDES OF EXCAVATION TO BE KEPT VERTICAL TO AT LEAST 150 ABOVE THE PIPE.

STANDARDS NEW ZEALAND PAEREWA AOTEROA

ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA

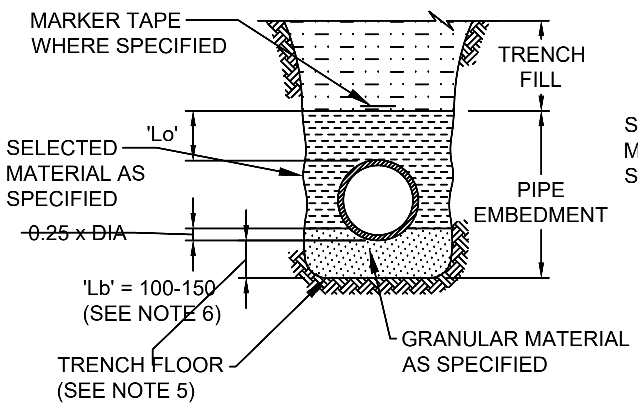
NZS 4404:2010
LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE

EMBEDMENT & TRENCHFILL
TYPICAL ARRANGEMENT

NOT TO SCALE

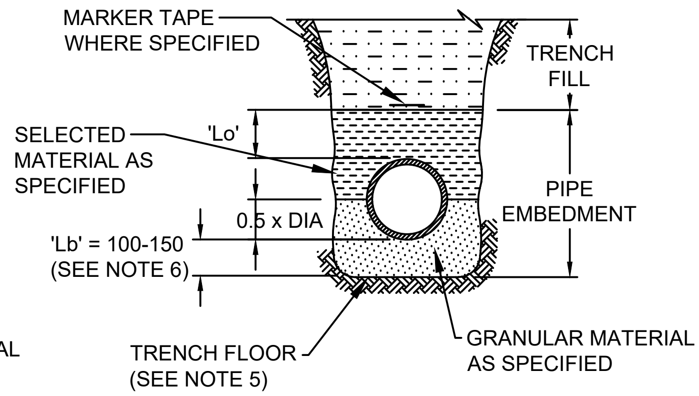
CM - 001

B7-1



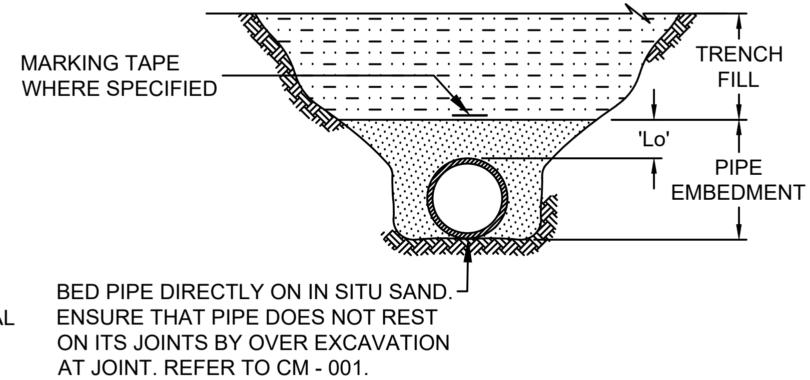
TYPE 1 SUPPORT

(SEE NOTE 9)

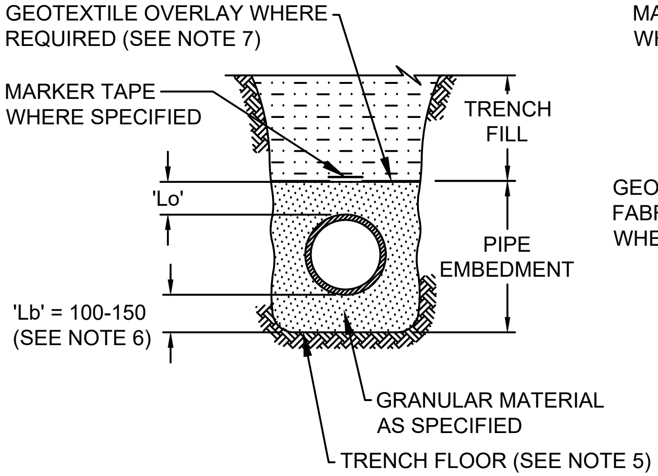


TYPE 2 SUPPORT

FOR RIGID PIPES ONLY (SEE NOTE 3)
(SEE NOTE 9)

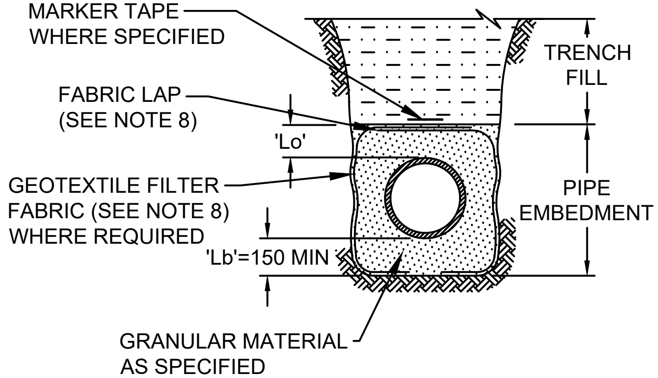


TRENCH IN SAND STRATA



TYPE 3 SUPPORT

FOR FLEXIBLE AND RIGID PIPES (SEE NOTE 3)



TYPE 4 SUPPORT

WITH GEOTEXTILE FOR FLEXIBLE AND RIGID PIPES (SEE NOTE 3)

NOTES:
1. ALL DIMENSIONS IN MILLIMETRES.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH CM - 001.
3. PIPE CLASSIFICATION:
   (a) RIGID PIPES: VC, RC, STEEL AND DI
   (b) FLEXIBLE PIPES: PVC, GRP, AND PE.
4. PLACEMENT OF EMBEDMENT, TRENCHFILL, & COMPACTION TO MEET THE REQUIREMENTS OF DRAWINGS AND SPECIFICATIONS.
5. EXCAVATE OR COMPACT TRENCH FLOOR TO PROVIDE A FLAT FIRM BASE TO SUPPORT BEDDING MATERIAL AND MINIMISE PIPELINE SETTLEMENT. WHEN EXCAVATED, REPLACE WITH GRANULAR MATERIAL AS SPECIFIED FOR BEDDING OR ADOPT TYPE 1, 2, 3, OR 4 SUPPORT AS REQUIRED.
6. ENSURE BEDDING IS DEEP ENOUGH THAT PIPE JOINT PROJECTIONS (SOCKETS, FLANGES) DO NOT TOUCH TRENCH FLOOR -SEE CM-001.
7. TYPE 4 SUPPORT TO BE USED WHERE MIGRATORY NATIVE SOILS (SANDS & CLAYS) ARE ENCOUNTERED ADJACENT TO THE EMBEDMENT ZONE AND SINGLE SIZE AGGREGATE IS USED.
8. GEOTEXTILE OVERLAY IS REQUIRED FOR COARSE AGGREGATE EMBEDMENT > 5mm. LAY GEOTEXTILE FILTER FABRIC AGAINST TRENCH FLOOR AND WALLS SUCH THAT IT FULLY ENCASES THE EMBEDMENT.
   - PRESS FILTER FABRIC INTO THE VOIDS BEFORE INSTALLING EMBEDMENT TO PREVENT FABRIC TEARING.
   - PROVIDE A MINIMUM OF 250 OVERLAP AT ALL FILTER FABRIC JOINTS.
9. IN SOME AREAS LOCAL PRACTICE MAY ALLOW USE OF SELECTED EXCAVATED MATERIAL AS PIPE EMBEDMENT.
10. IN UNSUITABLE GROUND CONDITIONS SPECIFIC DESIGN IS REQUIRED. SEE WSA 03 & WSA 04 DRAWINGS FOR GUIDANCE.
11. CONCRETE PIPES SHOULD BE BASED ON FIGURES 11 - 13 IN AS/NZS 3725.

EMBEDMENT TYPES TO BE SPECIFIED IN DESIGN DRAWINGS

STANDARDS NEW ZEALAND PAEREWA AOTEAROA
ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA

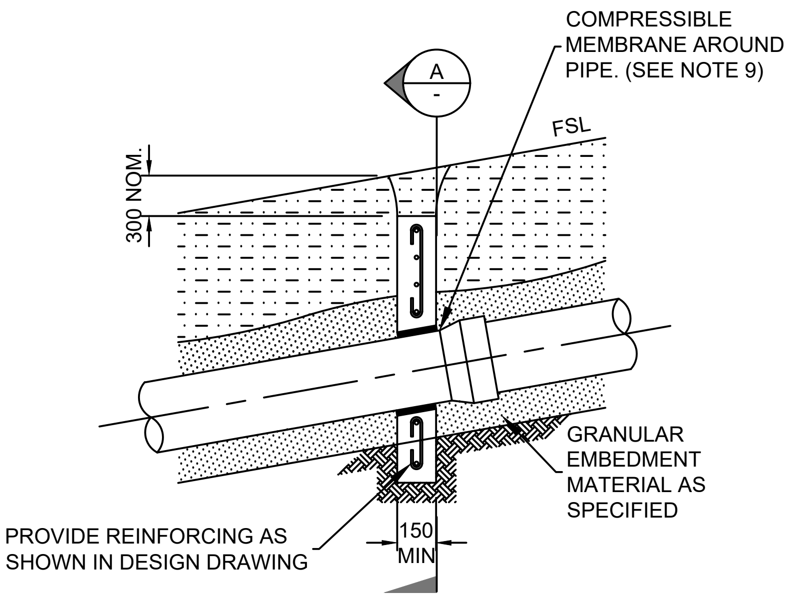
NZS 4404:2010
LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE

EMBEDMENT & TRENCHFILL TYPICAL ARRANGEMENT

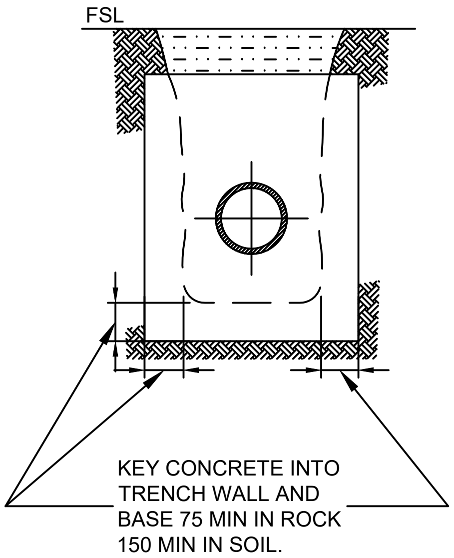
NOT TO SCALE

CM - 002

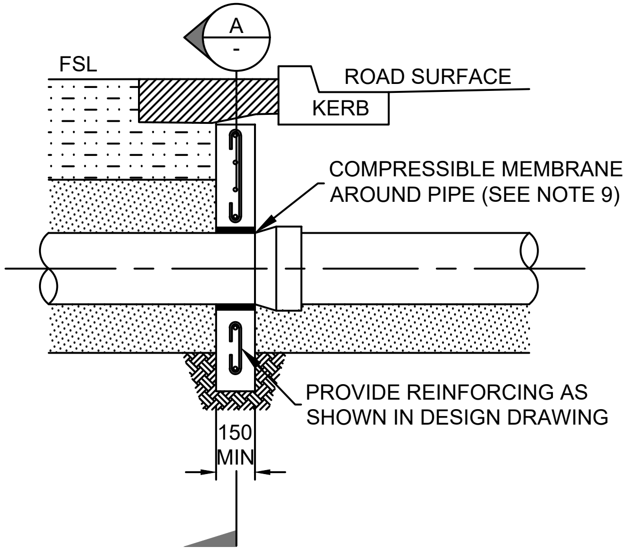
B7-2



CONCRETE BULKHEAD DETAIL



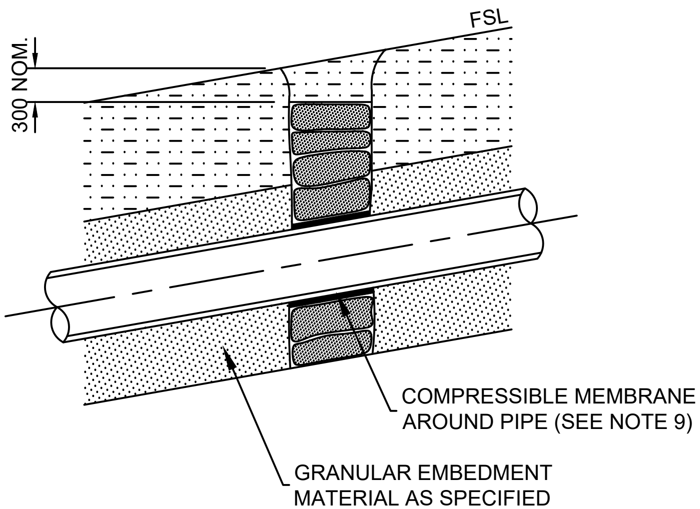
SECTION A



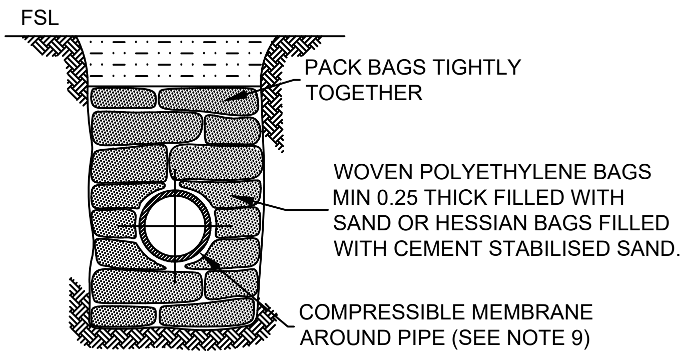
TYPICAL ROAD CROSSING BULKHEAD

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. CONSTRUCT CONCRETE BULKHEADS AND TRENCH STOPS AT LOCATIONS SPECIFIED IN DESIGN DRAWINGS.
3. CONSTRUCT BULKHEAD ADJACENT TO KERB AND GUTTER SHOULDER OF SEALED ROADS.
4. BULKHEAD AT A RETAINING WALL TO BE UNDER THE WALL.
5. KEY CONCRETE BULKHEADS INTO SIDES AND BOTTOM OF TRENCH AGAINST A BEARING SURFACE OF UNDISTURBED SOIL.
6. CONCRETE TO BE 17.5 MPA.
7. DO NOT DEFORM PIPES DURING PLACEMENT OF CONCRETE OR BAGS.
8. SEAL BAGS TO PREVENT LEAKAGE OF CONTAINED MATERIAL.
9. COMPRESSIBLE MEMBRANE AROUND PIPE TO BE 10 THICK POLYSTYRENE FOR BULKHEADS ADJACENT TO KERBS AND 3 THICK RUBBER FOR BULKHEADS AND TRENCHSTOPS ON SLOPES.
10. FOR SLOPES >35% REFER TO TERRITORIAL AUTHORITY FOR REQUIREMENTS.



TRENCH STOP DETAIL



SECTION B

STANDARDS NEW ZEALAND PAEREWA AOTEAROA

ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA

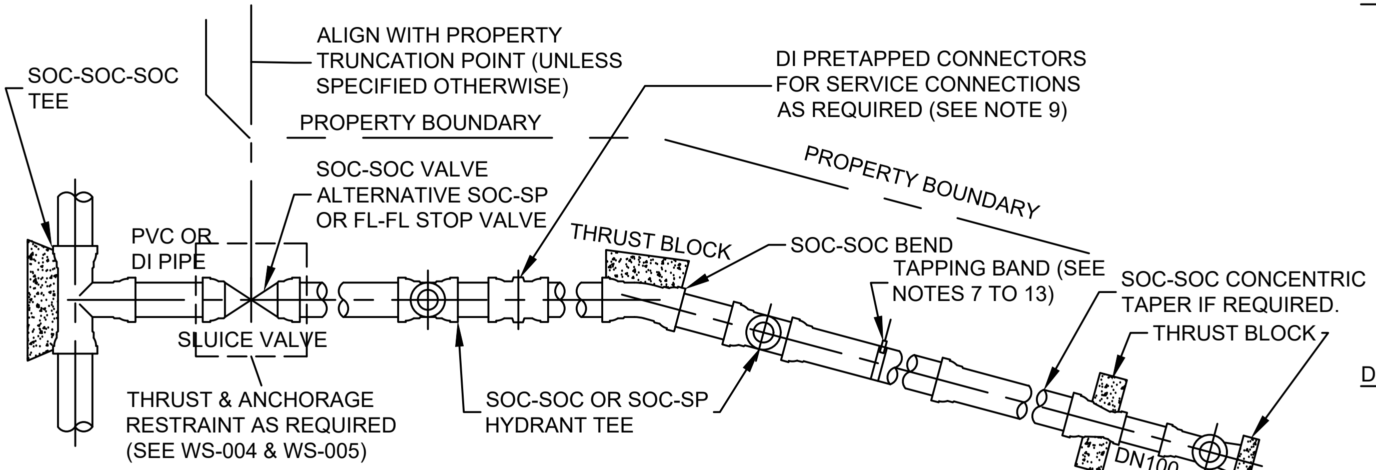
NZS 4404:2010
LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE

NOT TO SCALE

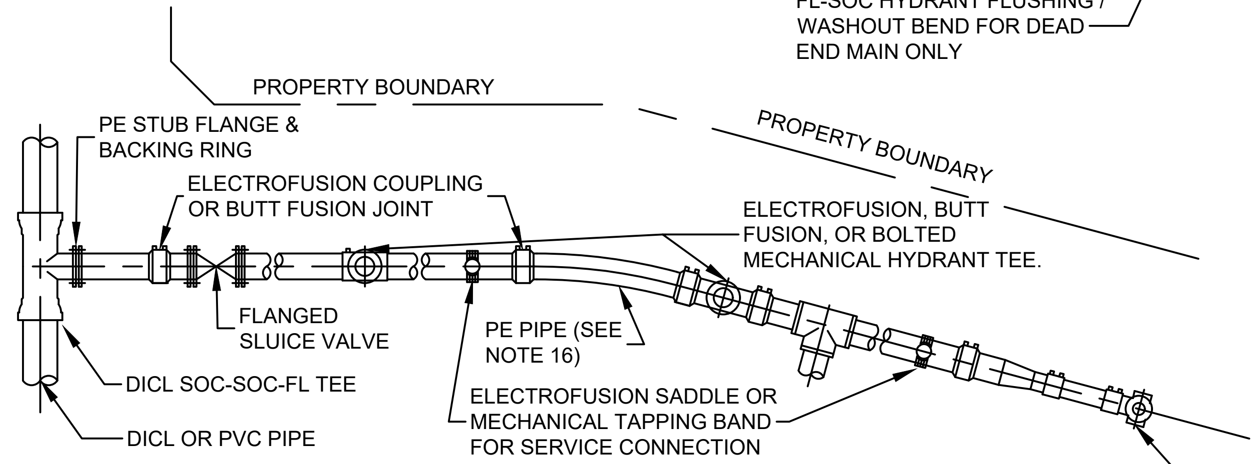
BULKHEADS & TRENCH STOP STANDARD DETAILS

CM - 003

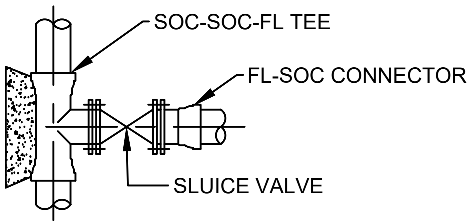
B7-3



TYPICAL INSTALLATION OF PVC & DI PIPES & FITTINGS



TYPICAL INSTALLATION OF PE PIPES & FITTINGS



TYPICAL VALVE CONNECTION DIRECT TO NEW MAIN

NOTE-

1. ALL DIMENSIONS IN MILLIMETRES.
2. INSTALL PIPEWORK PARALLEL TO PROPERTY BOUNDARIES.
3. STAINLESS STEEL AND NYLON COATED (TO AS/NZS 4158)TAPPING BANDS DO NOT REQUIRE ADDITIONAL CORROSION PROTECTION.
4. WRAP BOLTED CONNECTIONS USING OTHER THAN NYLON COATED FITTINGS AND STAINLESS STEEL BOLTS WITH A PETROLATUM TAPE SYSTEM.
5. WHERE MAINS ARE 300 OR LARGER BYPASSES SHOULD BE INSTALLED FOR ALL MANUAL SLUICE VALVES.
6. ALL VALVES AND FITTINGS SHALL BE COATED WITH A THERMAL BONDED POLYMERIC COATING APPLIED IN ACCORDANCE WITH AS/NZS 4158.

DI & PVC PIPE

7. DUCTILE IRON FITTINGS MAY BE USED WITH DI & PVC PIPE.
8. FITTINGS SHALL BE NYLON COATED AND LINED OR CEMENT LINED WITH A BITUMINOUS EXTERNAL COATING. DO NOT USE PVC FITTINGS WITH DI PIPE.
9. USE PRE TAPPED CONNECTORS ON DN 100 & DN 150 NEW MAIN INSTALLATIONS (UNLESS SPECIFIED OTHERWISE BY THE TERRITORIAL AUTHORITY.
10. USE TAPPING BANDS FOR CONNECTIONS TO EXISTING MAINS AND NEW MAINS >DN 150.
11. ELECTRICALLY ISOLATE COPPER SERVICES FROM DICL PIPE.

PVC PIPE

12. TAPPING BANDS ON PVC PIPE TO BE FULL CIRCLE CLAMPING.
13. WHERE PVC FITTINGS ARE USED, A PROTECTIVE MEMBRANE IS REQUIRED BETWEEN FITTING AND THRUST BLOCK. PVC FITTINGS TO BE USED ONLY ON PVC PIPE. DI SPIGOTS NOT TO BE INSERTED INTO PVC SOCKETS.
14. MAXIMUM SIZE OF DRILLED HOLES FOR SERVICE CONNECTIONS IN PVC PIPE TO BE 30% DN OR 50 (LOWER VALUE TO BE USED) LARGER HOLES CAN BE USED FOR UNDER PRESSURE TAPPING.

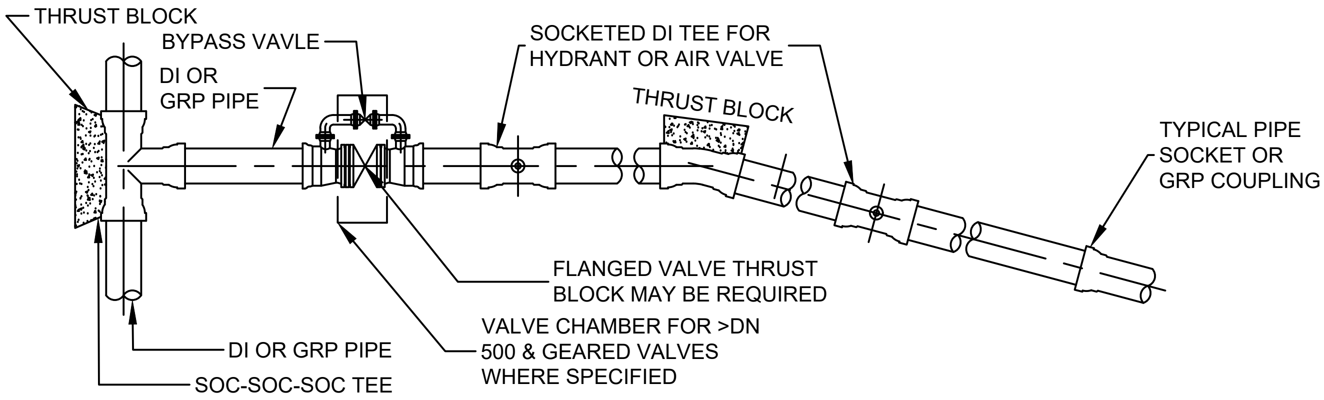
DI PIPE

15. DIRECT TAPPING OF >DN 200 DICL MAY BE AUTHORISED BY TERRITORIAL AUTHORITY.

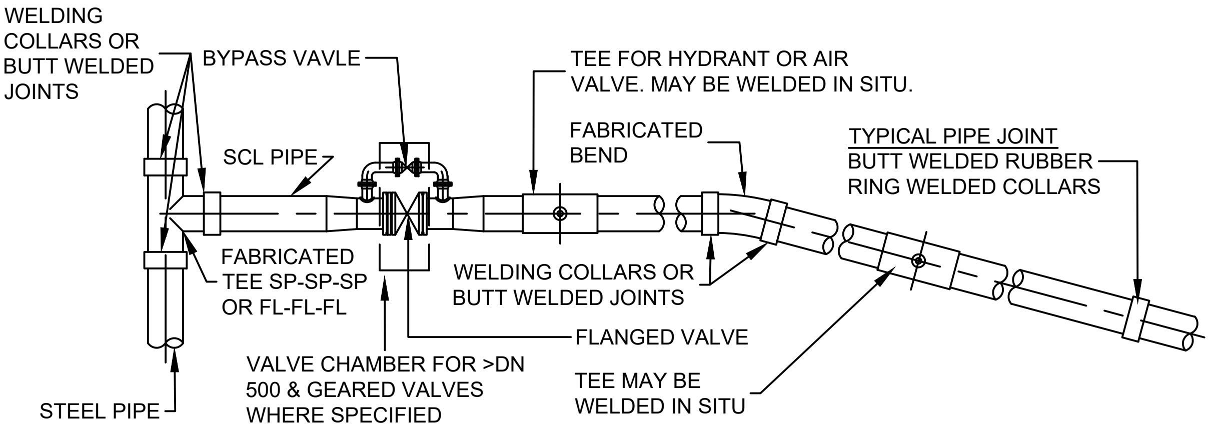
PE PIPE

16. PE PIPE MAY BE COLD BENT TO MINIMUM RADIUS OF 25 X (OD)STAKES OR OTHER SOURCES OF POINT LOADS SHALL NOT BE USED TO ASSIST IN BENDING THE PIPE.
17. MAKE ALLOWANCE DURING CONSTRUCTION FOR EXPANSION AND CONTRACTION OF PE PIPE DUE TO TEMPERATURE CHANGES.
18. BUTT WELDING IN ACCORDANCE WITH WSA-01 (POLYETHYLENE CODE) BUTT WELDING IN TRENCHES IS NOT PERMITTED.
19. ALL MECHANICAL COUPLINGS TO BE SELF-RESTRAINING.

STANDARDS NEW ZEALAND PAEREWA AOTEAROA ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA	NZS 4404:2010 LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE	NOT TO SCALE
	TYPICAL MAINS CONSTRUCTION - RETICULATION MAIN ARRANGEMENTS	WS-001
		B7-4

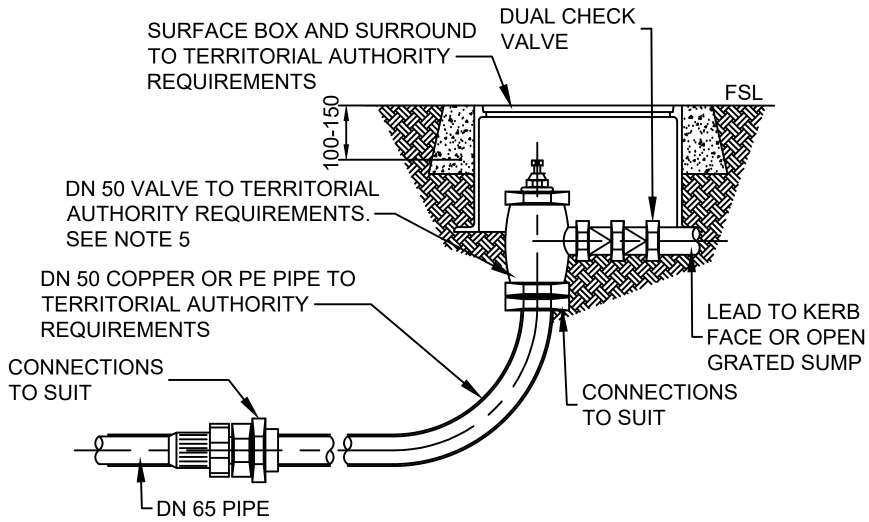


TYPICAL INSTALLATION OF DI AND GRP MAINS



TYPICAL INSTALLATION OF STEEL MAINS

THRUST BLOCKS REQUIRED WHERE NON-RESTRAINING RUBBER RING JOINTS USED



FLUSHING POINT

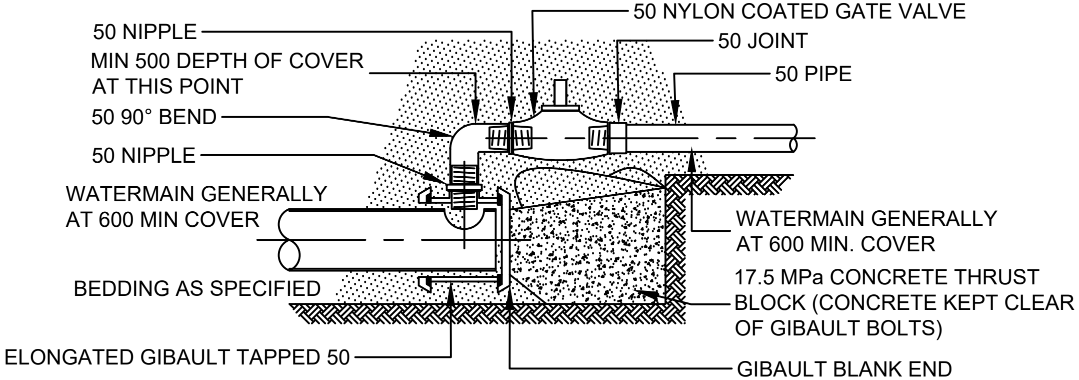
NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.
2. WHERE POSSIBLE USE A SINGLE LENGTH OF PE PIPE.
3. THRUST BLOCKS TO BE IN ACCORDANCE WITH TERRITORIAL AUTHORITY REQUIREMENTS.
4. PVC PIPE MAY BE USED AS SHROUD PIPE, CUT AS REQUIRED TO CLEAR HYDRANT FLANGE.
5. FIT THE FLUSHING POINT VALVE IN SUCH A WAY AS TO PREVENT MOVEMENT OR ROTATION OF THE VALVE BODY. PROVIDE A SUITABLE PLUG OR CAP TO KEEP OUT DIRT AND GRAVEL.
6. PROVIDE CORROSION PROTECTION FOR ALL NON COATED METALLIC SURFACES IN ACCORDANCE WITH TERRITORIAL AUTHORITY REQUIREMENTS.
7. SERVICE CONNECTIONS NOT PERMITTED ON DISTRIBUTION MAINS WITHOUT TERRITORIAL AUTHORITY APPROVAL.

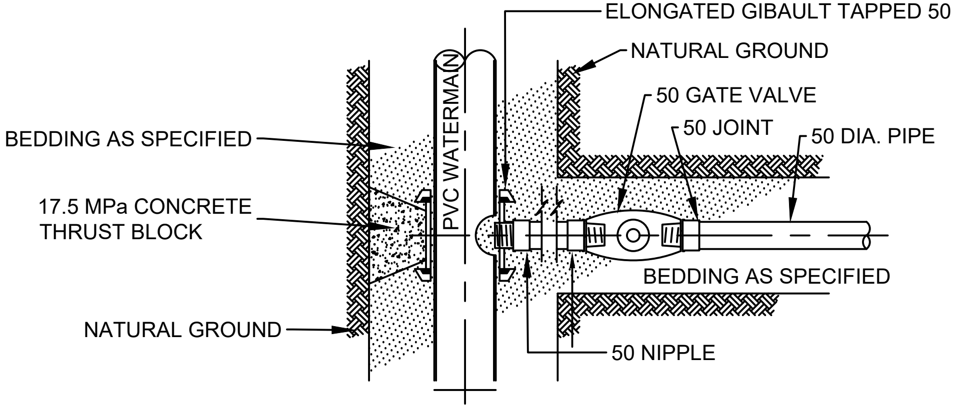
STANDARDS NEW ZEALAND PAEREWA AOTEAROA

ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA

NZS 4404:2010 LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE	NOT TO SCALE
TYPICAL MAINS CONSTRUCTION - DISTRIBUTION AND TRANSFER MAINS	WS-002
	B7-5

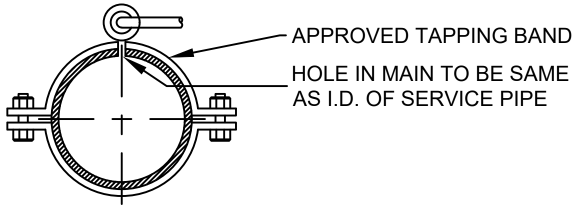


STRAIGHT LINE CONNECTION - METHOD 1 - ELEVATION

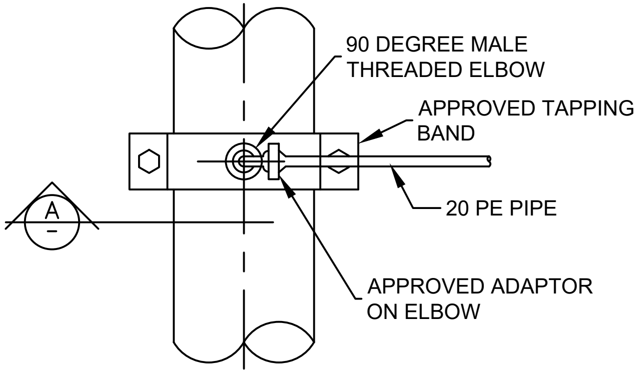


90° CONNECTION - PLAN

RIDER MAIN CONNECTIONS

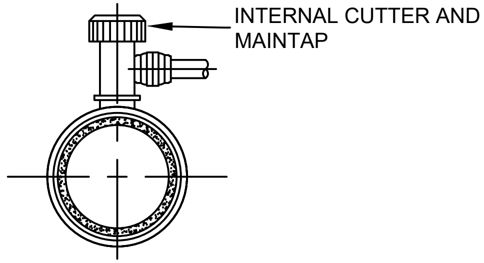


SECTION A



PLAN

STANDARD TAPPING METHODS



ELECTROFUSION TAPPING SADDLE

PE PIPE

NOTE:

1. ALL DIMENSIONS IN MILLIMETRES.
2. USE METAL GATE VALVE ON 20 CONNECTIONS WHERE REQUIRED BY T.A. OR WHERE SHUTTING DOWN MAIN TO REPAIR SERVICE WOULD CAUSE SIGNIFICANT INTERRUPTION TO SUPPLY.
3. USE PROPRIETARY IN LINE METAL VALVES APPROVED BY T.A. WHEN MAIN IS TAPPED UNDER PRESSURE.
4. WHERE POSSIBLE, LAY SERVICE CONNECTIONS AND RIDER CONNECTIONS TO PRINCIPAL MAIN. WHERE NOT POSSIBLE INSTALL METALLIC TAPE ON TOP OF CONNECTION.
5. RIDER MAINS AND SERVICE CONNECTIONS TO PRINCIPAL MAIN USE ELONGATED GIBAULT, PROPRIETARY TEE (RIDER MAIN ONLY) OR APPROVED PROPRIETARY TAPPING BANDS.

STANDARDS NEW ZEALAND PAEREWA AOTEAROA ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA	NZS 4404:2010 LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE	NOT TO SCALE
	PROPERTY SERVICES - CONNECTION TO AN EXISTING PVC MAIN	WS-003
		B7-6

MINIMUM BLOCK VOLUME FOR ANCHORAGE

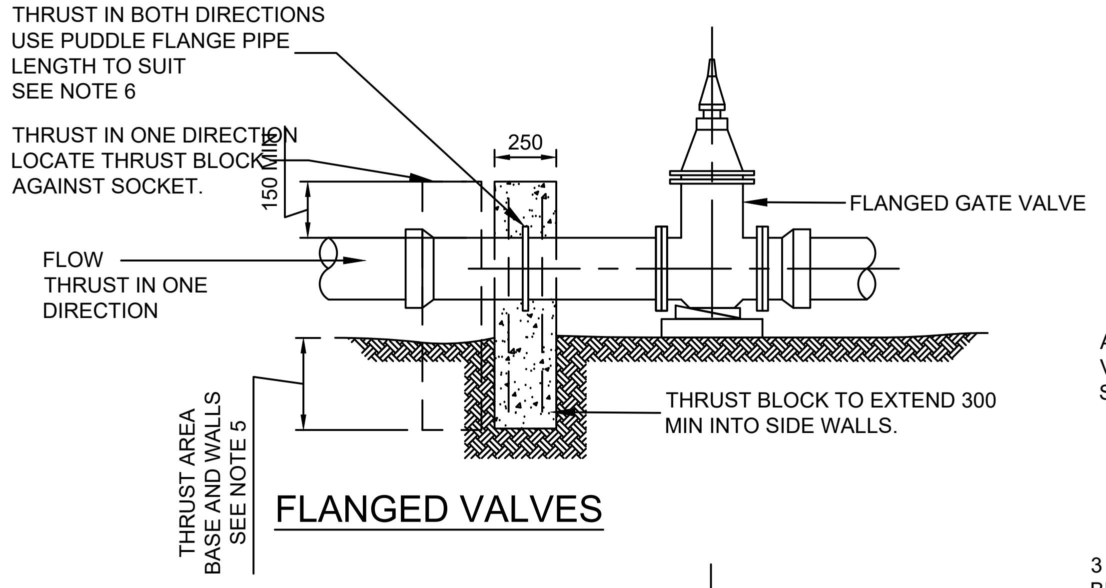
VERTICAL BENDS

FOR TEST PRESSURE OF 1000kPa (SEE NOTE 2)

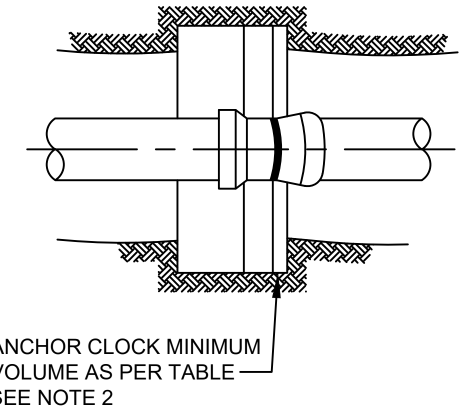
PIPE DN	CONCRETE VOLUME M^3		
	11.25° BEND	22.25° BEND	45° BEND
100	N	N	0.3
150	N	0.3	0.6
200	0.2	0.5	1.1
225	0.3	0.6	1.4
250	0.3	0.7	2.5
300	0.4	1.1	3.8
375	0.7	1.8	5.8
450	DETAILED DESIGN REQUIRED (ALTERNATIVE METHODS TO BE CONSIDERED)		
500			
600			
750			

'N' - NO ADDITIONAL RESTRAINT REQUIRED (COMPACTED TRENCHFILL SUFFICIENT)

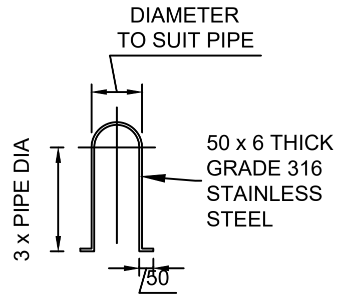
ANCHOR BLOCK CONSTRUCTION NOTES:
- LOCATE ANCHOR BLOCK CENTRALLY AROUND BEND.
- KEY ANCHOR BLOCK INTO BASE OF TRENCH A MINIMUM DEPTH OF 250.
- POUR CONCRETE AGAINST A SOLID EXCAVATION FACE.
- USE GRADE 17.5 MPa CONCRETE.
- KEEP CONCRETE CLEAR OF ALL BOLTS, NUTS, AND PIPE JOINTS.



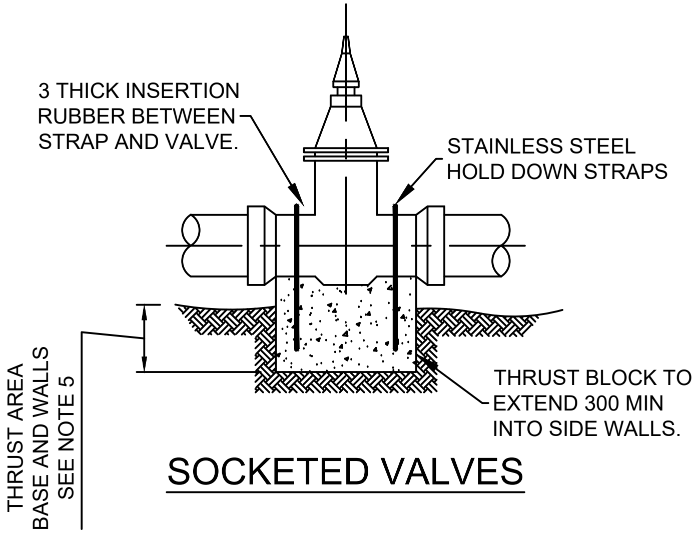
FLANGED VALVES



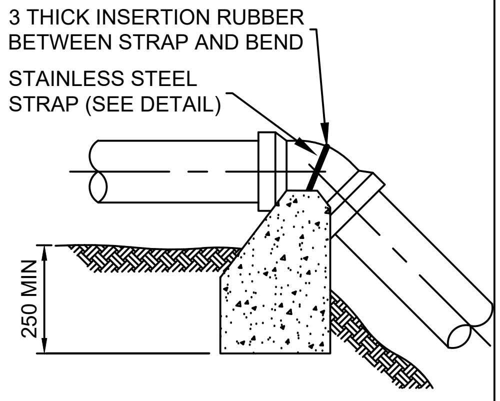
PLAN



TYPICAL SS STRAP



SOCKETED VALVES



ELEVATION
VERTICAL BENDS

NOTE:
1. ALL DIMENSIONS IN MILLIMETRES, UNLESS SHOWN OTHERWISE.
2. ANCHOR BLOCKS IN THE TABLE ARE DESIGNED FOR A TEST PRESSURE OF 1000 kPa (100 m HEAD)ADJUST CONCRETE VOLUME TO SUIT ACTUAL TEST PRESSURE.
3. WHERE DI PIPES AND FITTINGS WITH RESTRAINED JOINTS ARE USED THRUST BLOCKS ARE NOT REQUIRED.
4. THRUST BLOCK REINFORCEMENT AS SPECIFIED IN DESIGN DRAWINGS.
5. WHERE SPECIFIED PROVIDE CONCRETE THRUST BLOCKS FOR SOC-SOC VALVES. THRUST AREA TO BE AS FOR DEAD ENDS AS SHOWN IN WS-004.
6. INSTALL PUDDLE FLANGES ON CLASS K12 DICL PIPE.

STANDARDS NEW ZEALAND PAEREWA AOTEAROA

ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA

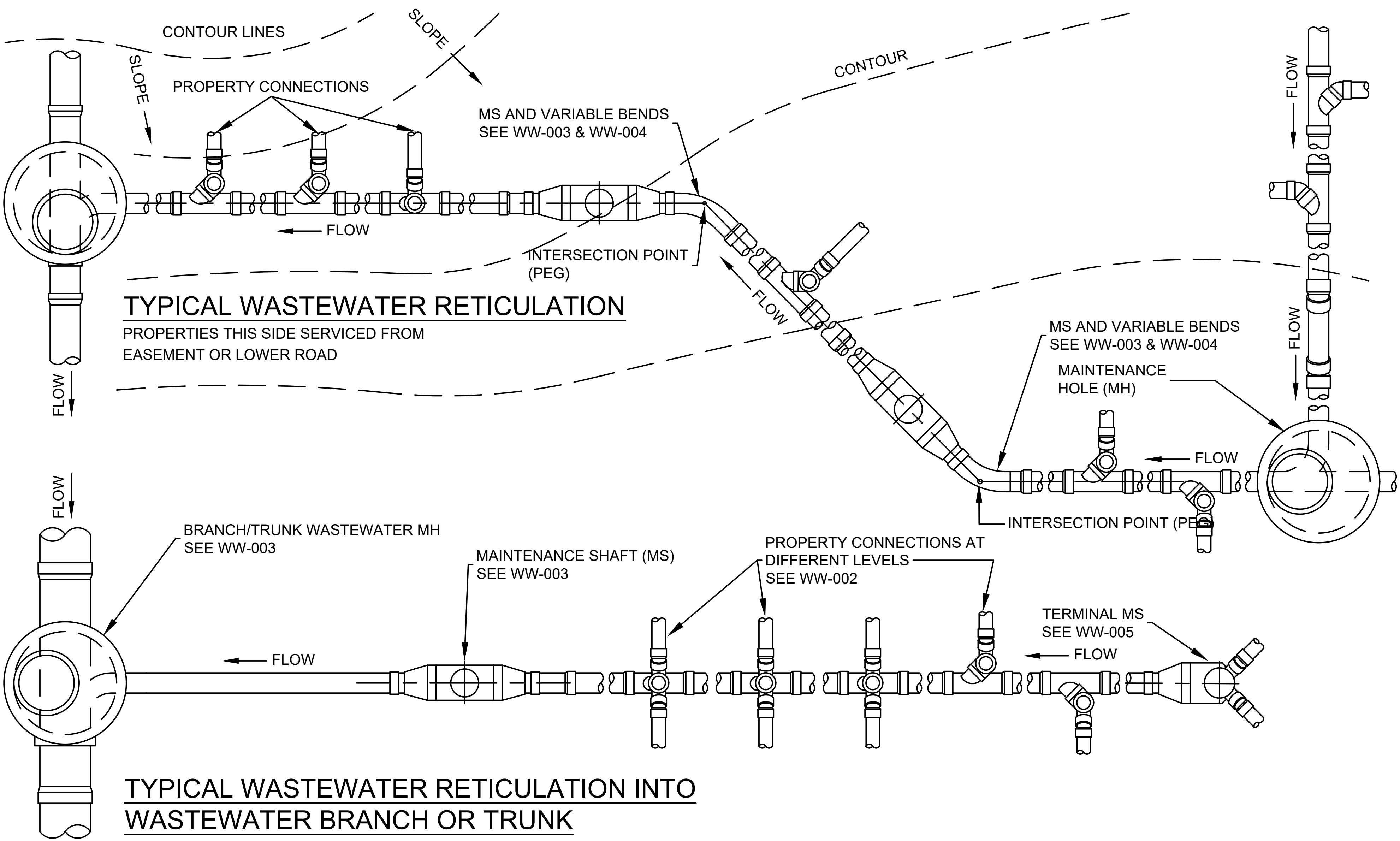
NZS 4404:2010
LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE

THRUST AND ANCHOR BLOCKS - GATE VALVES AND VERTICAL BENDS IF REQUIRED

NOT TO SCALE

WS-005

B7-7



TYPICAL WASTEWATER RETICULATION

PROPERTIES THIS SIDE SERVICED FROM
EASEMENT OR LOWER ROAD

TYPICAL WASTEWATER RETICULATION INTO WASTEWATER BRANCH OR TRUNK

NOTE:

1. GRADE WASTEWATER EVENLY BETWEEN MH/MS TO LEVELS SHOWN IN DESIGN DRAWINGS.
2. LAY PIPES AND FITTINGS WITH SOCKETS UPSTREAM WHEREVER PRACTICABLE.

STANDARDS NEW ZEALAND
PAERERA AOTEAROA
ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA

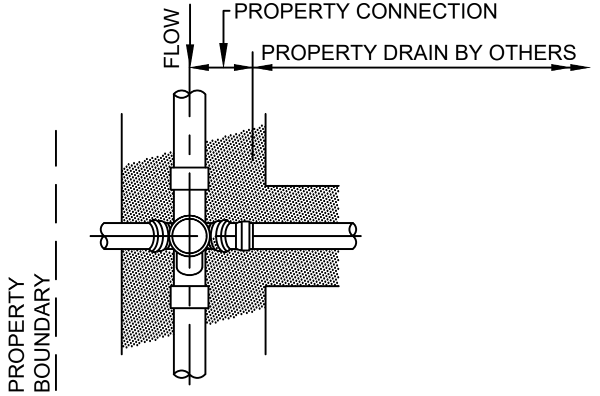
NZS 4404:2010
LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE

PIPELAYING - TYPICAL ARRANGEMENTS

NOT TO SCALE

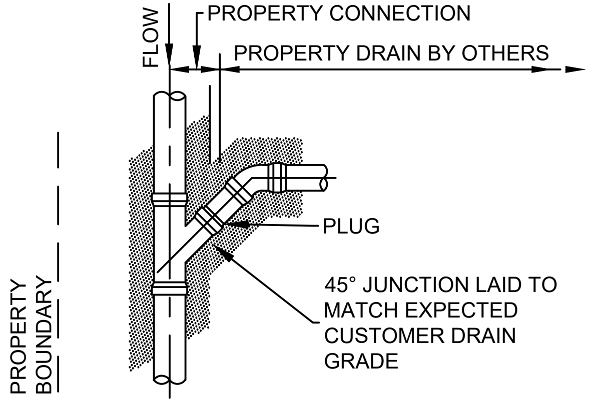
WW-001

B7-8



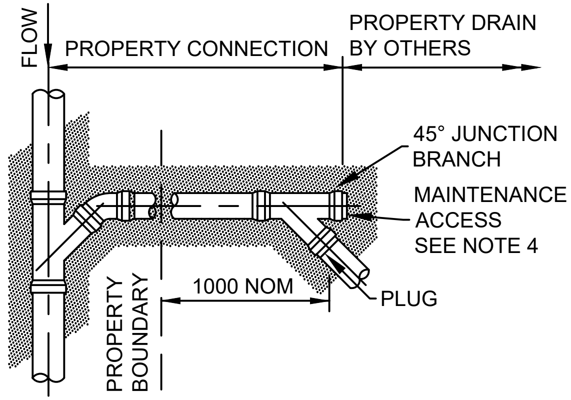
PLAN

WASTEWATER WITHIN PROPERTY



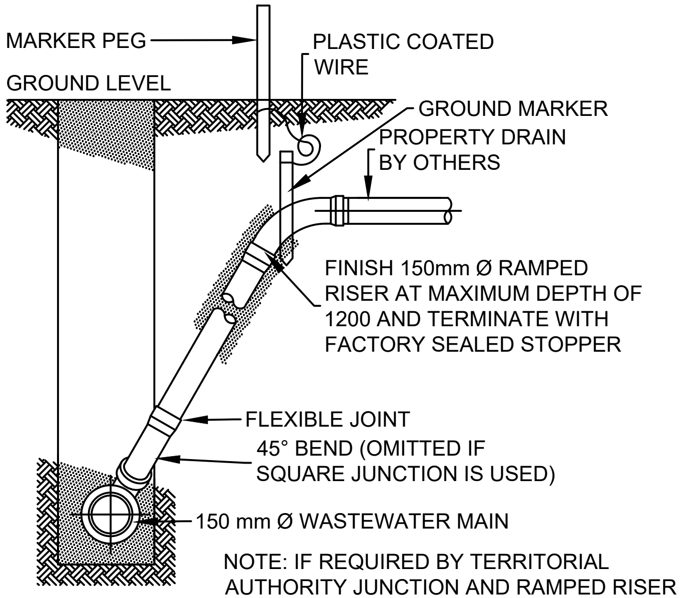
PLAN

WASTEWATER WITHIN PROPERTY



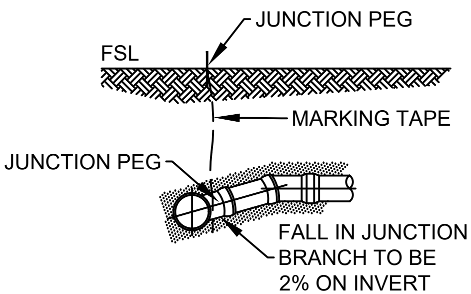
PLAN

WASTEWATER WITHIN PROPERTY

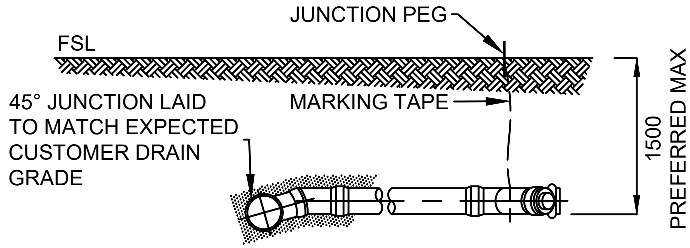


NOTE: IF REQUIRED BY TERRITORIAL AUTHORITY JUNCTION AND RAMPED RISER TO BE SURROUNDED BY MIN 150 mm THICKNESS OF 17.5 MPa CONCRETE DISCONTINUOUS AT PIPE JOINTS.

ELEVATION
Y JUNCTION RAMPED RISERS

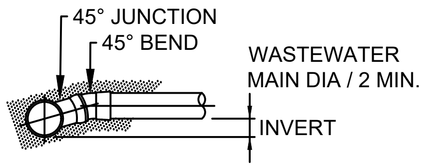


ELEVATION
STANDARD CONNECTION



ELEVATION
EXTENDED CONNECTION

MAY ALSO BE INSTALLED AS A SLOPED CONNECTION

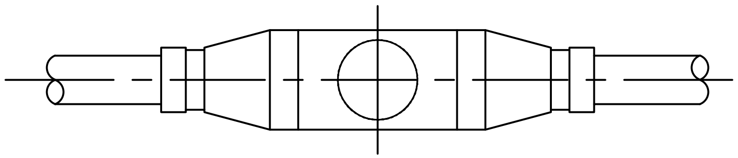


MINIMUM LEVEL
STANDARD CONNECTION

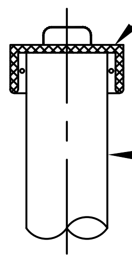
NOTE:

1. ALL DIMENSIONS IN MILLIMETRES.
2. ALL CONNECTION TYPES SHOWN IN THIS DRAWING ARE APPLICABLE TO VC, PVC.
3. LAY PROPERTY DRAIN CONNECTION AT DEPTH AS SHOWN IN DESIGN DRAWINGS.
4. PROVIDE RODDING POINTS WHERE REQUIRED BY TERRITORIAL AUTHORITY.
5. GRADE OF PROPERTY CONNECTION WASTEWATER PIPE TO BE NOT LESS THAN: DN 100 1.65%
   DN 150 1.2%

STANDARDS NEW ZEALAND PAEREWA AOTEAROA ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA	NZS 4404:2010 LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE	NOT TO SCALE
	PROPERTY CONNECTION - BURIED INTERFACE METHOD	WW-002
		B7-9



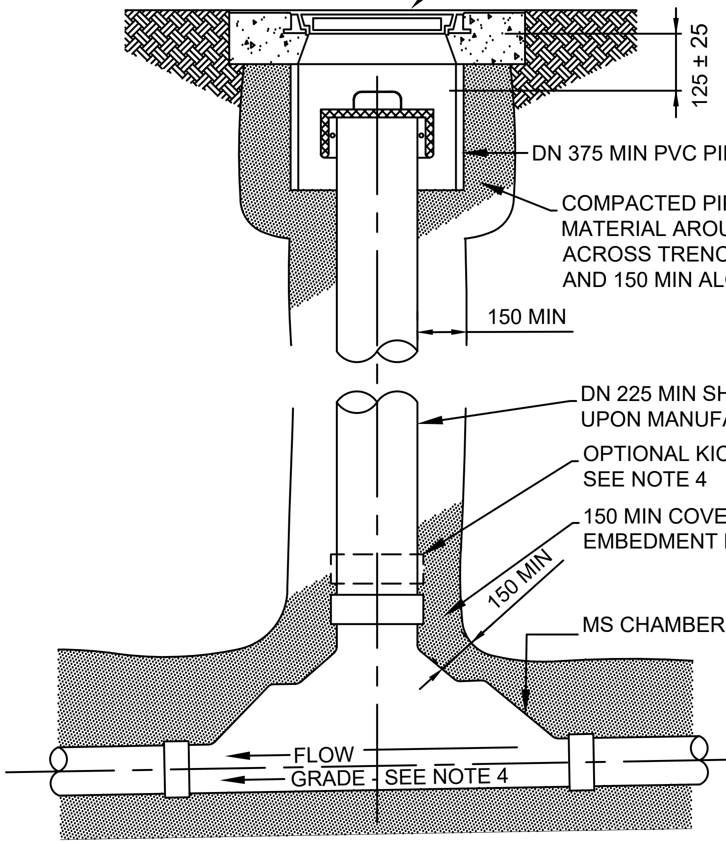
PLAN



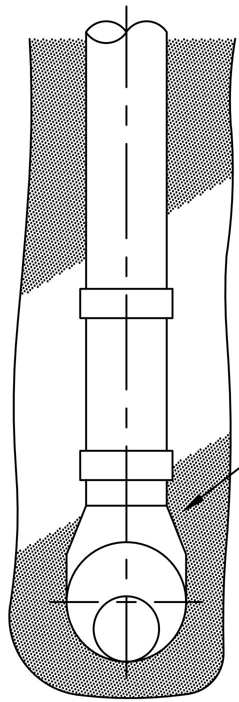
RISER SHAFT CAP

NOTE:

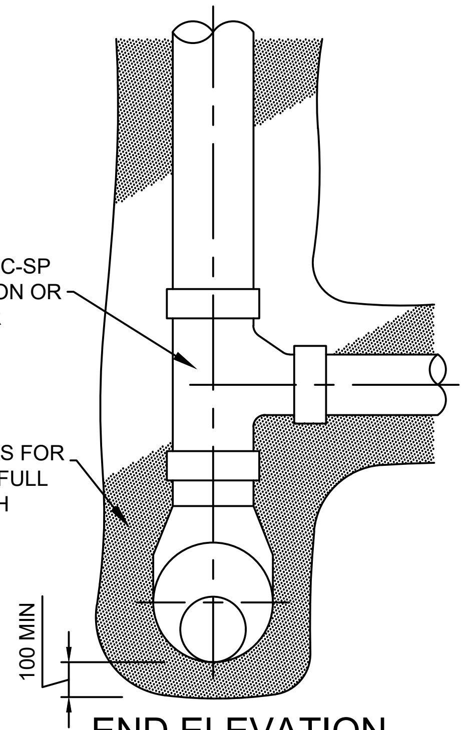
1. ALL DIMENSIONS IN MILLIMETRES.
2. MS MAY BE MANUFACTURED USING VARIOUS MATERIALS AND JOINTING SYSTEMS AS AUTHORISED BY TERRITORIAL AUTHORITY.
3. MAXIMUM DEPTH TO INVERT 3000.
4. ADJUST MS TO PIPE GRADE BY TILTING MS CHAMBER. MAX DEVIATION FROM VERTICAL OF THE RISER TO BE 1:10 OR A MAXIMUM OF 300 AT SURFACE. USE KICKER BEND IF REQUIRED TO ADJUST RISER TO VERTICAL.
5. ACCESS COVER, FRAME, AND SUPPORT SLAB TO BE AS AUTHORISED BY TERRITORIAL AUTHORITY.



END ELEVATION
MAINTENANCE SHAFT

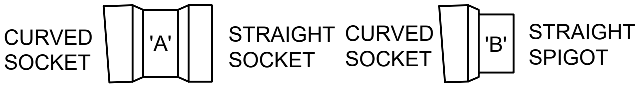


END ELEVATION
PLAIN RISER SHAFT

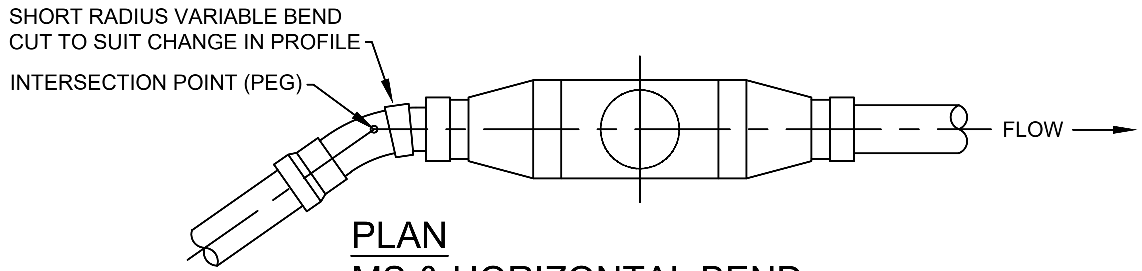


END ELEVATION
DROP JUNCTION

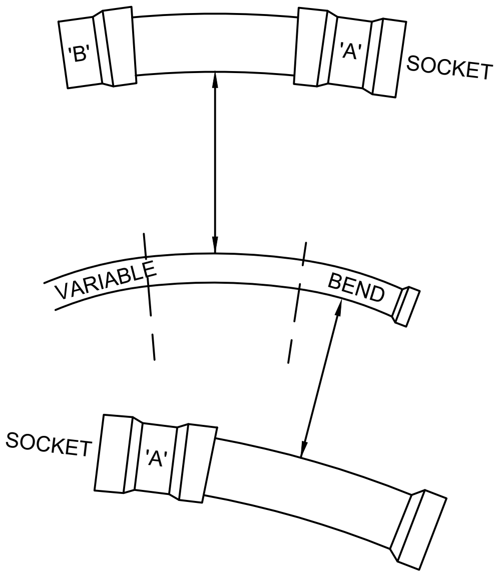
STANDARDS NEW ZEALAND PAEREWA AOTEAROA ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA	NZS 4404:2010 LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE	NOT TO SCALE
	MAINTENANCE SHAFTS - TYPICAL INSTALLATION	WW-003
		B7-10



LEGEND

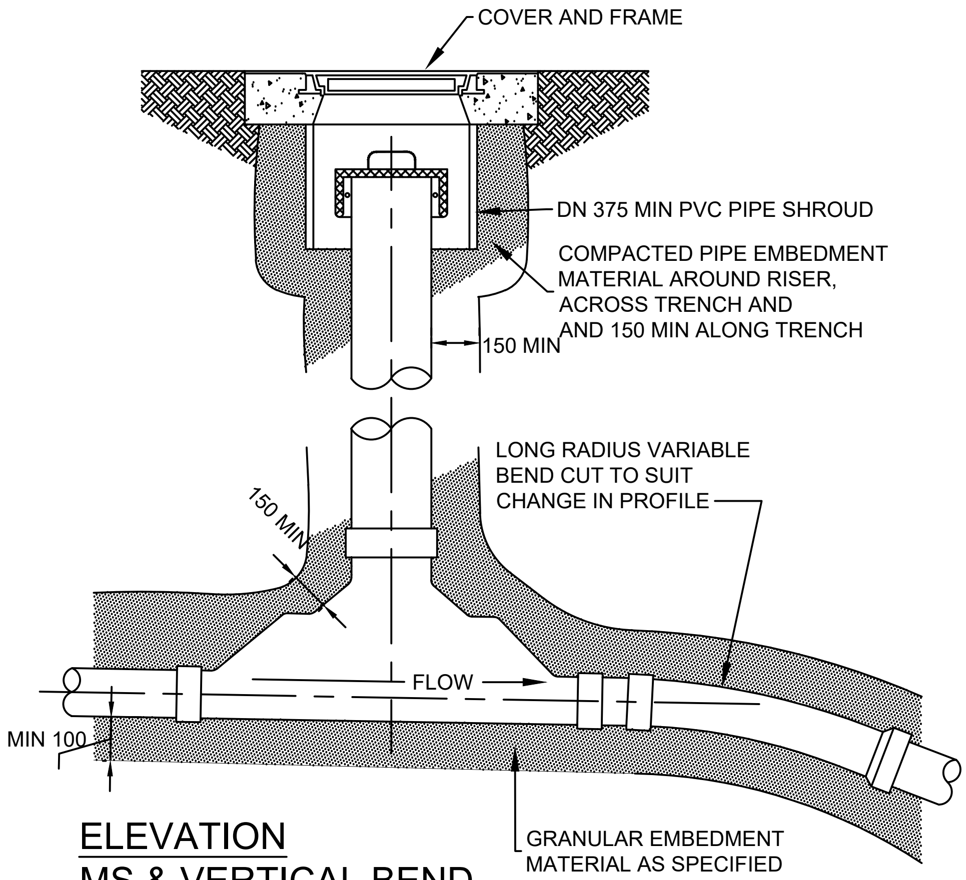


PLAN
MS & HORIZONTAL BEND



TYPICAL VARIABLE BENDS

ALL COMBINATIONS OF ENDS ACCEPTED

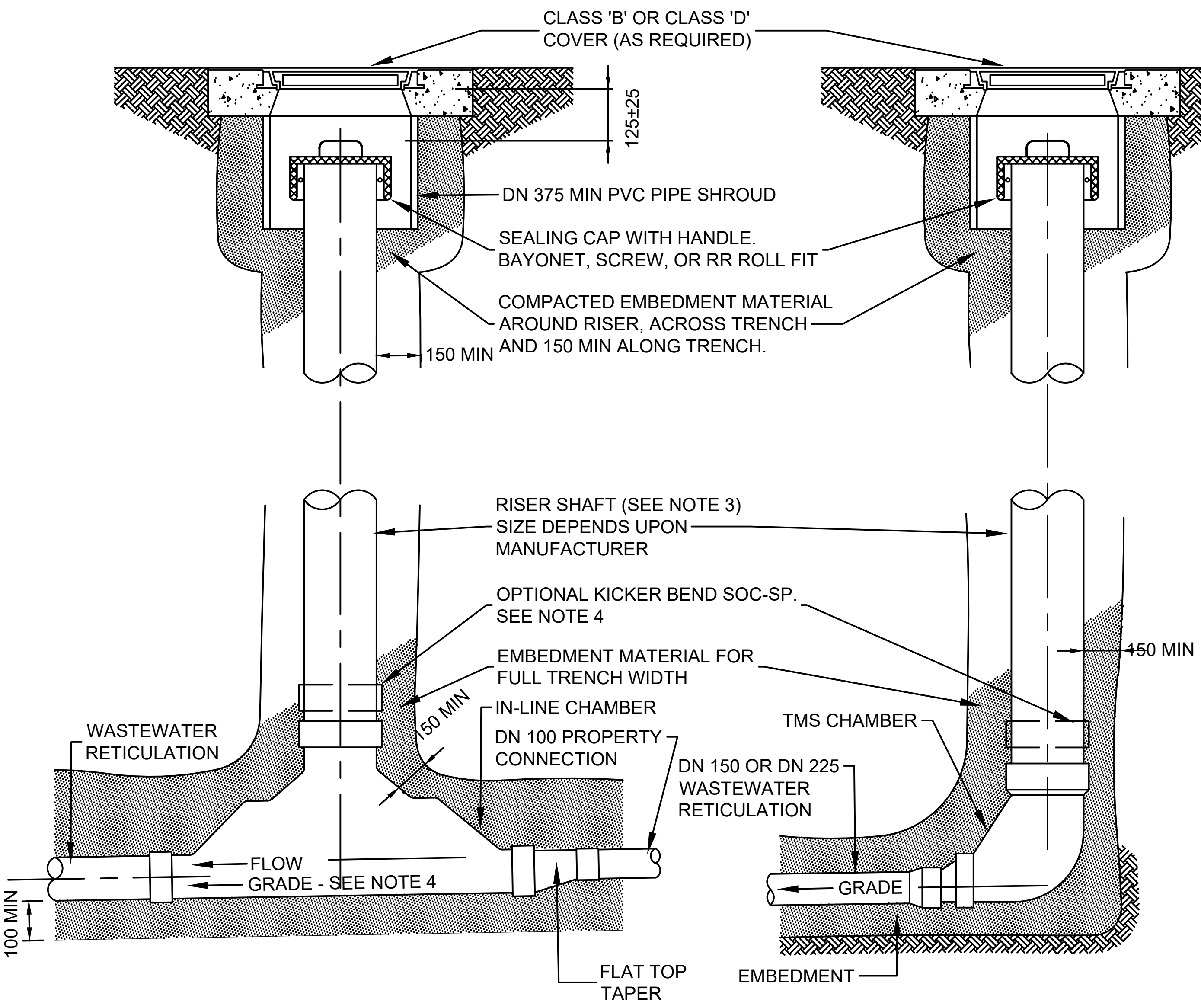


ELEVATION
MS & VERTICAL BEND

NOTE:

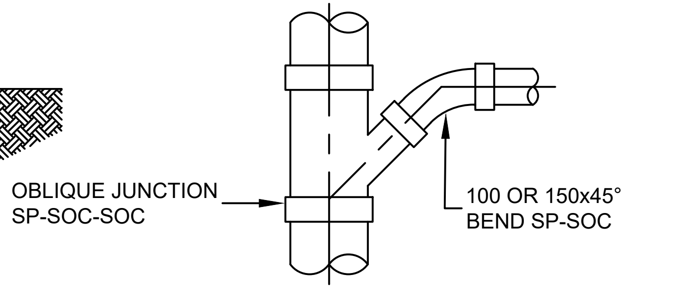
1. ALL DIMENSIONS IN MILLIMETRES.
2. VARIABLE BEND CUT TO LENGTH TO ACHIEVE REQUIRED DEFLECTION.
3. RECORD DETAILS OF BEND LOCATIONS AND ANGLES ON WORK AS CONSTRUCTED DRAWINGS.

STANDARDS NEW ZEALAND PAEREWA AOTEAROA ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA	NZS 4404:2010 LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE	NOT TO SCALE
	MAINTENANCE SHAFTS - MS AND VARIABLE BEND INSTALLATIONS	WW-004 B7-11



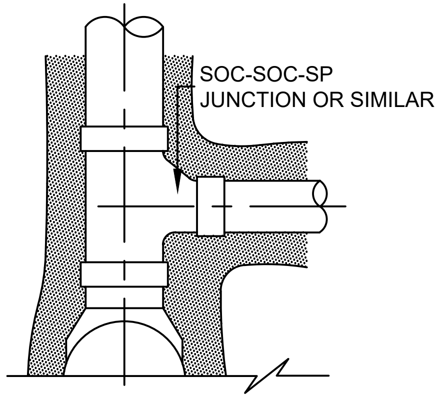
ELEVATION
TERMINAL MAINTENANCE SHAFT WITH
PROPERTY CONNECTION AHEAD

ELEVATION
TERMINAL MAINTENANCE SHAFT



TYPICAL PROPERTY CONNECTIONS

POSITIONED IN RISER AS SPECIFIED



DN 150 RETICULATION INLETS

POSITIONED IN RISER AS SPECIFIED

NOTE:
1. ALL DIMENSIONS IN MILLIMETRES.
2. ALL CONNECTION TYPES SHOWN ARE APPLICABLE TO VC, PVC (SOLVENT WELD) AND PVC (RUBBER RING) PIPES UNLESS OTHERWISE SHOWN.
3. INSTALL BRANCH CONNECTIONS AND PROPERTY CONNECTIONS (AS SHOWN ABOVE) IN RISER SHAFT (DROP JUNCTIONS) WHERE SHOWN IN DESIGN DRAWINGS. MAXIMUM OF 1 RETICULATION INLET OR 2 PROPERTY CONNECTIONS.
4. ADJUST MS TO PIPE GRADE BY TILTING CHAMBER. MAX DEVIATION FROM VERTICAL OF THE RISER TO BE 1:10 OR A MAXIMUM OF 300 AT SURFACE. USE KICKER BEND IF REQUIRED TO ADJUST RISER TO VERTICAL.

STANDARDS NEW ZEALAND PAEREWA AOTEAROA ORIGINAL SOURCE DRAWINGS: WATER SERVICES ASSOCIATION OF AUSTRALIA	NZS 4404:2010 LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURE	NOT TO SCALE
	MAINTENANCE SHAFTS - TMS AND CONNECTION INSTALLATION	WW-005
		B7-12

Appendix C – Field Testing of Pipelines

(Normative)

C1 Scope

Appendix C is based on some of the test methods in AS/NZS 2566.2, section 6, and associated appendices. This appendix specifies suggested methods of test and their application to field testing of pipelines for the purpose of determining pipeline acceptability. Field testing includes leak or hydrostatic pressure testing, as appropriate, for pressure and non-pressure pipelines. Testing may also be carried out in accordance with the material-specific and application-specific test methods of AS/NZS 2032, AS/NZS 2033, and AS/NZS 2566.2.

C1.1 Purpose of field testing

The purpose of field testing is to:

(a) Reveal the occurrence of faults in the laying procedure, for example, joints incorrectly installed or pipes damaged;

(b) Reveal the occurrence of faults in the assembly procedure of pipeline components, for example, tapping bands, maintenance structures, frames, and covers;

(c) In the case of pressure pipelines, determine that the pipeline will sustain a pressure greater than its design pressure without leakage;

(d) In the case of non-pressure pipelines, determine that the pipeline satisfies the requirements for infiltration and exfiltration; and

(e) Test the installed structural integrity of the pipeline.

Field testing is not intended to supplement or replace the test requirements of product standards.

C2 Non-pressure pipelines – Field leakage testing

Leakage testing is used to reveal locations of potential infiltration and exfiltration due to the inclusion of damaged pipes, seals, or incorrectly made joints in the pipeline at the completion of installation.

Leakage testing for acceptance of non-pressure pipelines shall be carried out by at least one of the following methods:

(a) Low pressure air testing;

(b) Hydrostatic testing

NOTE – Air tests provide qualitative data only, as air pressure losses cannot be related directly to water leakage rates.

For pipeline test sections installed below the water table, and for submarine pipelines, the test pressure used for the hydrostatic test, and for the air test, shall be increased to maintain the required differential between internal and external pressure.

A pipeline failing to meet the requirements of the air tests may be retested using the hydrostatic test method.

NOTE – Failure is still probable.

C2.1 Low pressure air test

The test length shall be acceptable where the gauged pressure exceeds 18 kPa (or not more than 7 kPa less than the pressure at the start of the test) for the time interval shown in table C1 after the shut-off of the air supply.

Table C1 is based on an air test pressure of 25 kPa (in excess of any external hydrostatic pressure due to groundwater) and, on this basis, air volume losses shall not exceed the greater of:

(a) A rate of 0.0009 $m^3/(min \times m^2)$ of pipe wall area; and
(b) A rate of 0.056 m^3/min, which is regarded as the lowest detectable individual air leak.

Column 2 and column 3 of table C1 give the times and lengths up to which (b) prevails over (a).

NOTE – For safety reasons air test pressures in excess of 50 kPa should not be applied.

Table C1 – Low pressure air and vacuum tests – Minimum time intervals for 7 kPa pressure change in pipeline

DN	**Minimum time** (minutes)	**Maximum length for minimum time to apply** (metres)	**Test length** (metres)				
			50	**100**	**150**	**200**	**250**
			Minimum test duration (minutes)				
80	1.5	231	1.5	1.5	1.5	1.5	1.6
100	2	185	2	2	2	2	3
150	3	123	3	3	3	5	6
225	4	82	4	5	8	10	13
300	6	62	6	9	14	18	23
375	7	49	7	14	22	29	36
450	9	41	10	21	31	41	52
525	10	35	14	28	42	56	70
600	11	31	18	37	55	73	92
675	13	27	23	46	70	93	116
750	14	25	29	57	86	115	143
900	17	21	41	83	124	165	207
1000	19	19	51	102	153	204	255
1050	20	18.8	56	112	169	225	281
1200	23	15	73	147	220	294	367
1500	28	12	115	230	344	459	574

NOTE –
The time interval may be reduced for a proportionate reduction in the allowable pressure drop. Where there is no detectable change in pressure after 1 hour of testing, the section under test shall be deemed acceptable.
This table is based on the following equation:

$T = 1.02D_ikLq$

where

T = time for a 7 kPa pressure drop, in seconds

D_i = pipeline internal diameter, in metres

q = allowable volume loss in cubic metre/minute/square metre taken as 0.0009 $m^3/min.m^2$

$k = 0.054DL$ but not less than 1

L = length of test section, in metres.

Columns 2 and 3 have been calculated with $k = 1.0$.
The appropriate air or vacuum test/pressure method for pipes larger than DN 750 should be established by reference to the specifier.

C2.1.1 Low pressure air test procedure

The procedure shall be as follows:

(a) Pump in air slowly until a pressure of 25 +5,−0 kPa is reached. Where the pipeline is below the water table this pressure shall be increased to achieve a differential pressure of 25 kPa. In no circumstances should the actual pressure exceed 50 kPa;

NOTE – Rapid pressurisation may cause significant air temperature changes, which will effect the testing accuracy.

(b) Maintain the pressure for at least 3.0 minutes;

(c) Where no leaks are detected, shut off the air supply;

(d) Where the pipeline fails the test, repressurise to 25 +5,−0 kPa and check for leaks by pouring a concentrated solution of soft soap and water over accessible joints and fittings;

(e) Repair any defects, then repeat steps (a) to (c);

(f) With the air supply shut off, monitor the pressure for the time intervals given in table C1.

The test length shall be acceptable where the pressure drops by 7 kPa, or less, over the required (tabulated) test period.

NOTE –

(1) The test length of pipeline should be restricted to pipeline sections between maintenance holes (the most convenient places for inserting test plugs or fixing temporary bulkheads). The method should not be used for test lengths in excess of 250 m and for pipe diameters larger than 1500 mm.

(2) The procedure for low pressure air testing of large diameter pipelines is potentially hazardous because of the very large forces to be resisted by temporary plugs or bulkheads and the serious consequences of accidental bulkhead blow-out. A relief valve, with a 50 kPa maximum setting, should be installed on all pressurising equipment.

C2.2 Hydrostatic test

The test length shall be acceptable where the specified allowable make up water is not exceeded. Where not specified, the allowable make up water shall be 0.5 L/hour per metre length per metre diameter.

C2.2.1 Hydrostatic test procedure

The procedure shall be as follows:

(a) The test pressure shall be not less than 20 kPa, or 20 kPa above the groundwater pressure at the pipe soffit at its highest point, whichever is the greater, and not exceed 60 kPa at the lowest point of the section;

(b) Steeply graded pipelines shall be tested in stages where the maximum pressure, as stated above, will be exceeded if the whole section is tested in one length;

(c) The pressure shall be maintained for at least 2 hours by adding measured volumes of water where necessary;

(d) Any visible leaks detected shall be repaired and the pipeline shall be retested.

C3 Pressure pipelines – Field hydrostatic pressure testing

The hydrostatic pressure test method shall be as specified.

Hydrostatic pressure testing requires selecting an appropriate configuration of method, pressure, and length of test section.

Test parameters and details shall be determined with due consideration to the following:

(a) Pipe material;
(b) Pipe diameter;
(c) Length of test section;
(d) Duration of the test;
(e) Magnitude of test pressure and rate of pressurisation;
(f) Presence of air in the pipeline;
(g) Time required for saturation of porous liners;
(h) Potential movement of pipeline thrust restraints;
(i) Design pressure for thrust and anchor supports;
(j) Accuracy of test equipment;
(k) Ambient temperature changes during testing;
(l) Presence of leaks in equipment used for testing or equipment attachment points (such as sealing plugs);
(m) Potential for leaks in the pipeline.

NOTE – It is advisable to begin testing early in the pipeline installation to confirm adequacy of laying procedures and, where appropriate, to increase the length tested progressively as experience is gained.

C3.1 Selection of test pressure

The hydrostatic test pressure at any point in the pipeline shall be:

(a) Not less than the design pressure; and
(b) Not more than 25% above the rated pressure of any pipeline component.

NOTE – The design pressure is the maximum system pressure at a point in the pipeline, considering future developments, static pressure, dynamic pressure, and an allowance for short-term surge pressure (water hammer), as determined by analysis.

Compressed air testing shall not be permitted for pressure pipe.

C3.2 Selecting test lengths

The pipeline length tested shall be either the whole, or a section (capable of being isolated), of the pipeline depending on the length and diameter, the availability of water, and the spacing between sectioning valves or blank ends.

The pipeline shall be divided into test sections such that:

(a) The hydrostatic test pressure at any point in the pipeline is:
    (i) Not less than the design pressure; and
    (ii) Not more than 25% above the rated pressure of any pipeline component; and
(b) Water is available for the test together with facilities for its disposal, in accordance with regulatory requirements, after the test.

NOTE –

(1) Pipelines longer than 1000 m may need to be tested in several sections. Where

long lengths are to be tested, radio or other electronic means of communication between test operatives, to coordinate test procedures and thus minimise the test duration, is desirable.

(2) Long test sections may incorporate a large number of mechanical (that is, flanged) joints, which should be checked for leakage. The longer the test section the harder it is to locate a leak, or discriminate between a leak and the other effects, such as the absorption of air into solution under pressure.

C3.3 Pre-test procedures

The pre-test procedures are as follows:

(a) All required temporary and permanent thrust blocks, or other pipeline thrust-resisting methods, including integral joint-restraint systems, shall be in place, and all concrete shall be adequately cured (normally a minimum of 7 days);

(b) Blank flanges or caps shall be installed at the beginning and end of the test section. Testing shall not take place against closed valves unless they are fully restrained and it is possible to check for leakage past the valve seat. Mechanical ends that are not end load resistant shall be temporarily strutted or anchored, to withstand the test pressures without movement;

NOTE – Temporary supports should not be removed until the pipeline has been depressurised. All test personnel should be informed of the loading limits on temporary fittings and supports.

(c) Where practicable, all bolted joints shall be left exposed to allow for re-tensioning during or after testing;

(d) Compacted embedment and fill material shall be placed to leave all joints, service connections and ball valves exposed wherever possible;

(e) For PE pipelines, the pressurising time shall not exceed 45 minutes;

NOTE – The pressurising time affects the duration of the PE pipeline test.

(f) The test equipment shall be placed in position and checked for satisfactory operation;

(g) The pump shall be of adequate size to raise and maintain the test pressure;

NOTE – A pump that is too small may increase the test duration or where too large it may be difficult to control the pressure.

(h) Two calibrated test gauges shall be used to cross check gauge accuracy;

(i) Slowly fill the test length of pipeline with water, preferably from the lowest point, ensuring air is vented at the high point valves. Allow a period, in the range of 3 hours to 24 hours, for the temperature of the test length and the test water to stabilise and for dissolved air to exit the system. The recommended rate of filling shall be based on a flow velocity of 0.05 m/s, calculated from the following equation:

$$Q_f \leq 12.5\pi D^2$$

where

Q_f = filling rate, in litres per second

D = pipe diameter, in metres

NOTE – The slow rate of 0.05 m/s avoids air entrainment when the filling water is cascading through downward gradients along the pipeline.

The period of stabilisation will depend on pipe dimensions, length, material, longitudinal profile, and air exit points. For cement-mortar lined pipe, the pipeline shall be filled at least 24 hours before the commencement of the test, to allow the lining to become saturated.

NOTE – A firm foam swab may be used ahead of the fill water to assist air removal especially
where the pipeline undulates. Extract the swab at a high-point wash-out.

Typical pressure test equipment and location are shown in figures C1 and C2.

C3.4 Post-test procedures

After testing, pipelines shall be depressurised slowly. All air venting facilities shall be open when emptying pipelines. The test water shall be drained to an approved waterway and all connection points shall be reinstated.

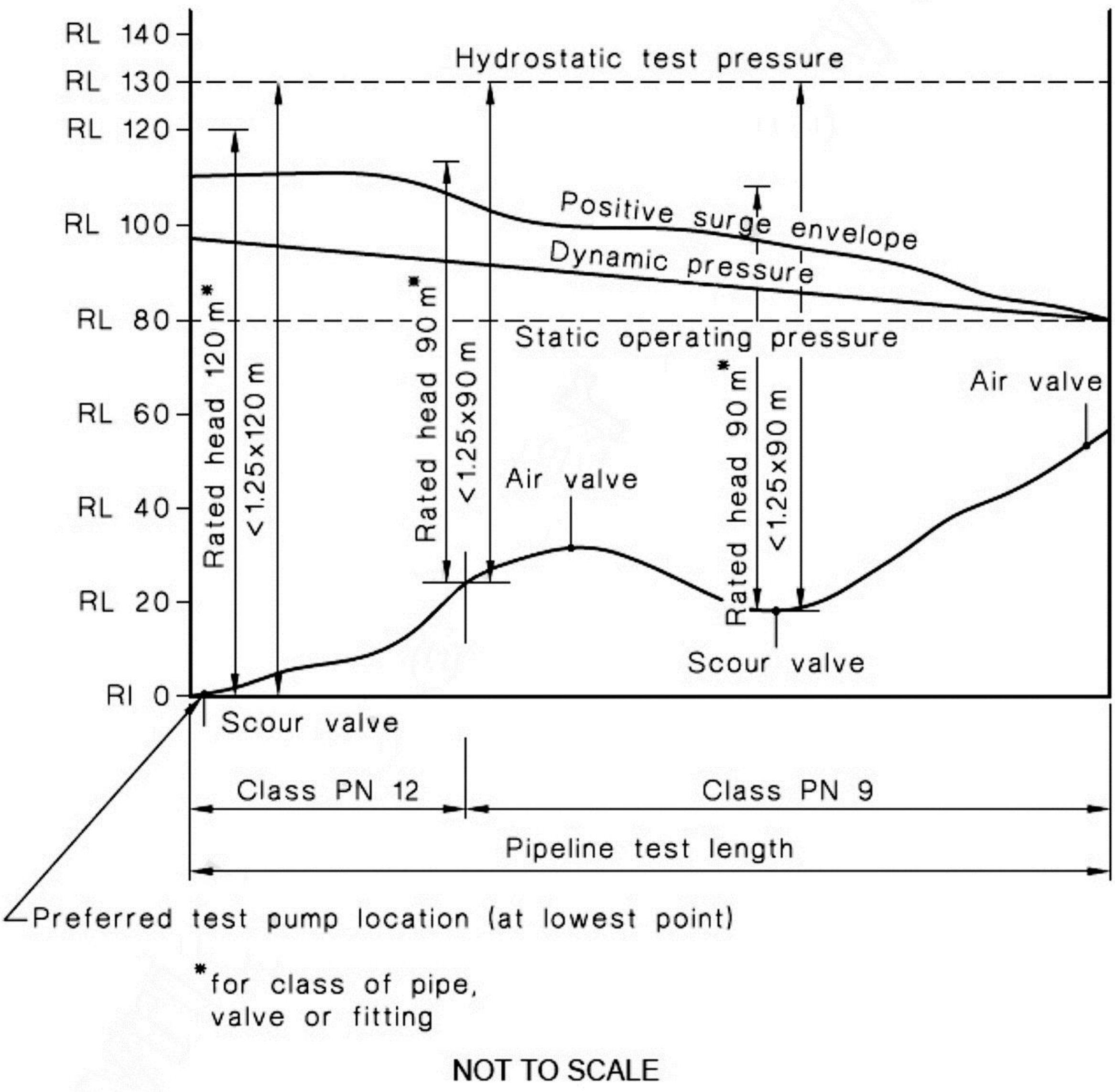


Figure C1 – Typical pressure pipeline under field hydrostatic test

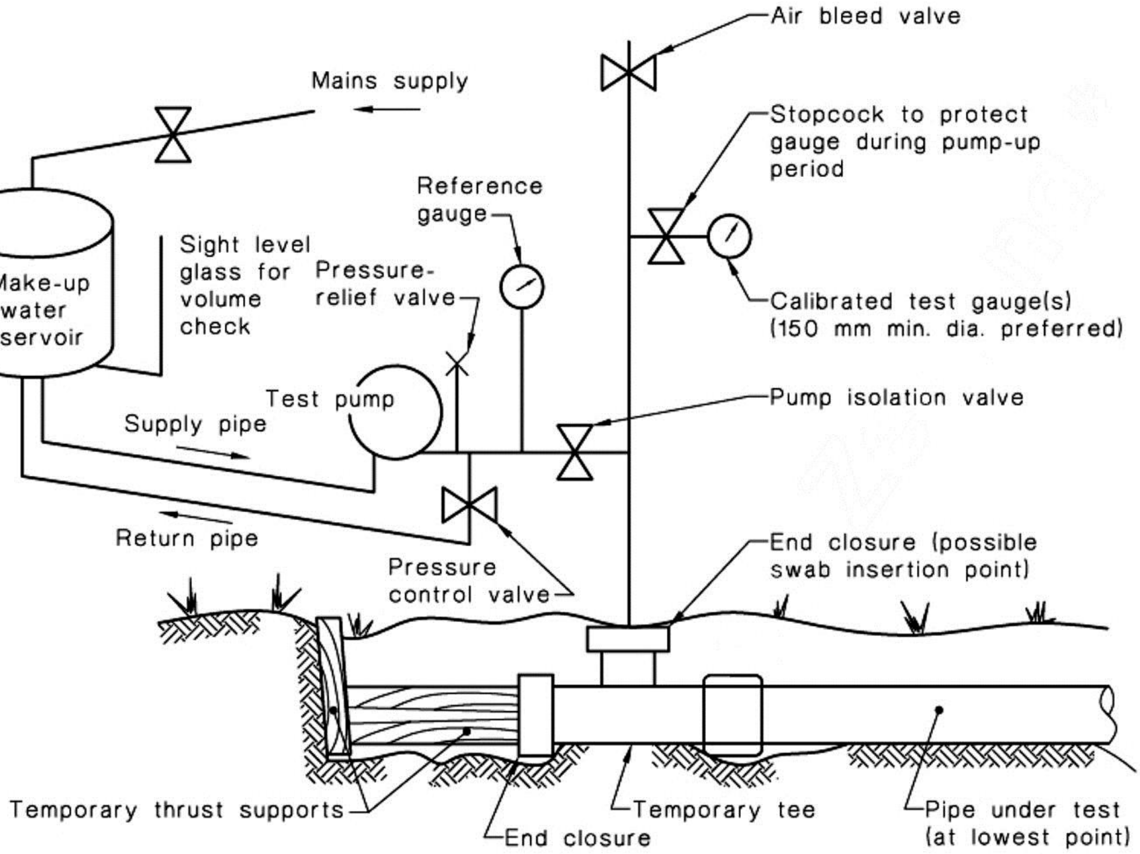


Figure C2 – Typical field pressure test equipment layout

C3.5 Constant pressure test (water loss method) – PVC, DI, GRP, and steel pipelines

This test is applicable for PVC, DI, GRP, and steel pipelines. The test length may be several kilometres in length (see C3.2).

C3.5.1 Procedure

The procedure shall be as follows:

(a) Close all valves apart from the test pump input and pressurise the test length to the specified test pressure (STP) – (see C3.1);

(b) Apply and then maintain the test pressure by the addition of measured and recorded quantities of make-up water at regular intervals over a period, in the range of 1 hour to 12 hours;

(c) Where pressure measurements are not made at the lowest part of the test length, make an allowance for the static head, between the lowest point of the pipeline and the point of measurement, to ensure that the test pressure is not exceeded at the lowest point.

The quantity of make-up water necessary to maintain the test pressure shall comply with the following equation:

$Q \leq 0.4LDH$

where

Q = allowable make-up water, in litres per hour
L = length of the test length, in kilometres
D = nominal diameter of the test length, in metres
H = average test head over length of pipeline under test, in metres

NOTE – The make-up water is not a leakage allowance, but is an allowance to cover the effects of the test head forcing small quantities of entrapped air into solution. Normally the test should last for a minimum of 2 hours and be concluded within 5 to 8 hours. The make-up water requirement should reduce with time as air goes into solution. Where, after 12 hours the make-up water still exceeds the allowable limit, testing should cease and the cause of loss investigated.

C3.5.2 Acceptance

(a) The test length shall be acceptable where there is no failure of any thrust block, pipe, fitting, joint, or any other pipeline component;
(b) There is no physical leakage;
(c) The quantity of make-up water necessary to maintain the test pressure complies with C3.5.1.

C3.6 Constant pressure test (water loss method) for viscoelastic pressure pipelines

This test is applicable to PE, PP, and ABS pressure pipelines. The test lengths may be several kilometres in length.

NOTE – This method is based on VAV P78, as outlined in AS/NZS 2566.2, Appendix A.

C3.6.1 Procedure

The procedure shall be as follows:

(a) Purge the air from pipeline;
(b) Apply the specified test pressure (STP) (see C3.1) to the test length;
(c) Shut off main and allow pressure to settle for 12 hours (pressure will drop significantly);
(d) Re-apply and maintain test pressure for 5 hours by successively pumping a sufficient amount of water;
(e) Measure and record water volume (V_1 in litres) required to maintain this pressure between Hour 2 and Hour 3;
(f) Measure and record water volume (V_2 in litres) required to maintain this pressure between Hour 4 and Hour 5;
(g) Calculate:

$$0.55V_1 + Q$$

where Q is the allowable make-up volume obtained from C3.5.1.

C3.6.2 Acceptance

The test length shall be acceptable where:

(a) The test length shall be acceptable where there is no failure of any thrust block, pipe, fitting, joint, or any other pipeline component;
(b) There is no physical leakage; and
(c) $V_2 \leq 0.55\,V_1 + Q$.

C3.7 Pressure rebound method for viscoelastic pressure pipelines

This test is applicable to PE, PP, and ABS pressure pipelines up to and including DN 315, where a short test time is required.

NOTE – This test is based on BS EN 805:2000, Appendix A (refer to AS/NZS 2566.2).

C3.7.1 Pressure measurement rig

The test rig shall be a recently calibrated pressure transducer, data logger, and check pressure gauge that has a dial of at least 100 mm diameter and a pressure range that places the specified test pressure (STP) (see C3.1) in the range 35% to 70% of the gauge's full scale. The transducer and the check gauge shall read within ±5% of each other. If they do not agree within this tolerance, the equipment shall be recalibrated or replaced.

C3.7.2 Procedure

The test procedure has the following three phases:

(a) A preliminary phase in which the pipeline is —
   (i) Depressurised and allowed to relax after the C3.3 pre-test procedure
   (ii) Pressurised quickly to the test pressure and maintained at this pressure for a period of time without further water being added
   (iii) The pressure is allowed to decay by viscoelastic creep, and
   (iv) Provided the pressure drop does not exceed a specified maximum, the pressure test can proceed to the second phase;

(b) A phase in which the volume of air remaining in the pipeline is assessed against an allowable maximum;

(c) The main test phase in which the pipeline is maintained at the test pressure for a period of time and decay due to viscoelastic creep commenced. The creep is interrupted by a rapid reduction of the pressure in the pipeline to a specified level. This rapid reduction in pressure results in contraction of the pipeline with an increase (rebound) in pressure. If, during the rebound period, the pressure versus time record shows a fall in pressure, the pipeline fails the test.

C3.7.3 Preliminary phase

The procedure shall be as follows:

(a) Reduce pressure to just above atmospheric at the highest point of the test length, and let stand for 60 minutes. Ensure no air enters the line;
(b) Raise the pressure smoothly to STP in less than 10 minutes. Hold the pressure at STP for 30 minutes by pumping continuously, or at short intervals as needed. Do not exceed STP;
(c) Inspect for leaks during the 30 minute period, then shut off pressure;
(d) Allow the pressure to decay for 60 minutes;
(e) Measure the pressure remaining at 60 minutes (P_{60});
(f) If $P_{60} \leq 70\%$ of STP the test is failed. The cause shall be located and rectified. Steps (a) to (e) shall be repeated. If $P_{60} > 70\%$ of STP, proceed to the air volume assessment.

C3.7.4 Air volume assessment

The procedure shall be as follows:

(a) Quickly (<5 min) reduce pressure by ΔP (10%–15% of STP);

(b) Measure water volume bled out (ΔV);

(c) Calculate $\Delta V_{max\ allowable}$ as follows:

$$\Delta V_{max\ allowable} = 1.2 \times V \times \Delta P\,(1/E_W + D/E_R)$$

where

1.2	=	air allowance
V	=	pipe volume, in litres
ΔP	=	measured pressure drop, in kilopascals
D	=	pipe internal diameter, in metres
E_R	=	pipe material modulus, in kilopascals (see table C2)
E_W	=	bulk modulus of water, in kilopascals (see table C3);

(d) If $\Delta V > \Delta V_{max\ allowable}$ the test has failed. The cause shall be located and rectified. The preliminary phase shall be repeated. If $\Delta V \leq \Delta V_{max\ allowable}$, proceed to the main test phase.

NOTE – ΔV and ΔP should be measured as accurately as possible, especially where the test length volume is small.

C3.7.5 Main test phase

Observe and record the pressure rise for 30 minutes.

In the event of failure, locate and repair leaks. If failure is marginal or doubtful, or if it is necessary to determine leakage rate, use a reference test (see C3.6).

NOTE – Figure C3 gives an example of a full pressure test with the main test phase extended
to 90 minutes.

Table C2 – Pipe E material modulus for PE 80B and PE 100

Temp (°C)	**PE 80B – *E* Modulus** (kPa×10³)			**PE 100 – *E* Modulus** (kPa×10³)		
	1 h	**2 h**	**3 h**	**1 h**	**2 h**	**3 h**
5	740	700	680	990	930	900
10	670	630	610	900	850	820
15	600	570	550	820	780	750
20	550	520	510	750	710	680
25	510	490	470	690	650	630
30	470	450	430	640	610	600

Table C3 – Bulk modulus *E*w – Water

Temperature (°C)	**Bulk Modulus** (kPa×10^3)
5	2080
10	2110
15	2140
20	2170
25	2210
30	2230

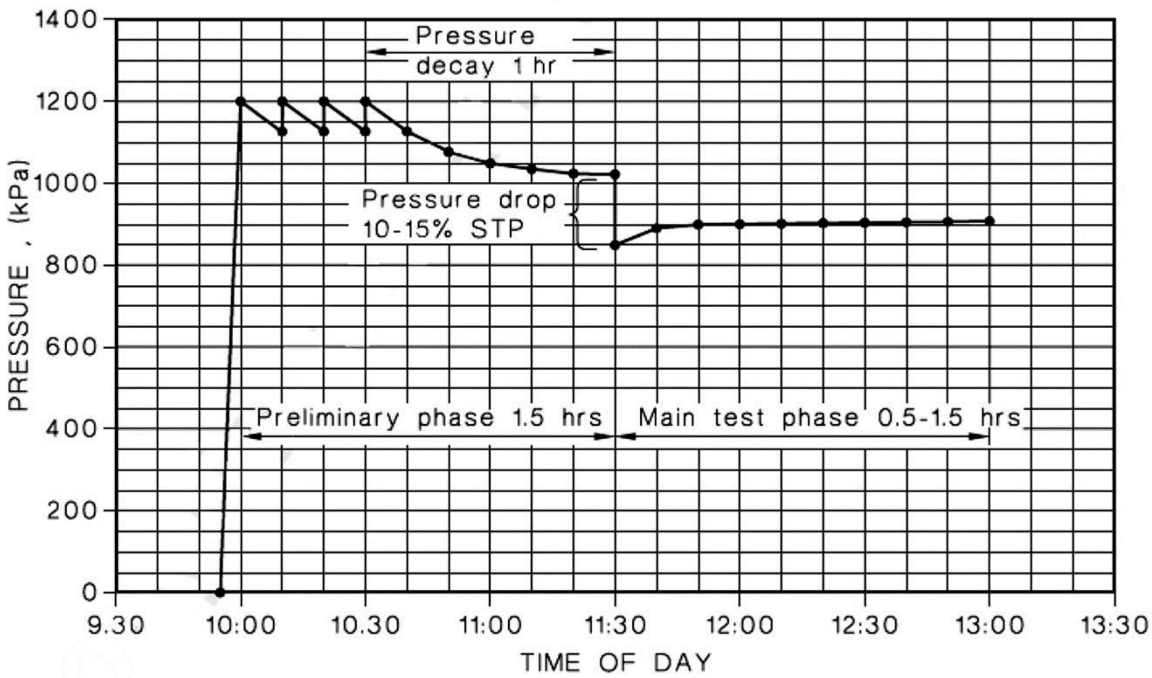


Figure C3 – Typical successful modified rebound test for a PE pipeline

C3.7.6 Acceptance

The test length shall be acceptable if:

(a) There is no failure of any thrust block, pipe, fitting, joint, or any other pipeline component;
(b) There is no physical leakage;
(c) The pressure rises or remains static in the 30-minute period.

If doubt exists about the pressure recovery, the monitoring period may be increased to 90 minutes, and any pressure drop that does occur shall not exceed 20 kPa over the 90-minute period.

If the pressure drops by more than 20 kPa during the 90-minute extended period, the test fails.

Repetition of the main test phase shall only be done by carrying out the whole test procedure, including the relaxation period of 60 minutes described in C3.7.3.

C3.8 Visual test for small pressure pipelines

This test is applicable for small pipelines of all materials (less than 200 m in length), and pipelines where pipeline joints have been left exposed for the test operation (such as coiled pipe).

C3.8.1 Procedure

The procedure shall be as follows:

(a) The test pressure (see C3.1) shall be applied and the test section isolated by closing the high point air release valves and the pump feed valve;

(b) The test section shall be visually inspected for leakage at all joints, especially bolted joints, all fittings, service connections, and ball valves;

(c) Pressure gauges shall be checked to ensure that pressure has not fallen significantly indicating an undetected leak;

(d) Any detected leak shall be repaired and the section shall be retested;

(e) Where no leak is detected, high point air release valves shall be opened, the pipeline shall be depressurised to slowly drain the line into an approved waterway and all connection points shall be reinstated.

C3.8.2 Acceptance

The test length shall be acceptable where:

(a) There is no failure of any thrust block, pipe, fitting, joint, or any other pipeline component;

(b) There is no physical leakage; and

(c) There is no pressure loss indicative of a leak.

Appendix D – Water Supply Disinfection Specification

(Normative)

D1 Disinfection of pipelines and fittings

After flushing the main to remove all debris and air, the main shall be filled with water containing a free available chlorine concentration of 15 g/m^3 ± 5 g/m^3 and allowed to stand for a minimum of 12 hours for all new mains. At the end of the disinfection period, the free available chlorine (FAC) concentration shall be at least 5 g/m^3. If the FAC is less than 5 g/m^3 at the completion of the period, the disinfection shall be repeated until a satisfactory result is obtained. Note that the main should not be drained after flushing unless all high points are 'vented' to allow for complete removal of air.

Under no circumstances will the use of handfuls of hypochlorite powder or chlorine tablets dumped into the pipe and hydrant tees be an acceptable practice.

The sterilising solution should be fed by gravity or pumped into one end of the main and the 'flushing' water in the pipe displaced out of the opposite end of the main until tests carried out show that the water being displaced contains the full FAC concentration. The authorised officer will arrange for testing of the FAC concentration and, to this end, the contractor shall give 24-hours notice of intention to sterilise.

The contractor shall provide all temporary fittings necessary to allow for the introduction of the sterilising solution to and its removal from the main.

See also D3.

D2 Methods of introducing the sterilising solution

Methods of introducing sterilising solution will depend on the volume of solution required for the particular main and the availability of appropriate equipment.

In general, wherever the pipe volume is less than 10 m^3, the most practical method is to add sufficient calcium or sodium hypochlorite (powder or solution) to a potable water tanker suitable for carrying potable water to achieve the desired 15 g/m^3 FAC concentration. (This may require two tankers full.)

For greater quantities, the sterilising solution may be injected into the main using a portable gas chlorinator or a hypochlorinator. An approved backflow preventer shall be installed if either of these options is used.

D3 Disposal of sterilising solution

After the satisfactory completion of the sterilising process, the chlorine solution shall be flushed into the sanitary wastewater pipe or, alternatively, retained in a temporary surface storage pond until the TA's authorised officer is satisfied that the FAC has reduced to a satisfactory concentration before being allowed to flow down the stormwater drainage system or into a natural watercourse.

D4 Acceptable method for sterilising mains

(a) Use sodium hypochlorite solution. This solution usually has 10% or 15%

FAC;

(b) Obtain a clean water tanker, as used for potable drinking water. The tanker should have a known water capacity;

(c) Measure the required amount of sodium hypochlorite solution into a beaker and pour it into the empty tanker;

NOTE – The final strength of the chlorine to water is to be 15 g/m^3 ±5 g/m^3.

(d) Fill the tanker to the appropriate volume and ensure the solution is well mixed;

(e) Charge the new main with the chlorinated water from the tanker at one end of the main or into a new hydrant through a standpipe. All service pipes and hydrants shall be left open and allowed to run for a couple of minutes. The services and hydrants shall then be closed to allow the highest end of the main to fill completely;

NOTE – The main should ideally be charged from the highest point. This will allow the water to be gravity fed into the main. If this is not possible the water tanker shall have a truck mounted pump to pump the chlorinated water in.

(f) Seal off the main and leave it charged with the chlorinated water for 24 hours;

(g) Take samples and test for residual chlorine;

(h) After 24 hours flush the main well until the chlorine smell is gone. Once the main is connected into the reticulation system it should be flushed thoroughly before the services are connected up.

NOTE – For large mains, a water tanker may not have the required capacity so a dose pump system shall be used and approved by the authorised officer.

Example:

A. Calculate the volume of the mains to be chlorinated, that is, 85 m of 100 mm dia. main

$$\text{Vol.} = \frac{85 \times \pi \times 0.1^2}{4} = 0.67\ m^3$$

$$= 667.6 \text{ litres}$$

Plus 110 m of 150 mm dia. main

$$\text{Vol.} = \frac{110 \times \pi \times 0.15^2}{4} = 1.944\ m^3$$

$$= 1.944 \text{ litres}$$

Total volume = 1,944 + 667.6 = 2,611.6 litres

B. The total volume of 2,611.6 litres is less than the volume of the water tanker (say 5,000 litres) so calculate how many millilitres of sodium hypochlorite is required for the 5,000 litre tanker to give a final solution of 15 g/m^3.

$$v = \frac{V \times c}{s \times 10}$$

v = volume of sodium hypochlorite in ml

V = volume of water tanker

c = concentration of final solution in g/m^3

s = strength of concentrated hypochlorite in % FAC

$$v = \frac{5000 \times 15}{15 \times 10} = 500 \text{ ml}$$

Appendix E – Typical Plan and Cross Section Figures from Table 3.3

(Informative)

The following figures are provided by Standards New Zealand. The copyright of these figures is waived.

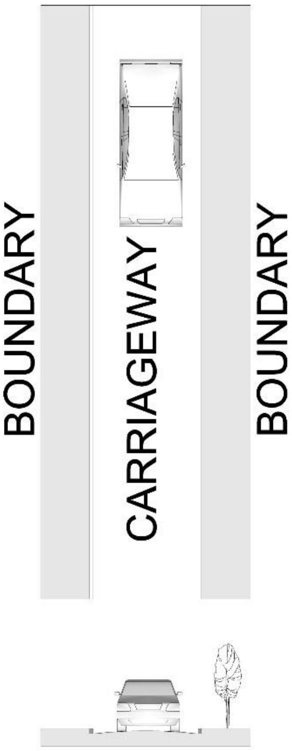


Figure E1 – Rural, live and play, access to lifestyle or clustered housing (1 to 6 du)

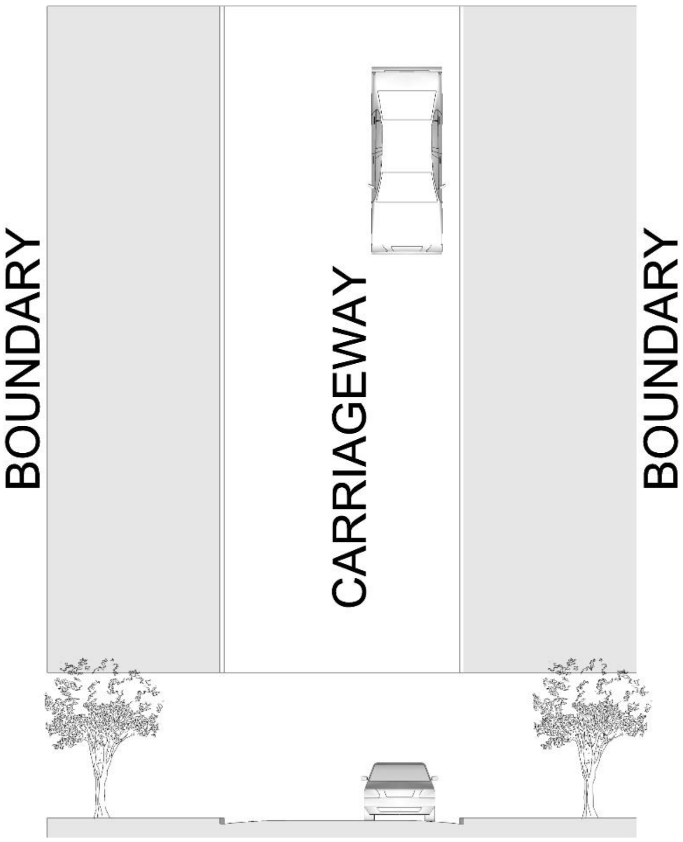


Figure E2 – Rural, live and play, access to lifestyle or clustered housing (1 to 20 du)

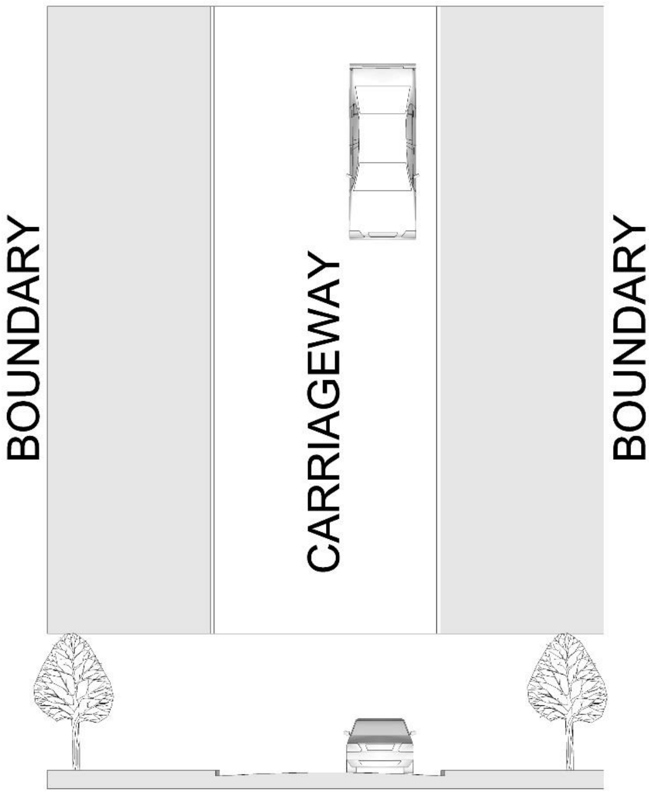


Figure E3 – Rural, live and play, access to housing

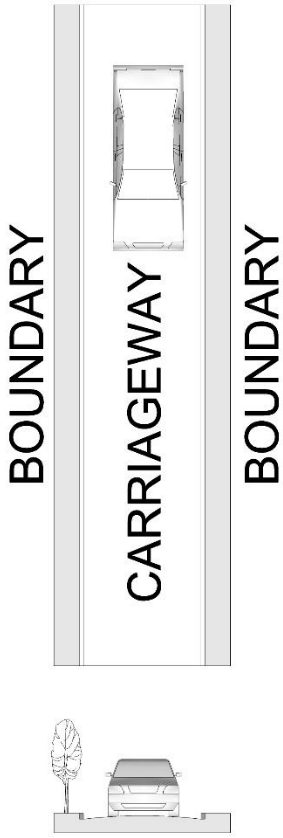


Figure E4 – Rural, shop and trade, side or rear service access

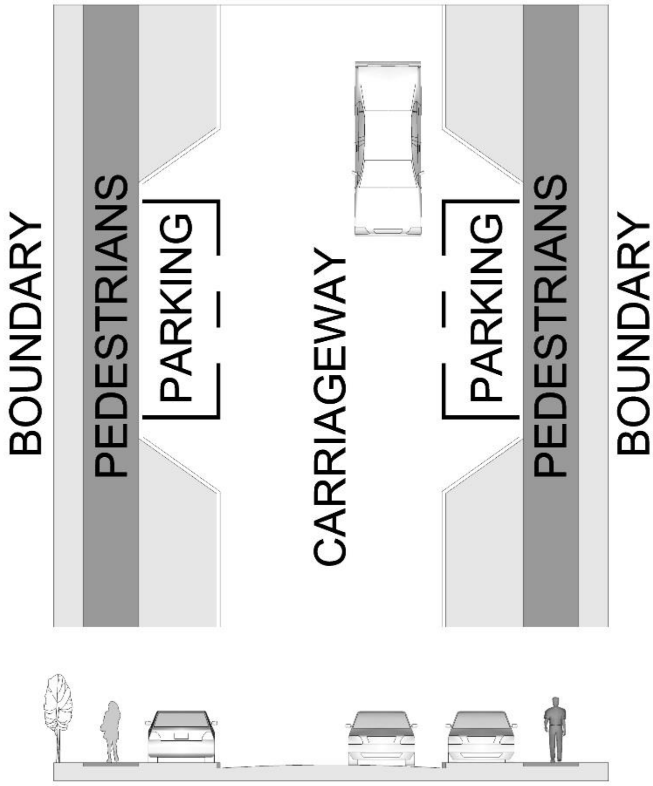


Figure E5 – Rural, shop and trade, access to trade

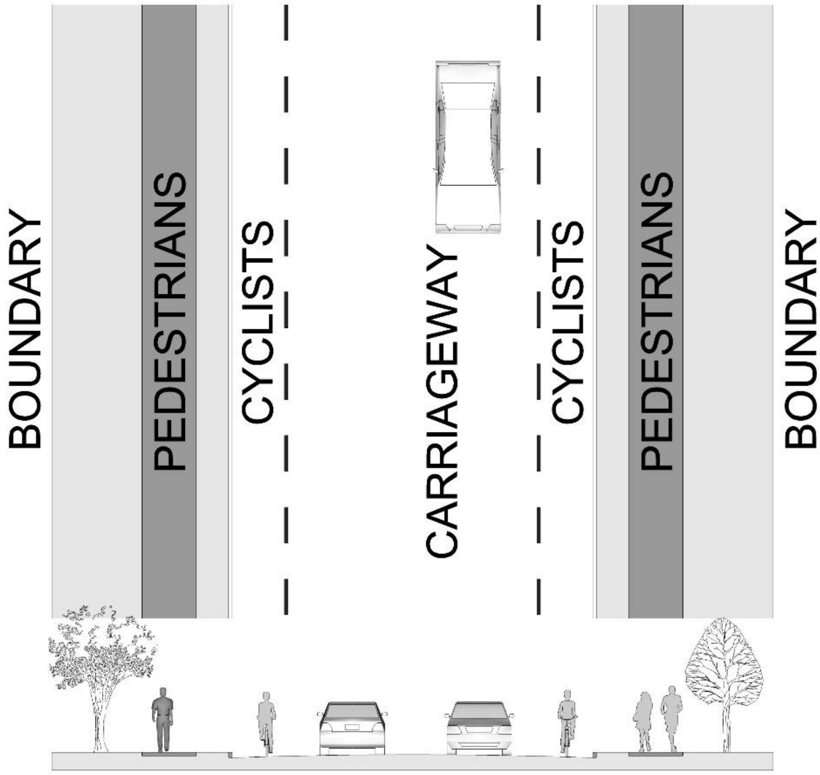


Figure E6 – Rural, make and move, primary freight access

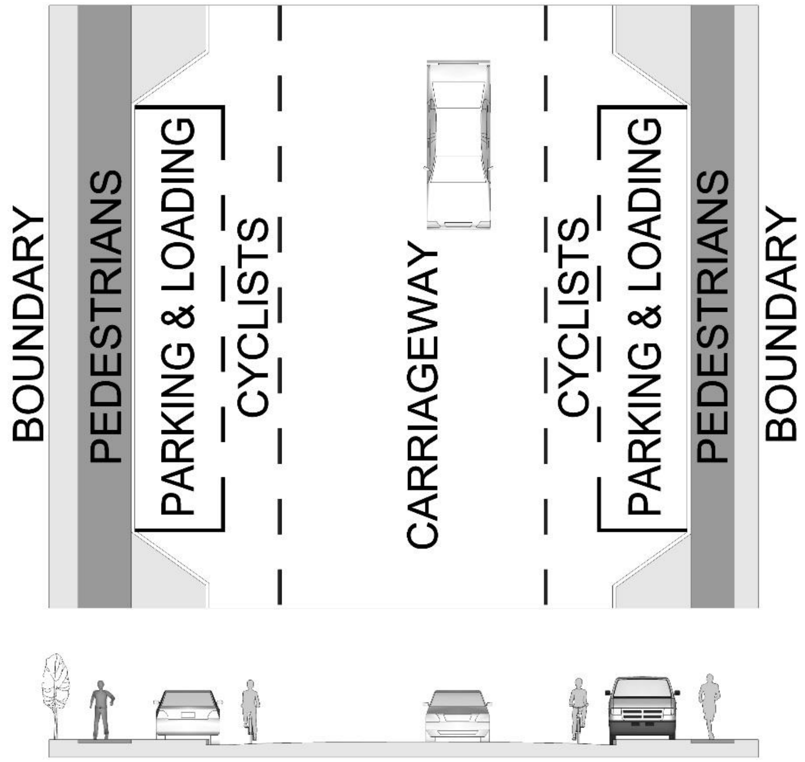


Figure E7 – Rural, make and move, access to office and education

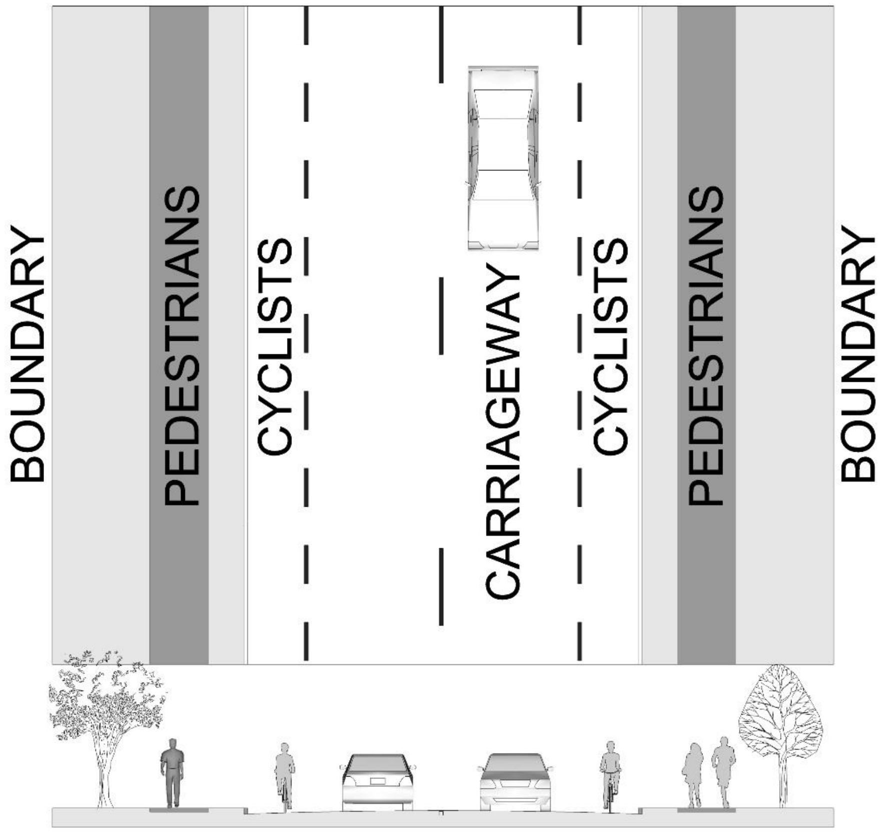


Figure E8 – Rural, all other situations (where not specified elsewhere in table 3.2)

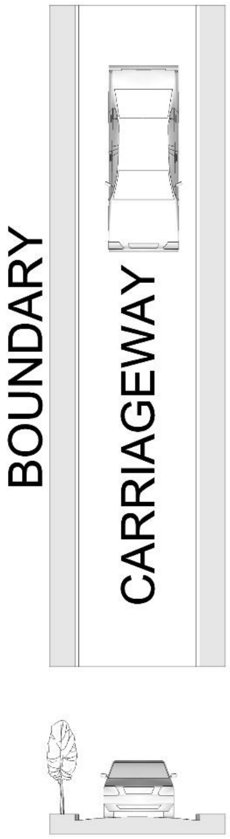


Figure E9 – Suburban, live and play, access to houses/townhouses (1 to 3 du, or 1 to 6 du)

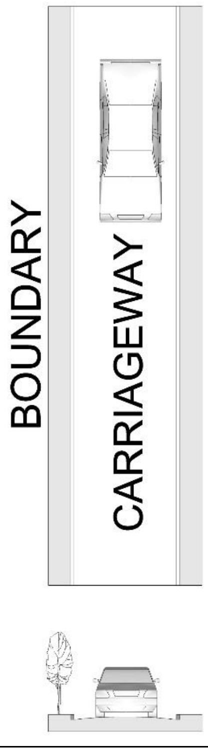


Figure E10 – Suburban, live and play, side or rear service access

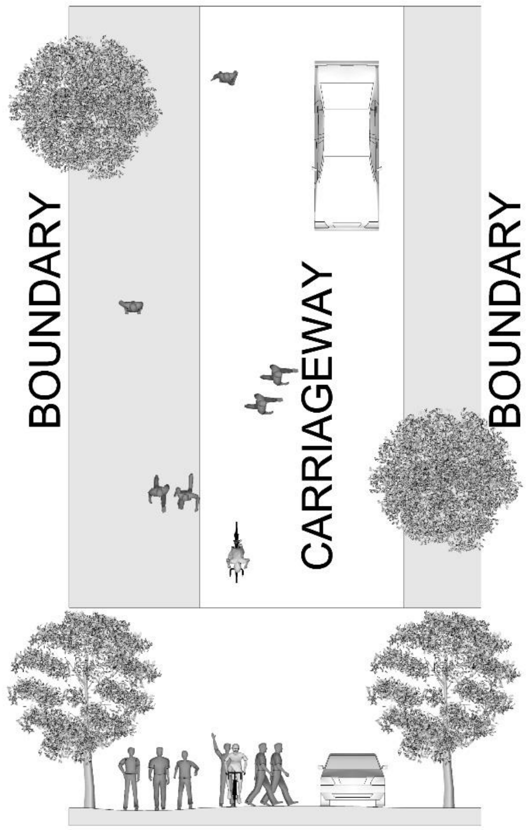


Figure E11 – Suburban, live and play, access to houses/townhouses (1 to 20 du)

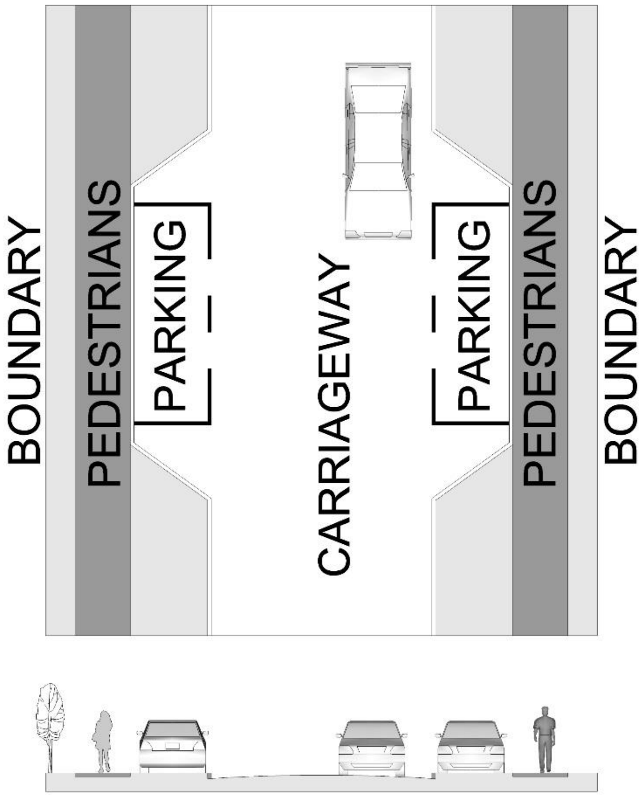


Figure E12 – Suburban, live and play, primary access to housing (1 to 200 du)

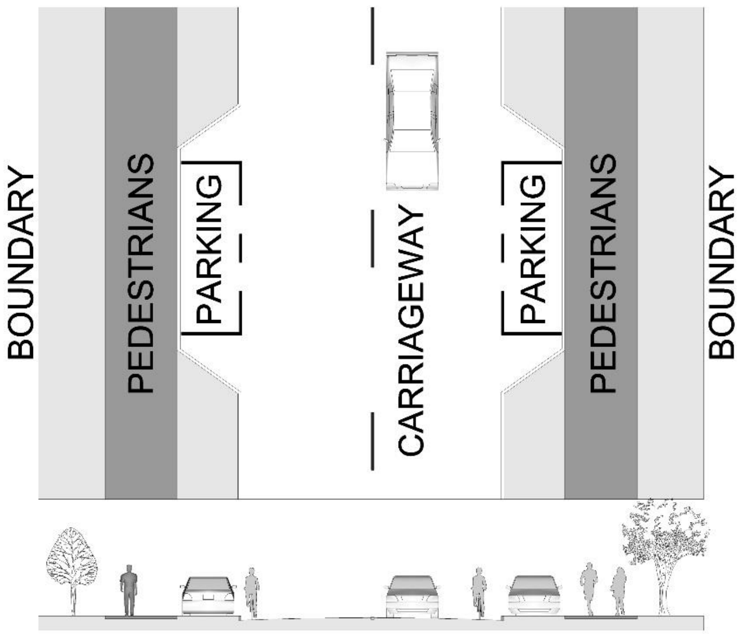


Figure E13 – Suburban, live and play, primary access to housing (up to 800 du)

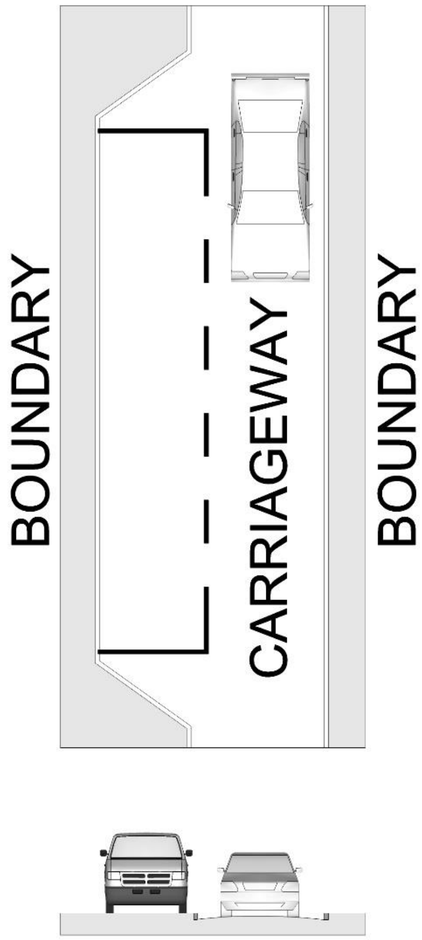


Figure E14 – Suburban, shop and trade, work and learn, side or rear service access

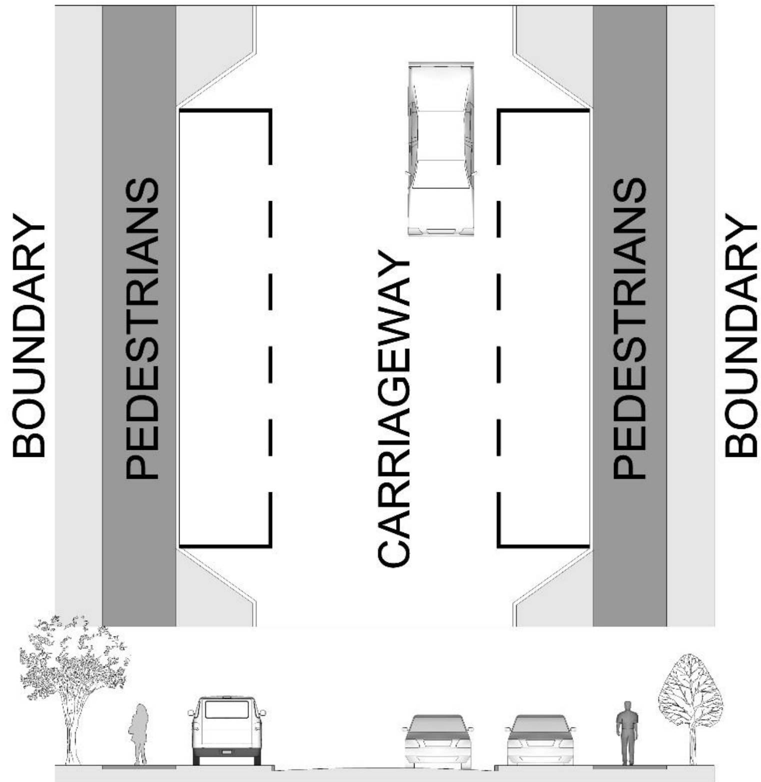


Figure E15 – Suburban, shop and trade, work and learn, access to trade, office, and education

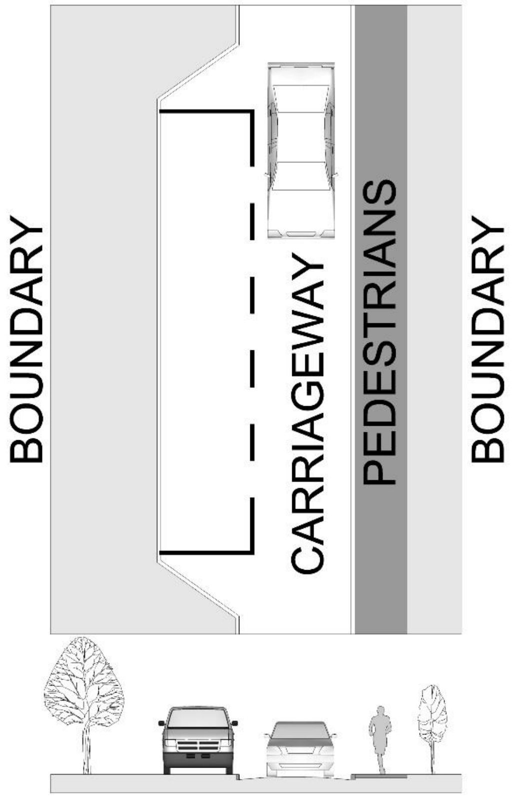


Figure E16 – Suburban, make and move, side or rear freight access

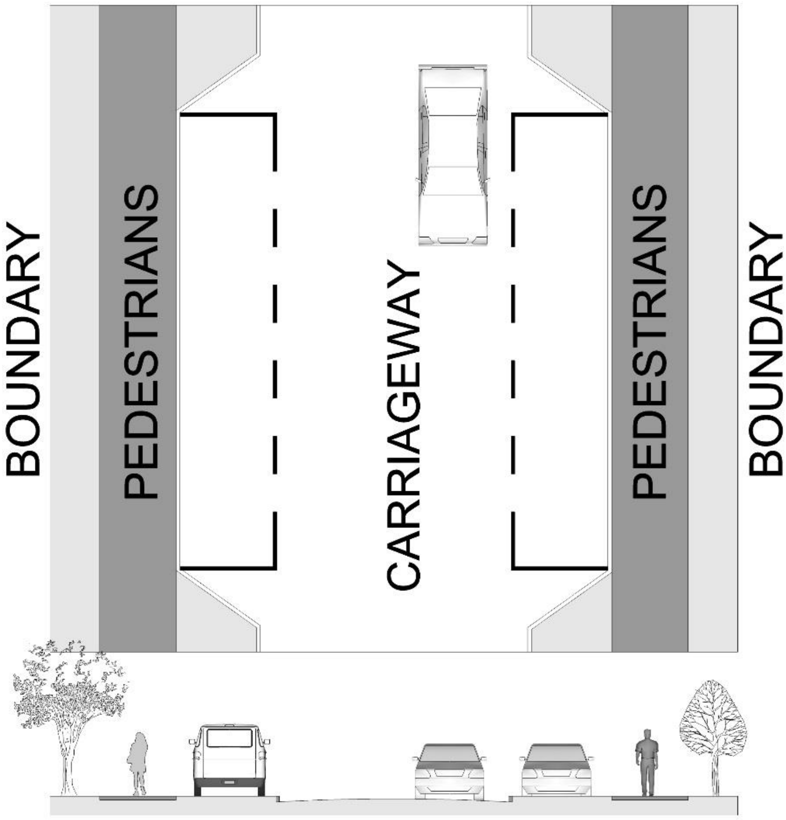


Figure E17 – Suburban, make and move, primary freight access

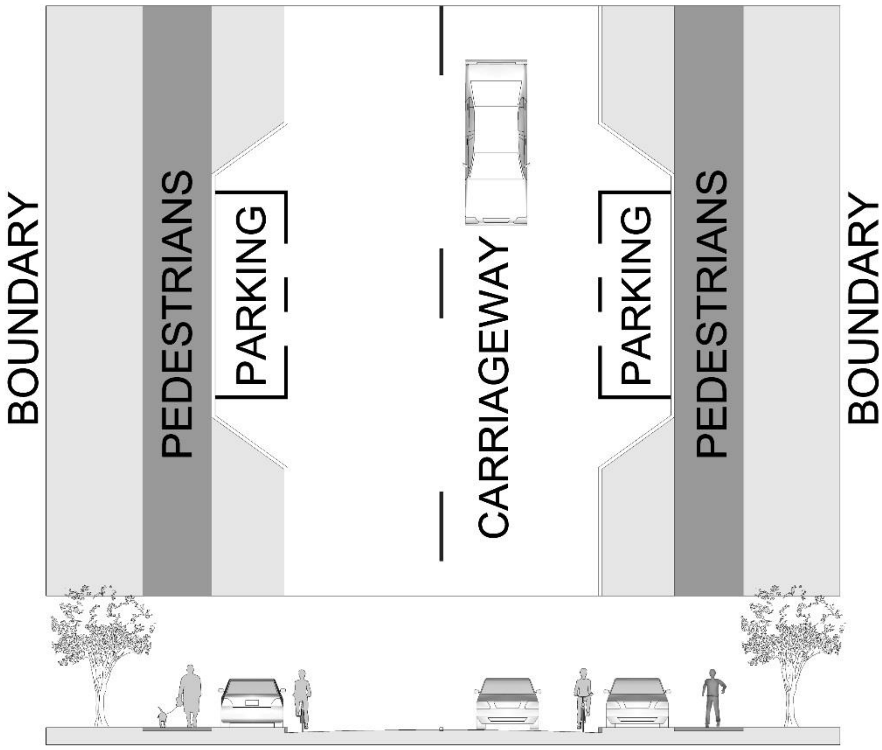


Figure E18 – Suburban, shop and trade, work and learn, make and move, all roads serving multi-purpose areas involving most or all of the indicated land uses, not specified elsewhere in table 3.2

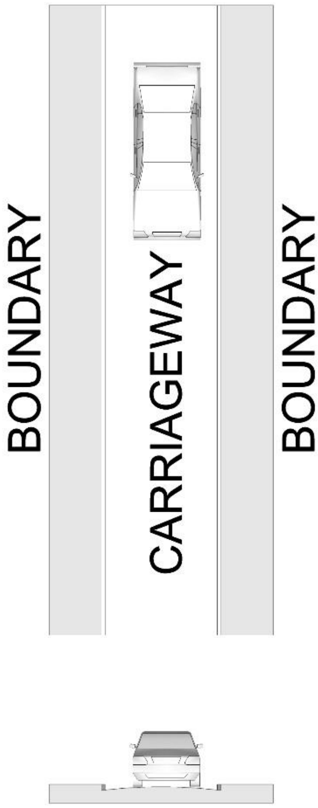


Figure E19 – Urban, live and play, access to lifestyle or clustered housing

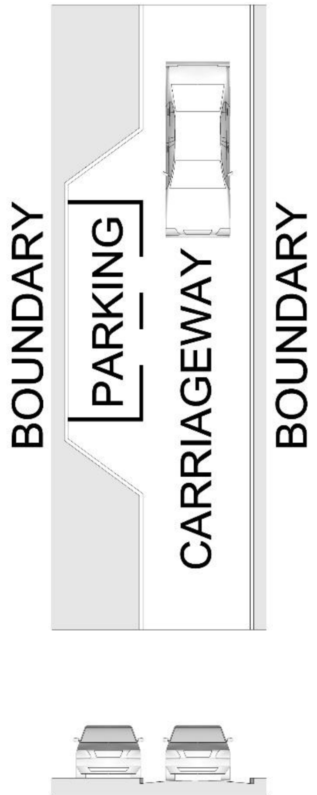


Figure E20 – Urban, live and play, side or rear service access

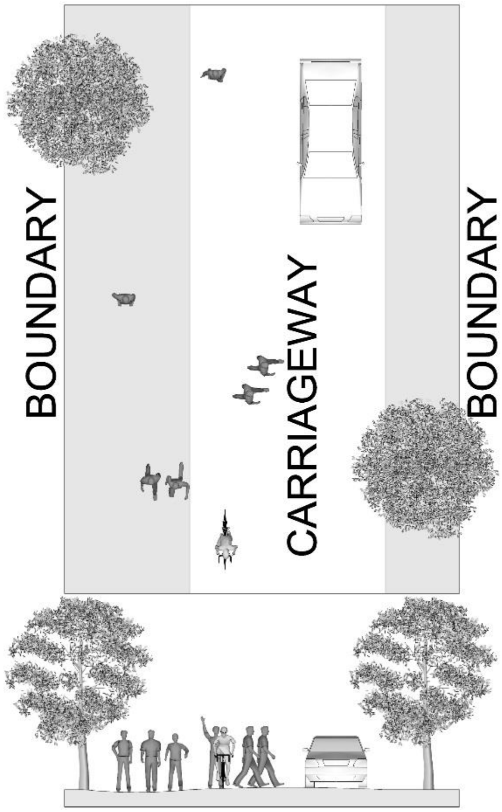


Figure E21 – Urban, live and play, access to houses/townhouses

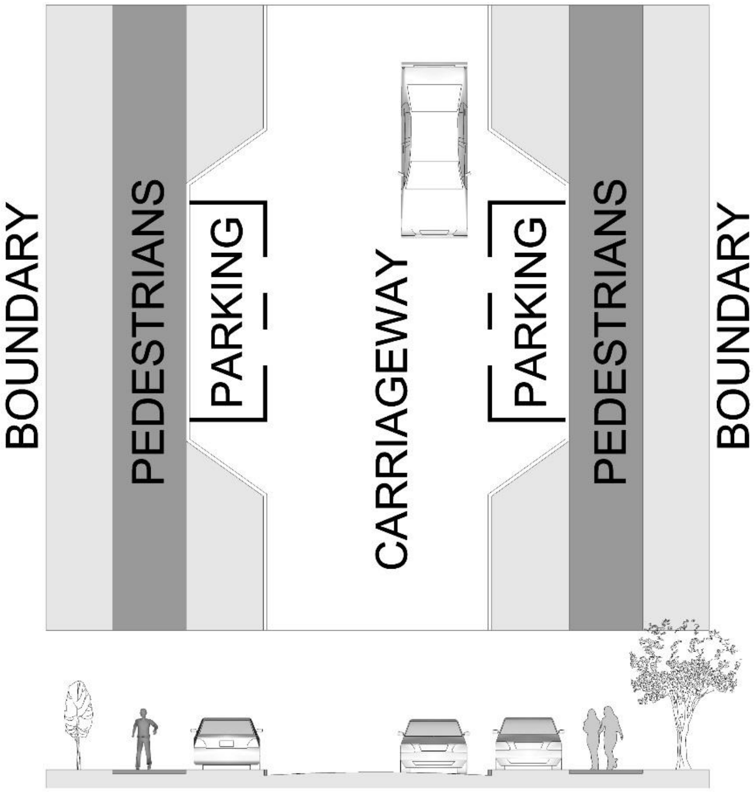


Figure E22 – Urban, live and play, primary access to housing

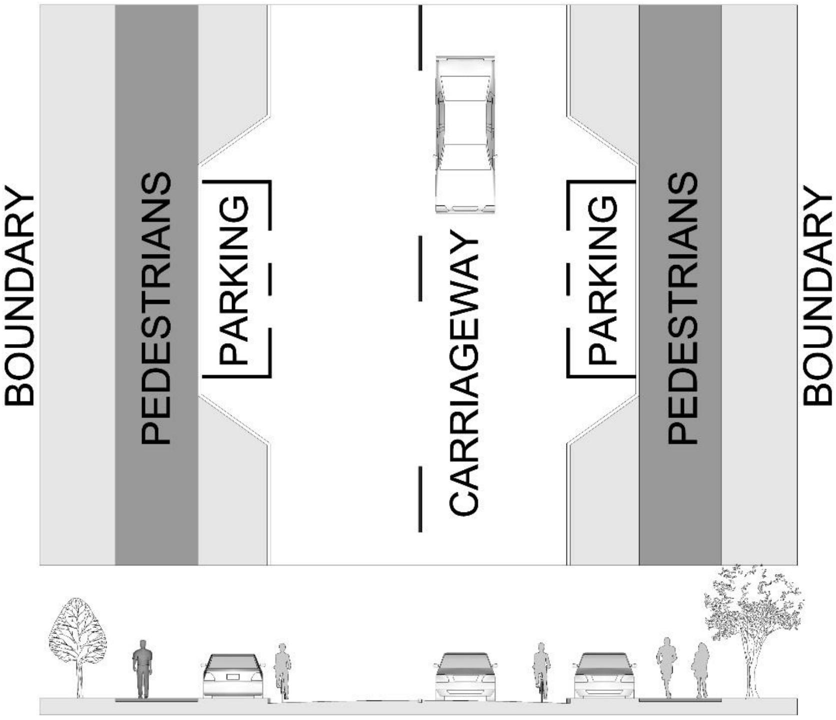


Figure E23 – Urban, live and play, all other land use activity types within this area type not specified elsewhere in table 3.2

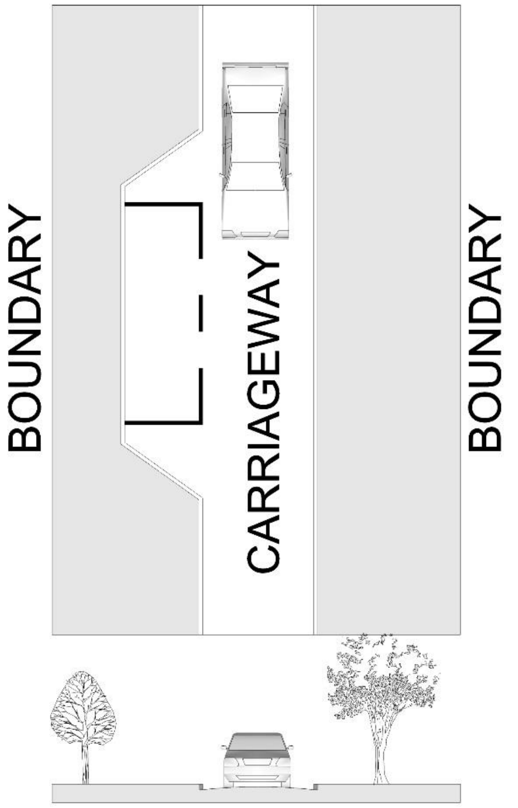


Figure E24 – Urban, shop and trade, side or rear service access

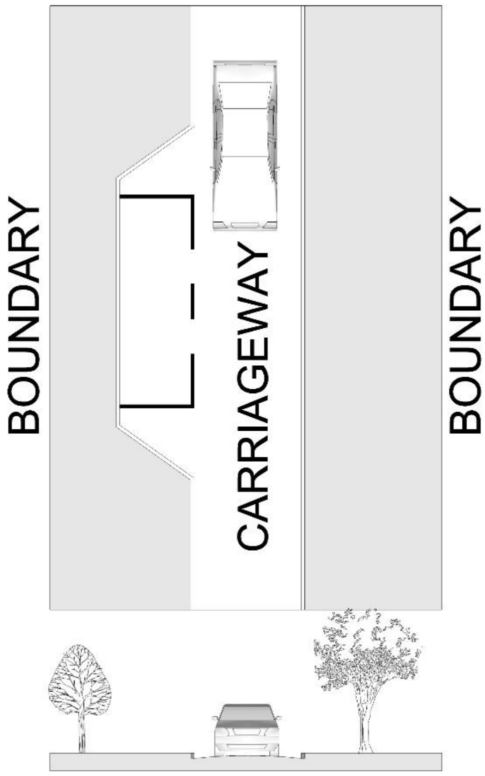


Figure E25 – Urban, shop and trade, access to lots, or shop or trade units

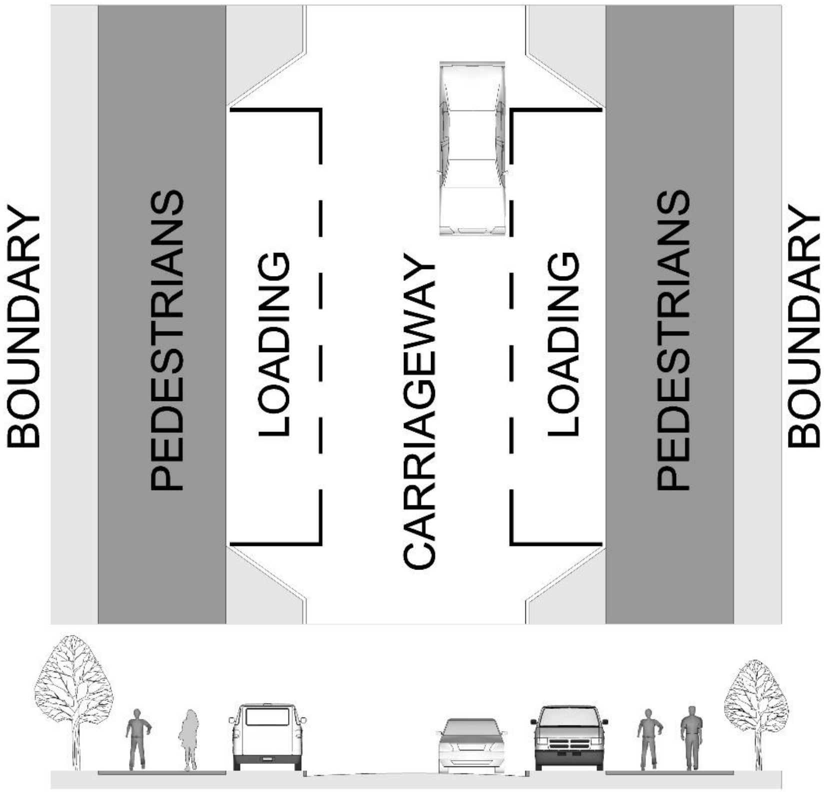


Figure E26 – Urban, shop and trade, primary access to trade

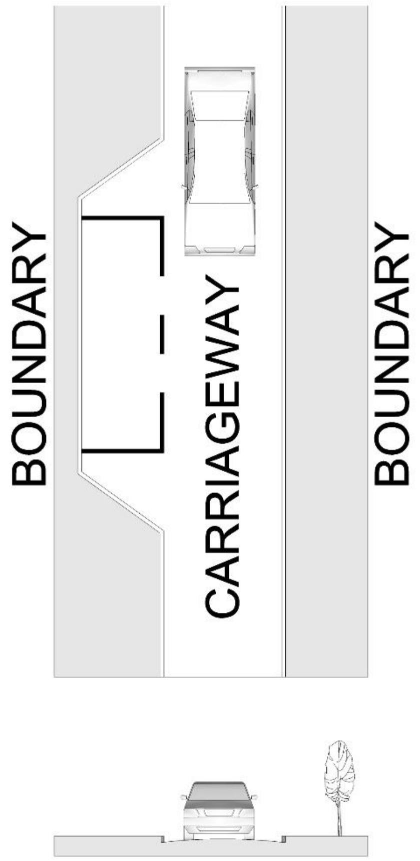


Figure E27 – Urban, work and learn, side or rear service access

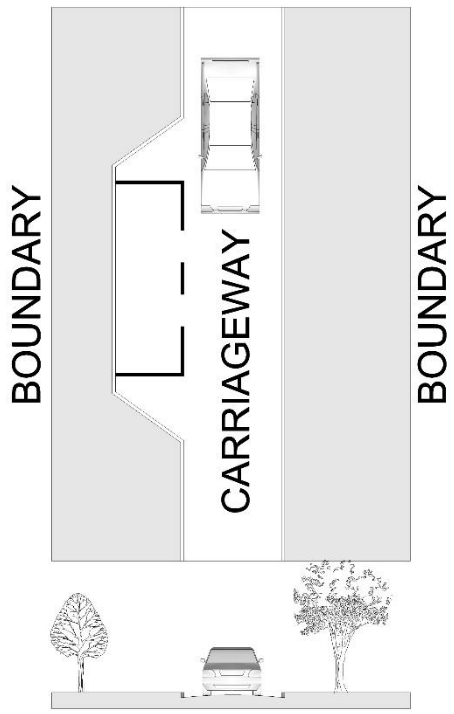


Figure E28 – Urban, work and learn, access to lots, or work or learn activities

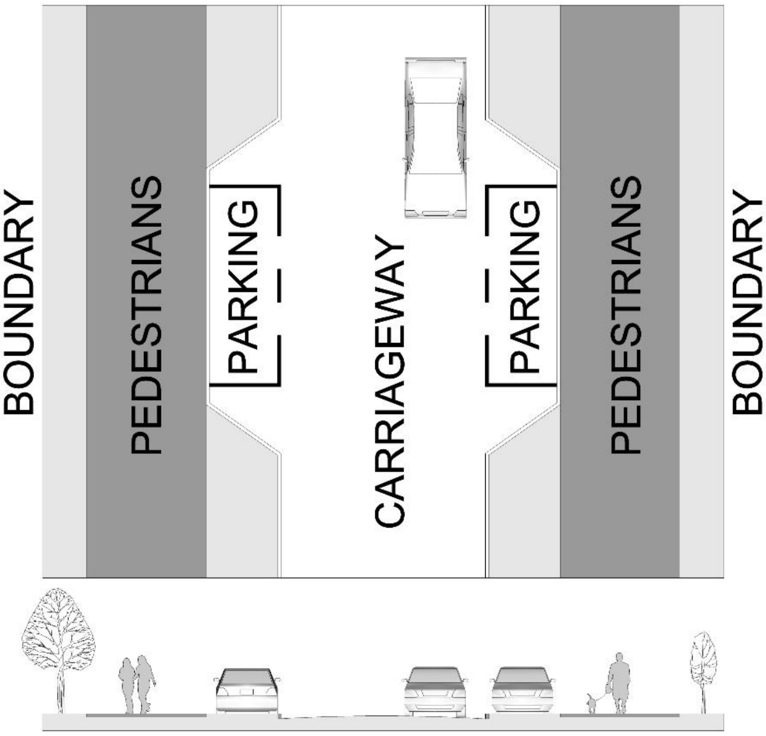


Figure E29 – Urban, work and learn, primary access to office and education

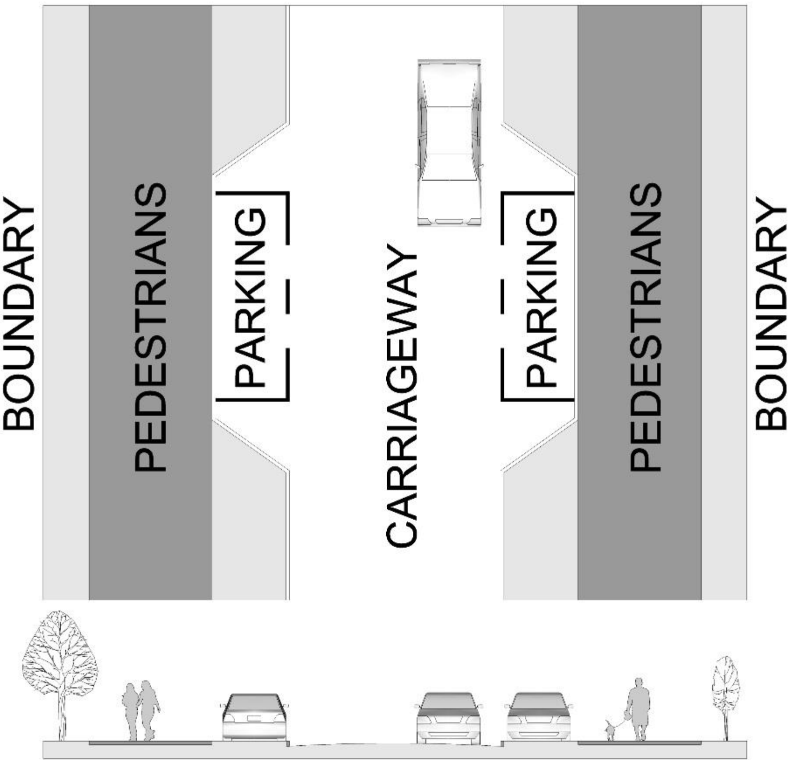


Figure E30 – Urban, mixed use, multiple user access

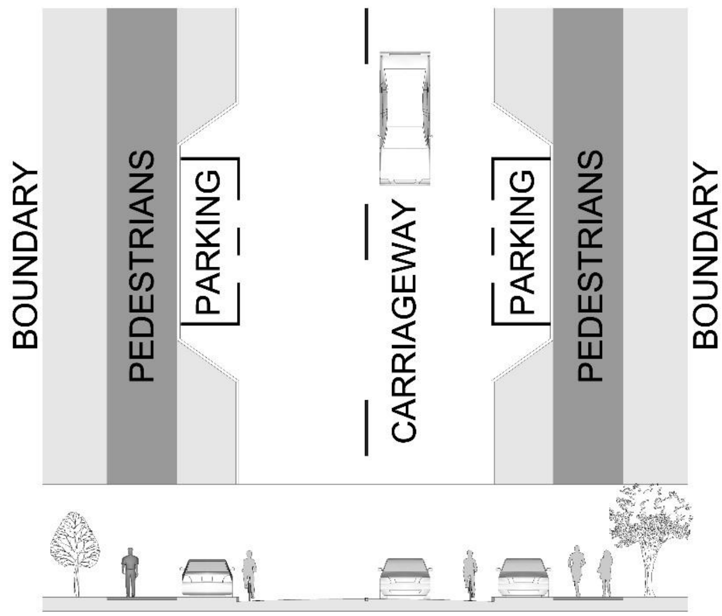


Figure E31 – Urban, mixed use, neighbourhood centres (and all other areas serving multiple land uses not listed elsewhere in table 3.2)

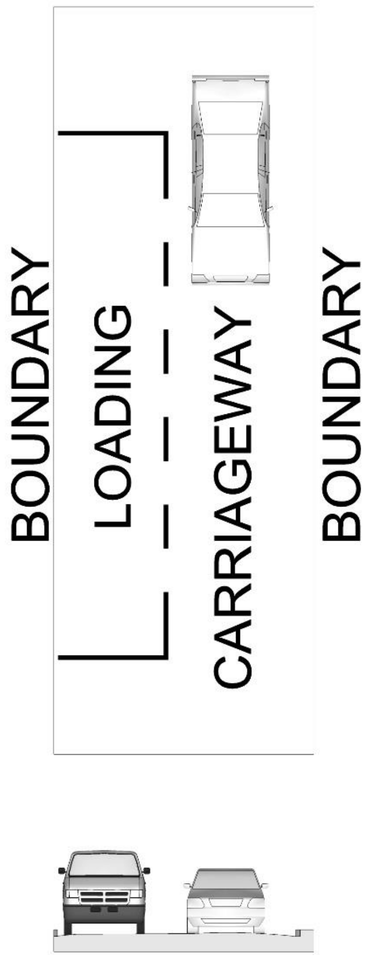


Figure E32 – Centre, mixed use, side or rear service access

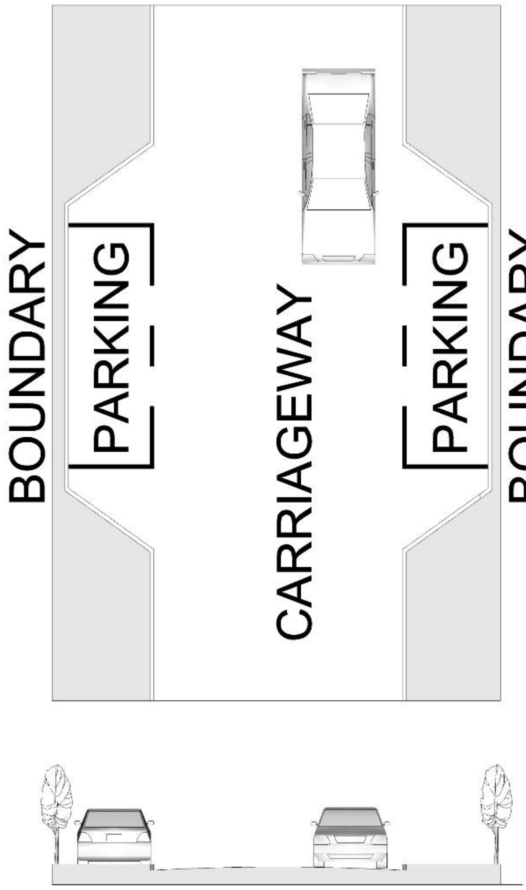


Figure E33 – Centre, mixed use, access to lots or mixed use activities

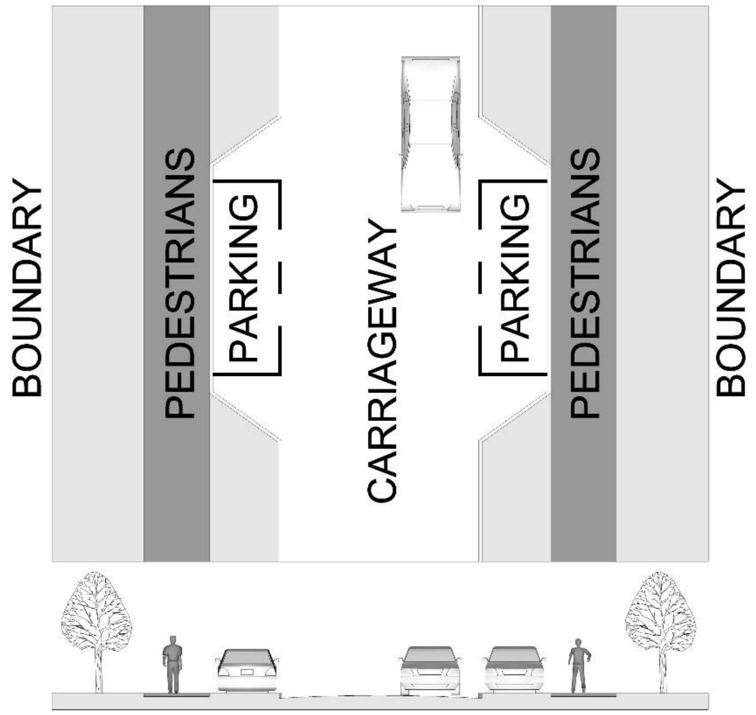


Figure E34 – Centre, mixed use, primary access and local movement

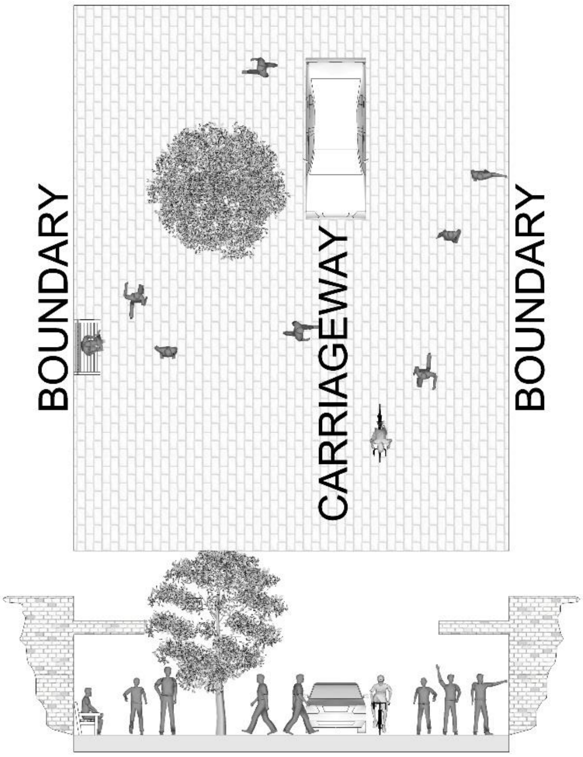


Figure E35 – Centre, mixed use, shared spaces, access way, mall, and community reserve

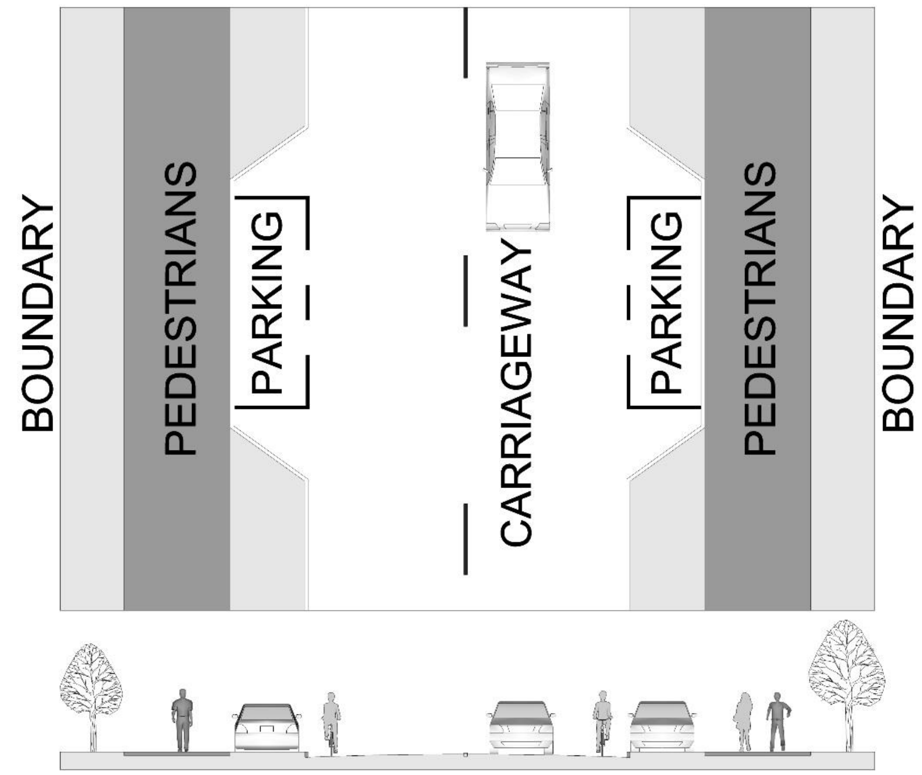


Figure E36 – Centre, mixed use, urban street

Appendix F – Irrigation System

(informative)

F1 Material and Installation Specification

F1. General

F1.1 Scope.

This standard relates to the supply and installation of a permanent automatically controlled watering system.

It includes Drip Irrigation, Fixed Location Systems, fixed spray, pop-up spray, mist spray and trickle irrigation.

The irrigation system shall be designed and installed in accordance with all governing ordinances, laws and regulations that meet all local conditions.

F1.2 Qualifications

Installers to be experienced, competent trades people familiar with the materials and techniques specified.

Designers to hold an NZQA National Certificate in Irrigation Design or equivalent.

F1.3 Design

The irrigation system will comply with the following standards.

1.3.1 INZ Design Standards for Piped Irrigation Systems in New Zealand 2013

1.3.2 AS/NZS 3500. Plumbing and drainage Part 1: Water services

1.3.3 INZ Code of Practice for the Design of Piped Irrigation Systems In New Zealand 2013

1.3.4 AS/NZS 2845.1 Water supply - Backflow prevention devices - Materials, design and performance requirements

1.3.5 AS 2845.3 Water supply - Backflow prevention devices - Field testing and maintenance

1.3.6 INZ Irrigation Installation Code of Practice 2013

F1.4 Design Evaluation

The design report as detailed in 1.91 will be submitted with the irrigation design plan so that the irrigation design and performance can be evaluated before QLDC approval.

F1.5 Adherence to Design Plan

Contractor must carry out the installation of the system in strict accordance with the Council approved design plan. Any variations must be approved by the Irrigation Designer or Engineers representative. The correct components as specified must be installed.

F1.6 Performance

Install an irrigation system in accordance with INZ Irrigation Installation Code of Practice 2013.

Meet statutory requirements for backflow prevention.

The uniformity performance indicator units for the individual spray heads and nozzles at the spacing's on the irrigation layout plans shall be greater than.
- Coefficient of uniformity (CU) 85%
- Distribution uniformity (DU) 0.80
- Scheduling coefficient (SC) 1.3

Minimum Sprinkler Operating Pressures
- Spray Heads 200 kPa
- Rotating Sprinkler up to 7.0m Radius 300 kPa
- Rotating Sprinkler over 10.0m Radius 350 kPa
- Rotating Sprinkler over 14.0m Radius 400 kPa
- Drip Irrigation 200 kPa

Maximum Pressure differential within a sprinkler zone 7%
Maximum zone water velocity 2.0 m/sec
Maximum mainline velocity 1.50 m/sec

The irrigation window for replacing 5mm ET is a maximum cycle time of 5 hours per night to avoid vandalism.

F1.7 System Pressure Test

It shall be Contractor's responsibility to demonstrate two successful pressure tests: The first at 224c certification the second 12 months after 224c certification sign off.

This will involve first isolating all points of connection to previously existing pipe where they are present.

Pressure testing shall be done in conjunction with the Engineer. The line will be retested until satisfactory. It shall be the Contractor's responsibility to provide all equipment required for the pressure test and provide suitable connection ports. At the point where the system can be pressurised, a 25mm ball valve shall be installed to enable the connection to be made without depressurising the system.

F1.8 MDPE Pressure Test Procedure

1.8.1 As per QLDC Code of Practice Appendix C

Where the initial pressure test fails, the cost to the Council of supervising subsequent tests shall be deducted from the payments.

Where an irrigation system fails the pressure test and yet the leak is unable to be detected by the Contractor, the Contractor shall be required to pay for a professional leak detection service.

F1.9 Commissioning

Prior to planting or seeding an area, the irrigation contractor shall be required to demonstrate that the system is correctly adjusted and ready to be used on the areas that are being planted.

1.9.1 Flush system thoroughly, check heads, sprays and drippers and clean if blocked. Clean strainers. Adjust system for even distribution with no dry areas.

1.9.2 The acceptable deviation from the design specification will be;

- flows ±5%
- pressures ±5%
- uniformity - not more than 2% (or 0.02) under the supplied
- performance as submitted for clause 1.3

The system shall be test-run and the correct operation of all components checked. Sprinkler zones should be verified to conform to the approved plan. Sprinkler radius and arc's will be adjusted to avoid overthrow outside of the required irrigation areas.

Once commissioning is complete, arrangement shall be made to demonstrate the system to representatives of the Council and/or the Engineer.

F1.10 Handover manual

Two operations manuals for the control system, sprinklers, valves and fittings shall be provided to the Engineer and a laminated copy of the irrigation as-built plans is to be placed inside the control box. The plans should identify each station for ease of operation. The manuals shall include the following.

1.10.1 Summary Irrigation Report
The summary report as detailed below.

1.10.1.1 Description of Systems
Description of the normal operating characteristics of the irrigation system and operating level.

1.10.1.2 Design Brief
General description of irrigation system and what and how it irrigates the different areas.

1.10.1.3 Sprinkler Pressure
The sprinkler pressures in each zone detailing the nominal, minimum and maximum for each sprinkler type

1.10.1.4 Valve Operating Pressures and Flows
The require set pressure and flow used on the downstream side of each valve in the irrigation system

1.10.1.5 Water Supply

1.10.1.5.1 Number of Supply Take Off points
Number of water supplies in system

1.10.1.5.2 Size off Take Point
The take off connection size for and number of connections

1.10.1.5.3 Maximum Flow of Water Supplies

The maximum flow from each water supply

1.10.1.5.4 Flow and Pressures at Water Supply Take off Points

The flow and pressure requirement for of each irrigation zone at the water supply

1.10.1.5.5 Filtration

Filtration required

1.10.1.6 Sprinkler Run Times

1.10.1.6.1 Application rates

Application rates or the sprinklers used.

1.10.1.6.2 Zone run Times

The expected zone run times based on an evaportranspiration (ET) rate of 5mm per day

1.10.1.6.3 Maximum System Run Time

The maximum expected system time base on 5mm application per day

1.10.1.7 Water Usage Total

Total water used per day per irrigation cycle replacing 5mm ET

1.10.1.8 Details of the process to follow in the event of a warranty claim.

1.10.1.9 The expiration date of the warranty for every item.

1.10.1.10 Make, model, size, specification, and date codes of all products.

1.10.1.11 Operation manuals or brochures on the valves and sprinklers.

1.10.1.12 Spare parts data.

1.10.1.13 Trouble shooting information.

1.10.1.14 Testing information.

1.10.1.15 Successful pressure test certification.

1.10.1.16 IQP certification of backflow preventor (if applicable).

All of the above information is to be provided in a addable electronic format and a PVC 3-ring or 4-ring binder. All loose sheets are to be laminated. The name and address of the installing Contractor and that of the company supplying the product (if different) is to be included on the front page of the binder.

The 'as-built' plan, operations manual and commissioning are required for practical completion. The Contractor is to complete and submit to the Engineer the Council’s ‘asset data information sheet’.

F1.11 Practical Completion

The Contractor is to liaise with the Engineer and nominated surveyors, to ensure the location of all system components are captured accurately. The following information shall be required:

- The location and depths of all pipe, sprinklers, valves (solenoid, ball and quick coupler) valve boxes, cabling, cable joints, controller, rain switch and soil moisture sensor (if applicable).
- The make and model information of all products, including those in the head works which may already be present (e.g. backflow preventer and water meter).
- Any cable/tubing joint not within a solenoid valve box.
- The size, type and pressure rating of all pipe work.
- Any service locations found outside of the originally documented

locations.

- Changes in mainline pipe direction and dimensions and offset measurements for all pipes and pipe junctions.

F1.12 As Built Plan

As the system progresses on a daily basis an accurate record of the location, type and size of all sprinklers, fittings, pipes and cables shall be maintained, preferably as a CAD file.

The as-built plan shall clearly illustrate with respect to permanent landmarks, based on dimensioned triangulation from at least two fixed above ground permanent points.

All information and data shall be submitted to the QLDC as per section 1.8.10 (QLDC Code of Practice)

F1.13 Warranty

The entire system shall be warranted against defective materials and workmanship for the period of 12 months from the date of practical completion. However certain component products shall have extended warranties:-

Irrigation Sprinklers - Minimum of 3 years
25mm Solenoid Drip Control Valves - Minimum of 3 years
25mm & 40mm Solenoid landscape Control Valves - Minimum of 5 years

F1.14 System Maintenance

During the maintenance period the contractor shall be responsible for making good any defects or faults that may occur, including leaks, sprinkler malfunction, control valve malfunction and trench subsidence.

The contractor shall respond to any defects bought to his attention by the client within 2 days.

F2.0 Material Specification.

F2.1 Sprinklers

2.1.1 General

Generally, sprinklers shall be laid out as shown on the plans, but in all cases, adjusted to provide correct and effective coverage of areas as constructed.

2.1.2. Popup Spray Heads

The sprinkler shall feature combination full circle and part circle matched precipitations spay nozzles with a 100mm pop up height. The sprinklers shall have a 15mm (1/2”) BSP female threaded connection and the riser shall be ratcheting to allow easy arc adjustment. Sprinklers shall be operated in groups by solenoid valves as shown on the irrigation plan. Refer standard drawing layout D7.

2.1.3 Popup Rotating sprinklers 20mm

The sprinklers shall feature combination full circle and adjustable part circle drive assemblies. The sprinklers shall have a 20mm (3/4”) BSP female threaded connection and a check-O-matic anti-drain value capable of holding back at least 3 metres of elevation. The riser shall have a pop up height of at least 127mm (5”). Sprinklers shall be operated in groups by solenoid valves as shown on the irrigation plan. Refer standard drawing layout D8.

F2.2 Drip Zones

2.2.1 General

Trees shall be irrigated with two drippers. Pipe work to the trees shall be generally as shown on the plan. Landscape inline drip pipe will be typically spaced at 600mm between laterals and 300mm from the beginning of each planted area.

2.2.2 Drippers

Each tree shall be irrigated with two pressure compensated 4.0 litre per hour drippers attached to a 13mm lateral pipe. The two drippers shall be connected via the 15mm LDPE to the 13mm lateral pipe (500KPa rated) which is to be installed in a ring around the two trees.

The dripper shall connect directly into the lateral pipe and be capable of being taken apart for cleaning. In the event that LDPE dripper lateral pipe is under paving or concrete then the LDPE Lateral will be installed 300mm into the tree pit. Drippers shall be capable of being taken apart for cleaning.

Refer standard drawing layout D6.

F2.3 Valves

2.3.1 Solenoid Control Valve Assemblies

The landscape turf and dripper stations shall be controlled with solenoid operated control valves. These will be sized as per the manufactures recommendations. Valves shall be fitted with adjustable pressure regulators specifically designed to fit the solenoid valve. Alternatively, preset or adjustable “in-line” type pressure regulators may be used for small flow drip stations; these shall be set that the downstream pressure is a maximum of 3 Bar. All valves shall feature BSP female threaded inlets, have flow control and internal bleed for manual operation.

In addition, those valves controlling drip zones shall incorporate a 120 mesh filter in the assembly to provide the drippers protection from any debris in the lines.

All solenoid valves will be housed in valve boxes and have manual isolating fitted upstream of the valve. Refer standard drawing layout D3.

2.3.2 Lateral Isolation valves

All lateral isolation valves shall be fig. 125 bronze gate valves, DR rated for in ground use. Valves shall be pressure rated at not less than 14 Bar.

2.3.3 Drip Lateral Isolation Valves

The isolation valve to each section when required shall be a 15mm or

20mm ball valve.

2.3.4 Quick Coupling Valves (QCV)

All quick coupling valves shall be 25mm (1”) BSP female threaded brass valves with single lug key. All quick couplers shall be housed in valve boxes. All QCVs shall be connected to the mainline with swing joint risers to allow correct levelling. All QCVs shall be securely anchored in the ground with a stabilising bar and stainless steel U bolt clamp.

2.3.5 Valve Boxes

All valve boxes shall be constructed from high impact plastic or galvanised steel. They must be able to support the weight of a vehicle without damage. Valve box lids shall be of the bolt-down type and be supplied with bolts fitted.

The following valve box sizes shall be used.

Lateral Isolation Valves 6” Round
Landscape & Drip Solenoid Valves 12” Rectangular
Dripper Lateral Manual Valves 6” Round
Cable Joints 6” Round
Water meter, Backflow preventer 22.5” Rectangular

Also refer standard drawing layout D1,D2,D3,D4,D5

All valve boxes shall feature T section lids so that the lid is fully supported by the body of the box.

2.3.6 Backflow Preventors

Each connection to the potable water supply must be protected by a double check valve backflow preventer assembly housed in a protective valve box, as detailed in the standard drawing layout D1 and D2.

2.3.7 Water Meter

Each connection to the potable water supply must have a water meter installed immediately upstream of the back flow preventer. The water meter shall be housed in a protective valve box, as detailed in the standard drawing layout D1and D2 . Meter type as per QLDC water metering policy.

F2.4 Pipework

2.4.1 General

The use of solvent weld fittings is not permitted.

2.4.2 Mainline

All pipes under constant pressure shall be uPVC to AS/NZS 1477, rated to 12.5 Bar, or PE100 PN12.5 to AS/NZS 4130, rated to 12.5 Bar. Pipes sized 100mm and above shall be PE while those below 100mm shall be MDPE.

2.4.3 Lateral

All lateral pipes downstream of a solenoid valve shall be PE 80B to AS/NZS 4130, rated to PN 9 (9 Bar).

2.4.4 Dripper Laterals

All lateral pipe downstream of the drip zone control valves shall be LDPE, sized as shown on the plans. The LDPE shall be manufactured to (NZS 7601), the following pressures shall apply 15mm – PN9.7, 20mm – PN 9, 25mm PN8.

The end of each lateral shall be terminated in a valve box with a threaded cap/plug to allow flushing.

2.4.5 Dripper Take Offs

From the LDPE lateral a 13mm lateral pipe will be installed in a ring around the tree. Refer Standard Drawing D6.

F2.5 Fittings

2.5.1 PVC Mainline Fittings

All mainline PVC pipe fittings shall be ductile iron with rubber ring or flanged connections. Cast iron or gun metal tapping bands shall be used for valve take offs. All mainline tees and bends shall be ductile iron. All flange connections shall be made using galvanized nuts, bolts and washers.

2.5.2 PE Fittings

All fittings for PE pipe shall be compression type. Take-offs for sprinklers shall be PE tapping saddles, manufactured to NZS/AS 4129, rated to PN 16.5 (16 Bar).

All tapping saddles shall have stainless nuts and bolts and a stainless retaining ring around the threaded section of the saddle.

2.5.3 LDPE Fittings (PN9)

LDPE pipe in the drip irrigation zones shall be joined with Hansen or Anka fittings designed for the purpose and manufactured to NZS 7601.

2.5.5 Inline Drip Fittings

All inline drip pipe shall be joined with Anka 15mm fittings.

2.5.6 Sprinkler Risers

All gear drive sprinklers shall be mounted on swing joint risers.

All sprinklers with an inlet 20mm and greater shall be mounted on articulated risers comprising 3 threaded MF elbows and a 300mm long threaded nipple. All swing joint risers shall have a nominal lay length of 300mm.

All Spray sprinklers shall be connected to the reticulation system comprising two BSP thread barbed elbows (with 4 barbs) and a 300mm length of 15mm LD polythene pipe. Refer standard drawing D7 and D8

F2.6 Road, Bridge & Stream Crossings

2.6.1 General

Where pipe crosses a bridge or stream, fusion or butt welded polyethylene pipe shall be used. The PVC pipe shall be terminated with a flange fitting to which the polyethylene flanges will be connected. The transition point and any elbows required shall be secured with thrust blocks to prevent movement. Refer to plan for PE pipe sizes.

The pipework shall be securely strapped to the bridge structure at no more than 1m intervals.

A drain down point shall be fitted to discharge the mainline at each stream crossing. This shall consist of a fusion tapping saddle and 50mm lever ball valve.

Wiring where applicable shall be installed in electrical ducting and securely strapped to the bridge structure at no more than 1m intervals.

2.6.2 Road & Path Crossings

With sizes equal too and less than 63mm a 100mm duct will be installed and when required a 50mm electrical duct complete with draw wire will be installed beside the 100mm duct. Pipes under roads will be installed to a minimum depth of 1m cover. Refer standard drawing layout D9.

F2.7 Control System

2.7.1 General

The control system can be battery powered controllers for irrigation which is used for establishment only. Irrigation which is required to be permanent controlled shall be the conventional AC powered controller suitable for outside installation. Decoder systems can be used on systems which have a greater station count than 24 valves. Decoder system are more acceptable to surge damage and general require a high level of technical expertise when trouble shooting.

Automatic controllers shall be provided for irrigation systems. These should be of 240 volt power supply.

The Controllers are solid state with the state of the art controller technology, which will provide the versatility required for operating the proposed irrigation system. They shall be housed in a protective plastic cabinet and some of their features are:

- Three independent programs, two that can run concurrently.
- Simple program review.
- Water budgeting.
- Programmable valve test.
- Self-diagnostic circuit breaker.
- Non-volatile memory.
- Time battery backup.
- Two year warranty

Battery controllers shall be submersible up to 2m in water as per IP-68 standards with a 2 year warranty. Batteries shall last for a minimum of 1 year's operation.

2.7.2 Control Cables

Cable from the field to the valves or sprinklers shall be multi core polyethylene sheathed cable.

Minimum wire size shall be 1.5mm2. In all cases, one of the cables in multi core shall be black to denote the common wire. No joints shall be made between the irrigation control unit and the valve.

2.7.3 System Grounding

The control system shall have equipment as recommended by the manufacturer to provide surge protection to the irrigation field units. In most circumstances this will be a copper clad earth rod installed in a 150mm valve box connected via 16mm2 copper cable to the irrigation field unit.

2.7.4 Wire Connectors

All wire joints shall be made using grease filled type connectors suitable for below grade burial. King type or 3M DBY or 3M DBR connectors shall be used.

2.7.5 Metallic Detector Tape

150mmabove the pipe a metallic detector tape printed with the works "Water Pipe Below" shall be laid over the position of the pipe line. Refer standard drawing layout.

F3.0 Installation

F3.1 Sprinklers

All pipe work shall be thoroughly flushed prior to any sprinklers being installed. The sprinklers shall be screwed on to the swing joint and set level with the surrounding ground by using a 500mm straight edge. A 400mm square of biodegradable coir matting shall be placed around each sprinkler to stabilise the soil around the sprinkler and provide a suitable environment for the seed to strike.

Soil around the sprinkler shall be compacted to prevent the sprinkler sinking. The sprinkler shall then be tested for correct operation and arc of coverage. Refer standard drawing layout D7 and D8.

F3.2 Drippers

Drippers shall be installed underneath the bark mulch Refer standard drawing layout D6.

F3.3 Valves

3.3.1 Solenoid Control Valves

All solenoid valves shall be installed in rectangular valve boxes. Threaded rigid PVC risers shall be used to ensure the valve sits a maximum of 100mm beneath the lid of the valve box for ease of maintenance. The valve assembly shall be centrally located within the box, and no part of the box shall be in contact with any part of the valve or connecting pipe work.

The valve assembly shall be fitted such that it is clear of any soil or backfill material. A 75mm layer of gravel shall be packed under each valve.

Drip zone valves shall incorporate a pressure regulator and 120 mesh filter.

Pressure regulators shall be adjusted to ensure the downstream pressure on the drip zones does not exceed 3 Bar. Refer standard drawing layout D3 and D5.

3.3.2 Mainline Isolation Valves

All mainline sluice valves shall be installed such that the operating nut is vertical, not on an incline. A 250mm (10") culvert pipe or similar shall be cut to fit around the valve and extend up into the valve box to allow easy access and prevent soil burying the valve.

All mainline sluice valves shall be correctly thrusted to prevent their movement as detailed in QLDC plan W05.

3.3.3 Lateral Isolation Valves

Lateral valves shall be installed at mainline depth. A 150mm duct tube shall be cut to fit over each valve operating handle and extend up into the valve box for operation with an extension key. Refer as detailed in QLDC plan W05.

3.3.4 Backflow Preventer

A line strainer shall be installed immediately upstream of the back flow preventer and its valves. An isolating valve must be installed upstream of the line strainer. The backflow preventer, line strainer and all associated valves shall be installed in an approved valve box that provides adequate access for testing and servicing, with the lid accessible at finished grade level. The assembly shall comply with the Water supplies Protection act 1961/87, in accordance with the practical solutions of the Building act 1991 for a medium hazard connection. The backflow Preventer must be tested by an independently qualified person (IQP) Refer standard drawing layout D1 and D2

3.3.5 Water Meter

A water meter shall be installed immediately upstream of the back flow preventer and its valves. The water meter shall be installed in an approved valve box that provides adequate access for testing and servicing (425mm x 575mm), with the lid accessible at finished grade level. Install with minimum of 10 pipe diameters upstream and 5 diameters downstream. Refer standard drawing layout D1 and D2

3.3.6 Quick Coupling Valves

All quick couplers shall be housed in valve boxes. All QCVs shall be connected to the mainline with swing joint risers to allow correct levelling. All QCVs shall be securely anchored in the ground with a stabilising bar and stainless steel U bolt clamp.

3.3.7 Drip Lateral Isolation Valves

Where drip isolation valves are used they shall be isolated with a lever ball valve.

These shall be housed in 150mm (6") boxes, located as close as possible to the LDPE feeder pipe.

3.3.8 Valve Boxes

All valve boxes shall be installed on treated timber or brick supports to prevent them settling. All valve box lids shall be set flush with surrounding ground. Where possible valve boxes shall be installed off pedestrian areas.

F3.4 Pipework

3.4.1 General

Pipe work installation involves the trenching, bedding, laying backfilling and commissioning of the pipe work system as shown on the plans.

3.4.2 Trench and Backfill

As per section 6.5 'Construction' from the QLDC Land Development and Subdivision Code of Practice:

6.5.1 Excavation

Excavation of existing carriageways shall conform to the TA's road opening procedures where these exist. Excavation in existing carriageways shall be carried out in a safe manner with the minimum disruption to traffic and pedestrians.

6.5.2 Embedment

Pipes and fitting shall be surrounded with a suitable bedding material in accordance with Appendix B drawings CM – 001 and CM – 002.

6.5.3 Backfilling and reinstatement

6.5.3.1 Carriageways

Backfilling shall be in accordance with the requirements of the TA.

Pipe trenches within a carriageway shall be backfilled using an approved hardfill placed immediately above the pipe embedment and compacted in layers not exceeding 200 mm in loose depth, as per Appendix B drawing CM – 002.

In existing sealed roads, the top section of the trench shall be backfilled as specified by 3.4.2.3. The depth of base course and type of finishing coat seal shall conform to the standard of the existing road construction.

6.5.3.2 Berms

Pipe trenches under grass berms and footpaths shall be backfilled in accordance with the requirements of Appendix B drawing CM – 002.

3.4.3 Pipework

All mainline pipes shall be installed to provide 1m of cover over the pipe in roads, with all other areas being a minimum of 400mm. All pipework shall be joined in accordance with manufacturer's instructions. Refer standard drawing layout. D9

3.4.4 Thrust Blocks

Concrete thrust blocks cast in situ shall be installed on the PVC mainline at each bend, tee, sluice valve or end of line to prevent movement. Pre cast blocks shall not be used. Prior to pouring concrete, the pipe and fittings shall be wrapped in polythene sheet. The thrust block shall be constructed in such a way that the load is evenly spread over a vertical trench wall in undisturbed ground.

3.4.5 Dripper Laterals

The LDPE laterals may be installed by mole plough as long as the minimum depth of 400mm is obtained, dripper, refer standard drawing layout. The lateral pipe must be flushed before the installation of drippers shall be installed on a 13mm lateral ring around the tree. Refer standard drawing layout.

The end of each 15mm lateral shall be fitted with a threaded end cap or in the case of a ring main shall be fitted via a tee to facilitate flushing prior to installing the dripper and for future maintenance.

3.4.6 Inline Drip Pipe

Inline drip pipe for landscape plantings shall be installed on top of the ground and securely anchored by ground staples at 1 metre intervals. Lateral lines supplying water to the in line drippers shall be thoroughly flushed so as to prevent any blockages in the inline drippers. The in line drip pipe will be covered by a bark mulch.

3.4.7 Fittings

All fittings shall be installed in accordance with manufacturer's instructions and in accordance with their intended design use.

F3.5 Control System

3.5.1 General

All electrical work shall be carried out in accordance with relevant

New Zealand standards and codes of practice by experienced personnel.

3.5.2 Field Control Cabling

All wire from the irrigation control unit to the valves shall be run in continuous lengths, no joins are permitted in these cables. The cable shall be laid beside the pipe. At joints and valves, 500mm of slack cable shall be left to allow the valve wiring to be completed with ease above ground.

At the control location each pair of wires shall be clearly labelled with the station number that they operate for ease of installation. All wire shall be laid in the trench adjacent to the pipe, the cable shall be 'snaked' and an expansion loop shall be left at bends and tee junctions to avoid stretching the cable when backfilling. The cable shall be laid on one side of the pipe, it shall not be laid crossing over the pipe.

At points where thrust blocks are to be poured the cable must not be buried in the concrete.

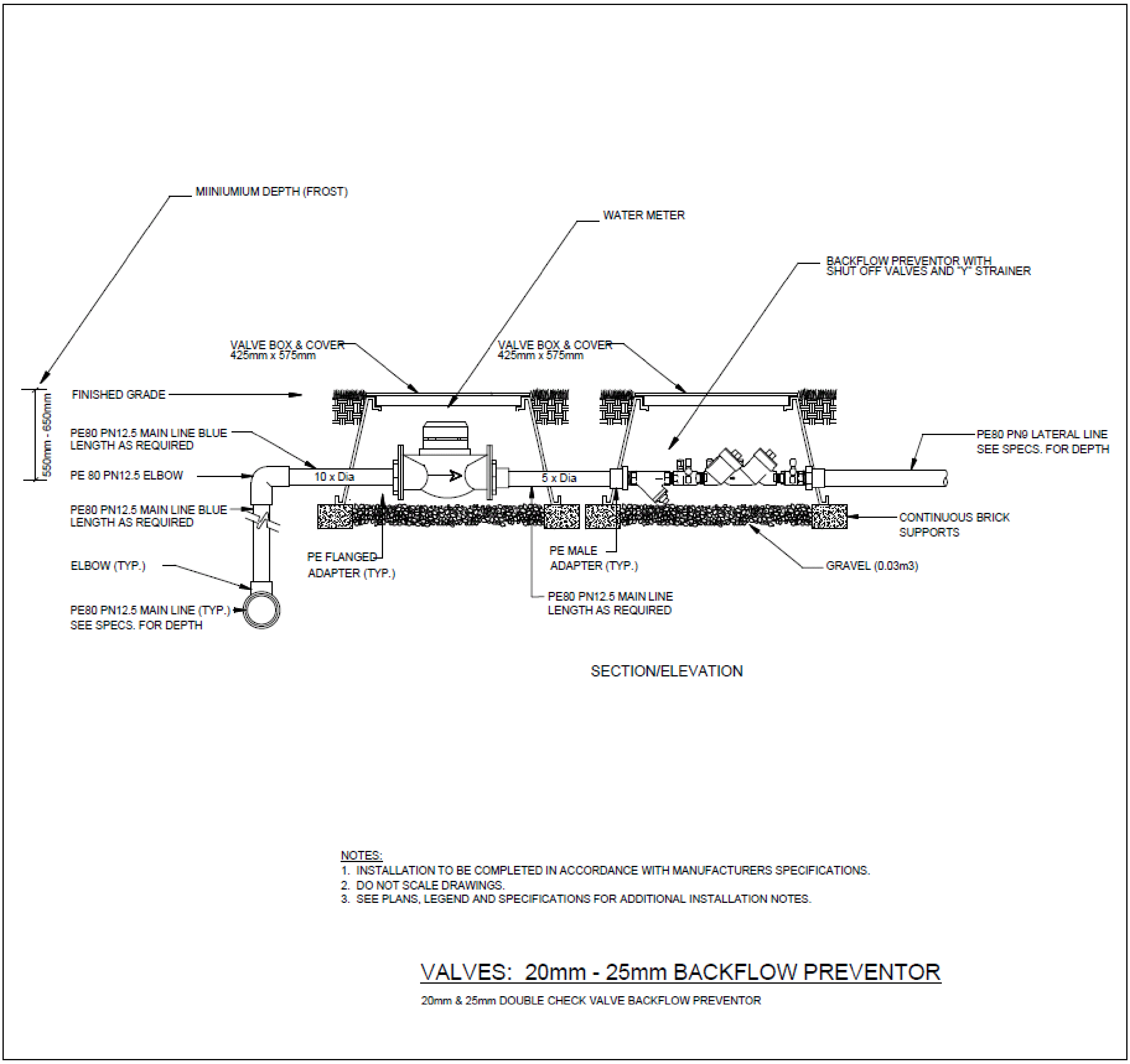
Wherever a cable junction is to be made there shall be at least 500mm of spare cable that can be brought above ground for ease of maintenance.

An accurate record of each control unit number and the stations they operate shall be maintained as the installation progresses. This shall be transferred to the controller as soon as possible and on a frequent basis.

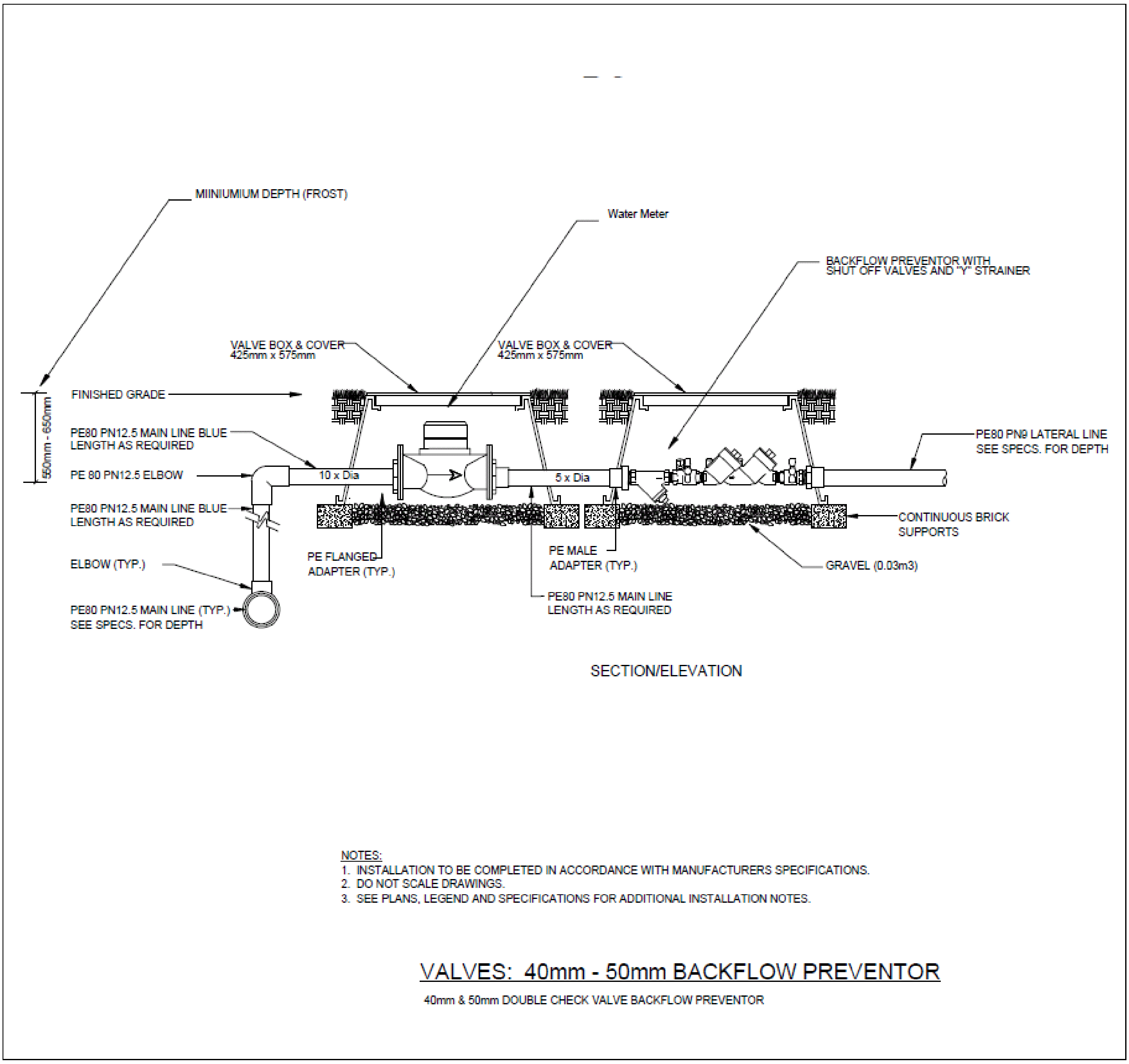
3.5.3 Irrigation Control Units

Controllers shall be installed as per the local authority codes and manufactures recommendations. Controllers shall also be earthed independently of the building earth. This earth shall have a maximum resistance as tested of 10 Ohms.

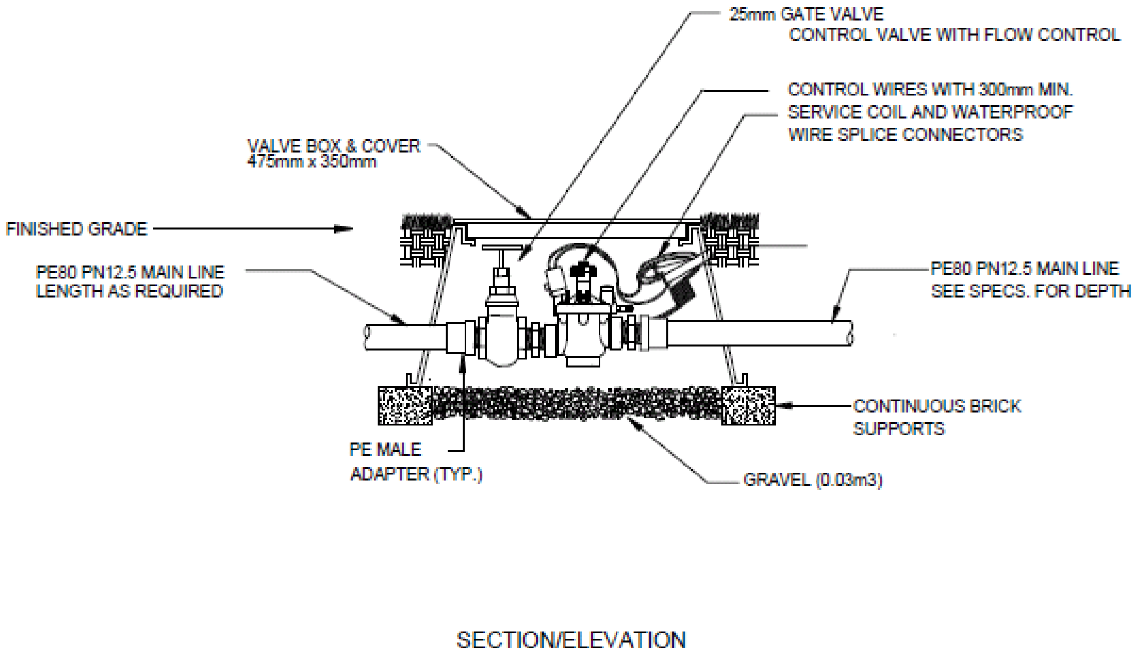
F2 Irrigation Standard Drawings



Drawing 0-1: Connection 20mm – 25mm



Drawing F0-2: Connection 40mm – 50mm

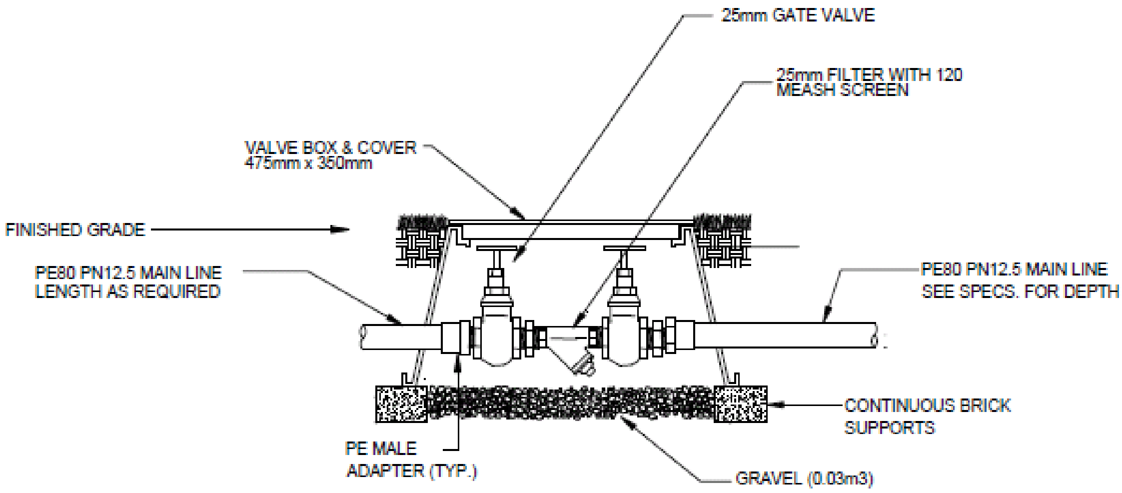


NOTES:
1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
2. DO NOT SCALE DRAWINGS.
3. SEE PLANS, LEGEND AND SPECIFICATIONS FOR ADDITIONAL INSTALLATION NOTES.

ISOLATING VALVE: 25mm SOLENOID VALVE

25mm Isolating Valve with Solenoid Valve

Drawing F0-3: Control Valving 25mm



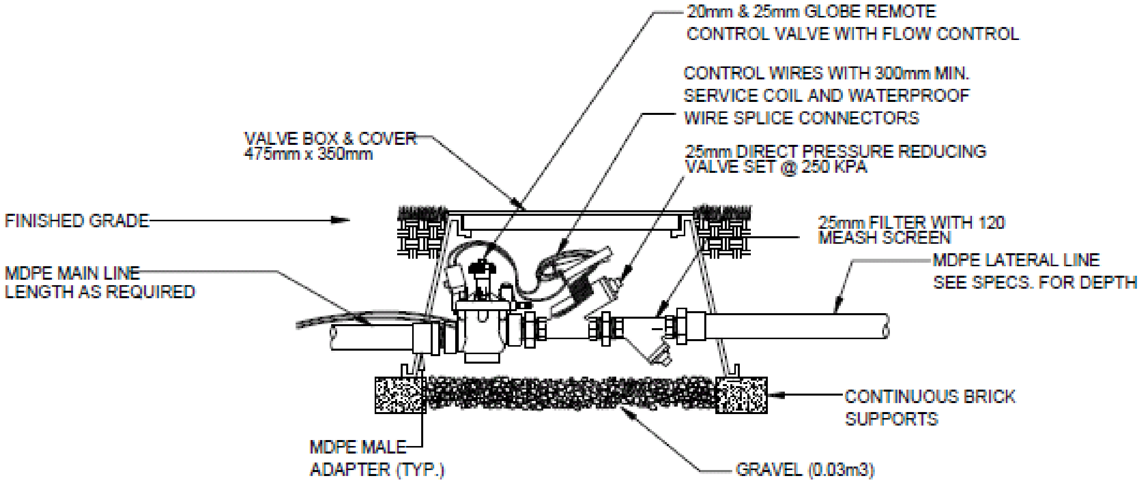
SECTION/ELEVATION

NOTES:
1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
2. DO NOT SCALE DRAWINGS.
3. SEE PLANS, LEGEND AND SPECIFICATIONS FOR ADDITIONAL INSTALLATION NOTES.

25mm FILTER WITH ISOLATING VAVLES

25mm Flilter with Isolating Valves

Drawing F0-4: Filter – 25mm



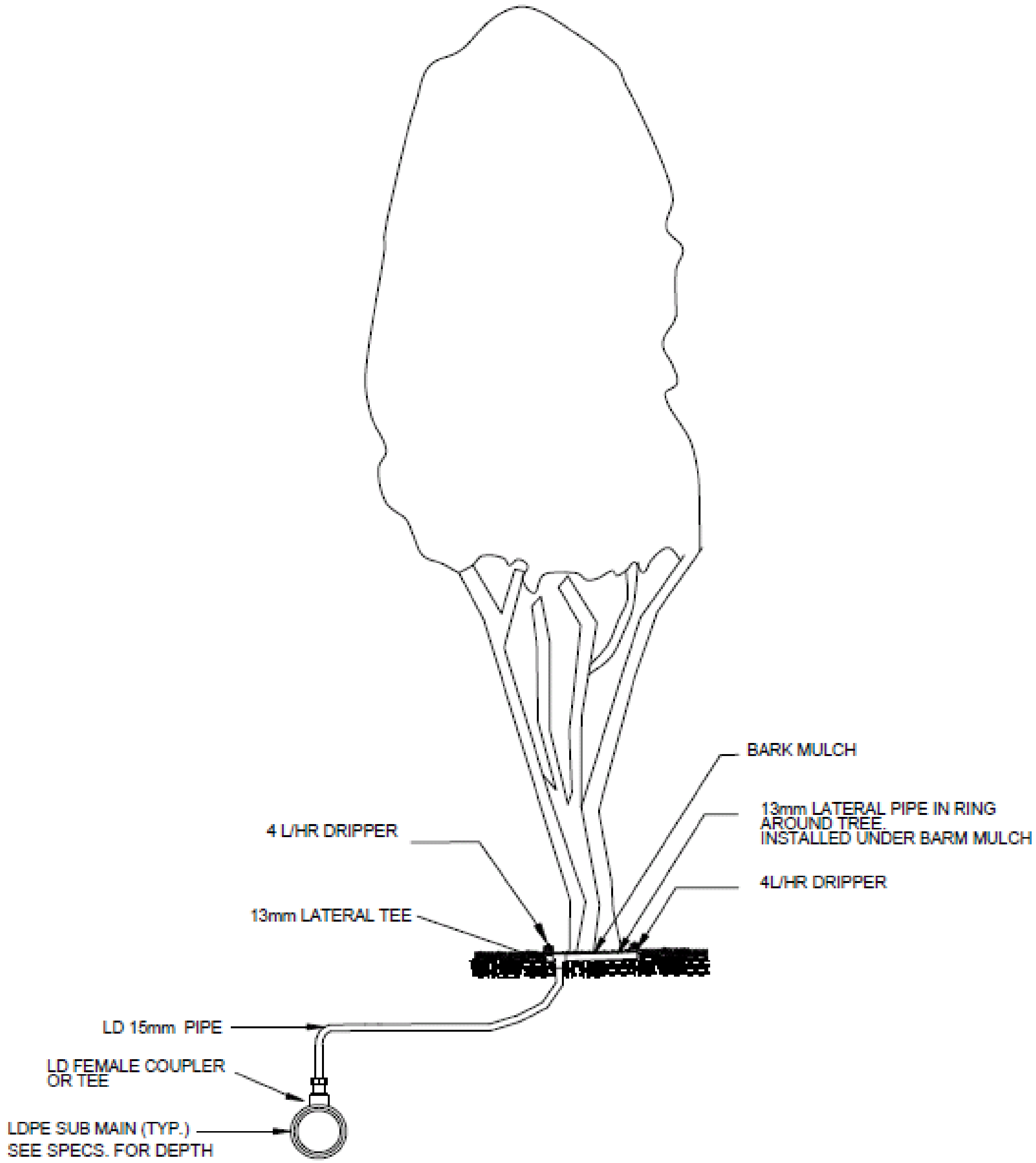
SECTION/ELEVATION

NOTES:
1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
2. DO NOT SCALE DRAWINGS.
3. SEE PLANS, LEGEND AND SPECIFICATIONS FOR ADDITIONAL INSTALLATION NOTES.

TRICKLE CONTROL VALVES: 25mm SOLENOID VALVE

25mm Solenoid Valve with 25mm Press/Reg Valve & 25mm Filter

Drawing F0-5: Trickle Control 25mm



SECTION/ELEVATION

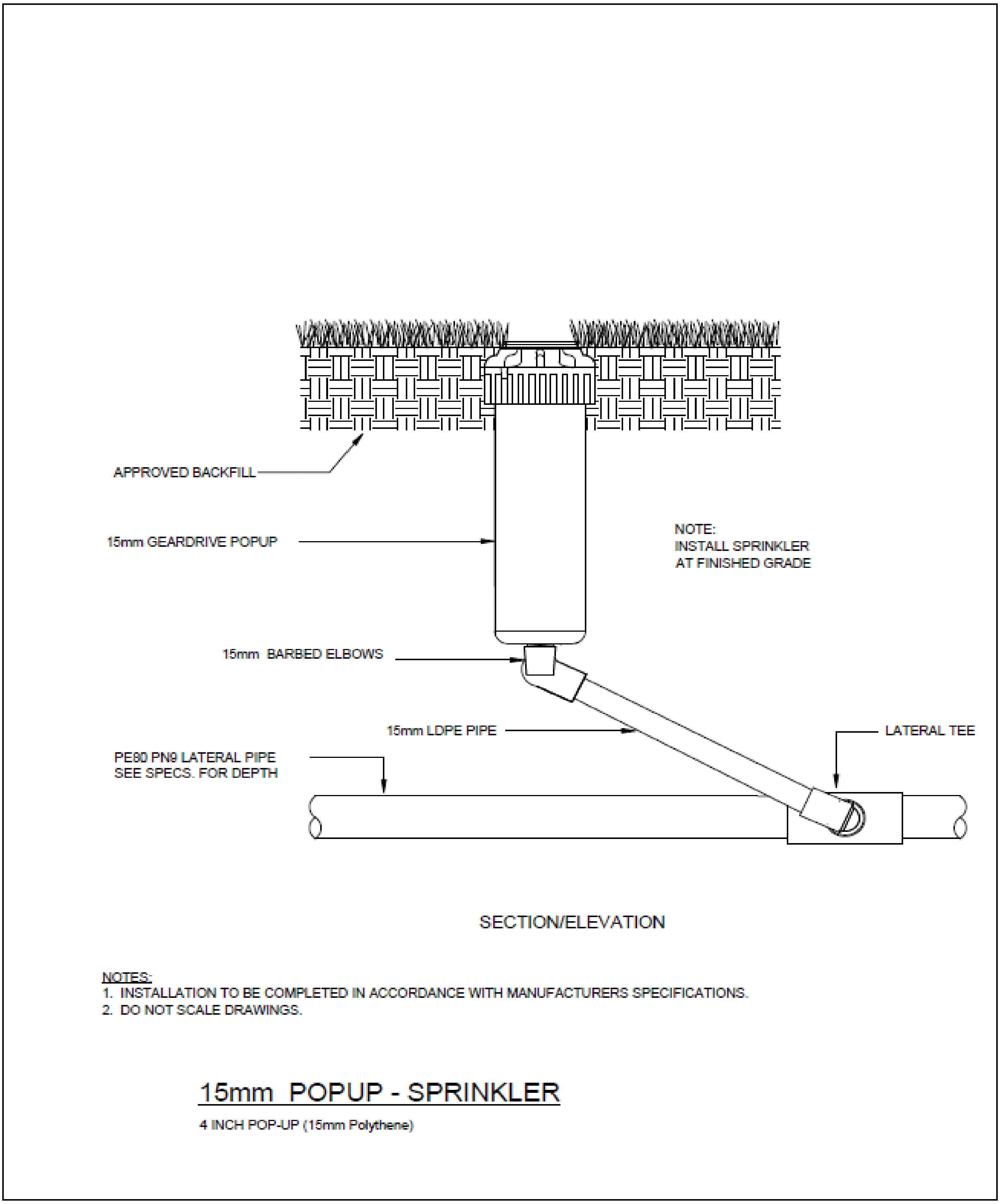
NOTES:

1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS.
2. DO NOT SCALE DRAWINGS.
3. SEE PLANS, LEGEND AND SPECIFICATIONS FOR ADDITIONAL INSTALLATION NOTES.

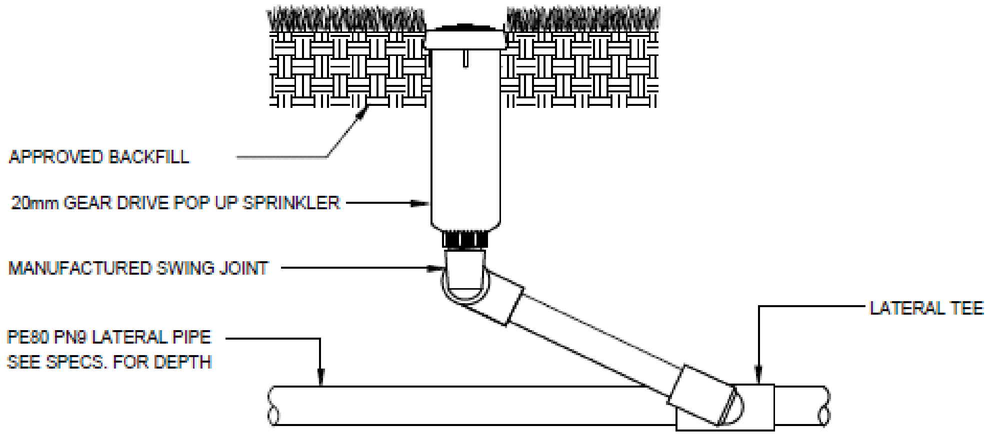
TRICKLE: DRIPPER

4 L/H Compensating Cleanable Dripper

Drawing F0-6: Trickle Dripper



Drawing F0-7: Popup Sprinkler 15mm



SECTION/ELEVATION

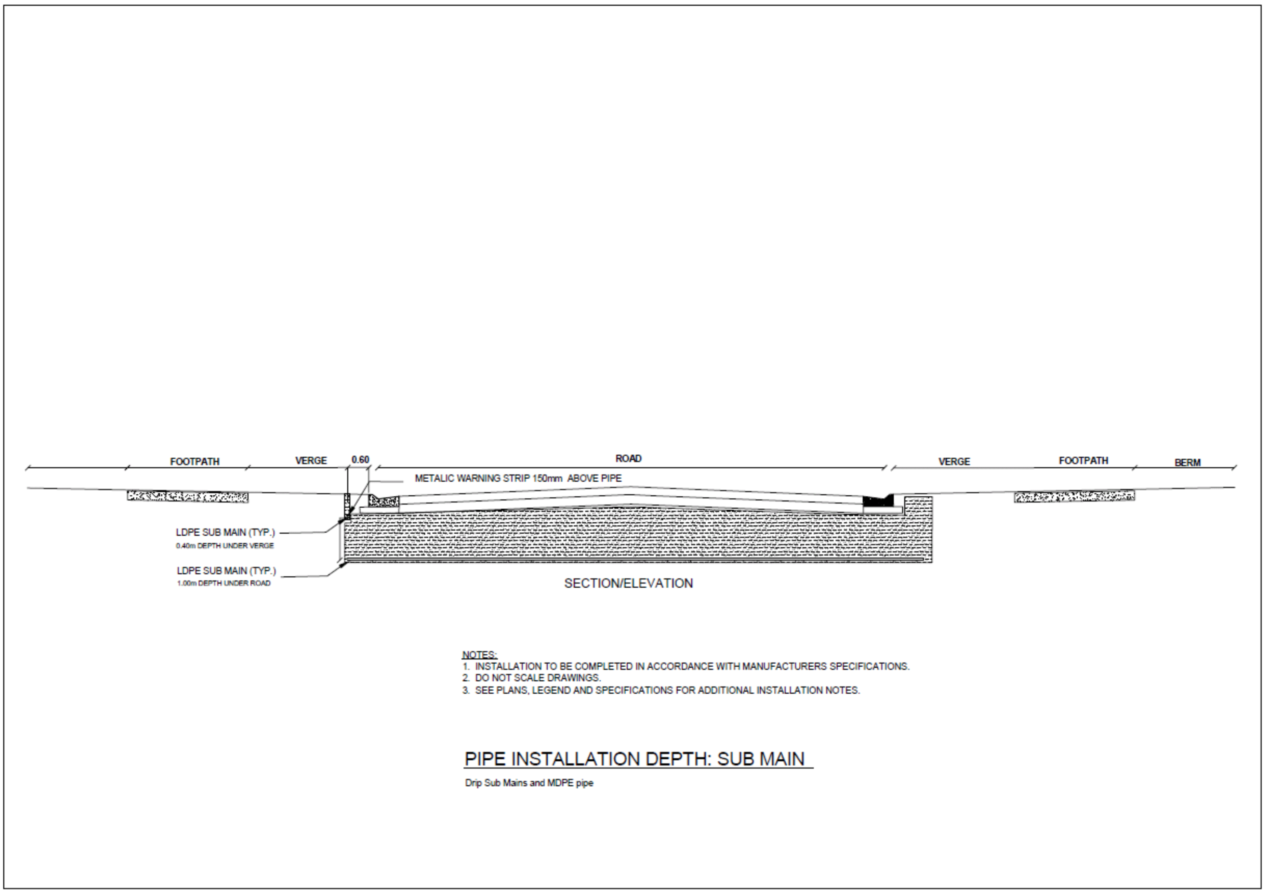
NOTES:

1. INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS.
2. DO NOT SCALE DRAWINGS.
3. INSTALL SPRINKLER AT FINISHED GRADE

20 mm GEAR DRIVE 100mm POP-UP

SINGLE-STREAM SPRINKLER, SWING JOINT

Drawing F0-8: Gear Drive Popup 20mm



Drawing F0-9: Pipe Installation - Submain

Appendix G – Sewer Pump Station

(normative)

G1 General Requirements

#	Function	Details
1	Landscaping	
	i.	All-weather vehicle access to the wet-well, valves, electrical and any other major equipment installed on site. Where indivisible components requiring servicing are between 20 and 200kg, design the access for a (crane mounted on a) light truck of: • *length = 5 metres,* • width = 2.5 metres and • maximum axle loading on 7.00 x 15 single tyred axle = 2500 kg ensuring that: • the rear axle of the truck mounted crane can be brought to within 2m of the vertical centreline of the component to be lifted, and • Insure there is sufficient head room to operate the crane.
	ii.	Hard surfacing (concrete or asphalt) to all areas where sludge, raw sewage or chemicals are likely to spill, draining to the wastewater system or wet-well
	iii.	Washdown area for pump cleaning – with drain back to wet well
	iv.	Ability to locate a mobile standby generator
2	Pumps	
	i.	Duty and standby required
	ii.	Flygt submersible where (where possible Flygt N-Technology pumps)
3	Motor control	
	i.	Soft starters compatible with Flygt pumps.
4	Pipework and valves	
	i.	Knife gate valves used for isolate of each pump and non-return ball valves (both should be housed in individual valve chamber beside wet well).
	ii.	Cast ball check valve
5	Wet well and emergency storage	
	i.	Minimum of nine hours storage (ADWF). A smaller wet well with off line storage is preferred. Where the pump station is considered “large” and has a standby generator and spare pump supplied (additional to duty / standby pumps) – with the agreement with Council, emergency storage may be reduced.
	ii.	May be constructed from pre cast concrete or fibre glass.
	iii.	Venting – Where applicable use of McBerns GM375 Mixed Media Odour filters
	iv.	Automatic well washing (on hinged bracket)
	v.	Manhole adjacent to pump station with cutoff valve. Note - SS knife valve with deflector plate on inlet pipe with valve spindle to top of well. *Allows wet-well and associated pipework to be safely isolated from the sewer system*
	vi.	All pipe work, riser joint & attachments within wet well shall be stainless steel 316
	vii.	Cover lids – aluminium construction; Type - SIKA pathway 1200 wide series
	viii.	Valve chambers and pits with a 50mm minimum diameter drain hole falling into the wet-well
	ix.	Locate the covers to enhance equipment maintenance and to permit the setting up of davits or tripods for entry to confined spaces.
	x.	Drop structure on the inlet at an angle of at least 45 degrees to prevent the forming of vortices on pumping
	xi.	Any ducts (electrical / control) shall be a minimum of 100mm diameter
6	Switchboard	
	i.	Beige in colour to reduce internal heat build-up.

	ii.	Weatherproof protection hoods for any instruments exposed to sunlight. *To prevent degradation of liquid crystal displays by ultraviolet light or moisture ingress from heating and cooling effects*.
	iii.	RTU aerial: Locate the external line-of-site aerial on the furthest side of the building from the road boundary whilst maintaining line of sight. Detail securing of aerials against wind and snow loading. Mount the aerial on a 50mm diameter aluminium scaffolding tube extending two metres above the top of the electrical control cabinet or building. Ensure this pipe is easily lowered to the ground for aerial maintenance
	iv.	Remote pump starting and stopping shall also be provided from the SCADA system
	v.	All ducting from the sewer well and valve chambers to electrical cabinet shall be filled with builders foam
	vi.	UPS required for SCADA control system – to operate for a minimum of 4 hours.
7	Remote Terminal Unit (RTU)	
	i.	Developer to provide proposed method of RTU communication to Veolia for approval. The developer is responsible for all costs associated with the provision of the SCADA communication.
	ii.	Developer is required to use the maintenance contractor for all changes required for the software configuration to Council's SCADA system and includes graphical interface, pump station reports and pump station generated alarms.
8	Magflow meter	
	i.	Isolating valve in the same or a separate concrete chamber downstream of the meter. *This valve allows isolation of the pressure main if the meter has to be removed, eliminating the requirement to drain the whole pressure main*
12	Water supply	
	i.	RPZ - Wilkins Double Check Valve assembly (Model 350) with DekoRRa 301-BG-C2 insulated backflow enclosure
	ii.	Inlet supply – 32mm Outlet – 25mm with female camlock connection and isolating valve
13	Public Toilets	
	i.	All new public toilet facilities with a pump station or septic tank must be connected to SCADA and comply with this Electrical and SCADA Standard.
	ii.	The following parameters should be monitored for new public toilets connected to SCADA: • Well levels • Pump status • High/low warnings • Any faults • Loss of communications
	iii.	Spare capacity in the RTU should be provided for a flow meter to be installed in the future.

ELECTRICAL & SCADA STANDARD

FOR WASTEWATER PUMP STATION SWITCHBOARD DESIGN & INSTALLATION IN THE QUEENSTOWN LAKES DISTRICT

Final version. July 2017

ELECTRICAL & SCADA STANDARD

WASTEWATER PUMP STATION SWITCHBOARD DESIGN

for:

Queenstown Lakes District Council

Queenstown Lakes District Council
10 Gorge Rd, Queenstown
Telephone (03) 441 0499

QUEENSTOWN LAKES DISTRICT COUNCIL

VERSION CONTROL

Pages	Update action	Date	By
All	Document revision	Nov 2016	Veolia
All	Document review	Feb 2017	Switchbuild
All	Document review	7 March 2017	QLDC
All	Draft version 1 issued.	7 March 2017	Veolia
All	Draft review	13 April 2017	QLDC, Pumptech
All	Amendments & updates	16 May 2017	Switchbuild
All	Final version	19 May 2017	Veolia
All	Final QLDC version	27 July 2017	QLDC

OVERVIEW

This Electrical & SCADA Standard for Submersible WWPS has been prepared for Queenstown Lakes District Council (QLDC) to provide for a consistent approach to QLDC submersible WWPS infrastructure through the enforcement by QLDC of a uniform standard.

The specification is prepared specific for Submersible WWPS [2 pump WWPS, external (non building housed) switchboard of <30 kW].

It is intended that:

- This Electrical & SCADA Standard: Submersible WWPS apply for all submersible WWPS of <30 kW within the Queenstown-Lakes District.
- This Electrical & SCADA Standard: Submersible WWPS form the basis for the preparation of tailored individual specifications for pump stations of ≥ 30kW within the Queenstown-Lakes District.

TABLE OF CONTENTS

APPENDICES

DRAWINGS

The enclosed Specification for the Design and Construction of Submersible Wastewater Pumping Station Switchboards up to 30 kW contains references to the following Australian and New Zealand Standards:

AS/NZS 60947.8: Low voltage switchgear and control gear - Protection of electric motors - Built-in thermal detectors and associated control units

AS/NZS 1100: Technical drawing

AS 1101: Graphic symbols for general engineering

AS/NZS 1102: Graphical symbols for electrotechnical documentation

AS 1307.2: Surge arresters - Metal-oxide surge arresters without gaps for a.c. systems

AS 1319: Safety signs for the occupational environment

AS/NZS 1554.6: Structural steel welding - Welding stainless steels for structural purposes

AS 1627.1: Metal finishing - Preparation and pre-treatment of surfaces - Removal of oil, grease and related contamination

AS/NZS 2053.2: Conduits and fittings for electrical installations - Rigid plain conduits and fittings of insulating material

AS/NZS CISPR 11: Industrial, scientific and medical (ISM) radio frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement

AS 2184: Low voltage switchgear and controlgear - Moulded-case circuit-breakers for rated voltages up to and including 600 V a.c. and 250 V d.c.

AS/NZS: 61000.3.6 Electromagnetic compatibility (EMC) - Limits - Assessment of emission limits for distorting loads in MV and HV power systems

AS/NZS 3000: Electrical installations (known as the Australian/New Zealand Wiring Rules)

AS/NZS 3008.1.2: Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical New Zealand installation conditions

AS 3111: Approval and test specification - Miniature overcurrent circuit-breakers

AS 3112: Approval and test specification - Plugs and socket-outlets

AS/NZS 3133: Approval and test specification - Air-break switches

AS/NZS 3190: Approval and test specification - Residual current devices (current-operated earth-leakage devices)

AS/NZS 3439.1: Low-voltage switchgear and controlgear assemblies - Type-tested and partially type-tested assemblies

AS/NZS 61000.6.1: Electromagnetic compatibility (EMC) - Generic standards - Immunity for residential, commercial and light-industrial environments

AS/NZS 4383: Preparation of documents used in electrotechnology

AS/NZS 4792: Hot-dip galvanised (zinc) coatings on ferrous hollow sections, applied by a continuous or a specialised process

AS/NZS 5000.1: Electric cables - Polymeric insulated - For working voltages up to and including 0.6/1 (1.2) kV

AS 5000.2: Electric cables - Polymeric insulated - For working voltages up to and including 450/750 V

AS/NZS 60044.1: Instrument transformer - Current transformers

AS 60269.1: Low-voltage fuses - General requirements

AS 60269.2: Low-voltage fuses - - Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application)

AS 60269.4: Low-voltage fuses - - Supplementary requirements for fuse-links for the protection of semiconductor devices

AS 60417: Graphical symbols for use on equipment

AS/NZS 60529: Degrees of protection provided by enclosures (IP Code)

AS 60947.2: Low-voltage switchgear and controlgear - Circuit-breakers

AS 60947.4.1: Low-voltage switchgear and controlgear - Contactors and motor-starters - Electromechanical contactors and motor-starters

AS 60947.4.2: Low-voltage switchgear and controlgear - Contactors and motor-starters - A.C. semiconductor motor controllers and starters

AS 60947.5.1: Low-voltage switchgear and controlgear - Control circuit devices and switching elements - Electromechanical control circuit devices

AS 61800.3: Adjustable speed electrical power drive systems - EMC requirements and specific test methods

AS/NZS CISPR 11: Industrial scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement

AS IEC 61131.1: Programmable controllers - General information

AS IEC 61131.2: Programmable controllers - Equipment requirements and tests

AS IEC 61131.3: Programmable controllers - Programming languages

IEC 60073: Basic and safety principles for man-machine interface, marking and identification - Coding principles for indicators and actuators

AS 60204.1: Safety of machinery—Electrical equipment of machines

AS 4024: Safeguarding of Machinery

AE-5014: Aurora Energy Network Connection Standards

1. SCOPE OF WORKS

Installation of switchboards designed for the purpose of providing submersible pump control need to meet numerous standards for vesting as future QLDC owned and operated facilities.

1.1 Key design parameters

As a minimum, the switchboard shall be designed to achieve the following;

- House all electrical components,
- Allow for space to accommodate larger switchgear should this be required in the future,
- Be safe for network operators to use without requirement of electrical qualification,
- Be positioned away from wells and other civil structures that might detrimentally affect operation and maintenance of the facility,
- Be built to withstand local environmental conditions together with the potential harm that may result from wastewater odours.
- Conform to this Electrical and SCADA standard.
- For QLDC sites be connected to the QLDC SCADA base station for system monitoring. This station is located at the Veolia Site office.
- For the Lake Hayes Scheme be connected to the SCADA base station for system monitoring. This station is located at the Fulton Hogan controlled, Lake Hayes Estate Treatment Station.

1.2 Conformance to standards

Any electrical contractor engaged to design and install electrical switchgear at new or upgraded wastewater pump stations needs to ensure the above, high level design parameters are met whilst conforming to the following relevant standards;

- Pump station design to meet QLDC infrastructure code requirements,
- Electrical installation to meet all relevant industry and safety standards,
- All electrical work shall be performed in accordance with AS/NZS 3000 and the requirements of the supplier of electrical energy.
- Design and functionality to meet this Electrical and SCADA standard,
- Design approval by QLDC or their approved representatives.

1.3 Expected deliverables

Equipment to be supplied and installed by the Electrical Contractor shall include but not be limited to:

(1) Civil works for switchboard footings.
(2) Supervision over installation of conduits and ducting.
(3) Supply of pumping station electrical cabinet, main switchboard and motor control.
(4) Wet well level indications, controls and associated wiring.
(5) Installation of mounting pole and floodlight.
(6) Installation of telemetry hardware and RTU.

1.4 Provision of documents

The provision of documents associated with the deliverable of new pump station switchboards shall be determined by the requirements of the contract. This shall include, but not be limited to, the following;

- Component list / specification / asset description. This list shall be supplied in a format determined by QLDC for the purpose of populating their Asset Management Database.
- Functional control description for the purpose of understanding pump station control logic and functionality.
- User manuals and operation manuals.
- Electrical drawings.
- Declaration of Conformity Statements
- Electrical Certificates of Compliance.
- Test certificates and commissioning documents.
- Programming software and print outs of control logic files.

1.5 Commissioning

Commissioning is the most important aspect of the contract. Electrical contractors are expected to liaise closely with QLDC 3 Waters Contractors Veolia (QLDC sites) and Fulton Hogan (Lake Hayes Sites) throughout this process.
A commissioning plan shall be developed together with check sheets that aim to test every functionality of the electrical and mechanical components installed.

Commissioning shall be witnessed by the appropriate QLDC staff and Veolia or Fulton Hogan representatives and signed off by them.

Commissioning checks completed on new wastewater facilities shall include functional testing on the following components;

- Pump performance
- Primary pump control
- Secondary pump control
- Well level measurement
- Flowmeter
- RTU communications and SCADA connectivity
- SCADA I/O checks

2. ELECTRICAL SUPPLY

2.1 General

The power supply shall be a 400/230 V ac, 50 Hz, 3 phase, 4 wire, earthed neutral electrical supply. Where possible, the pillar / plinth which houses the connection to the supplier of electrical energy shall be at pillar / pole top or transformer.

2.2 Electricity Metering

The supplier of electrical energy meters, CT's (if required) and other equipment shall be installed in a manner acceptable to the supplier of electrical energy.

The Electrical Contractor shall arrange with the supplier of electrical energy for the reuse of the existing or replacement of electrical meters as required.

The electrical contractor shall liaise with QLDCs energy retailer to request appropriate power metering at site. Depending on the anticipated power consumption of the facility, QLDC may request a pulse output off the power metering connected through to the RTU for remote monitoring of power use.

3. SWITCHBOARD DESIGN

3.1 Structural design

3.2 Concrete Footing

A concrete footing shall be installed except where ground conditions are deemed to be unstable by either the QLDC Chief Engineer or the Electrical Contractor, in which case an engineered design by an appropriately qualified civil engineer will need to be supplied.

The concrete footing dimensions shall be sized so that is larger in area than the footprint of the switchboard enclosure.

3.3 Plinth

Where the switchboard is floor-mounted, the switchboard shall be provided with a bolt-on, hot dip galvanised rolled steel or stainless steel channel plinth. The plinth shall be approximately 100 mm high and secured to the concrete footing using grade 316 stainless steel bolts and masonry anchors.

The plinth shall not be drilled except for enclosure and securing mounting holes.

3.3.1 Gasket

Where a plinth is required, a rubber gasket shall be installed between the plinth and the switchboard enclosure to ensure that moisture cannot be trapped between the surfaces. The gasket shall be 3mm thick, 3-ply insertion rubber reinforced with 2-ply canvas.

3.3.2 Bolts and fastening equipment

- Bolts used to secure switchboards or major items of equipment shall be in accordance with AS 1252 and have a bolting category of 8.8/S.
- All other bolts, nut, washers and fasteners shall be hot dipped galvanised or grade 316 stainless steel.
- All minor fastenings, saddles, screws, washers, nuts, metal threads etc. shall be grade 316 stainless steel.
- All stainless steel shall be insulated from other metals using plastic washers and spacers to ensure that no galvanic action and/or corrosion can take place.

3.3.3 Conduits

- Conduits shall be supplied and installed for cables in accordance with AS/NZS 3000, this clause and the drawings.
- The Electrical Contractor shall size conduits in accordance with AS/NZS 3000 for the number and size of cables to be installed within each conduit, but shall in no case be smaller in nominal size than 20 millimetre diameter.
- Electrical conduits and conduit fittings shall be medium duty rigid UPVC conduits and fittings in accordance with AS/NZS 2053.2.
- The Electrical Contractor shall install all conduits between the pumping station switchboard and the wetwell.
- The main conduits for the pump power and level control devices between the pumping station and the wetwell shall be 3 x 150mm diameter.
- Any underground bends or elbows installed should be swept long radius bends.
- Conduits shall be installed with a polypropylene draw wire in place to facilitate the drawing in of cables.
- Add in blocking the ducts from the sewer well to the cabinet to eliminate any fumes entering the cabinet

3.4 Switchboard specification

Design of the switchboard shall reflect the functionality required of the wastewater pump station.

The switchboard shall be designed with separate internal panels comprising the following critical hardware;

3.4.1 Switchgear

- Generator changeover switch or
- auto changeover switch if there is an on-site generator.

- If there is no on-site generator, an externally mounted generator plug is required for the purpose of connecting a mobile generator.
- External generator plug to be mounted in a lockable enclosure on the side of the switchboard.
- Generator plug should be designed to use with a portable generator of suitable size and application that can be used to run the pump station without the need for on site supervision from an operator ie the front doors of the external enclosure must be able to be closed and locked when a portable generator is connected to the switchboard.
- Generator plug to be IP54 rated.
- Sizing and specification of this socket shall be determined by rating of the pump motors and switchboard.
- Single phase likely to be a 3 pin 10 Amp socket with RCD protection
- 3 phase socket 32 amp, 5 pin plug.

3.4.2 Motor Control Centre

- Internal Switchboard Form 3A comprising individual compartments for the main incomer, tariff metering, local services, DB, level duty and telemetry controls, field terminations and pump starters (1 per starter)
- Live parts within an enclosure must be arranged to provide basic protection against direct or indirect contact.
- Soft starters or VSDs to run the pumps
- Pump motor isolators
- Power factor capacitors
- Phase rotation relays
- Under current / over current
- Over voltage / under voltage

3.4.3 Telemetry and SCADA hardware

- RTU to communicate to the SCADA base station
- PSU to provide low voltage supply to critical control gear,
- 24V DC UPS for backup power supply
- Suitable communication aerial
- Telemetry panel to be located in the upper portion of the switchboard, close to eye level.

3.4.4 Metering

- Network metering to conform to local Power Supply Authority Standards.

3.4.5 Distribution

- Circuit breakers for local distribution
- This may or may not include the pump circuit breakers

3.4.6 Pump control hardware and instrumentation

- Pump controller
- Primary level control

3.4.7 Flowmeter

- Electromagnetic flowmeter transmitter or display unit
- Pressure monitoring (if any)

3.5 Switchboard and component rating

External enclosures should be rated to IP56.

The switchboard shall be designed and manufactured in accordance with the drawings QLDC_WWPS_01 provided with this Specification and the following:

- Components installed such as motor fuses holders, isolating switches, contactors and motor plugs and sockets etc. shall be sized to suit these ratings.

- The motor starters/VSDs, motor fuses and thermal overloads used for the pumps shall be sized to suit the pump ratings.
- All switching and control devices shall be secured in the switchboard using DIN rail mounting wherever possible.

3.5.1 Switchboard Enclosure

Where a switchboard is to be installed externally, or when required by the project specification for internal switchboards, a custom built metal enclosure shall be in accordance with the following:

1) Principal switchboard enclosure requirements indicated in Appendix A, or where no Principal switchboard enclosure requirements are indicated should be 316 stainless steel to be resistant against UV and malodours generated from wastewater or other corrosive marine environments (e.g. marine) or where required by the project specification.

2) Front access shall be provided by hinged lockable doors. Opening the doors shall give access to a dead front panel on which controls and indications are mounted. Locks shall be in accordance with Section 3.4.1. Gas struts shall be used to assist door opening and being restrained.

3) Locking of the enclosure is by means of a stainless steel swing handle and roller rod assembly able to accommodate a standard QLDC water/waste water padlock.

4) Exterior sheetmetal shall have a minimum thickness of 2 mm. Large doors, or doors or panels with a large number of cut-outs, shall have additional thickness or shall have stiffeners added to ensure rigidity.

5) The top surface shall slope to prevent accumulation of water. The slope on single sided enclosures shall be such so as to direct water away from the front of the cubicle.

6) With doors and covers in position, provide a degree of protection in accordance with AS 1939 of not less than:
   (a) IP56 if any component within the enclosure has an IP rating of less than IP5X or
   (b) IP26 if all components within the enclosure have an IP rating of IP5X or greater.

7) Equipment which is installed within outdoor cubicles shall be protected against the effects of excessive temperature by either:
   (a) The equipment being de-rated to accommodate the higher ambient temperatures which are to be expected within the cubicles or
   (b) The cubicles being ventilated to ensure that the cubicle internal temperatures do not exceed the temperature ratings of the equipment (any ventilation shall not decrease the IP rating of the enclosure) and/or the fitting of a metal sun shield of appropriate design allowing for orientation when installed.

8) Ground and floor mounted cubicles shall be provided with a bolt-on, painted hot-dip galvanised (to AS/NZS 4680) rolled steel channel or stainless steel plinth 100mm high.

9) Seismic restraints should be used to secure the switchboard to any adjacent wall.

10) Provided with an interior switchable LED lamp(s) and a switched socket outlet (with RCD protection), accessible when the front door is open.

11) Switchboards and control panels shall be provided with thermostatically controlled anti-condensation heaters in accordance with Section 3.6.9.

12) Switchboard to be of beige colour with exact colour specification required to be ‘RAL 7035 Light Grey Ripple’ colour in order to ensure maximum heat dissipation from radiant and/or solar heat.

13) EG exteriors shall be powder coated with a minimum of one zinc shield base coat and one architectural polyester top coat to a thickness of 80 + or – 20 microns.

14) Stainless exteriors shall be roughed surface with a minimum of one 2 pack polyester etch primer and one architectural polyester top coat.

3.5.2 Displays and local lamp indication

All switches, controls, instrument displays and pump and level indicators used for the operation of the pump station shall be positioned on the switchboard such that there must be no direct or indirect contact with live conductive parts.

3.5.3 Stainless Steel Fabrication

Metalwork required to be manufactured from stainless steel shall be constructed in accordance with the following:

1) Manufactured from grade 316 stainless steel
2) Welding shall be in accordance with Table 4.5.1 or Table 4.5.2 of AS/NZS 1554.6 and the surface finish of welds shall be Grade II (a) or (c) in accordance with Table 6.2.1 of AS/NZS 1554.6.
3) Have a uniform texture on the external surface.

3.6 Ancillary extras

3.6.1 Door locks

Locking of cubicle doors, except for vandal resistant cubicles, shall be 3 point for all doors of height greater than 1000mm. Locks shall be cut with barrels allowing for QLDC contractor access. It should be noted that a different key is used to access Wanaka facilities from those in Queenstown.

Allowance shall be made for all internal doors to open at an angle of 90° when installed in the switchboard.

Padlocks are an acceptable method of securing external cabinet doors on electrical switchboards.

3.6.2 Mounting Pole for Antenna and Floodlight

The Electrical Contractor shall install a radio antenna on a mounting pole in accordance with drawing QLDC_WWPS_01

The mounting pole height shall be determined by the Telemetry Contractor and shall not be less than the height shown on drawing QLDC_WWPS_01

Mounting poles shall be manufactured from stainless steel in accordance with AS/NZS 4792.

3.6.3 Station Identification Signage

A station identification sign may be provided by the QLDC Chief Engineer. Where provided this shall be affixed to the switchboard enclosure by the Electrical Contractor in such a manner as to preserve the IP rating of the switchboard.

3.6.4 Electrical Danger Warning Sign

The Electrical Contractor shall supply and install a danger warning sign on the outside of one of the front doors of the switchboard enclosure. The danger warning sign shall be in accordance with AS 1319 and in particular clause 2.3.4 and shall be engraved “400 VOLTS” as per NZS 3000:2007.

3.6.5 Protection against shock

All electrical equipment installed within the pumping station switchboard shall be shrouded to IP 2X in accordance with AS/NZS 60529 to avoid accidental contact.

Electrical control equipment with an ingress protection rating less than IP 52 shall be mounted within metal enclosure(s) with an ingress protection rating of not less than IP 52 in accordance with AS/NZS 60529.

3.6.6 Service conditions

The equipment supplied shall be suitable and approved for operation in the following range of ambient conditions:

Maximum internal temperature	50°C
Minimum air temperature	-10°C

Equipment which is installed within the cubicle shall be protected against the effects of excessive temperature by either the equipment being de-rated to accommodate the higher ambient temperatures which are to be expected within the cubicles or the cubicles being ventilated to ensure that the cubicle internal temperatures do not exceed the temperature ratings of the equipment. Any ventilation shall not reduce the IP rating of the enclosure.

3.6.7 Forced ventilation or cooling

All cabinets exposed to direct sun should be shaded where possible or have a double skinned top / side.
Forced ventilation is only required when any Motor Control Centre (MCC) inside an electrical cabinet incorporates Variable Speed Drives (VSDs). The load banks inside VSDs result in the generation of additional heat output.
Cooling fans on both the internal enclosures and external cabinet are required in all instances when VSDs are mounted.

Electrical contractors are required to calculate the additional heat output resulting from VSD installations and ensure that this additional heat is dissipated and removed through installation of forced ventilation or cooling. No such cooling mechanisms are required where soft starters rated at ≤ 30kW are installed.

3.6.8 Cubicle Heaters

Cubicle heaters shall be in accordance with the following:

(1) Black heat strip heaters rated at approximately 20 watts per square metre of cubicle surface area and suitable for operation at 230 volts.

(2) Shall be of such a number and shall be installed so that heat from the heaters can readily circulate throughout the cubicles and that heat energy from the heaters will not damage materials or components adjacent to the heaters.

(3) Provided with a thermostat which will energise the heaters when the air temperature inside the cubicle is below 20ºC. The thermostat can be either built-in or separate and shall preferably be adjustable. On long panels additional thermostatically controlled heaters shall be supplied and installed, if required, to ensure adequate temperature control within the switchboard or control panel.

(4) Heater and thermostat terminals shall be shrouded to eliminate the possibility of accidental personal contact.

3.6.9 Switchboard Light

An interior switchable LED lamp shall be provided to provide illumination in the switchboard enclosure when the front door is open. The light shall be installed in a location as shown on the electrical drawings QLDC_WWPS_01

4. CABLE SPECIFICATION

4.1 General

- Power, instrumentation and control cables shall be installed in accordance with this clause and AS/NZS 3000.
- The Electrical Contractor shall install all cables between the pumping station switchboard and the wetwell.

4.2 Cable Routes and Methods of Installation

- Unless specified otherwise, cable shall be installed underground in conduits with pits as specified.

4.3 Cable Pits

- Unless otherwise agreed or specified cable pits shall be provided for all underground cable runs where cables change direction and at intervals in straight runs so as to allow easy pulling of the cables.
- Cable pits shall be provided with drainage facilities.
- Cable pits in footpaths or where there is no vehicle traffic shall be provided with covers equivalent to Gatic light duty category.
- Cable pits located where there is vehicle traffic (or loading) shall be provided with covers equivalent to Gatic heavy duty category.

4.4 Cable Joints

- Intermediate joints in cables shall not be permitted.

4.5 Cable Handling

- Cables shall be handled carefully from cable drums or spools.
- Kinks shall not be allowed to develop during unwinding or during installation.
- Cables shall not be subjected to bending radii of less than twelve times the outside diameter of the cables or the manufacturer's recommended minimum radius (whichever is the greater) at any stage during installation of the cables.
- Care shall be taken during installation of cables that the insulation and/or sheathing of the cables is not cut, abraded or otherwise damaged.
- Any cables which are damaged during installation shall be repaired or replaced by the Electrical Contractor to the satisfaction of the QLDC Chief Engineer at the Electrical Contractor's expense.

4.6 Cable Termination

- Cables shall be terminated at the terminals provided in the switchboards and control panels and on the various items of equipment which are supplied and/or installed by the Electrical Contractor.
- Spare cores shall be terminated.
- Cables shall be supported as necessary at all points of termination to prevent undue mechanical strain on the terminations.

4.7 Instrumentation Cable Screens

- Screens of instrumentation cables shall be individually terminated at both ends at insulated terminals.
- The screen between the cable sheath and the terminal shall be insulated with heat shrink tubing.
- The cable screens shall then be earthed at the switchboard end only by looping an earthing conductor between terminals.

4.8 Labelling

- Individual cores of control or instrumentation cables shall be labelled with printed slip on type full circle ferrules.
- The core identification shall correspond with the wiring diagrams.
- Cables shall be identified at the ends by a corrosion resistant tag printed with the cable identification used on circuit diagrams.

4.9 Field Cables

4.9.1 Power Cables

- Power cables shall be in accordance with AS/NZS 5000.1 or 5000.2. Sheathed cables shall have a PVC sheath unless otherwise specified and shall be suitable for use underground.
- All cables shall be of multistrand construction with copper conductors.
- The minimum cross sectional area of any cable shall be 1.5 mm^2.
- The Electrical Contractor shall be responsible for selecting cable sizes in accordance with AS/NZS 3008.1.2.

4.9.2 Control Cables

- Control cables which are required to operate at low voltages shall be stranded PVC insulated PVC sheathed conductor cables manufactured in accordance with AS/NZS 5000.1 or 5000.2 and having a minimum conductor cross sectional area of 1.5 mm^2.
- Control cables which are required to operate at extra low voltage shall be rated for the voltages and currents which they have to carry.
- Conductor cross sectional area shall be not less than 0.5 mm^2.
- For cables which connect input contacts to the switchboard the conductors shall be coloured red or white (as applicable) for single core cables and red/white for two core cables.
- Red coloured cores shall be connected to the terminal nearest the supply or active and white cores shall be used for the switched wires.
- For cables which connect output devices the conductor insulation shall be coloured red or black (as applicable) for single core cables and red/black for two core cables.
- Red coloured cores shall be connected to the terminal nearest the supply or active.

4.9.3 Instrumentation Cables

- Instrumentation cables shall consist of either single pairs or multiple pairs with each pair being of twisted PVC insulated stranded copper conductors in either case.
- Each instrumentation cable shall have an overall screen with a stranded copper drain wire and PVC sheath.
- The conductors of each pair shall have a minimum conductor area of 0.5 mm^2.
- Multicore cables shall be provided with a number of spare pairs equal to not less than 25% of the total number of installed pairs rounded to the next higher whole number.
- All spare pairs shall be terminated in terminals.

5. INTERNAL WIRING

5.1 Type

- The Electrical Contractor shall be responsible for selecting cable sizes, in accordance with AS/NZS 3008.1.2.
- Wiring shall be insulated stranded copper conductor in accordance with AS/NZS 5000.1 or 5000.2. Insulation material selected to suit environment.
- The wiring shall be adequately sized to carry the current and the minimum conductor size shall be 0.5mm^2 except in the case of current transformer wiring which shall have a minimum size of 2.5mm^2.
- The ends of control wiring that terminate within the switchboard shall be fitted with bootlace ferrules and identification labels.

5.2 Colour Coding

The insulation of cables and wires shall be in accordance with AS/NZS 3000 and as follows:

(1) Low voltage ac power circuits and CT wiring to be colour coded in accordance with the phase to which they are connected, i.e. RED, WHITE, BLUE with neutrals coloured BLACK.

(2) Low voltage ac cables to be RED or WHITE or BLUE with BLACK neutral.

Note: *Control supplies shall be derived from the white phase unless otherwise indicated.*

(3) Extra low voltage dc circuits to be coded GREY (+) and PINK (-).

(4) Extra low voltage ac circuits to be coded BROWN (phase) ORANGE (Neutral)

Note: *For two wire dc systems a black wire shall be used for the "earthy" end of the supply, and a red or blue conductor used for the other end depending if the supply is positive or negative with respect to earth.*

(5) Instrumentation loop wiring (4-20 mA, 1-5 V) to be coded GREY where not included within screened cables. Core colours within screened cables may be to the manufacturer's standard.

(6) Earth cable to be GREEN/YELLOW.

5.3 Wiring Installation

Wiring of size 2.5mm^2 or less shall be run wherever possible in side slotted PVC ducts with snap on covers. Ducts shall be adequately sized to accommodate the wiring, including field wiring where applicable. Where ducting is impractical, wiring may be loomed using proprietary looming or sleeving.

5.4 Termination

Internal wiring shall terminate at relays, contactors, switches etc.

All other outgoing wiring shall terminate at rail mounted clip-on type terminal blocks.

All terminals shall be mounted within a PVC enclosure in the cabling cubicle and be adequately shrouded to prevent accidental contact.

5.5 Junction boxes

Termination of motor cables from the pumps should be at a junction box located ***outside*** of the wet well. This is to allow ease of pump removal and to avoid degradation of asset from junction boxes or cable terminations damaged by gases in the wet well.

The purpose of the junction boxes is to allow electrical disconnection of the pump for removal or maintenance purposes without the need to disconnect the terminations at the switchboard.

The size and location of the junction boxes depends on pump motor size and the civil design and spatial layout of the new facility.

Junction boxes shall be located either in the valve chamber, attached to the side of concrete wall and positioned at a suitable point so as not to interfere with pipework, valve operation or lid / hatch opening.

Above ground junction boxes may be used where larger pump motors need to be terminated prior to the switchboard. These shall be secure and in lockable stainless steel cabinets and conform to all relevant industry and safety standards. The location of these junction boxes shall be between the switchboard and the wet well but shall not interfere with normal operations nor introduce any ergonomic or trip hazard within the pump station site.

The junction boxes shall be labelled clearly to map to the correct pump number.

6. MAJOR COMPONENTS

6.1 Motor Control Panel

The motor control panel shall be installed in the pumping station switchboard. The motor control panel shall be constructed of metal and have an ingress protection rating of not less than IP 52 in accordance with AS/NZS 60529.

The motor control panel is to have a mechanism that prevents access to the electrical wiring and components by unqualified personnel. This may be in the form of lockable handles, key locks, tool or other methods approved by the QLDC Chief Engineer.

The motor control panel shall house all controls for the pumping units. Operator control and indication equipment shall be located on the front panel of the motor control panel.

6.2 Remote Telemetry Unit

An RTU shall be installed in the pumping station switchboard by the Telemetry Contractor as shown on drawing QLDC_WWPS_01

The RTU shall be enclosed in a metal enclosure with an ingress protection rating of not less than IP 32 in accordance with AS/NZS 60529.

6.3 Earthing

Pumping station switchboard earthing shall be provided in accordance with AS/NZS 3000 and in particular the multiple earthed neutral (MEN) provisions of the rules. Any external earthing cables must be protected against mechanical damage.

6.4 Labelling

6.4.1 Controls and Indications

Controls and indications shall be labelled with titles provided in this Specification or, where these are not specified, titles which adequately and accurately describe the function of units.

The use of the manufacturer's standard escutcheon plates is permitted.

Purpose made labels shall be manufactured from engraved, laminated plastic which results in:

(1) white lettering on a red background for warning labels and

(2) black lettering on a white background for other labels.

The minimum lettering height for purpose made labels shall be 4mm.

Labels, other than manufacturer's standard escutcheon plates which shall be attached in accordance with the manufacturer's directions, shall be fixed to the surface by pins, screws.

Embossing tape shall not be used.

6.4.2 Contactors, Relays and Other Control Equipment

Contactors, relays and other components shall be labelled with the designation or label name used in the control circuits.

Labels shall be fixed by rivets, pins or screws.

Embossing tape shall not be used.

6.4.3 Terminals

Terminals shall be labelled with number corresponding to the control circuits and termination schedules.

6.4.4 Wiring

Wiring shall be labelled by means of slip on ferrules or heat shrink numbered to correspond with the control circuits. Jumper wires of less than 50 mm length and which are visible for their entire length need only be labelled once, but other wiring shall be labelled at each end.

6.5 Controls and Indications

6.5.1 General

Controls, indications and alarms shall be provided as required to operate the station.

6.5.2 Motor Protection

Motor thermal overload protection shall be provided as a minimum. Thermal overload protection shall be provided using a thermal overload relay or the soft starter/VSD inbuilt thermal protection. Where soft starter inbuilt thermal protection is used, the circuit shall be designed to ensure that the soft starter protection continues to monitor motor current when the soft starter is bypassed.

6.5.3 Control Voltages

Pump control circuits shall operate at 24 V dc, with the exception of the pump contactor coil circuits which where required to, may operate at 230 V ac.

6.5.4 Labelling

The following controls shall be provided and labelled (labels shown in upper case, colour shown in brackets) as a minimum:

(1) PUMP 1 MODE SELECTOR, AUTO/OFF/MANUAL
(2) PUMP 1 START
(3) PUMP 1 STOP
(4) PUMP 2 MODE SELECTOR, AUTO/OFF/MANUAL
(5) PUMP 2 START
(6) PUMP 2 STOP
(7) DUTY SELECTOR, 1-2/2-1/ROTATION
(8) PUMP STATION FAULT RESET (Black)
(9) MODE SELECTOR AUTO CONTROL / RTU CONTROL

6.5.5 Indications

The following indications shall be provided and labelled (labels shown in upper case, colour shown in brackets) as a minimum:

(1) PUMP 1 RUN (Green)
(2) PUMP 2 RUN (Green)
(3) PUMP 1 MOTOR FAULT (Red)
(4) PUMP 2 MOTOR FAULT (Red)
(5) PUMP 1 REMOTE LOCKOUT (Amber)
(6) PUMP 2 REMOTE LOCKOUT (Amber)
(7) PUMP 1 HOURS RUN
(8) PUMP 2 HOURS RUN
(9) PUMP 1 MOTOR CURRENT
(10) PUMP 2 MOTOR CURRENT
(11) SCADA (RTU) CONTROL ACTIVE (Blue)
(12) WETWELL HIGH LEVEL (Red)
(13) PUMP CONTROLLER FAULT (Red)
(14) WETWELL LEVEL (%)
(15) AC MAINS ON (White)

6.6 Control Circuits

Control Circuits shall be designed in accordance with the requirements of AS 60204.1 and AS 4024 and with this clause unless otherwise specified in the project Specification or shown on the Specification drawings.

Control circuits shall comply with the following:

(1) Local control circuits shall operate at 24 V dc.
(2) The following shall operate at 24 V dc:
    a. Indicator lights.
    b. Pushbuttons (with the possible exception of emergency stop pushbuttons).
    c. Control and selector switches.
    d. Other control equipment on cubicle front panels and false mounting panels.
    e. Control relays.
    f. Control wiring external to the switchboards or control panel.

(3) Alarm relays shall be energised in the non-alarm condition (failsafe).

(4) All functional unit (e.g. all pump) control circuits shall be designed to ensure that the functional unit is stopped (and latched out) if a power supply failure is detected in the switchboard at the site (as detected by the phase failure and under voltage relay). A delay shall be incorporated to ensure that short power "flicks" of less than 10 seconds duration are not considered as a power failure. This requirement shall apply in addition to any phase failure shutdown protection that may be provided on any functional unit variable speed drive or soft starter installed. Automatic fault reset shall be provided on power restoration for common controls and all functional units.

(5) Controls circuits shall be designed to ensure that all latched circuits are reset automatically and that items of equipment will be available to run without the need for manual resetting following a power failure.

(6) Control circuits and/or PLC programming shall be designed to ensure that starting of the first duty functional unit is delayed for an adjustable period of time after power is restored following a power supply failure (as detected by the phase failure and under voltage relay).

(7) Control circuits shall be designed to ensure that all faults are reset using a local FAULT RESET pushbutton. This local reset shall operate independently of any PLC installed and continue to operate if any PLC fails.

(8) Fault circuits shall be designed to ensure that items of equipment or functional unit alarms (once detected) remain active in the control system (following a fault sensing device reset) until the alarm is reset using the local FAULT RESET pushbutton or a remote fault reset function (when provided). This control system reset shall only be possible following resetting of the fault sensing device.

(9) Control circuits and switchboards shall be designed to ensure that manual resetting of all fault sensing devices (e.g. thermal overload, Soft Starter, VFD etc.) shall be possible from the front panel of (and external to) the switchboard (or false mounting panels where controls and indications are installed on the false mounting panel). This requirement does not apply to short circuit protective devices (i.e. circuit breakers) that are not providing motor overload protection (i.e. TOL protection).

(10) Control circuits for functional unit (e.g. a pump) shall be designed to ensure that RUN and FAULT (as a minimum) indicator lamps continue to operate when the functional unit has MANUAL mode selected and when any PLC installed fails. This requirement shall include functional units operated by variable speed drives (VFD's) where the functional unit has MANUAL of OFF selected and is operated directly from the VFD (or the VFD control panel).

(11) Pump protection faults (e.g. No Flow) shall be latched and time delayed and shall continue to provide protection when the pump is operating in all modes (e.g. MANUAL mode).

(12) All functional unit faults detected shall activate the functional unit local and remote (e.g. SCADA and telemetry) fault indication signals.

7. INSTALLATION REQUIREMENTS OF ELECTRICAL COMPONENTS

7.1 Ratings

Where current and/or voltage ratings for components are specified and/or shown on the specification drawings, components shall have ratings not less than those specified or shown.

Where current and/or voltage ratings are not specified or shown then components shall have current and voltage ratings adequate for the duty which they are to perform.

When determining the ratings allowance shall be made for:

(1) frequency of usage,
(2) making and breaking currents,
(3) power factor (where applicable),
(4) prospective fault current and
(5) ambient temperatures which will occur at the point of installation.

7.2 Degree of Protection

The degree of protection of components which are mounted on the outside of switchboards or control panels shall be suitable for the location and application and shall not be less than that of the switchboards or control panels.

The degree of protection for electrical equipment installed within the switchboard shall provide a degree of protection of not less than IP2X in accordance with AS/NZS 60529.

7.3 Circuit Breakers

All circuit breakers installed shall be selected to ensure that they discriminate with, and operate prior to, the supplier of electrical energy fuses upon occurrence of a fault. Circuit breakers installed to protect pump motor circuits shall be selected in accordance with the manufacturer's requirements to meet this specification.

7.3.1 Discrimination

Where circuit breakers are installed in series, discrimination shall be provided for tripping currents up to the maximum prospective fault current for the installation.

7.3.2 Moulded Case Circuit Breakers

Moulded case circuit breakers shall be in accordance with either AS 2184 or AS 60947.2 and the following:

(1) Three pole.
(2) Suitable for 400 volt 3 phase 50 Hz operation.
(3) Quick make manual closing.
(4) Quick break manual opening.
(5) Trip free.
(6) Automatic opening on overcurrent and short circuit.
(7) Provided with mechanical status indication, i.e. open, closed and fault.
(8) Lockable in the open position.
(9) Provided with safety interlocks to prevent the compartment door from being opened with the breaker in the closed position and to prevent the breaker from being closed with the compartment door opened.
(10) Suitable for uninterrupted duty.
(11) Rated for the full load current of the circuit.
(12) Have a rated short circuit making capacity not less than the prospective short circuit current of the supply.
(13) Have a rated service short circuit breaking capacity not less than the prospective short circuit current of the supply.
(14) Provided with instantaneous tripping.
(15) Provided with inverse time delay tripping.

7.3.3 Miniature Circuit Breakers

Single pole and multi-pole miniature circuit breakers shall be in accordance with AS 3111 and the following:

(1) Shall have a current interrupting capacity suitable for the prospective fault current and not less than 6 kA symmetrical.

(2) 3 single-pole breakers shall be replaceable by 1 three-pole breaker and vice versa.

(3) Any miniature circuit breaker which is used to isolate its associated electric motor shall, in addition, be provided with facilities to padlock the switch in the OPEN or OFF position.

7.4 Residual Current Devices

Residual current devices shall:

(1) Be in accordance with AS 3190.

(2) Be type II devices in accordance with AS 3190.

(3) Be combined miniature circuit breaker/residual current devices in accordance with the requirements of the miniature circuit breaker requirements of this specification.

Residual current devices shall be tested before being placed into service to ensure that:

(1) the tripping current is set to the appropriate value; and

(2) the unit trips in less than 30 milliseconds at a test current of 10 mA.

7.5 Isolating Switches

Isolating switches shall be in accordance with AS/NZS 3133. Any switch which is used to directly isolate its associated electric motor by switching the phase conductors shall be a motor control switch as defined in the Standard and shall, in addition, be provided with facilities to padlock the switch in the OPEN or OFF position.

All single phase isolating switches which are rated at 20 A and above and all multiphase isolating switches shall include a positive indication, which shall include the words 'ON' and 'OFF', of the position of the switch.

7.6 Composite Fuse Switch Units

Composite Fuse Switch (CFS) units shall be in accordance with the air break switch requirement of this specification and the following:

(3) Accommodate HRC fuses.

(4) Triple pole units.

(5) Individual contacts separately and fully shrouded.

(6) Barriers included between fuse cartridges to reduce the possibility of a phase to phase or phase to earth fault occurring.

(7) Shrouds, barriers and the complete moving contact assembly shall be removable from the CFS enclosure for maintenance purposes.

(8) Provided with facilities to padlock the unit in the OPEN or OFF position.

(9) Provided with safety interlocks to prevent the compartment door from being opened with the CFS unit in the closed position and to prevent the CFS unit from being closed with the compartment door opened.

7.7 Low-Voltage Fuses

Low voltage fuses shall be in accordance with the general requirements of AS 60269.1, applicable requirements of AS 60269.2 and AS 60269.4 and the following:

(1) Suitable for use on a 400/230V 50 Hz supply.

(2) Fuse links shall:
   (a) have a rated breaking capacity of not less than 50 kA at 400 volts 50 Hz or the prospective fault level at the point of installation whichever is higher and
   (b) be of the 'gG' or 'gM' type unless otherwise approved by the QLDC Chief Engineer.

(3) Fuse holders shall:
   (a) have a rated current and a rated power acceptance suitable for the fuse links and
   (b) have a protection rating of not less than IP2X in accordance with AS/NZS 60529 with the fuse carriers removed.

(4) Labels shall be fitted on, or immediately adjacent to, each fuse base or each 3 phase set of bases to identify the function and designation of the fuses and to specify the current ratings of the fuse links.

7.8 Meters

7.8.1 General

Where amps and voltages are not displayed on VSD or soft starter display panels, ammeters and voltmeters shall be provided. They shall be square bezel pattern, nominal size 96 mm with an approximate 240º movement. A multi-function meter may be used in place of individual voltmeter, ammeter, kilowatt meter etc. to measure and display the required parameters in a single unit.

7.8.2 Ammeters

Ammeters shall be in accordance with the following:

(1) Provided with a selector switch to allow selection of individual phase currents. An OFF position shall be provided.

(2) Accuracy of ±2.5% or better.

(3) Scaled to correspond to the rated primary current.

(4) Where used for measuring motor current, be overscaled to approximately 6 times the rated current of the associated motor. Full load current shall occur between 60% and 90% of full scale.

(5) Where used for other than measuring motor current, be overscaled to approximately two times the rated current of the circuit.

7.8.3 Voltmeters

Voltmeters shall be in accordance with the following:

(1) Provided with a voltmeter selector switch and potential fuses to allow selection of individual phase to phase voltages. No OFF position shall be provided.

(2) Accuracy of ±2.5% or better.

(3) Scaled to read between 0 and 500 volts.

7.8.4 Multi-function Meters

Multi-function meters shall be in accordance with the following:

(1) Measure and display voltage, current and power in a single integral unit at not less than ± 1% accuracy.

Additional parameters (energy, power factor, individual and total harmonic distortions etc.) shall be included as required by the project specification and/or drawings. The display shall be retained during power failure where used for energy measurement.

(2) Panel mounting.

(3) Suitable for monitoring a 3 phase unbalanced supply and load.

(4) Operation from a 230 V ac auxiliary supply.

(5) Provided with the following remote interfaces where required by the project specification:

(a) Digital and analogue inputs/outputs programmable to represent the selected parameters.

(b) RS-485 serial port with industry standard Ethernet protocol.

7.8.5 Hours Run Meters

Hours run meters shall be synchronous motor driven units with a display capable of registering not less than 999999 hours and shall be non-resettable.

7.8.6 Current Transformers

7.8.6.1 Metering Current Transformers

Metering current transformers shall be in accordance with AS 60044.1 and the following:

(1) Accuracy not lower than Class 0.2 or, where used with test sockets, kW meters, kWh meters or multi-function meters, not lower than Class 1M or higher as required by the project specification.

(2) Rated secondary current of 5 A.

(3) Rated burden sufficient to cover the burden imposed by the connected equipment including cables. Where a test socket is required, an additional burden of 5 VA shall be allowed for external equipment which may be plugged into the socket.

7.8.6.2 Protection Current Transformers

Protection current transformers shall be in accordance with AS 60044.1 and the following:

(1) Designated as 10P150F20 unless otherwise specified or required to suit the protection relay.

(2) Rated secondary current of preferably 1A.

(3) Transformer ratio shall be determined for correct operation of the associated relay under fault condition taking into consideration the rated accuracy limit factor of the transformer and the burden of the connected circuit.

(4) Provided with test taps where required to be used in conjunction with a test socket.

7.9 Control Relays

All control, interposing, latching and auxiliary relays shall be in accordance with AS 60947.5.1 and the following:

(1) If there is no control circuit or the voltage is not specified, then 24 V dc shall be used unless otherwise agreed by the QLDC Chief Engineer.

(2) Contacts shall be suitable for the type of duty required and shall have a current rating adequate for the load and, in any case, not less than 1 A.

(3) Plug in relays shall be provided with an LED status indicator.

If relays are of the plug-in type and mixed extra-low and low voltages are used within the relays, then all relays which have mixed voltages shall have a Certificate of Suitability from a recognised Statutory Authority for mixed voltage application. Such relays shall not be physically interchangeable with other plug-in relays within the system.

7.10 Timing Relays

Timing relays shall be in accordance with the following:

(1) Electronic type with an adjustable range.

(2) Suitable for operation on the voltage shown on the control circuit drawings or specified in the project specification. If there is no control circuit or the voltage is not specified, then 24 V dc shall be used unless otherwise agreed by the QLDC Chief Engineer.

(3) Contacts shall be suitable for the type of duty required and shall have a current rating adequate for the load and, in any case, not less than 1 A.

(4) Accuracy Class 1.5 or better.

7.11 Equipment Electronic Relays

Any electronic relays that are installed to control individual items of equipment (e.g. a pump) shall comply with the following:

(1) Have a minimum of 20% spare inputs and outputs installed.

(2) Be of the Make and Model specified in Appendix A, unless otherwise approved by the QLDC Chief Engineer.

(3) Operate from 24 V dc.

(4) A copy of all manuals including a disk copy of the program shall be provided.

(5) A copy of any programming software unless the software is the same as that used for programming the main control PLC.

(6) All hardware connectors necessary to allow for connection of a personal or laptop computer to the relay for making program changes shall be provided.

7.11.1 Float Switches

Float switches shall be of the make and model specified in Appendix A and shall contain both normally open and normally closed contacts.

7.11.2 Undervoltage and Phase Imbalance Relays

The relay shall be a combined phase imbalance and undervoltage type with a contact opening for the following:

(1) Voltage below 80% of nominal 400 V ac.

(2) Phase imbalance greater than value set. This value shall be adjustable from 5-15% and initially set at 10%.

7.11.3 Control Switching Devices and Indicator Lights

Pushbuttons, rotary switches and indicator lights shall be in accordance with AS 60947.5.1.

Indicator lights shall be high intensity LED type.

The colours of pushbuttons and indicator lights shall be in accordance with those defined in the project specification, this specification, or if not specified, in accordance with IEC 60073.

8. PUMP MOTOR CONTROL

8.1 Motor control mode

The mode and method of pump motor control shall be determined by the contract specification.
For small wastewater pump stations where this electrical and SCADA standard applies, soft starters are the preferential method of motor control. This assumes that the pumps shall only be required to run at full speed.

8.2 Motor Starting

Direct on line (DOL) starting may be used where allowed by the supplier of electrical energy if approved by the QLDC Chief Engineer. Soft starters/VSDs of the make and model specified in Appendix A and installed to manufacture recommendations shall be used for motor starting where the direct on line starting current exceeds the limitation on starting current set by the supplier of electrical energy. The use of VSDs over soft starters shall be approved by the Principal.

8.3 Motor Contactors

Motor contactors shall be in accordance with the following:

(1) 3-pole or where necessary 4-pole, air break, electromechanical type in accordance with AS 60947.4.1.

(2) Provided with Type 2 co-ordination with short-circuit protective devices in accordance with AS 60947.4.1.

(3) Utilisation category AC-3 and intermittent duty not less than Class 12 as defined in AS 60947.4.1, or a higher category and/or duty class to suit the specified operation requirements if required.

(4) A mechanical endurance of not less than 1 million operating cycles.

(5) Operating coils shall operate at 230 volts 50 Hz single phase.

8.4 Soft Starters

Soft starters shall be ac semiconductor type in accordance with AS 60947.4.2 and the following:

(1) Be of the make and model specified in Appendix A.

(2) Electronic starters are to be installed as per the manufactures recommendations.

(3) Provided with a bypass contactor to minimize energy loss and/or heat generation during operation unless otherwise agreed by the QLDC Chief Engineer.

(4) Where an emergency stop is required by the project specification, a contactor shall be provided in series with the soft starter with the emergency stop pushbutton hard-wired directly in the contactor circuit.

(5) Be designed and constructed to operate satisfactorily with an emergency stop contactor installed between the starter and the motor. This requirement shall apply at all motor loads up to and including the full load rating of the soft starter.

8.5 Variable Speed Drives

The switchboard design, electrical drawings and line diagrams developed as part of this standard is intended to cover for electrical installations and MCC specification where submersible pump motors are controlled on soft start rather than variable speed drive.

Should the contract specification or principal to the contract identify a requirement for VSD controlled pumps, installation of VSDs should, at minimum, conform to the requirements below;

(1) Shall be of the make and model specified in Appendix A.

(2) Electronic starters are to be installed as per the manufactures recommendations.

(3) C-tick compliant with harmonic and RFI filters incorporating input ac chokes if necessary to comply with the limits of electromagnetic and harmonic disturbances in accordance with AS/NZS CISPR 11, be rated and suitable for use in the first environment in accordance with AS 61800.3 and meet with the requirements of the supplier of electrical energy.

(4) Electromagnetic immunity in accordance with AS/NZS 4252.1.

(5) Capable of sustaining not less than 110% rated output current for a minimum of 1 minute.

(6) Motor cables and wiring shall be in accordance with the variable frequency drive supplier's recommendations. Such requirements shall include the cable type and installation method to satisfy the radio frequency interference and other requirements specified in this Specification.

(7) Harmonic mitigation shall be provided in accordance with network requirements.

(8) Output filters shall be provided to ensure motor maximum voltages are not exceeded.

8.6 Motor Protection Units

8.6.1 Thermal Overload Units

Thermal overload units shall be in accordance with AS 60947.4.1 and the following:

(1) Triple pole, differential action to enhance the performance of protection against phase imbalance or phase failure.

(2) Incorporate ambient temperature compensation.

(3) Include a provision to allow the trip setting to be adjusted.

(4) Suitable for alternative manual or automatic reset and initially selected to automatic reset if the control circuit has a separate RESET pushbutton.

8.6.2 Electronic Motor Protection Relays

Electronic motor protection relays shall be provided for the protection of motors rated at 15 kW and above and a soft starter or VFD is not fitted. The protection relays shall be in accordance with the following:

(1) Provide protection and separate indication for each of the following:

(a) Overload

(b) Winding overtemperature by means of thermistors

(c) Single phasing and asymmetry.

(2) Have selectable current and trip time settings.

(3) Have a test feature.

(4) Suitable for operation from a 230 V ac supply.

(5) Provide finger protection for the terminals (IP 2X) other than the main connections.

(6) Unaffected by the passage of short circuit currents through the unit.

Directly connected units (i.e. without the need for external current transformers) are preferred.

8.6.3 Thermistor Control Units

Thermistor control units shall be used to monitor the operation of thermistors built into motors unless the thermistors are monitored by an electronic motor protection relay.

The control units shall be in accordance with AS 1023.1 and the following:

(1) Suitable for a 230 V ac supply voltage.

(2) Provide a visual indication that a trip has occurred.

(3) Match the type of thermistor, i.e. positive or negative coefficient type.

9. PROGRAMMABLE LOGIC CONTROLLERS

9.1 Specification

(1) Shall be of the Make and Model specified in Appendix A unless otherwise approved by the QLDC Chief Engineer.

(2) Ethernet link shall preferably be used for inter-PLC communications and for communications with a host SCADA system where applicable. Any PLC connected to a SCADA system shall be fitted with one (1) dedicated communication port for that purpose.

(3) An electronic copy of PLC ladder program shall be supplied unless agreed by the QLDC Chief Engineer.

(4) A copy of PLC manuals shall be supplied unless agreed by the QLDC Chief Engineer.

9.2 PLC Programming

The Contractor shall be responsible for programming the PLC.

The contractor should ensure all key parameters and set points may be operator adjustable by the operation and maintenance contractor to allow for adjustment in operational efficiency.

The contractor is advised to communicate the control philosophy of the pump station to the operation and maintenance contractor at the earliest opportunity in order that submersible pump operation is consistent with other pump stations across the Queenstown Lakes district.

9.3 PID control

PLC control loops employing PID control shall be designed and programmed to ensure that the analogue PLC process variable output signal (i.e. pump speed control signal) is set equal to zero % and the PID calculations cease when the controlled device is not running (i.e. pump is stopped). The process variable signal shall commence calculations using signals that are present when the controlled device commences operation (i.e. “anti-reset windup” shall be programmed into the PLC). Such programming and calculations shall ensure that the process variable does not drive to full scale 100% when the controlled device is started.

When telemetry analogue output signals are used as inputs to the control system for setpoints or control setting, PLC programming shall be designed to ensure that only valid signals are accepted by the PLC. This shall be achieved using time based validation of input signals. The validation shall check input values at regular time intervals (expected to be in the order of 2-10 seconds) and accept the most recent valid value as the control variable. Time validation shall not be used on control signals that are used as feedback in PID control loops. If an invalid setpoint or control signal (e.g. signal < 4 mA or > 20 mA) is detected by the control PLC, the previous value of that signal shall continue to be used by the control system until the next different valid control signal is detected.

If PLC programmes are protected by password, then that password shall be noted in the site documentation and be recorded at the SCADA base station.

9.4 HMI Touchscreen

Any touchscreen installed shall be in accordance with the following:

(1) Shall be of the Make and Model specified in Appendix A unless otherwise approved by the QLDC Chief Engineer.

(2) All parameters above shall be easily viewable and adjustable from the front of the touchscreen.

(3) The Touchscreen shall communicate directly to the main control PLC.

(4) The touchscreen shall be provided with two levels of security access coding to restrict access to authorised personnel only. Level one shall be for all liquid level and flow setpoints and level two shall be for PID control parameters and PLC time delay settings in addition to flow and level setpoints. No security shall be required for viewing operational parameters and status information.

(5) The touchscreen shall be colour with a minimum screen size of 140 mm.

(6) The Contractor shall program the touchscreen and provide an electronic copy of the final program to the Principal.

(7) The Contractor shall design the touchscreen screen displays. All such screen displays shall be approved by the QLDC Chief Engineer.

(8) Draft versions of HMI screens are to be sent for peer review.

Any touchscreen installed shall be mounted in the common control cubicle of the switchboard.

The following information shall be displayed on the touchscreen as a minimum:

(1) The current duty selection status for each item of equipment.

(2) Operational status (e.g. run/stop, open/close) for each item of equipment.

(3) Status of all alarms installed for each item of equipment.

(4) Other operation parameters for each item of equipment.

(5) The duty setpoints for each item of equipment.

The touchscreen shall be used to interface and display the following PLC parameters:

(1) All level and flow operational values.

(2) Alarm setpoints.

(3) Control parameters.

(4) PID control parameters for all control systems.

10. PUMP CONTROL SYSTEM

10.1 Pump configuration

The configuration of the pumps shall be determined at the design stage. This can be one of two configurations;

(1) Duty / standby. This set up will work to run only one pump at any one time. This may be as a result of constraints to power supply and / or hydraulic conditions. This set up will work to run a standby pump when the standby pump start level is reached. This will be as a result of duty pump failure and/or high inflow conditions. Under this configuration the duty pump has to stop running prior to standby start.

(2) Duty / assist. This set up will work to run an assist pump when the assist pump start level is reached. This may be as a result of duty pump failure and/or high inflow conditions. Under this configuration the assist pump can run together with the duty pump.

10.2 Duty rotation

The pump controller shall be programmed to rotate duty pump after each pump cycle. This is to ensure all pumps are regularly run.

Where this function is not a feature of the controller, a duty selector switch shall be installed and shall be labelled 1-2, 2-1.

When 1-2 is selected, pump 1 shall be the duty pump and operate from the duty 1 start and stop levels.

When 2-1 is selected, pump 2 shall be the duty pump and operate from the duty 1 start and stop levels.

The initial setting for the duty start and stop level setpoints shall be determined by the design.

10.3 Pump mode control

A mode selector switch shall be provided for each pump. The mode selector shall have an AUTO, OFF and MANUAL position.

- When pump 1 mode selector has MANUAL selected, pump 1 shall start. irrespective of the wetwell level or SCADA control systems.
- When pump 1 mode selector has AUTO selected, pump 1 shall operate off the primary level measurement device and pump controller.
- When pump 1 mode selector has OFF selected pump 1 shall not run.
- Control for the pump 2 mode selector shall be similar to that of pump 1.
- The operation of pumps when in MANUAL mode shall be independent of any electronic device(s) or common control components other than motor protection. and shall not be connected to such device(s) (e.g. manual running shall be possible during complete failure of the primary level measurement device and pump controller or SCADA system). Manual running shall be possible during complete failure of the primary level measurement device and pump controller or SCADA system.

10.4 Pump control systems

Pumps shall start and stop depending on the sewage level in the wetwell as determined by set points programmed in the pump controller.

The pumping station shall be controlled by two independent pump control systems as follows;

(1) Primary pump control (operating off a pump controller and wet well level measurement device),

(2) Secondary pump control system (operating off floats or alternative).

Remote pump starting and stopping shall also be provided from the SCADA system using Control Outputs off the RTU.

Design of wastewater pump stations in this manner allows for a good level of redundancy should one of these pump control systems fail.

10.4.1 Primary pump control

The primary level measurement device and pump controller shall operate when the mode selector has AUTO selected.

Pump start and stop points shall be programmed into the pump controller and labelled as follows:

(1) START DUTY PUMP

(2) STOP DUTY PUMP

(3) START STANDBY PUMP

(4) STOP STANDBY PUMP

All of the above level setpoints shall represent wetwell level and shall be adjustable between 5% and 95% of wetwell level in 1% increments. All level settings shall be programmed in the pump controller and remain operator adjustable.

- The duty pump shall start when the sewage level increases to the START DUTY level and stop when the level falls to the STOP DUTY level.
- The standby pump will start when the sewage level increases to the START STANDBY level and stop when the level falls to the STOP STANDBY level.

10.4.2 Secondary pump control

The secondary pump control system shall operate from independent float switches suspended in the wet well. The control circuit shall be wired completely independently from the primary control system in order to provide a fully redundant pump control function.

This secondary pump control system is required to work when any component of the primary control system fails. The functional control of this secondary pump control system is required to achieve the following;

- Automatic switch over of duty / standby and assist pump control functions without intervention of operators,
- Secondary pump start set point configured to be higher than primary control duty start setpoint,
- Pump run signals to be communicated through to the RTU.
- SCADA alarm output to notify operators of the failure of primary pump control system.

Design of the secondary pump control system shall align with the pump configuration when in primary control mode.

10.4.3 RTU Control

Basic automated control of the pumps can also be achieved through pump control programmes downloaded to the RTU at site. The use of these programmes must be agreed by the QLDC Chief Engineer. The programmes shall be supplied by QLDC's SCADA system administrators.

This method of pump control differs from the primary and secondary control systems in that it requires manual selection by the operator on site via a control switch.

It is a useful mechanism for running the pump station in automatic control when the pump controller has failed but the level measurement device remains operational.

10.4.3.1 RTU control switch

In order to facilitate this feature, a two way mode switch is required to be installed. This switch shall be labelled Level Control / Local - RTU

Activation of this switch to RTU control enables the following;

- Disengage of primary pump control system,
- Activation of RTU control outputs.
- Automated pump running off set points programmed into RTU.
- Remote manual control of pumps via the SCADA system (this should only be possible when the local pump control mode switches are in AUTO).

The pump run signal from the SCADA system shall operate the pump when the pump mode selector for that pump is in the AUTO position but shall not operate the pump if the pump mode selector is in the MANUAL or OFF position.

10.5 Remote fault resetting

10.5.1 High / low level resets

High and low level fault conditions shall be able to be reset manually or via the SCADA system.

A pulse signal from the SCADA system shall be initiated from the base station which when activated will reset the pump station fault. This is a useful mechanism when the high and low level faults activate as a result of a level condition which clears itself.

11. PUMP CONTROL HARDWARE

11.1 Pump controller

For small wastewater pump stations servicing residential developments, QLDC is satisfied that the telemetry RTU can provide basic primary pump control functionality. This negates the need for a separate pump controller. The use of these programmes must be agreed by the QLDC Chief Engineer.
Secondary pump control systems are a compulsory requirement of all pump station designs.

Approved pump controllers presently in use across the Queenstown Lakes District include the following devices;

- Siemens MultiRanger 200 (MR200) pump controller,
- MultiTrode MultiSmart pump controller.
- PLC type as specified in Appendix A.

The pump controller shall provide for a 4-20 mA DC wetwell level input signal, a relay output with changeover contacts for Duty 1 pump run, Duty 2 pump run and level transducer fault.

If the pump controller is programmable, then the Electrical Contractor shall supply a device programmer or appropriate PC software and hardware to program the device.

11.2 Level measurement

Level measurement at QLDC wastewater pump stations is to be undertaken through use of a hydrostatic level transducer. They shall be suitable for use in wastewater and installed to manufactures recommendations.

The transducers shall be configured into any pump control module on site and also be connected to the RTU for remote monitoring via SCADA.

Primary level measurement requires a method of returning an analogue level well level % back to the SCADA independent of the output from the pump controller. This is to ensure remote monitoring of well level can be observed where the pump controller is not operational.

11.2.1 Installation

The level sensor shall be mounted in accordance with the manufacturer's instructions. Hydrostatic level transducers need to be installed in stilling tubes mounted inside the pump station.

The purpose of the stilling tube is to protect the sensor. The stilling tube shall be made of PVC or stainless steel in order that it is suitable for use in wastewater. It shall be hydraulically linked to the well level in order that sensor measurement accurately reflects well level.

The stilling tube shall be attached to a side wall of the wet well and allow for easy access for operators to remove and clean the transducer inside. All mounting brackets, bolts, nuts and washers shall be manufactured from grade 316 stainless steel.

The level sensor shall be located such that the level sensor and mounting equipment shall not interfere or foul with the pumps during their removal and reinstatement in the wetwell or with the normal removal of any safety grid installed in the wetwell.

- The wetwell level sensor shall be hard wired to the pumping station switchboard.
- Power for all level sensors shall be provided from the switchboard.
- All cables shall be in accordance with this Specification.
- If the level sensor is a non contact type then the level sensor shall be located such that the beam does not detect pumps, pipes and other obstacles in the wetwell.
- Electrical installation of this instrument requires the analogue input signal to be split between RTU and pump controller.
- This is to be achieved using a signal isolator in order that each of these circuits remain separate from each other.

11.2.2 Level display

A local level display of well level (%) shall be mounted on the control panel of the switchboard in order that operators are able to determine the level of liquid in the pump station without the need to dial into the SCADA system.

11.2.3 Scaling

Configuration of the level measurement device to the pump controller is required as part of local pump control commissioning. The span of the level measurement (metres) is a critical value and allows QLDC and the maintenance contractor to correlate liquid level with volume for the purpose of engineering design and performance.

- The span of the level transducer should reflect the depth of the wet well from a point above the invert level to the emergency storage chamber to the bottom of the wet well. This is to ensure that any overflow to the emergency storage chamber is captured via the level measurement device.
- The electrical contractor shall supply this value to the maintenance contractor during the commissioning phase.

11.2.4 Operation

- The hydrostatic level transducer shall operate from a DC battery-backed supply so that it continues to operate and provide a wetwell level signal to the telemetry system during times of power failure.
- The level transducer shall be capable of measuring level over the whole height of the wetwell in which it is installed.
- Where the level transducer 4-20 mA signal has a fixed range, that range should be chosen to correspond as closely as possible to the actual wetwell full level.
- The 4-20 mA signal shall be calibrated such that 4 mA is the wetwell empty level and 20 mA corresponds to overflow level.
- If the level sensor is a non-contact type then the unit shall have in built temperature compensation and be suitable for the conditions inside the wetwell.
- The unit shall have an ingress protection rating of not less than IP 65 in accordance with AS/NZS 60529.

12. BACK UP FLOATS AND PROBES

Back up float switches and/or level probes have an important role to play in the signalling of critical pump station levels to the operator. These are generally set up in order that low level and high level alarms are generated when the liquid of sewage reaches certain levels in the main wet well.
Back up float signals are required to be connected through to the RTU for SCADA alarming. Any high or low level float switches installed need to be independent of the main level measurement device for the purpose of autonomous status feedback.

This standard allows for high and low level liquid detection through the use of two alternative instruments;

- Float switches as per the Make and Model specified in Appendix A unless otherwise approved by the QLDC Chief Engineer,
- Liquid level probe, as per the Make and Model specified in Appendix A unless otherwise approved by the QLDC Chief Engineer.

12.1 Float Switches

Two float switches are generally required to provide indication of pump station status. These floats are designed to operate independently of the primary level control system and are linked through to the RTU for SCADA alarming.

- High level
- Low level

Float switches shall be the type specified in Appendix A or equivalent suitable for specific gravity of 1.0 and with cable length to suit the application.

High and low level floats will manual PUSH TO RESET buttons mounted on the switchboard to allow for local reset.
Remote reset of high and low level fault conditions shall also be made available through the SCADA.

Float switches shall be mounted on a float hanger as shown in Drawing QLDC_WWPS_01 The Contractor shall supply and install a float hanger which is similar in design to QLDC_WWPS_01, with float supports to prevent movement and entanglement.

12.2 Liquid level probes

The level probes allow for a floatless level relay system to be installed with the benefit that one probe can provide a number of outputs.

The probes are available with up to 10 sensors for multi functional alarming and back up pump control. The more basic model, with three sensors, allows for standard high and low level alarming with the potential for a third set point to be configured against an overflow point or back up pump start level.

13. FLOW AND PRESSURE MONITORING

13.1 Flowmeters

All QLDC pump station facilities are to be installed with electromagnetic (magflow) flowmeters on the discharge rising main in order to monitor pump station performance.

Magflow meters installed should be installed to the following standard;

- Make and Model specified in Appendix A unless otherwise approved by the QLDC Chief Engineer
- Be installed full bore on the common rising main,
- Be of a diameter that matches the rising main so as not to incur flow restriction or dynamic head losses,
- Mechanical installation via flange connection to the rising main,
- Be mechanically installed to manufactures recommendations conforming the requirement of 5 x dia straight line lengths upstream of the flowmeter and 2 x dia straight line lengths downstream of the flowmeter.
- Be installed inside a manhole or chamber. QLDC recommends use of 1050mm dia manholes for magflow meters of 200mm dia or less.
- Manholes to be installed with 2 x 50mm conduit running between manhole and pump station switchboard or building (one for power, one for signal cable).
- Transmitter or head units to be mounted inside pump station switchboard or building to allow for operators to determine pump flow
- Transmitter or head units to be hardwired with analogue connection through to RTU for remote flow measurement.
- Flowmeter scaling to be determined by Council's maintenance contractor. Council's maintenance contractor shall provide a scaling range (litres/sec) that shall be configured to the 4-20mA range of the magflow meter installed.
- Transmitter or head units to be hardwired with analogue connection through to RTU for remote flow measurement.
- Pulse output from magflow meter to be configured so that 1 pulse count = 1m3 pumped volume.
- Flowmeter scaling to be determined by Council's maintenance contractor. Council's maintenance contractor shall provide a scaling range (litres/sec) that shall be configured to the 4-20mA range of the magflow meter installed.
- Analogue and digital inputs for magflow connection to be pre-determined by SCADA I/O schedule issued by Council's maintenance contractor.

13.2 Pressure transducers

All QLDC pump station facilities are to be installed with pressure transducers tapped onto the discharge rising main in order to monitor pump performance and pipeline integrity.

Pressure transducers should be installed to the following standard;

- Make and Model specified in Appendix A unless otherwise approved by the QLDC Chief Engineer.
- Measuring range of transducer to be appropriate to anticipated pipeline pressures modelled for.
- Connection of transducer to be allowed for via ½' BSP female threaded tapping point above isolation valve mounted on the rising main.
- Pressure transducer to be connected through to SCADA for remote monitoring only. No local display is required.
- Pressure transducers may be hardwire connected through to RTU or through use of alternative protocols such as Modbus. This is because this measurement is considered non critical.
- Analogue inputs for pressure monitoring connection to be pre-determined by SCADA I/O schedule.

14. SCADA AND TELEMETRY

14.1 Roles and responsibilities

Electrical contractors engaged to connect submersible wastewater pump stations to the QLDC SCADA network should be aware of the contractors involved in the administration and management of the SCADA system;

- Countrynet: QLDC telemetry network provider
- Abbey Systems: QLDC SCADA hardware and software supplier
- QLDC: SCADA system asset owners
- Veolia: QLDC 3 Waters Contractor and SCADA administration / management for QLDC sites. SCADA and SCADA software provider.
- Fulton Hogan Central: QLDC 3 Waters Contractor and SCADA administration / management for the Lake Hayes Scheme
- Switchbuild; Lake Hayes Scheme SCADA hardware and SCADA software provider

Liaison with Veolia for QLDC sites and Fulton Hogan for Lake Hayes sites at the start of this process is recommended in order to confirm all aspects of SCADA design, installation and commissioning.

14.2 SCADA

Veolia or Fulton Hogan shall be responsible for delivery of the following items associated with the installation of SCADA hardware and subsequent connection of the site to the QLDC SCADA system;

- Supply of the RTU
- Selection of communication protocol (control hardware to RTU)
- Selection of communication protocol (RTU to SCADA base station)
- Selection of telemetry hardware required
- Development of SCADA I/O schedule
- Allocation of RTU address
- Commissioning checks on all SCADA I/O
- Allocation of SCADA alarm signals
- Configuration of the base station including datalogging, reporting and alarms.
- Development of SCADA GUI screen/s

14.3 SCADA work required of contractor

Any electrical contractors engaged to connect a remote facility to the QLDC SCADA system shall be required to complete the following;

- Installation of the RTU
- Connection of control hardware to RTU
- Installation of telemetry hardware
- Connection of telemetry hardware to RTU
- Connection of local digital and analogue signals to RTU
- End to end signal testing
- Commissioning checks on all SCADA I/O

14.4 RTU supply and installation

The QLDC SCADA system uses Abbey Systems Swampfox Remote Telemetry Units (RTUs) to communicate with remote pump station facilities.

The QLDC Lake Hayes Scheme SCADA system uses Kingfisher Remote Telemetry(RTU's) to communicate with remote pump station facilities.

Installation of these RTUs shall conform to the following standards;

- Installed to manufactures recommendations
- Installed with back up 24v DC UPS
- Installed inside a dedicated telemetry panel at eye level.

- There must be a minimum of 75mm clearance around the remote telemetry unit and the radio transmitter.
- All connections to the RTU shall be via a telemetry terminal strip.
- Assignment of terminals to field I/O shall be in accordance with Appendix B.

14.4.1 RTU wiring

All contact signals must be voltage free (rated at not less than 24 V dc 0.5 A, 2 wires per signal).

All field wired 4-20 mA signals shall be isolated for connection to the RTU, and shall comply with the following:

(a) Linear with the respect to the measured variable.

(b) Capable of driving a load of 750 Ohms.

(c) Two wire, shielded with shield earthed at the switchboard end.

14.4.2 Backup power supply for RTU

QLDC require all RTUs to be installed with a backup power supply in order that remote monitoring of the pump station can continue in the event of a power outage (mains fail).

This shall be achieved through the use of a DC UPS with capacity to supply the RTU and critical instruments for four hours.

14.5 Signal transmission and telemetry hardware

Signal transmission from the pump station to the SCADA base station shall involve the installation of an antenna.
The type and size of antenna to be installed shall be determined by the 3 Waters Contractor or the radio survey (see below).
The most common form of hardware installed at pump stations across the Queenstown lakes district includes;

- Radio antenna (whip aerial or yagi),
- Microwave dish,
- Cellular antenna

14.5.1 Antenna installation

Installation of antenna shall be undertaken to the following conditions;

- Conformance against relevant standards
- The antenna shall be mounted on a stainless steel mounting pipe.
- All fastening and securing brackets, nuts, bolts, washers etc. shall be manufactured from grade 316 stainless steel.
- The radio antenna installation shall be designed and constructed to withstand the prevailing conditions and wind speeds of 120 km/h.
- All cabling to be glanded through the switchboard.
- IP rating of the switchboard shall not be compromised by the mounting of the antenna.
- The antenna shall not be mounted less than 3m above ground level.

14.5.2 Communication method

QLDC 3 Waters Contractors will advise of the preferred method of communication between pump station and SCADA base station. Method of protocol may vary depending on geographical location.

Methods of communication between RTU and SCADA base station used across Queenstown lakes district include the following;

- VHF Radio
- IP radio
- Cellular

14.5.3 Radio Path Survey

It should be noted that it may be necessary for the electrical contractor to conduct a radio path survey to determine the availability of an acceptable radio path from the base station to the pumping station.

The results of this survey shall be provided to the 3 Waters Contractor who will liaise with the contractor as to an agreed specification for the communication system prior to its installation.

14.6 SCADA I/O

The following signals shall be provided to the telemetry terminal strip for input to the RTU using the terminal numbers specified in Appendix B:

14.6.1 Digital inputs

(1) AC POWER FAILURE (opens on fault: from under-voltage and supply failure relay)
(2) HIGH LEVEL ALARM (opens on fault, from wetwell level device)
(3) LOW LEVEL ALARMS
(4) PUMP 1 RUNNING (closed when running, from motor starter)
(5) PUMP 2 RUNNING (closed when running, from motor starter)
(6) PUMP 1 FAULT (opens on fault)
(7) PUMP 2 FAULT (opens on fault)
(8) PUMP 1 AUTO SELECTED (closed when auto selected)
(9) PUMP 2 AUTO SELECTED (closed when auto selected)
(10) PUMP CONTROL FAULT (opens on fault)
(11) FLOW VOLUME (totaliser pulse from flowmeter)
(12) SCADA CONTROL (on when selected)

14.7 Analogue inputs

(1) MOTOR 1 CURRENT (Amps)
(2) MOTOR 2 CURRENT (Amps)
(3) WETWELL LEVEL (% full)
(4) INSTANTANEOUS FLOW (litres/sec)
(5) DISCHARGE PRESSURE (kPa)

14.8 Digital outputs

The following signals shall be provided from the output of the RTU to the telemetry terminal strip. This allows for some remote operation and control of the site.

(1) SCADA RUN PUMP 1 (closed when pump to run)
(2) SCADA RUN PUMP 2 (closed when pump to run)
(3) HIGH / LOW LEVEL RESET

14.9 Analogue outputs

No analogue outputs are required for wastewater pump station operation.

15. SCADA SOFTWARE CONFIGURATION

15.1 SCADA administration

The SCADA software provider is responsible for software configuration of the pump station to the SCADA base station. Pumping station measurements and status shall be stored and archived for performance monitoring and engineering design requirements by QLDC and third parties.

Council's maintenance contractor shall provide the following:

(1) A graphical user interface (GUI) at the SCADA base station for the pumping station.

(2) The calculation, display and logging of alarms at the base station (both pump station and telemetry generated).

(3) Configuration of all remote signals and measurements as specified in Appendix B.

15.2 Graphical User Interface (GUI)

The SCADA software provider shall produce and make operational the GUI for the pumping station. The GUI shall display all critical pump station and measurements to ensure pump station performance can be monitored remotely by network operators.

The SCADA software provider shall configure and test all alarms and indications included on the pumping station GUI. Testing of these shall be made in conjunction with the electrical contractor on site.

15.3 Pump station alarms

The SCADA software provider shall configure the SCADA base station such that the following pumping station alarms are displayed on the GUI, appear in event logs and activate the appropriate pager(s) in accordance with existing alarm classes, where appropriate, or as determined by the QLDC Chief Engineer:

(1) High Level.

(2) Power Fail.

(3) Pump 1 Fault.

(4) Pump 2 Fault.

(5) Wetwell Level Device Fault.

16. INSPECTION AND COMMISSIONING

16.1 General

All electrical equipment manufactured under the Contract shall be tested at the manufacturer's works to ensure that the equipment complies with this Specification.

Witness tests may be carried out in the presence of and to the satisfaction of the Principal inspecting officer.

The Electrical Contractor shall give the QLDC Chief Engineer a minimum of ten (10) working days' notice of the manufacturer's intention to conduct tests.

All works testing costs, including the supply of plant, materials, gauges and instruments shall be the responsibility of the Contractor. All test instruments shall have current calibration certificates, if applicable, and all certificates shall be made available for checking by the inspecting officer.

16.2 Commissioning format

Council's maintenance contractors have developed a structure for testing of new pump station facilities vested to QLDC. The format of this commissioning follows a logical review of the operation and functional testing of all major mechanical and electrical components and instruments. A recommended format for facility commissioning is as follows;

- Civil works and structures
- Pipework and valving
- Switchboard construction to specification
- Pump performance
- Fault conditions
- Primary pump control
- Secondary pump control
- Local pump control
- Auto pump control
- Remote pump control
- High and low level alarming
- Instrumentation
- SCADA communication
- SCADA signals (local vs SCADA)
- SCADA measurements

16.3 Pump station functionality

Works tests shall be carried out to thoroughly test out functions of control and back up pumping systems, alarm outputs, local and remote status indication, pushbutton and reset functions.

Testing shall include, but not be limited to, the following

16.3.1 Pump performance

- Duty flow output vs design curve
- Discharge pressure vs design curve
- AUTO/ MANUAL / OFF mode switches

16.3.2 Fault conditions

- Pump RUN / pump FAULT
- High and low level faults alarm outputs and control outputs (if any)
- Primary pump control fault
- Level measurement fault

16.3.3 Primary pump control

- Duty pump start / stop set points
- Standby pump start / stop set points
- Assist pump start / stop set points
- Duty pump rotation (method)

16.3.4 Secondary pump control

- SCADA alarm outputs
- Duty pump start / stop set points
- Standby pump start / stop set points
- Assist pump start / stop set points

16.4 Switchboard inspection

At the completion of the installation or at the completion of agreed subsections of the work, the Electrical Contractor shall, in the presence of the inspecting officer conduct site acceptance tests on all equipment which has been supplied and/or installed as part of the Contract. The testing shall be in accordance with the Specification and to the satisfaction of the inspecting officer.

The Electrical Contractor shall give the inspecting officer not less than ten (10) working days' notice of his intention to undertake the tests.

The provision of all necessary equipment for testing shall be the responsibility of the Contractor. All test instruments shall have current calibration certificates, if applicable, and all certificates shall be made available for checking by the inspecting officer before testing commences.

16.5 Switchboard testing

The Electrical Contractor shall, in the presence of the QLDC Chief Engineer inspecting officer, carry out site tests to demonstrate that the installation is in accordance with the specified requirements and that the installation operates correctly.

Equipment which has been satisfactorily performance tested or witness tested in the manufacturer's works need not be site tested except to:

(1) check the installation and interconnections;
(2) check for any damage or deterioration which may have occurred since the works tests; and
(3) demonstrate that the system functions in accordance with the Specification.

16.5.1 Control circuits / local distribution

The tests shall be carried out in accordance with the relevant Standards and shall include the following where applicable:

(1) insulation resistance tests
(2) earth resistance tests
(3) continuity tests
(4) polarity tests
(5) calibration checks
(6) sequencing tests
(7) functional tests

The series of test below are required demonstrate the integrity and correct operation of the system including protective devices and remote operations, indications and controls.

Protective units, relays etc. which allow current injection or similar to check their settings shall, during testing, have each function tested and calibrated.

Units which may be adjusted (e.g. thermal overload relays) shall be adjusted to the appropriate settings in accordance with the manufacturer's written instructions.

16.5.2 SCADA Testing

The Electrical Contractor shall liaise with the SCADA software provider throughout SCADA testing to ensure local pump station status is reflected through the SCADA system

The inspection and tests shall include, but not be limited to the following:

(1) SCADA comms check to ensure strength of signal and protocol type allows for robust signalling and communication back to the SCADA base station,

(2) Performance tests to ensure that all inputs and outputs confirm to the SCADA I/O schedule.

(3) Instrument checks to ensure mapping and scaling ranges are accurately determined and match.

(4) Remote control checks to ensure all control outputs installed at site map through to the correct local functionality.

16.5.3 Test Results

The results of all site tests shall be neatly and legibly recorded during the progress of the test on the approved test sheets. A copy of the test sheets, co-signed by the Electrical Contractor and the inspecting officer, shall be handed to the inspecting officer on completion of the tests.

Sign off on SCADA signalling, controls and alarms is required by both the maintenance contractor and electrical on-site contractor.

An example of a generic test sheet is provided in Appendix D. The test sheet shall be modified by the Contractor to include any additional tests required to demonstrate compliance with this specification and any variations approved by the QLDC Chief Engineer.

Commissioning sheets should be provided in the O & M manual in order to provide operators with a record of pump station performance results during testing and commissioning.

17. ELECTRICAL DRAWINGS

17.1 General

All drawings produced shall be in accordance with AS/NZS 1100, AS 1101, AS/NZS 1102, AS/NZS 4383 and AS/NZS 60417 as applicable.

Contractors Drawings shall be prepared using a CAD system.

Drawings shall be plotted at the same scale as they were drawn/composed (1:1) to maintain the original intended line and text attributes.

The drawing shall be A1 or A3 size in accordance with (AS/NZS 1100 Part 101).

17.2 CAD Files

- The Contractor shall provide CAD files for all electrical and instrumentation Final Contractors Drawings. CAD files shall be provided to the QLDC Chief Engineer at the same time as the Final Contractors Drawings.
- Each CAD drawing file shall contain all information used to produce the drawing including externally referenced information (e.g. AutoCAD X'refs should be bound into the drawing file).
- Drawings produced using AutoCAD shall be supplied in .DWG format. All other CAD files shall be supplied in DXF format.
- Drawings produced using AutoCAD shall, where possible, be produced using QLDC Chief Engineer drafting defaults (a copy of the Principal defaults file shall be made available to the Contractor on request). Each drawing produced using AutoCAD and not using the Principal standard defaults shall be supplied with an individual plotter setup file(s) to enable reproduction of the original drawing.
- CAD files (including .PC2, .PC3, .CTB or .STB files) shall be named with the drawing number in accordance with this clause except that the dash "-" shall be replaced with an underscore "_" (e.g. 00_4031.DWG).
- CAD files (including .PC2 files etc.) shall be named with the drawing number.

17.3 Drawing Details

Drawings produced by the Electrical Contractor shall show the following information, where applicable:

(1) Detailed material and parts list.

(2) Electrical power and control circuit schematic drawings which shall:

- Give ratings of all components.
- Show all cable types and sizes.
- Be drawn as vertical ladders with each line numbered.
- Show cross referencing of remote contacts etc. using line numbers and other drawing numbers if required.
- Identify spare cores of field cables by their respective cable, core and terminal numbers where applicable.

Drawing GENERAL 09-01 has been included as a means of establishing quality standards required for electrical schematic drawings. Circuitry shown is not an indication of facilities or methods required to achieve requirements.

(3) Layouts of the pumping station switchboard and motor control panel.

17.4 Submission of draft electrical drawings

The Electrical Contractor shall:

(1) Submit a copy of the scaled drawings to the QLDC Chief Engineer for examination prior to manufacture or commencement of work.

(2) Allow time in his/her program for the QLDC Chief Engineer to examine, or subsequently re-examine in accordance herewith, the drawings submitted by the Electrical Contractor. The time to be allowed to the QLDC Chief Engineer for such examination shall be not less than ten (10) working days.

Upon examining the drawings, the QLDC Chief Engineer may direct comments or queries to the Electrical Contractor on those drawings. If drawing modifications are required as a result of the examination, the Electrical Contractor shall supply revised drawings for re-examination.

(3) Not depart from the details shown on drawings examined by the QLDC Chief Engineer in accordance with this Clause unless the Electrical Contractor has first amended the drawing accordingly, submitted it for re-examination in accordance with this Clause and had it returned by the QLDC Chief Engineer signifying approval to proceed.

If manufacture or construction commences prior to approval from the QLDC Chief Engineer, any re-work shall be at the Electrical Contractor's expense.

17.5 Submission of final electrical drawings

Prior to the date of practical completion, the Electrical Contractor shall provide two (2) sets of Final Contractors Drawings which have not been folded, punched or marked to the QLDC Chief Engineer. The QLDC Chief Engineer shall determine if copies submitted as Final Contractor Drawings are of an acceptable quality. If the drawings are deemed by the QLDC Chief Engineer to be unacceptable, the Electrical Contractor shall re-submit drawings which are of an acceptable standard.

Final Contractors Drawings shall:

(1) Be provided for all equipment and structures included in the Contract.

(2) Include all "As Constructed" information which shall include all changes brought about during manufacture, installation, construction, testing and commissioning.

(3) Show signatures of authorising and/or approving personnel.

(4) Be on white paper not less than 80 gsm thick and shall be suitable for reproduction by conforming with the requirements of AS/NZS 1100.

One copy of the Final Contractors Drawings protected by a protective sleeve shall be left in the pumping station switchboard.

18. OPERATIONS AND MAINTENANCE MANUAL

18.1 Format

The Electrical Contractor shall supply to the Engineer's Representative three (3) copies of Operations and Maintenance Manuals ("O&M Manuals") which shall be prepared according to the content requirements provided in Appendix D.

A first draft copy shall be submitted to QLDC 3 Waters contractor, for review as part of the process to ensure all pertinent information is included.
Operations and Maintenance Manuals shall be in accordance with the following requirements:

(1) Wholly in the English language, clear, legible and contain all pertinent information relating to the functional control, operation and maintenance of the facility and its components.
(2) Be presented in a format that matches the example contents page in Appendix D.
(3) Include the manufacturer's manuals for all supplied equipment. This includes but is not limited to manuals for installation, configuration, programming, maintenance and troubleshooting.
(4) Include complete parts listing which shall include the manufacturer's name, parts catalogue number and, where applicable, the local agent's name, address and telephone number.
(5) Include drawings of the actual equipment supplied, including detailed ladder and schematic circuit diagrams.
(6) Include any relevant safety procedures.
(7) Where PLCs are supplied, hard copy program listings in ladder format shall be provided. In addition, electronic copies of the PLC programs and supporting files shall be supplied on CD ROMs.
(8) Any passwords or codes required for access.

18.2 Content

The operating component of the Operations and Maintenance Manual shall include a description of the operation of the equipment and clear and logical instructions for the operator.
The operating manual shall describe the operation of the equipment under manual and under remote and/or automatic control.

The instructions shall include:
(1) starting, running and stopping procedures;
(2) functional control processes;
(3) sequencing and control logic descriptions;
(4) measured parameters;
(5) Fault conditions and SCADA alarms.

The maintenance component of the Operations and Maintenance Manuals shall contain all relevant information for the maintenance and repair of the equipment and shall include:

(1) Identification of items of equipment, including model and serial numbers.
(2) A brief description of the equipment and its operation.
(3) All necessary setting up procedures.
(4) All maintenance procedures including suggested preventative maintenance schedules.

18.3 Asset register

QLDC wish for any electrical contractor installing switchgear at a submersible pump station to document the components installed for the purpose of recording within QLDCs HANSEN Asset Management System.

The list of components and instruments detailed on this list should reflect the 'big ticket items' mirrored in the switchboard specification in Section 3.2

Contractors may wish to seek additional information on this requirement from both Council's maintenance contractor and QLDC.

Contractors shall be required to populate an Excel spreadsheet issued by QLDC titled; Asset register template for consultants/ contractors/ project managers (Sept 2015, Version 9).

This register seeks to quantify the components installed in newly vested facilities and capture their cost (both capital and installation).

Costs of big ticket items are required for QLDC insurance purposes.

18.4 Provision of additional documentation

All relevant documentation generated as a result of testing, inspection and certification of installation shall be supplied by the electrical contractor. This shall include, but not be limited to, Declaration of Conformity Statements and Electrical Certificates of Compliance.

APPENDIX A

EQUIPMENT DATA SHEET

Note : Compatible alternatives may be considered with the approval of QLDC Chief Engineer

Component	Equipment Standard	Comment
Panel Operators	Schneider 22mm ZB5 Rockwell 800F	
MCB's and RCD's	Schneider Acti 9	
Motor Circuit Breakers	Schneider GV2 Rockwell 140m	
Signal Isolators	Intech	
Interface Relays	Omron Rockwell	
Contactors and Overloads	Schneider LC1 – LRD series Rockwell 100 – 193 series	
Surge	Weidmuller	
Terminals	Weidmuller	
Complex Selector Switches	Kraus and Naimer	
RTU: QLDC Sites	Abbey Systems Swampfox SF-3	
RTU: Lake Hayes Sites	Lake Hayes Sites Kingfisher	
DC UPS	Phoenix Trio UPS. 5Amp minimum. With fault, mains and battery monitoring.	
Communications	Swampfox SF-3 Schneider Q Series Radio Microwave IP – Countrynet Cellular – Veolia supplied modems.	
Pump controller	Siemens MultiRanger 200 (MR200). Panel mount MultiTrode MultiSmart pump controller.	

Wetwell Level Device	Endress & Hauser FMX21 Hydrostatic Level Transducer (4-20mA HART)	
Soft Starter/VSD	Danfoss MCD Series Aucom EMX Danfoss VLT Aqua VSDs	
PLC	Schneider M340 Allen Bradley Micrologix Series (1100 or 1400)	
HMI	Schneider Magelis	
Floats	Flygt ENM-10	
Level probe	MultiTrode level probe	
Magflow meter	Endress and Hauser Promag (remote)	
Pressure transducer	Endress & Hauser Cerabar T PMP131 (4-20mA)	
Motor Plug and Sockets	Smerechal DSN3 up to 15 kW Smerechal DSN6 for 16 kW to 30 kW	Compatible alternatives may be considered
Generator Plug	PDL (for 3 phase socket), Cutler-Hammer Pro-Connect or equivalent.	Compatible alternatives may be considered
Switchboard Enclosure	Switchbuild Dunedin Ltd Phone 03 466 4281 Email sales@switchbuild.co.nz Bremca. 25 Bond St, Invercargill. Phone 03 218 8038	
Switchboard Locks	Flush mounted internal lock with QLDC tumbler pattern	

APPENDIX B

SCADA STANDARD I/O TEMPLATE

DIGITAL INPUTS

0	*kwh pulse*	
1	*P1 Run*	
2	*P2 Run*	
3	*Flow Pulse*	
4	*P1 Auto*	
5	*P2 Auto*	
6	*P1 Fault*	
7	*P2 Fault*	
8	*Hi Level Alarm*	
9	*Lo Level Alarm*	
10	*RTU Control On*	
11	*Critical High Level Alarm*	
12	*Phase Fail*	
13	*Critical Low Level Alarm*	
14	*Seal Fail Pump 1*	
15	*Seal Fail Pump 2*	
16	*Surge Alarm*	
17		
18		
19		
20	*Multiranger Fault*	
21	*UPS Fault*	
22	*UPS Online Mains Fail*	
23	*UPS Battery Low*	
24		
25		
26		
27		
28	*Gen Run*	
29	*Gen on Load*	
30	*Gen Fuel Low*	
31	*Generator Fault*	
32	*PLC Fail*	
33	*Flow Fail*	
34	*Low Pressure*	
35	*RTU Control Enabled*	

ANALOG INPUT SIGNALS

AI		
0	Well Level (by pressure)	
1	P1 Current	
2	P2 Current	
3	Flow L/s	
4	*MR Level by ultrasonic*	
5	*P3 Current*	
6	*P4 Current*	
7	*P1 Speed*	
8	*P2 Speed*	
9	*P3 Speed*	
10	*P4 Speed*	
11	*Pressure*	

DIGITAL OUTPUTS

DO				
0	General Reset	pulse		
1	Start/Stop P1	On/Off		
2	Start/Stop P2	On/Off		
3	P1 Reset	pulse		
4	P2 Reset	pulse		
5	Standby Stop	pulse		
6	Duty 1-2 = Off, 2-1 = On		On/Off	
7	RTU Control Enable		On/Off	
8				
9				
10	-			
11	-			
12	-			
13	-			
14	-			

Items listed below are derived from digital inputs				
Pulse				
0	kwh			
1	*P1 Run Hrs*			
2	*P2 Run Hrs*			
3	*Flow*			
4	-			
5	-			
6	-			
7	-			
8	-			
9	-			
10	-			
11	-			

APPENDIX C

OPERATIONS AND MAINTENANCE MANUAL REQUIRED CONTENT

INTRODUCTION

WASTEWATER PUMP STATION OVERVIEW

- Site Location
- WWPS Criticality

PRINCIPAL COMPONENT DESCRIPTIONS

- Pump Chamber / wet well
- Submersible Pumps
- Valve Chamber
- Electrical cabinet & switchboard
- Soft starters
- Pump controller
- Hydrostatic level transducer
- Power metering
- Magflow meter
- Telemetry
- Generator
- Generator controller
- Rising Main

PUMP CONTROL & SCADA

- Pump controls
- Fault lamps
- Pump configuration
- Pump operation
- Duty / standby pump operation
- Manual / auto operation
- Remote pump operation via SCADA
- Primary pump control
- Secondary pump control
- High and low level alarms
- SCADA I/O
- Digital Inputs
- Digital Outputs
- Analogue Inputs
- Pulse counts
- SCADA Alarms and Operating Responses

HANSEN ASSET INVENTORY

WWPS OPERATIONS & MAINTENANCE

- Monthly Operating / Maintenance Activities
- Yearly Operating / Maintenance Activities
- Troubleshooting
- Pump chamber Level High alarm response
- Pump fault
- Soft starter fault
- Adjusting pump set points on the MultiRanger
- Adjusting pump set points on the SCADA
- Odour complaint

- Wastewater overflow response
- Unblocking a partially or fully blocked pump
- Generator fault
- Loss of SCADA signal

OPERATIONS & MAINTENANCE PROCEDURES

- Cleaning the pump chamber
- Cleaning the level sensor
- Cleaning & maintenance of pressure transducer
- Lifting a pump
- Installing a pump into the pump chamber
- Pump fault troubleshooting
- Isolating plant and equipment
- Unblocking the check (non-return) valves
- Electrical service check
- Pump maintenance & service
- Test running the generator
- Standby generator service

HEALTH & SAFETY

- Risk Assessment

APPENDIX D

WWPS COMMISSIONING TESTS AND CHECK SHEETS

SUBMERSIBLE WASTEWATER PUMPING STATION

TESTING & COMMISSIONING PROCEDURES

TEST/COMMISSIONING PROCEDURES

The following procedures will be used as a basis of commissioning/testing the pumping stations.

Other tests considered necessary to establish the correct operation of the plant and equipment installed shall be performed during commissioning at the discretion of Council as required.

TEST EQUIPMENT REQUIRED (Supplied By Contractor)

Note : It is the responsibility of the Contractor to provide current calibration certificates for the test equipment used during commissioning.

The following test equipment will be required for the testing.

1. Insulation resistance tester (1000V).
2. Earth continuity testing instrument.
3. RCD test equipment.
4. Power factor measuring instrument.
5. Digital multimeter.
6. Low current instrumentation ammeter/calibrator (4-20 mA).
7. Clamp on ammeter (rated for full load current of pump motors).

1. SWITCHBOARD CONSTRUCTION

Objectives:

To establish general compliance with construction requirements of specification.

Test Procedure:

- Check construction of switchboard including material 316 SS construction.
- Check switchboard rating is IP rating.
- Check main switchboard including IP rating.
- Check motor control panel including IP rating.
- Check RTU including IP rating.
- Check component ratings for pump CB's, soft starters, bypass contactor are the same.
- Check switchboard constructed from stainless steel.
- Check controls and indications are provided as per design drawings.
- Check plinth hot dipped galvanised secured with 316 SS anchors.
- Check high security locks are fitted with QLDC tumbler.
- Check internal wiring PVC and minimum size & colour coding as per specification.
- Check wiring installed in PVC ducts and terminated in terminals.
- Check controls & indications are labelled as required.
- Check relays, terminals and cables are labelled as required.
- Check current transformer wiring is 2.5 mm^2.
- Check terminal enclosure is installed and manufactured from PVC.
- Check miniature circuit breakers are lockable in the OFF position.
- Check that an RCD was installed on the GPO circuit.
- Check Current Transformers are class 2M or better (2M or less).
- Check that Current Transducers are class 1M or better (1M or less)
- Check ammeter selector (if installed) fitted with an OFF position.
- Check hours run meter has 5 digits minimum.
- Check surge arresters have a discharge current of 20kA.
- Check indicator lamps are 22 mm dia.
- Check phase imbalance relay adjustable from 5 to 15 %.
- Check floodlight is rated at 150 Watts minimum.

Acceptance Criteria:	**Results**
• Switchboard constructed from 316 SS. • Switchboard exterior appears to be IP 56. • Main switchboard is IP 32. • Motor control panel is IP 52. • RTU is IP 32. • All components rated for (15 or 30 kW). • Switchboard constructed from stainless steel. • Controls and indications are as per design drawings. • Plinth is hot dipped galvanised secured with 316 SS anchors.	

• High security swing locks fitted. • Internal wiring PVC, min. 1.5 mm^2 (control) and 2.5 mm^2 (power), colour coding grey for LV & violet for instrumentation. • Wiring installed in ducts and terminated in terminals. • Controls & ind. labels to be engraved plastic 4 mm high letters. • Relays, terminals and cables are labeled as required. • Current transformer wiring is 2.5 mm^2. • Terminal enclosure is installed and manufactured from PVC. • Miniature circuit breakers are lockable in the OFF position. • RCD is installed on the GPO circuit. • Current Transformers are class 2M or better (2M or less). • Current Transducers are class 1M or better (1M or less) • Ammeter selector (if installed) fitted with an OFF position. • Hours run meter has 5 digits minimum. • Surge arresters have a discharge current of 20kA. • Indicator lamps are 22 mm dia. • Phase imbalance relay adjustable from 5 to 15 %. • Floodlight is rated at 150 Watts minimum.	
Test Result **Pass** **Fail**	
Accepted by **Passed By (Contractor)** ________________ **Date :** ________ **Passed By (Veolia Water / Fulton Hogan)** ________________ **Date :** ________	

2. SWITCHBOARD GENERAL EQUIPMENT TESTS

Objectives:

To establish switchboard general equipment complies with specification.

Test Procedure:

- Switch on cubicle light switch in switchboard.
- Check operation of switchboard light.
- Switch on floodlight switch in switchboard.
- Check operation of floodlight.
- Check anti-condensation heater and thermostat fitted.
- Connect measuring meter, turn thermostat temperature down.
- Check that 230V is applied to anti-condensation heater.
- Reset thermostat to operating temperature.
- Test operation of 230V GPO on switchboard.
- Test operation of GPO RCD using RCD test equipment.
- Activate LAMP TEST pushbutton and check all lights operate.

Acceptance Criteria:	**Results**
• Switchboard light installed and operates when switched on. • Floodlight operates as required. • Anti-condensation heater fitted. • Anti-condensation heater operating. • Switchboard GPO operates. • RCD operates at required test current. • LAMP TEST operates all lamps correctly.	

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ______________________ **Date :** ____________

Passed By (Veolia / Fulton Hogan) ______________________ **Date :** ____________

3. SWITCHBOARD PROPRIETARY TESTS

Objectives:

To establish that proprietary test have been conducted.

Test Procedure:

- Disconnect main power supply.
- Check MEN earthing system used.
- Perform insulation resistance test on main busbars.
- Perform earth loop impedance test on main earthing system.

Acceptance Criteria:	Results
• MEN earthing used. • Insulation resistance above 1.0 MΩ. • Earth loop impedance less than 0.5 Ω.	

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ____________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ____________________ **Date :** __________

4. GENERATOR CONNECTION TESTS

Objectives:

To establish correct connections of generator plug.

Test Procedure:

- Ensure generator is not plugged in.
- Ensure that Main Isolator is closed.
- Check that Generator Isolator can not be closed.
- Switch off Main Isolator.
- Perform conductivity test between all phases of generator plug to main busbars.
- Check that Red, Yellow and Blue phases are connected correctly.
- Close generator isolator.
- Check that Main Isolator can not be closed.
- Open Generator Isolator.
- Close Main isolator.

Acceptance Criteria:	**Results**
• Generator Isolator can not be closed when Main Isolator is closed. • Red, Yellow and Blue phases connected correctly. • Main Isolator can not be closed when Generator Isolator is closed.	

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ______________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ______________________ **Date :** __________

5. PHASE FAILURE RELAY TESTS

Objectives:

To establish correct operation of phase failure relay.

Test Procedure:

- Check that AC POWER OK lamp is illuminated.
- Remove one wire from phase failure relay.
- Check that AC POWER OK lamp goes out.
- Replace wire on phase failure relay.
- Check that AC POWER OK lamp is illuminated.

Acceptance Criteria:	Results
• AC POWER OK lamp goes out on phase failure. • AC POWER OK lamp on when power restored.	

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ____________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ____________________ **Date :** __________

6. PUMP OPERATION & MOTOR CURRENT TESTS

Objectives:

To establish correct pump and motor current instrumentation operation.

Test Procedure:

6.1 Motor Direction

- Connect main power supply.
- Start Pump 1 and check for correct operation (rotation direction).
- Start Pump 2 and check for correct operation (rotation direction).
- Plug Pump 1 into Pump 2 starter and check for correct operation (rotation direction).
- Plug Pump 2 into Pump 1 starter and check for correct operation (rotation direction).
- Plug Pump 1 into Pump 1 starter and Pump 2 to Pump 2 starter.

6.2 Motor Current

- Connect low current ammeter (4-20 mA) to motor current transducer on Pump 1.
- Measure Pump 1 motor current using clamp on (tong) ammeter.
- Observe Pump 1 motor current on switchboard ammeter.
- Compare motor current readings for Pump 1.
- Connect low current ammeter (4-20 mA) to motor current transducer on Pump 2.
- Measure Pump 2 motor current using clamp on (tong) ammeter.
- Observe Pump 2 motor current on switchboard ammeter.
- Compare motor current readings for Pump 2.

Acceptance Criteria:	Results
6.3 Motor Direction • Pumps run correctly and pumps. • Pumps operate correctly when connected to other starter. **6.4 Motor Current** • Pump 1 panel ammeter and analogue the same. • Pump 2 panel ammeter and analogue the same.	

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ______________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ______________________ **Date :** __________

7. PUMP OPERATING MODE TESTS

Objectives:

To establish correct operation of the pump mode selector switches.

Test Procedure:

7.1 Off Mode

- Select OFF on the Pump 1 and Pump 2 MODE SELECTOR switches.
- Allow sump level to increase.
- Check that pumps do not run.

7.2 Manual Operation

- Select RUN mode on Pump 1 mode selector.
- Check that Pump 1 starts.
- Select OFF mode on Pump 1 mode selector.
- Select RUN mode on Pump 2 mode selector.
- Check that Pump 2 starts.
- Run pump(s) until sump is empty (below duty 1 start level).
- Select OFF mode on Pump 2 mode selector.

7.3 Pump 1 Automatic Duty 1 Operation

- Select DUTY 1-2 on the DUTY SELECTOR switch.
- Select AUTO on Pump 1 and Pump 2 MODE SELECTOR switches.
- Allow sump level to increase.
- Check that Pump 1 starts at DUTY 1 start level.
- Check thatPump 1 stops at DUTY 1 stop level.

7.4 Pump 2 Automatic Duty 1 Operation

- Select DUTY 2-1 on the DUTY SELECTOR switch.
- Allow sump level to increase.
- Check that Pump 2 starts at DUTY 1 start level.
- Check that Pump 2 stops at DUTY 1 stop level.

7.5 Pump 1 Automatic Duty 2 Operation

- Select DUTY 2-1 on the DUTY SELECTOR switch.
- Select OFF on the Pump 2 MODE SELECTOR switch.
- Allow sump level to increase.
- Check that Pump 1 starts at DUTY 2 start level.
- Check that Pump 1 stops at DUTY2 stop level.
- Select AUTO on the Pump 2 DUTY SELECTOR switch.

7.6 Pump 2 Automatic Duty 2 Operation

- Select DUTY 1-2 on the DUTY SELECTOR switch.
- Select OFF on the Pump 1 MODE SELECTOR switch.

7. PUMP OPERATING MODE TESTS

- Allow sump level to increase.
- Check that Pump 2 starts at DUTY 2 start level.
- Check that Pump 2 stops at DUTY 2 stop level
- Select AUTO on the Pump 1 MODE SELECTOR switch.
- Allow sump to be pumped down to DUTY 1 stop level.

7.7 Rotation Operation

- Select ROTATION on duty selector switch.
- Ensure that Pump 1 & 2 have AUTO mode selected.
- Allow sump to fill.
- Observe which pump is started at DUTY 1 start level.
- Allow sump to be pumped down to DUTY 1 stop level.
- Allow sump to fill.
- Check that the duty rotation changes and the other pump now starts at DUTY 1 start level.

Acceptance Criteria:	Results
7.8 Off Mode • Pumps do not run start when OFF selected. **7.9 Manual Operation** • Pump 1 starts on manual start. • Pump 2 starts on manual start. **Pump 1 Automatic Operation** • At DUTY 1 start level Pump 1 starts. • At DUTY 1 stop level Pump 1 stops. **Pump 2 Automatic Operation** • At DUTY 1 start level Pump 2 starts. • At DUTY 1 stop level Pump 2 stops. **Pump 1 Automatic Duty 2 Operation** • At DUTY 2 start level Pump 1 starts. • At DUTY 2 stop level Pump 1 stops. **Pump 2 Automatic Duty 2 Operation** • At DUTY 2 start level Pump 2 starts. • At DUTY 2 stop level Pump 2 stops. **Rotation Operation** • Duty rotation alternates correctly between pump starts.	

Test Result **Pass** **Fail**

Accepted by

7. PUMP OPERATING MODE TESTS

Passed By (Contractor)	**Date :**
Passed By (Veolia / Fulton Hogan)	**Date :**

8. PUMP POWER AND INDICATION TESTS

Objectives:

To establish correct operation of the starter, contactors and run indications.

Test Procedure:

- Connect power factor measuring instrument to main supply.

8.1 Pump 1

- Select RUN mode on the Pump 1 MODE SELECTOR.
- Check Pump 1 hours run meter is operational.
- Check that PUMP 1 RUN indicator lamp is illuminated.
- Check Power Factor to ensure that it is not less that 0.95 lagging.
- Select OFF mode on the Pump 1 MODE SELECTOR.
- Check that Pump 1 is stopped using soft starter pump control.

Pump 2

- Select RUN mode on the Pump 2 MODE SELECTOR.
- Check Pump 2 Hours Run Meter is operational.
- Check that PUMP 2 RUN indicator lamp is illuminated.
- Check Power Factor to ensure that it is not less that 0.95 lagging.
- Select OFF mode on the Pump 2 MODE SELECTOR.
- Check that Pump 2 is stopped using soft starter pump control.

Acceptance Criteria:	Results
Pump 1 • Pump 1 hours run meter is operational. • PUMP 1 RUN indicator lamp illuminates. • Power Factor is not lower that 0.95 lagging. • Pump 1 is stopped using soft starter pump control. **Pump 2** • Pump 2 Hours Run Meter is operational. • PUMP 2 RUN indicator lamp illuminates. • Power Factor is not lower that 0.95 lagging. • Pump 2 is stopped using soft starter pump control.	

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ______________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ______________________ **Date :** __________

9. PUMP SOFT STARTER & FAULT CIRCUIT TESTS

Objectives:

To establish correct operation of the soft starters and pump fault circuits.

Test Procedure:

Pump 1

- Ensure that no faults are present.
- Check that Pump 1 alarm relay is energised.
- Select OFF on Pump 1 mode selector.
- Adjust the soft starter overload current to minimum Amperes.
- Select RUN on Pump 1 mode selector.
- Check that Pump 1 alarm relay de-energises.
- Check that Pump 1 Fault indicator is illuminated.
- Select OFF on Pump 1 mode selector.
- Press Pump 1 RESET pushbutton.
- Check that Pump 1 alarm relay re-energises.
- Check that Pump 1 Fault indicator is not illuminated.
- Adjust the soft starter overload current to motor current.
- Select AUTO on Pump 1 mode selector.

Pump 2

- Ensure that no faults are present.
- Check that Pump 2 alarm relay is energised.
- Select OFF on Pump 2 mode selector.
- Adjust the soft starter overload current to minimum Amperes.
- Select RUN on Pump 2 mode selector.
- Check that Pump 2 alarm relay de-energises.
- Check that Pump 2 Fault indicator is illuminated.
- Select OFF on Pump 2 mode selector.
- Press Pump 2 RESET pushbutton.
- Check that Pump 2 alarm relay re-energises.
- Check that Pump 2 Fault indicator is not illuminated.
- Adjust the soft starter overload current to motor current.
- Select AUTO on Pump 2 mode selector.

Acceptance Criteria:	Results
Pump 1 • Fault relay is energised with no fault present. • Fault relay de-energises on fault. • Pump 1 Fault indicator illuminates on fault. • Fault relay energises when RESET operated. • Pump 1 Fault indicator not illuminated when reset.	

9. PUMP SOFT STARTER & FAULT CIRCUIT TESTS

Pump 2

- Fault relay is energised with no fault present.
- Fault relay de-energises on fault.
- Pump 2 Fault indicator illuminates on fault.
- Fault Relay energises when RESET operated.
- Pump 2 Fault indicator not illuminated when reset.

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ______________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ______________________ **Date :** __________

10.LEVEL DEVICE TESTS

Objectives:

To establish correct operation of the level indicator/controller & associated controls.

Test Procedure:

- Ensure that power is switched on to switchboard.
- Check that sump level is displayed on the Level Device.
- Switch off power to switchboard.
- Check that level is displayed on the Level Device using battery backup power.
- Connect low current ammeter (4-20 mA) into analogue output.
- Switch pumps on and empty sump.
- Check that sump level reads 0 %.
- Check that High Level Alarm relay is energised.
- Switch pumps off and allow sump to fill.
- Check that de-energises at HLA setpoint on controller.
- Check that HIGH LEVEL ALARM light is illuminated.
- With sump level just below overflow pipe, measure distance from top of sewerage to top of sump and calculate sump level in %.
- Check that sump level is the same as level displayed on level device.
- Select RUN mode on Pump 1 and 2.
- Check that Level Device Faulty relay is energised.
- Simulate sump level device fault condition.
- Check that de-energises.
- Check that SUMP LEVEL SYSTEM FAULT light is illuminated.
- Select AUTO mode on Pump 1 and 2.

Acceptance Criteria:	Results
• Level displayed with power on. • Level displayed with power off (using 12 V battery). • Sump level reads 0 % with empty sump. • energised below HIGH LEVEL sump level. • de-energises above HIGH LEVEL sump level. • HIGH LEVEL ALARM light operates. • Actual sump level the same as displayed sump level. • Level device fault is energised with no fault present. • Level device fault de-energises when fault exists. • SUMP LEVEL SYSTEM FAULT light operates when level device fault exists.	

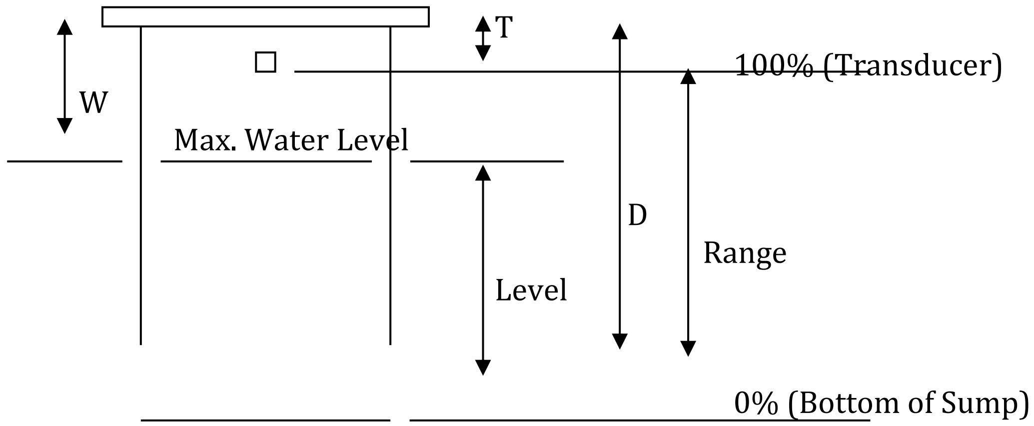
Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ______________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ______________________ **Date :** __________

General Sump Details



Measured & Operational Site Details

LEVEL	mm	Value
10.1.1 DEVICE SETUP & CALIBRATION DETAILS		
Bottom Of Transducer To **Top / Bot** Of Sump Cover		T
Sump Depth To **Top / Bot** Of Sump Cover		D
Level Device Range		
Maximum Water Level Measurement (Water level to cover)		W
Level Device Reading at Maximum Water Level		
Required Current at Maximum Water Level		
Actual Current at Maximum Water Level		
10.1.2		
10.1.3 SETTING DETAILS		
Overflow Level Float		
Emergency Start Float		
Emergency Stop Float		
High Level Alarm		
Start Duty 2 Pump		
Start Duty 1 Pump		
Stop Duty 2 Pump		
Stop Duty 1 Pump		

10.1.4 Formula

Level Device Range = D - T

Sump level = D – W

Required Current at Maximum Water Level = $\left[\frac{D - W}{Range} \times 16 + 4 \right]$

11.EMERGENCY FLOAT SYSTEM TESTS

Objectives:

To establish correct operation of the emergency float system.

Test Procedure:

Emergency Level Float System

- Ensure that pump station has been operational.
- Disconnect battery power to Level Device.
- Switch power off to Level Device.
- Select AUTO on Pump 1 and Pump 2 mode selectors.
- Check that both pumps do not run.
- Check that Emergency Start Float Relay is de-energised.
- Allow sump level to increase.
- Check the Emergency Start Float Relay energises when level reaches Emergency Start Level and Pump 1 starts.
- Check that Pump 2 starts after a time delay.
- Check that Pump 1 and 2 stop when level falls below Emergency Stop Level.
- Replace battery power to Level Device.
- Switch power on to Level Device.

Overflow Level

- Lower Overflow Level Alarm float into sewerage.
- Check that the Overflow Alarm Relay energises and OVERFLOW ALARM is illuminated.
- Reset Overflow Float to correct level.

Acceptance Criteria:	**Results**
Emergency Level Float System • Pumps do not run when level below emergency start. • Emergency start relay is de-energised. • Emergency start relay energises when level reaches Emergency Start Level and Pump 1 starts. • After a time delay and Pump 2 starts. • Pump 1 and 2 stop when level falls below Emergency Stop Level. **Overflow Level** • Overflow alarm relay energises and OVERFLOW ALARM is illuminated.	

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ____________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ____________________ **Date :** __________

12.SCADA CONTROL TESTS

Objectives:

To establish correct operation of common control circuits.

Test Procedure:

SCADA Control

- Ensure that SCADA control is not active.
- Check SCADA Control Relay is de-energised and SCADA CONTROL ACTIVE indicator lamp is off.
- Initiate SCADA control.
- Check SCADA Control Relay is energised and SCADA CONTROL ACTIVE indicator lamp is on.

Acceptance Criteria:	Results
• SCADA Control Relay de-energised & SCADA indicator lamp off when SCADA control is not active. • SCADA Control Relay energised & SCADA indicator lamp on when SCADA control is active.	

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ______________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ______________________ **Date :** __________

13. SCADA TESTS

Objectives:

To establish all SCADA signals returned correctly to base.

Test Procedure:

SCADA Control

- Review historical logs / alarm logs for all the tests above.
- Check that power fail, pump run, pump fault, emergency level control active, level device fault, high level, pump currents and well level all indicate correctly.
- Check alarms generated to pager for power failure, pump fault, level device fault, emergency level control active and high level alarm.

Acceptance Criteria:	Results
• Power fail indication and alarm paged out • Pump 1 and Pump 2 run indication paged out • Pump 1 and Pump 2 fault indication and alarm paged out • Emergency level control active indication and alarm paged out • Level device fault indication and alarm paged out • High Level alarm paged out • Overflow alarm paged out • Pump 1 and Pump 2 currents indicated correctly • Wet well level indicated correctly	

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ______________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ______________________ **Date :** __________

14. FLOWMETER TESTS

Objectives:

To establish the flowmeter is working accurately to measure and record pumped flow output from the wastewater pump station.

Installation check procedure:

Mechanical installation

- Check that magflow meter is installed to manufactures' recommendations and observes the minimum straight line dimensions required upstream and downstream of the sensor.
- Check that the magflow meter is installed with grounding disks where installation has been performed in pipelines made of plastic, concrete or those with an insulated lining or coating metal.
- Check that rubber gaskets are installed on both sides of the grounding disk as per manufactures recommendations.
- Check that the flowmeter is installed in a manhole or similar chamber to allow for any operation or maintenance checking required.

Acceptance Criteria:	Results
• Transmitter or head units to be hardwired with analogue connection through to RTU for remote flow measurement. • Transmitter or head units to be mounted inside switchboard to ensure a visible local display is available for operators to view. • Scaling range (4-20Ma) is greater than the maximum flow out of the pump station by a factor of ≥ 1.2 • Scaling range is communicated through to SCADA supervisor. • Pulse output from magflow meter to be configured so that 1 pulse count = 1m3 pumped volume. • Local display to match SCADA flow measurement. Commissioning officers and SCADA supervisor to check. • Analogue and digital inputs for magflow connection to be pre-determined by SCADA I/O schedule • No local alarming or control outputs are required to be configured from flow measurements from the magflow meter. • Any relevant alarming or low / high (abnormal) flow conditions are to be configured against the analogue value returned to SCADA.	

Test Result **Pass** **Fail**

Accepted by

Passed By (Contractor) ______________________ **Date :** __________

Passed By (Veolia / Fulton Hogan) ________________ **Date :** __________

APPENDIX E

DRAWINGS

QLDC_WWPS_01	QLDC Pump Station Standardisation
QLDC_WWPS_01	REG Electrical Drawings Register
QLDC_WWPS_01	GA - General Arrangements
QLDC_WWPS_01	LDL1 - Label Schedule
QLDC_WWPS_01	01- Wiring Schematics

Appendix H – Water Supply Pump Station Design Guidelines
(informative)

H1 Introduction

The Water Supply Pumping Station Design Standard provides a standardised guide for public water supply systems which presents, as far as practical, uniform concepts for water system design. It offers some flexibility, enabling design engineers and consultants to consider alternative designs for specific situations whilst still delivering the optimum design.

Scope
The key issues addressed in these standards are

i. General design principles;
ii. Pumps and pump station design;
iii. Pipeworks and valving;
iv. Hydraulic considerations;
v. Mechanical and electrical design;
vi. Building construction;
vii. Telemetry and SCADA control systems;
viii. Generators and power back-up;
ix. Landscaping requirements;
x. Testing and commissioning requirements;

H2 Design and Construction Requirements

Site requirements:

- Not be subject to flooding
- Be readily accessible at all times
- Be shaped to divert stormwater around the wells, pumps and structure
- Be protected to prevent vandalism

Acceptance of Alternative Designs
For operational reasons it is a requirement that there be a large degree of uniformity among the Council's water supply pumping stations. Council will consider alternative designs on their merits, where the design results in an equivalent or better performing infrastructural development than that complying with this standard. Any acceptance of alternative designs applies to that particular proposal only.

Alternative designs may be considered:

i. To provide flexibility to meet the circumstances and requirements of the site
ii. As a means of encouraging innovative design
iii. To produce a lower life cycle costing and / or greater operational reliability or
iv. To provide the required resilience in case of land movement due to seismic events

Operation and Maintenance
Design all system components for safe and convenient operational and maintenance procedures:

i. Keep all equipment out of hazardous environments where possible and keep the number of confined spaces generated through the construction of the new facilities to an absolute minimum
ii. Lay out the site, including vehicular access, to allow easy access to the infrastructure components
iii. Locate pipework to facilitate access to and maintenance of equipment. Provide an uninterrupted accessway around pumps and detail any pipework crossing this path either below floor level in ducts with suitable removable gratings or fixed above head height.
iv. Mount surface pumps on a plinth 200mm above floor level.
v. Detail cables to be either below floor level in ducts with suitable removable gratings or fixed above head height.
vi. Place equipment to facilitate visual inspections and routine maintenance
vii. Specify guard rails or chains around the top of any potential hazard of falling
viii. Consider potential future expansions and make provisions for such
ix. Design the control and alarm system to enable operators to react quickly and properly in emergencies
x. Size and select equipment that facilitates a long service life, low operational costs and low maintenance requirements
xi. Keep the system as simple as possible but as sophisticated as necessary, whilst considering the implications of a rural versus an urban setting;

xii. Prepare complete and useful records - system and equipment drawings and specifications, system calculations, hydraulic models, user manuals and manufacturer/supplier contacts, flow charts, diagrams and Process and Instrumentation Diagrams (P&IDs), legal survey plans and address maps, etc. and include this information in the Operations and Maintenance Manual

Pipe Hydraulics
Design pressure pipelines and fittings to minimise hydraulic.

Velocities in pipes must not be greater than 2.0 m/s unless appropriate water hammer analysis has been done.

Provide a surge and fatigue analysis on all critical plastic pipelines including all pressure mains and where velocities in plastic pipes are greater than 1.0 m/s. Provide action points or mitigation measures to deal with the identified surges

Wall and Floor Penetrations:
Provide a water stop puddle flange, centred in the concrete for all pipes passing through walls below ground level

Fixings Restraints and Supports
Design restraints, fixings and supports to the fittings, including the ability to withstand the required seismic loading. Where these items are not detailed on the drawings, ensure that the Contractor designs and supplies these fixings to comply with the Building Code.

All fixings to concrete or masonry shall be by bolts, cast-in fixings or chemical. Terrier and powder charged fixings shall not be used.

Specify corrosion protection on fixings, which exhibits equivalent or better corrosion resistance than the material to which they are connected.

Detail clamping to connect fixings to structural steelwork rather than welding or drilling.

Seismic Detailing
Design flexible connections into pipework on the external side of exterior walls, to allow for relative movement during seismic events. Locate these joints no further than 1.0m from the external wall where possible. Consider punching shear when detailing both the pipework and the wall construction. Flexible connections can be provided by rubber joints, polyethylene pipe or mechanical couplings. If rubber bellows are used, specify that the flexible element is EDPM rubber.

Health and Safety Signage
Provide safety signage (no smoking, confined spaces, power, speed limits, potable/non potable water sources, hearing protection areas, site visitor instruction board, rotating machinery etc.) on all facilities prior to commissioning.

Detail confined space warning signs for pump house accesses that are considered a confined space.

Provide a noise hazard warning sign on the personnel door if there are pumps or diesel inside.

Security
Vandalism is likely at all sites. Detail the building architecture, façade, features and external equipment to discourage vandalism and to minimise damage. Provide an external security light, controlled by a passive infrared sensor for all but simple electrical cabinet installations. Fence all facilities for site delineation and where necessary to restrict access by humans or animals where: ·

i. There is a safety issue for any person that is on the site
ii. Significant vandalism or damage to the site could be expected, or
iii. There is potential for theft or sabotage

Landscaping to afford visibility of the whole site and so to prevent anti-social, unsafe or destructive behaviour.

Locks
Provide standard Council locks to all buildings, chambers and pits, gates and any sensitive or dangerous areas to prevent unauthorised access. Detail locking systems that prevent levers or bolt cutters being used to remove the locks.

H3 Booster Pumps

Booster pumps may be in an open or closed system. Therefore, design the booster pump to either fill a reservoir or to directly supply the network. Each booster pumping station should contain at least two pumps (one duty pump and one standby pump).

Design in-line booster pumps so that:

- Negative Pressure Is Not Produced In their Suction Lines
- Total dynamic head and flow for the system curve can be obtained by all combinations

Number of Pumps
When designing the pumps, include an extra pump over the required number for redundancy i.e. small pump stations shall have a minimum of two pumps. Ensure standby pumps are available for service at all times. Where possible, pumps in a pump set should be identical for operational purposes.

As a guide, where the pump station has the minimum three pumps, the likely set-up and operation may be as follows:

i. Two duty pumps and one stand-by:
    a. Both pumps on VSD - The pump will run up to close to its maximum before the VSD is disengaged and the pump runs at constant speed. The second pump will pick up and provide additional demand up to its maximum duty point
ii. One pump on VSD and one on a Soft start
    a. Once the first pump reaches close to its maximum duty point, the VSD is disengaged and the soft start pump will start and run at its full speed
    b. The VSD pump will then start again and provide any additional capacity required up to the maximum

In both cases the standby pump will be called on if one of the duty pumps goes down. Provide an optimal control scenario for the specific pump station. This approach ensures that the pumps are operated at the maximum possible efficiency for the duties.

Specify 3-phase 415 volt pumps if their motors are greater than 3 kW. Specify water detection and over temperature detection in the motor housing of pumps larger than 3kW. Rate pumps to achieve their design output at no more than 2900 rpm.

Pump Features
Specify pumps with hard metal-to-metal face mechanical seals, high quality stainless steel or high tensile steel shafts and high grade bronze, stainless steel or cast iron impellers.

Specify a dynamically balanced unit to ensure long life and vibration-free operational conditions, confirmed by specifying a vibration test to ISO 10816 on the installed unit to confirm alignment, vibration and base harmonics.

Detail grease lubricated, heavy duty ball or roller bearing type bearings and renewable shaft sleeves and wear rings.

<u>For dry-well mounted pumps, specify</u>:

i. Suctions with easy access to clear the impellor eye. This can be a special access cover or an easily removable section of pipe. For example, pumps with suctions greater than 200 mm diameter can be fitted with inspection plates for hand access into the volute and impellor.
ii. End suction pump sets complete with a substantial base plate to mount the pump and motor. Detail the mounting plate to ensure correct alignment at all times and to minimise harmonic vibrations.
iii. “Back pullout” design end suction pump sets, with the motor and wet end of the pump able to be slid out of the volute with minimal work.

<u>For in-line pumps ensure that</u>:

i. The inlet and outlet are placed at the same level where the inlet and outlet pipe diameters are the same.
ii. Accessibility is easy when the pumps are installed in parallel as the pipework can be in the way.
iii. Pumps are installed in a position to permit proposer lubrication and servicing

Allowance for Future Capacity or Extension
For staged developments such as in Greenfield areas, pump stations can be staged with fewer pumps in the early stage(s) and provision made for the ultimate development scenario. Size these early stage pumping units for the ultimate design flow rate. If an intermediate design flow rate is required, select the pumping units for both conditions, intermediate and ultimate development.

Consider the feasibility of using smaller pump impellers for the earlier stages and upsizing the impellers for the later and ultimate development stages as this could be cost effective if the higher duties can be achieved without overloading the pump. Additional future capacity could also be achieved by replacing pumps installed in the early stages with larger pumps. The starters could be sized for the larger pumps from the start and fitted with circuit breakers and overloads.

If additional pumps are required, make provision for these pumps in the pump station building, the manifold pipework and switchgears. Analyse the various pumping combinations to arrive at the most cost effective combination of staging options.

Well Pump and Motor Information
Provide the details of all proposed pumps and motors with the Design Report, specifically:

- Make and model
- Physical information (mass, dimensions, delivery diameter etc.)
- Mechanical details (materials, bearing and seal types etc.)
- Manufacturing and testing standards
- Guaranteed performance details (Q/H curves, total pumpset efficiency, rpm
- Minimum operating speed for a variable speed set-up and the reason for this limit
- Rating (kW, rpm, voltage)
- Maximum starts per hour
- Confirmation of continuous rating
- Methods of protection

H4 Pump Suction and Discharge

Design the suction and discharge manifold for future flows without having to take a pump out of service for extended periods of time. Design and size suction pipework so that:

i. It is one size larger than the pump inlet size
ii. Suction pipe is easily accessible to clear any blockages
iii. Suction pipe velocities in table 1 are not exceeded
iv. Allowed on short-term basis (e.g. emergency conditions)
v. Suction cavitation is avoided by flooded suction or having a NPSHA > NPSHR
vi. Eccentric reducers have the obvert horizontal to prevent air entrapment.
vii. Suction lift is within allowable limits for the pump.

Design and size discharge pipework so that:

i. It is one size larger than the pump inlet size.
ii. Discharge pipe velocities in table 1 are not exceeded. Higher velocities should only be allowed on short-term basis (e.g. emergency conditions).
iii. It can withstand the total maximum pressure (including surge)

Suction and Discharge Velocities (m/s)

Pipe Diameter	Velocity (m/s)
Suction Pipe Velocities	
≤ 250 mm ≤1.0	≤1.0
>250 mm ≤ 1.5	≤ 1.5
Discharge Pipe Velocities	
≤ 250 mm ≤ 1.5	≤ 1.5
>250 mm ≤ 2.0	≤ 2.0

H5 Pump Motors

Select motors with sufficient capacity to drive the pump. Ensure the motor is non-overloading over the range of duties at which the pumps is expected to operate. Where these requirements cannot be met, submit a non-conformance report to Council.

Do not unnecessarily oversize the motors to achieve the above requirements or the future capacity requirements. Select motors with care as efficiency and the power factor drops in motors running below the load rating.

H6 Pump Station SCADA

Veolia is Council’s manager / operator of the SCADA system.

Provide instrumentation and control at pump stations to measure, control, and monitor the pumping system, as covered in Electrical & SCADA Standard.

Swampfox RTU manufactured by Abbey Systems shall be installed to allow for remote monitoring and alarming functionality (details of IO template for SCADA signals shown in the Electrical & SCADA Standard).

- Developer to provide proposed method of RTU communication to Veolia for approval
- The developer is responsible for all costs associated with the provision of the SCADA communication
- Swampfox to be purchased from Abbey Systems and have area radio channel pre-configured
- Developer is required to use Veolia for all changes required for the software configuration to Council's SCADA system and includes graphical interface, pump station reports and pump station generated alarms

H7 Appurtenant Design

If the pump station's electrical panel is located in a building as defined by the Building Code, specify as a minimum:

i. 4.5 kg fire extinguisher
ii. Approximately A3 size blackboard on wall by personnel door
iii. Lectern, or hinged plan table if space allows

Pressure Gauges
Specify the installation of pressure gauges which read in kPa, with a pressure range such that the maximum pressure reading is around 50% to 60% of the range. Specify test points on the pump inlet and on ALL delivery pipes. Detail test points that are:

- 1/4 inch BSP female thread
- Fitted with a pipe plug
- Installed as close to the pump as possible
- On the pump side of any valves where possible
- With an accuracy to ±5% or better

Specify test points flush with the inside wall of the pipe, with the test point positioned to minimise the potential for the various velocities or turbulence inside the pipe to affect the gauge reading.

Detail a hole diameter through the test point fitting of less than 4mm to minimise turbulence. This diameter can be increased at distances greater than 4mm from the inside pipe wall.

Water Sample Point
Provide lockable water sampling points that located in an easy and safe access to enable safe collection of water samples for both bacteriological and chemical analysis. These shall be located
On the outside of the Pump station building.

H8 Flow Meters

Specify a Mag-flow meter on the pressure main from the pumping station. Meter type shall be as detailed in QLDC the Water Meter Policy dated August 2015. Meter display shall be located with switch board cabinet.

H9 Valving

Detail sufficient isolation valves to enable the pump station to operate while one pump, or any other major plant item, is being serviced. Specify valves rated to PN16.

Reflux valves to be installed downstream of the pump and upstream of the isolation valve. These should ideally be inside the pump station building. Wafer type non-return valves can be specified for smaller pump headworks (<80 mm pipe diameter).

Locate isolation valves on the discharge pipe at least three pipe diameters from the pump control valves. As far as practicable provide each section of piping which may be isolated with a valved pipe drain.

Install pump control valves (valves to control flow during the start-up or shut-down of the pump) even when a variable speed drive is provided. Configure and connect the control valves so that:

- The pump starts on a closed valve
- They open slowly during start-up
- When the pump is signalled to stop the pump continues to run whilst the control valve slowly moves to the shut position, to avoid water hammer.

H10 Building Construction

Design the building to adequately house and allow the efficient operation, servicing and removal of all equipment in the building.

Provide adequate space to move tools and equipment required to perform the entire spectrum of operation and maintenance procedures. Consider future expansion in the design of the building.

Provide a minimum clearance around and between pumps, diesels, open cabinet doors and extended racks of 600 mm.

Locate electrical equipment away from wet areas.

Design a minimum 1.2m wide x 2.0m high personnel service door. Specify solid timber or aluminium doors, with heavy-duty hardware. Detail that large doors fitted for machinery access will open from the inside.

Specify pre-painted long run steel roofing.
Protection of Equipment, Surfaces, Coatings and Dissimilar metals, considering the site's context.

Do not build over pipes or fittings as they require replacement at a future date. If pipes are built over, detail a service pit to contain them, which is large enough for workman to replace the pipe without any excavation or demolition

H11 Electrical and Instrumentation Design

Design the electrical installation, including the generator and diesel engines, the motor starters and the three phase generator inlet plug, in compliance with electrical standard.

H12 Noise, Ventilation and Air Conditioning

Design ventilation to the pump station and control temperatures inside the room regardless of the outside temperature to a range of:

- Minimum of 5ºC
- Maximum of 40°C,.

Consider heat contributions from all sources inside the building or cabinet. Design the ventilation in tandem with the soundproofing, as ventilation may increase external noise levels directly or indirectly.

If air conditioning is required to control the maximum temperature in an electrical room, include measures to maintain internal relative humidity between 40% - 60%, to avoid condensation and static electrical shock.

For intermittent ventilation i.e. active only when there are personnel inside the pump station, specify a fan capable of 30 complete air changes per hour.

Noise generated by the pumping station shall not exceed the Council District plan permitted levels. The design shall include measures to reduce noise appropriately.

H13 Generators – Backup Power Supply

Backup generators are required on most pumps. Whether or not a proposed project will require a backup generator will be confirmed by Council and will depend on the risks associated with power failure. Generators may be permanent and fixed or portable as discussed with and agreed to by Council.

As a minimum specify a unit capable of powering the largest pump, plus all auxiliary equipment (ventilation fans, battery chargers, lighting etc.). It must be capable of powering the pump sets from stand still and zero reticulation pressure and, if required, of starting the standby pump when the duty pump is already running at full load.

Size the generator to match the load and method of starting employed at the pumping station. The generator must be a minimum size in relation to VSDs and must have advanced speed control in order to avoid "hunting" of the generator. The generator set must be able to run continuously at the rated output for several days at a time.

Where an onsite generator is not required by Council a mobile standby generator connection shall be provided and located on the outside of the building. Ensure there is sufficient space for parking a standby generator adjacent to the pump station and way from the footpath or carriageway.

H14 Testing and Commissioning

Council Pumping and Control staff must witness any commissioning work and testing. Involve specialist suppliers and contractors as necessary. Provide at least five working days' notice of the SCADA functionality checking, any commissioning or testing to Council. Also notify Council of the expected date of handover of operation of the pumping station.

Pre-test any work required to be tested in the presence of Council, to prove it is satisfactory. Prior to pre-testing, ensure that:

i. The installation is in accordance with the specification and drawings, except as varied by accepted non-conformances
ii. All equipment is in proper working order
iii. Programming and settings have been completed and checked
iv. Any automatic controls that might invalidate the tests have been overridden
v. The testing and commissioning schedule (including has been prepared and presented to the commissioning personnel and to Council two weeks before the start of commissioning
vi. Rotation of installed pumps is correct
vii. The outstanding work/defect list is completed

Specify a water test for all concrete tanks and below ground structures to Testing Reinforced Concrete Structures for water tightness where testing is practical.
Provide draft Operations and Maintenance Manuals (OMM) and as-built plans to Council at least 5 days prior to commissioning.
Provide generator load tests.
Provide pump tests to confirm that the finished station meets the design flows.

Appendix I – Street Tree Planting Guidelines

(informative)

The Goals of the Street Tree Planting Guidelines are:

1. To establish minimum expected standards, specifications, and work procedures.
2. To communicate these expectations to all persons and agencies engaged in the planting of street trees within Queenstown Lakes District.
3. To ensure high quality and consistent work practices that results in a healthy, stainable and aesthetically pleasing urban forest.

Introduction

Queenstown Lakes District Council (QLDC) is responsible for the planting, maintenance and replacement of council reserve trees throughout the district. These public and often highly visible trees form an important element of QLDC's asset which is managed by the Property and Infrastructure Team.

Following consultation with QLDC regarding species choice, location and planting methodology, the majority of new street tree planting within new subdivisions are planted as an integral component of any new development, usually requiring the developer to adhere to a fixed maintenance period. Following the completion of this maintenance period, QLDC assess the condition and quality of the new planting and accepts responsibility for the trees and their ongoing maintenance.

This guideline has been produced to provide a minimum standard and direction for the planting of new trees specifically within council's road corridor. It is designed for new sub divisions, retrofitting into existing streets, car parks and all other suburban areas under the maintenance of QLDC.

The processes and expectations laid out in this document will provide clear guidance on planting the right tree, in the right environment and in the right place to provide a valuable tree asset that will enhance the local environment and benefit residents while requiring a minimal ongoing maintenance burden for QLDC and its rate payers.

QLDC is committed to protecting and enhancing the valuable tree asset that is within its area of responsibility. QLDC is also committed to future collaborative working with developers in order to ensure the sustainability of the tree asset for the benefit of future generations. QLDC recognise that amenity trees are planted on the basis of the multitude of social, cultural, economic and environmental benefits they provide for the community and are a significant element in meeting community driven expectations and outcomes.

Background

The Queenstown Lakes District is recognised both nationally and internationally for its enviable environment that is further enhanced by the presence of many magnificent trees and hedgerows which during Spring provide a beautiful display of blossom and emerging new foliage, in Summer welcome shade, in Autumn a spectacular display of rustic colours and in Winter an intricate weave of bare colourful twigs.

Overall, the majority of the districts urban forest trees have attained maturity, with many trees entering senescence and nearing the end of their safe useful life. Therefore it is imperative that all new tree planting is appropriate to the location, successful and sustainable in order for successive tree generations to mature and continue the districts tree heritage into the future.

QLDC has inherited many tree related issues that cause conflict with existing services, residents and the surrounding built environment. Unsuitable species, poor planting location and the lack of available space for roots to extend resulting in hard surface defects as a result of natural root development and expansion (direct damage). This is a common problem throughout the Queenstown Lakes District and beyond.

Street Tree Planting & Climate Change

How do street trees help combat climate change?

- Trees sequester carbon dioxide directly from the air and transform it into living matter - trunks, branches, roots, leaves, and flowers.
- Deciduous trees planted in strategic locations conserve energy by shading buildings during the summer months. This directly results in a reduced requirement for artificial cooling of buildings and corresponding reduced energy use which means reduced greenhouse gas emissions onsite and from power plants.
- An effective tree canopy in towns and cities helps reduce urban heat island effect, where heavy concentrations of buildings and asphalt adsorb heat and raise urban temperatures by as much as 10°. Lower temperatures mean less energy use for artificial cooling and reduced emissions.
- One large mature tree will sequester 8–10 tons of carbon dioxide from the atmosphere over its lifetime.

The overall effect of urban trees is to cool the local environment during the summer months. Deciduous trees provide summer shade that helps to filter some sunlight from reaching the surface below their canopies. When trees shade buildings, this can reduce summer demand for air conditioning, which in many towns and cities is powered by greenhouse-gas-emitting fossil fuels, such as natural gas or coal. Shade around air-conditioning units can also reduce energy use by partially pre-cooling air before it enters the building. During winter months, deciduous trees provide a spectacular display of autumn colours before they shed their leaves and allow sunlight to penetrate through the canopy, allowing buildings to benefit from the natural warmth of the winter sun.

TREE PLANTING GUIDANCE

Site Assessment
All trees require fundamental environmental resources. Many sites considered for tree planting are unable to provide these resources, which can contribute to eventual tree decline and failure.

There are many factors to be considered when planting, particularly in the urban environment, therefore a process is necessary to methodically assess the many variables that will be encountered. This stage of planning is essential as these factors impact on soil water retention and movement, drainage, nutrient availability, the severity of soil compaction and root development. Tree roots require very specific conditions in order to thrive and support the tree both structurally and physiologically. Perhaps the most important factor is to ensure that the soil is not overly compacted which can severely inhibit the natural ingress of air allowing gaseous exchange to occur.

Natural factors to be assessed and considered can include:

- Heat and exposure - Increased temperature and sun scorch
- Low temperature, chilling and frost
- Drought
- Mineral deficiency
- Water logging
- Competition for light, water and nutrients
- Acid pH of soil and water
- Exposure to high winds and turbulence
- Soil compaction

Man-made factors to consider can include:

- Above ground factors - Proximity to buildings, utilities, distances to adjacent trees, visibility splays and distance back from kerb edge are significant factors that will determine the appropriate tree species for the location.
- Surrounding surfacing - Roads, pavement, car parking, driveways, new sub division/development site (usually a highly modified environment), berms, verges. The interaction of pavements and berms/verges is a common issue for tree root development.
- Underground factors – Utilities and services will require investigation to establish suitable placement of tree planting locations, or the services should be located away from planned tree planting locations in all new sub-divisions. Development of the rooting environment will need to ascertain whether any utilities are potentially affected by the proposed tree planting. Mitigation and protection may be required, however, incorporation of services through tree pits is widely accepted where appropriate.

The existing soil should always be considered for use in the tree pit, though it may require soil improvements and/or decompaction, this will vary to individual site requirements and it is recommended that discussions take place with a professional arborist to establish a suitable outcome. The top soil is often removed as part of development. The underlying soil that's left should not normally be considered suitable for tree growth.

Tree Species Selection

When choosing the species of tree to plant, it is recommended that guidance is sought from a suitably qualified professional arborist experienced in the local climatic conditions. Although it is desirable to plant large trees in the urban environment due to their eventual visual benefits to the streetscape, it is not always practical as a result of man-made restrictions such as overhead services and proximity to buildings and highways.

Therefore careful consideration needs to be taken before deciding on the eventual species of tree to be planted.

There are many variables to be considered when choosing a species for any particular site. These variables relate to both the trees to be planted and the conditions in which they are to grow. Design demands are often paramount, but cannot be considered in isolation from all the other factors involved in suitable species selection. All potential impacts on the likely success and longevity of any new planting should be considered.

Nursery catalogues are a useful source of information regarding a species or cultivar to be used. However, catalogues are primarily designed to sell trees and the information contained in them is often partial and incomplete, there are many publications available describing tree species and their characteristics. Local experience and knowledge of young tree performance is often as valuable, and there are occasions when specialist advice is needed.

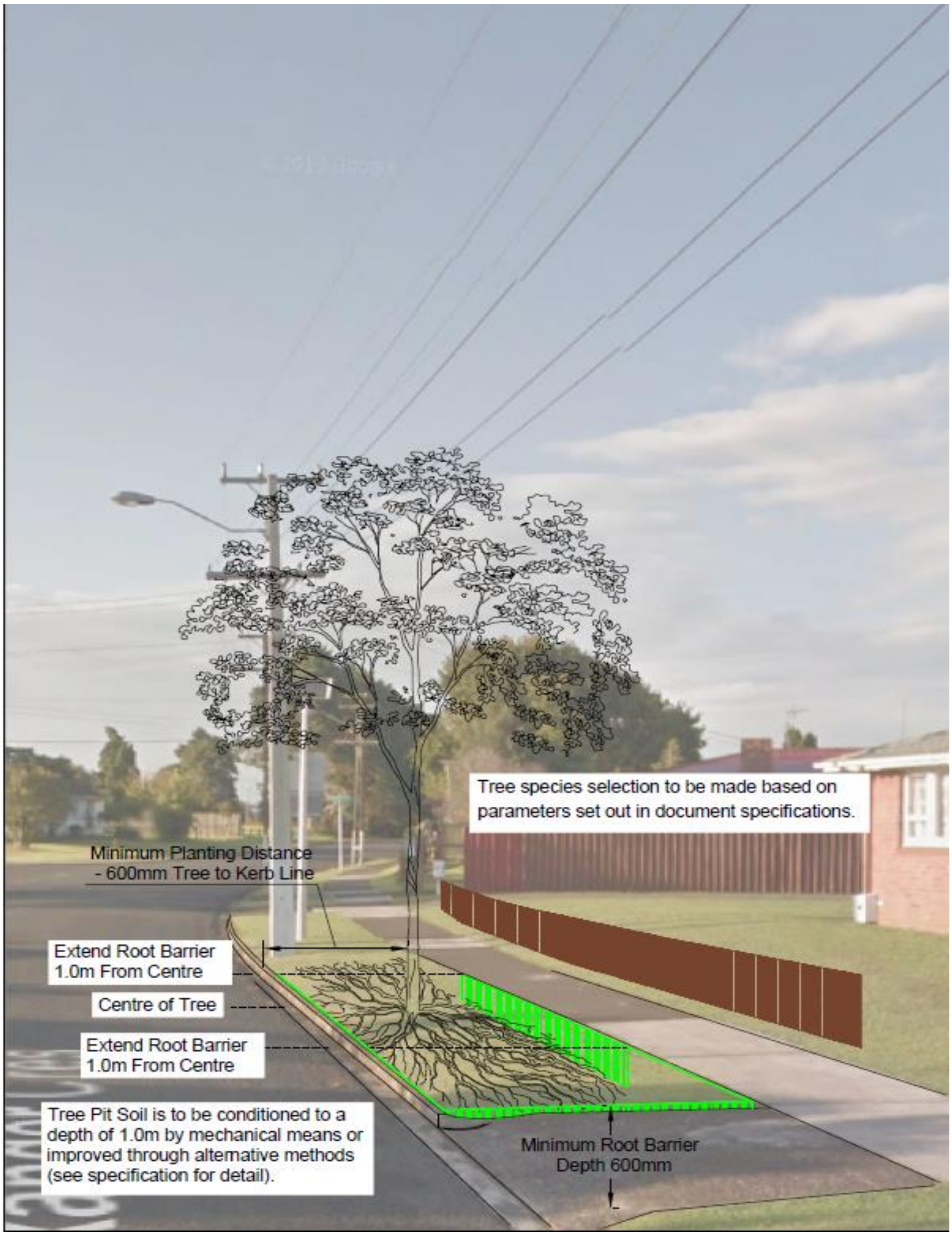
Trees are adaptive and respond to the local environment in which they are growing, often producing modifications of form which do not match the nursery catalogue description. Site constraints are likely to affect the eventual form, development, speed of growth and eventual longevity of the young tree.

It is imperative that before any decision is made regarding species choice for planting within any QLDC reserve, an early consultation process is initiated with QLDC and the final decision on species choice is agreed with QLDC.

The Parameters for New Street Tree Planting
The following parameters are set out to provide a guide to aid the correct selection of species for the location. In all locations the following must be adhered to,

- No tree shall be planted closer than 600mm from the inside edge of the road kerb.
- No tree shall be planted to obscure visibility splays.
- No square tree pit opening shall be less than 1200x1200mm and when suitable no less than 1500x1500mm.
- Appropriate, vertically ribbed root barriers or root deflection systems shall be installed and be no less than 600mm deep. In a berm/verge situation the root barrier shall be installed at linear meter either side of the tree centre, longitudinally adjacent the footpath and road kerb. When a square tree pit opening is created the root barriers or deflection system shall be installed at the outer edge of the tree pit.
- Where practicable, the rooting environment shall be manipulated to provide no less than 8 cubic meters of good usable and uncompacted growing medium to encourage the tree to establish and develop to its full potential (Note: final tree pit sizes to be negotiated with QLDC dependant on site constraints and surrounding soil type). Where achievable the soil volume provision shall be greater than 8 cubic meters (advice from a suitably qualified professional arborist should be sought in the relevant amount of soil volume per tree species and the combination of trees per pit).
- In situations where established adjacent trees are already in situ, it is essential that no root damage occurs to any existing trees during planting and the ultimate dimensions of both trees should be considered.
- The distance to potential obstructions are required to be measured or calculated at the planning stage. Such restrictions can include overhead services, adjacent buildings, highways, road signage, lighting columns, power lines and street furniture.
- When new or renewal footpath construction is being undertaken the pavement layout should maximise the space available for the rooting environment of the tree. Flexible pavement options shall be incorporated to protect pavement deflection.
- Once the tree list has been selected for the planting location no other species list shall be used. As new varieties and cultivars are made available that are suitable to each of the species lists they will be populated into the appropriate list.

New street trees shall not be planted where the projected mature canopy spread is within 5 meters of any street light or overhead services.



Example of berm/verge tree selection and protection (Image created by Arborlab)

Tree Stock Selection

Tree production is the first link in establishing healthy and sustainable street tree planting. Its importance is obvious, and planting projects have often failed through using poor quality trees. Healthy landscape trees are derived from high quality nursery stock. Ensuring that high quality trees are supplied for planting is essential to the successful long term sustainability of any street tree planting programme and an understanding of nursery production systems is therefore critical to enable differentiation between nursery trees of a high or low quality.

If plant quality is sacrificed for superficial looks, stock is sometimes forced to reach a saleable size in the shortest possible time, and while it might be large, it is not necessarily hardy or physiologically ready for planting.

Tree longevity in the landscape begins not at the planting site but at the nursery. The selection of physiologically healthy, mechanically sound and resilient trees is fundamental. Poor production practices on the nursery can cause problems years or even decades after the tree has been growing in the landscape.
The production of young trees is a specialized and complex process, and expert advice is needed when evaluating nursery production systems and good practice. The choice of production system is the responsibility of the specifier and is inextricably linked to the individual site constraints.

Tree Pit Formation
Planting in 100% Engineered Environment – Footpaths, Car Parks, New Roads, Road Upgrades & Combined Tree Storm Water Applications
Based upon a basic conflict of principals between the compaction required for engineering and uncompacted soil environment requirements for root development, provision in areas where the compaction levels are likely to be high will require additional mitigation for the successful integration of trees into the engineered environment.
This Guideline sets a desired minimum requirement, where practicable, of 8m3 of good usable growing medium per tree in these environments (final tree pit sizes to be negotiated with QLDC dependant on site constraints and surrounding soil type).

Combining these factors is achievable through various methods. All of these methods have a higher installation cost associated with them when compared with traditional methods of planting, however it is essential to integrate both the trees requirements and those of the engineered environment to provide a long term benefit. If the rooting environment cannot be manipulated to provide a positive and sustainable rooting environment then no planting should be undertaken.

It is essential that all underground utilities and their locations are confirmed as they may need to be relocated during the installation phase of the tree planting (see drawing 1 below). Research shows that when an adequate soil volume is provided and the infrastructure is correctly built the root development will have very limited interactions with underground services.

Integration of soil into the engineered environment can currently be achieved via three main options, all have been tested worldwide:

- Soil cells
- Vault or rafting
- Structural Soils

Soil cells are the most widely available and a simple way of integration. There are several manufacturers with similar products.

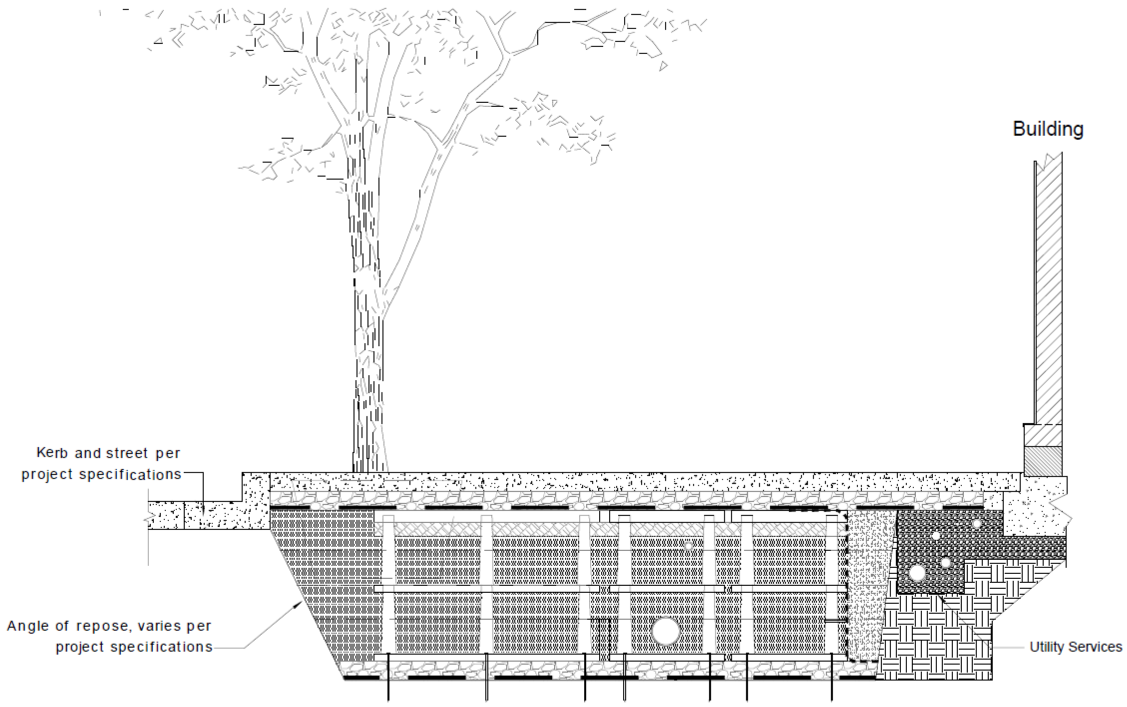
Vaults and rafts are widely used throughout North America (particularly Canada). They require pre cast or cast concrete, as a result they are normally purpose built due to the varying on site factors.

Structural soils blend an aggregate with a clay based soil that allows the blend to have a surface placed over it. More suited for pavements or foot traffic, this system is not suitable for heavier applications such as car parking.

The proposed soil to be integrated into either the soil cells or raft/vault system will require confirmation.

Combined tree and storm water applications are now often an additional benefit when planting trees in engineered tree pits. The emphasis of the soil being uncompacted allows the ingress of water into the proposed solution/pit for temporary holding.

The trees will utilise water runoff from the surrounding area, the soil will release the water at a slower rate post rainfall event and also potentially provide water cleansing affects. The method of integration of water into the engineered tree pit is required to be illustrated, clearly showing how water enters, exits and integrates to the storm water network. Dependant on the soil volume, soil type and potential expected outcomes for the project, the total storm water potential from the proposed engineered tree pit shall be estimated and form part of the information provided to QLDC.

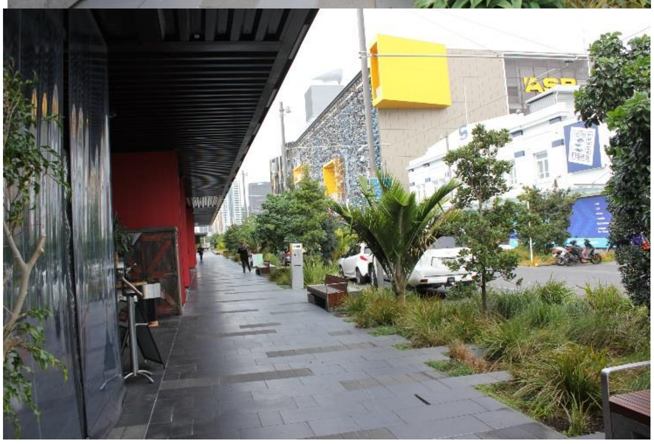


Drawing 1 - Example of engineered tree pit cross section (Image created by Arborlab, amended from DeepRoot drawing)

Integration of trees and infrastructure. Example of soil cells being laid out into tree pit areas. Image courtesy of Paul Malcolm, MetroGreen.

Tree pits and car parking combined

Use of vertical / slot drainage to combine trees and storm water.



Good species selection in line with the proximity of the building. As the trees develop, some pruning required, for buildings and power line for proposed tram network.

Planting in Partially Engineered Environment – Berms/Verges with Areas of Soft Landscape, Central Median Areas of Roads

Many roads and streets throughout the Queenstown Lakes District have footpaths that have a concrete path, flanked with grass. It is common place for trees to be planted in these areas. The total width of the berm/verge including both areas of concrete and grass needs to be considered when proposals of new street planting is taken into account. There are various layouts of these across Queenstown with differing dimensions of pavement to berm ratios. Prevention of root damage to the surrounding footpath is required. This can be achieved in various ways such as position of planting, root barriers, soil amelioration and flexible pavement options.

The underlying soil type and geology is a critical factor. Soil in situ is likely to need some degree of amelioration. In areas the soil amelioration will require more detailed information. If the soil is not improved or at the very least broken up the roots are unable to penetrate. This leads to surface rooting causing issues with the surrounding infrastructure.

Root barriers will require 1 linear meter either side of the tree stem adjacent all footpaths, road kerbs and other likely areas potentially affected by the rooting matter within 3m of the stem of the tree. The root barriers shall have suitable vertical ribs, this will direct the roots down and prevent girdling that can have long term detrimental effects to the trees development to a depth of 600mm

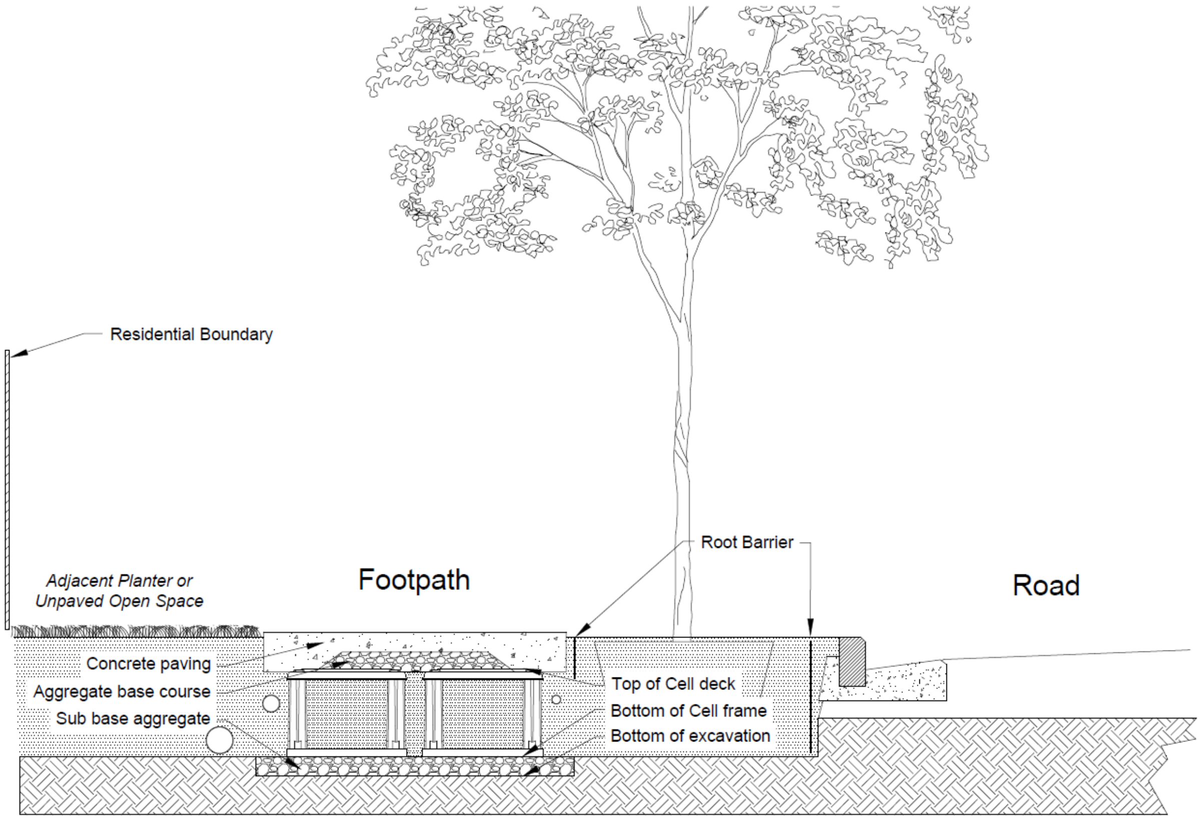
Consideration to directing the rooting material of the tree under the pavement will provide additional rooting environment and therefore aid the trees development. Pile and beam footpath constructions or the use of soil cells under the pavement, along with the other amelioration techniques illustrated provide integration with minimised defects in the future (see drawing 2 & 3 below).

Flexible pavement options that allow movement of the pavement can also be considered e.g. http://www.tripstop.net/

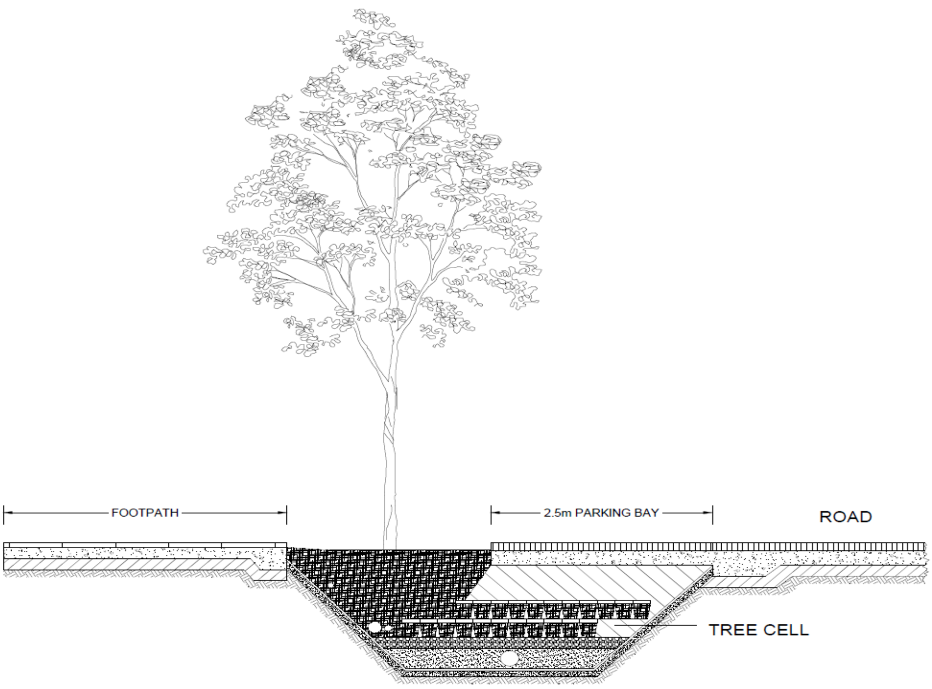
<u>Partially engineered check list</u>

- Soil type ascertained
- Degree of soil amelioration required and proposed
- Root barriers and pavement construction methods proposed to integrate trees

Urban trees successfully growing within an engineered tree pit environment



Drawing 2 - Partially engineered example – Directing roots underneath pavements (Image created by Arborlab, amended from DeepRoot drawing)



Drawing 3 - Partially engineered example – Directing roots underneath parking bay (Image created by Arborlab, amended from MetroGreen drawing)

Planting in Areas of Soft Landscape Greater Than 3m Away From Kerbs, Pavements & Other Engineered Obstructions
In areas of soft landscape away from infrastructure the emphasis will require a suitable species to fit the location. A proposal of the planting specification and soil amelioration will need to be submitted to QLDC for approval.

Soft landscape check list

- Soil type ascertained
- Degree of soil amelioration required and proposed

Planting Methodology
A planting methodology shall be presented to QLDC for assessment which shall include such details as:

- Planting pit specification
- Soil type (existing and replacement soil)
- Irrigation specification details (if irrigation is to be installed prior to the formation of access driveways, this shall be installed at a depth of no less than 75cm to avoid damage)
- Tree support (normally 3 stakes supporting the new tree at a point no higher than 1/3rd of the trees height)
- Ground treatment around the base of the tree e.g. mulch, hard surfacing, grill

Only when QLDC is satisfied with the proposed planting methodology shall planting works proceed.

Street Tree Maintenance and Associated Requirements

- Post-planting maintenance and management is important to ensure the establishment and sustainability of all new street tree planting. A full tree management programme with budgetary provision should be in place for all planting schemes. This management programme should be in place for a minimum period of three years (this maintenance period is usually stipulated as a condition of consent).
- The timing and frequency of any irrigation should take into account the prevailing weather conditions, soil moisture release characteristics, and the response of the tree species to water deficits. Regular monitoring must be undertaken to assess the effectiveness of any irrigation.
- *NOTE Nursery trees produced in ideal conditions can take time to adapt to localized planting conditions.*
- Any given volume of soil has the capacity to hold a given volume of water. The water holding capacity of the soil should be established and taken into account when assessing irrigation needs.
- In addition to water-holding capacity, the amount of water available to the tree should be established. Assessing all newly planted trees is impractical, but sample assessments should be made
- The frequency of irrigation is more important than the volume of water given at any one time. This should be accounted for in irrigation plans. Irrigation plans should also take into account the assessments made at the original site assessment and the subsequent species choice made.
- Formative pruning should be carried out as required throughout the early years of a tree's life in the landscape. Some of the nursery-prepared branching structure is temporary and formative pruning should continue until a permanent structurally sound scaffold system of branches typical of the species and appropriate to the site circumstances is produced.
- A formal assessment of young tree health and development should be carried out every six months. This assessment should include foliar appearance, leaf size and density, extension growth and incremental girth development. Continual assessment on an ad hoc basis should be carried out throughout the year.
- All stakes and ties should be checked at least every three months to ensure that the root system remains stable and firm in the ground, and that ties are still effective and not causing any damage to the tree. Any stakes and ties that are found to be not fit for purpose should be adjusted or replaced.
- All stakes and ties should be removed as soon as the developing root system is strong enough to support the tree.
- *NOTE Three full growing seasons are usually long enough for this to occur.*
- Where underground guying systems are used, the wires or straps should be cut as soon as the tree is self-supporting.
- The area around the base of the tree should be maintained in a weed-free condition. The use of herbicides should be avoided and wherever possible aged mulch should be used.
- All mulches should be replenished and hand-weeded as necessary and at least once annually. The mulched area should be enlarged, if practicable, as the tree develops.

- All grilles, grids, guards and other protective furniture should be checked at least annually. Such furniture should be removed as soon as it is no longer necessary to protect the tree, or where there is a risk of physical damage to the tree.
- The soil around newly planted trees should be regularly inspected for soil capping or compaction. Remedial action should be taken as necessary.
- *NOTE Inspections can be visual, but where conditions are extreme, on-site testing and amelioration might be necessary. This can include manually loosening the pit surface with hand tools or more extensive action using an air spade or equivalent. Mulching can prevent further compaction.*
- All trees should be checked on a regular basis for mammal, human and other external damage. Remedial action, where this is possible, should be implemented as soon as practicable following discovery.
- All trees should be checked on a regular basis for pests and diseases. Remedial action should be taken promptly on discovery, where necessary.
- Unless specific nutritional deficiencies are identified, no fertilizer should be applied to newly planted trees.

NOTE If visual inspection reveals symptoms of nutrient deficiency such as leaf scorching, pale foliage or necrotic spots, then further investigation will be necessary with remedial action taken. Remedial action may, in addition to fertilizer application, include pH testing, assessment of organic content and levels of compaction.

- Any tree that fails during the maintenance period shall be replaced with a new tree of the same species and specification.
- The details of all new street tree planting shall be recorded in such a way as this information may be transferred to Queenstown Lakes District Councils GIS software, the information required shall include:
  - Planting locations
  - Tree species planted and size
  - Photographs of the individual trees at the end of the three year maintenance period
  - All maintenance works undertaken during the three year maintenance period

Worldwide case studies
http://www.deeproot.com/silvapdfs/caseStudies/LidlCarPark.pdf
http://www.youtube.com/watch?v=8jcLtlbRuRs
http://www.youtube.com/watch?v=mLffDaa2Pak
http://www.youtube.com/watch?v=TlJDJXqwNyA
http://www.deeproot.com/silvapdfs/caseStudies/Charlotte%20Suspended%20Pavement.pdf
http://water.epa.gov/polwaste/green/upload/stormwater2streettrees.pdf
http://www.vtfpr.org/urban/documents/Main%20Streets%20to%20Green%20Streets.pdf
http://urbanforestry.frec.vt.edu/stormwater/Resources/TreesAndStructuralSoilsManual.pdf
http://vancouver.ca/files/cov/StreetTreeGuidelines.pdf
http://www.fao.org/uploads/media/Trees_for_parking_lots_and_paved_areas.pdf

Engineered tree pit examples
Soil cells
www.deeproot.com
www.metrogreen.co.nz

Vaults & rafts
http://www1.toronto.ca/city_of_toronto/parks_forestry__recreation/urban_forestry/files/pdf/TreePlantingSolutions_BestPracticesManual.pdf - Section 3.1
Structural Soils
http://www.hort.cornell.edu/uhi/outreach/pdfs/custructuralsoilwebpdf.pdf

Internet based information
http://thefield.asla.org/2014/04/24/planting-trees-in-suspended-pavement/
http://thefield.asla.org/2014/05/06/rethinking-runoff-shrubs-stormwater/#more-2576
http://thefield.asla.org/2014/01/30/structural-soil-part-1/#more-2176
http://thefield.asla.org/2014/02/19/structural-soil-part-2/#more-2185
http://thefield.asla.org/2013/09/10/soak-it-up-design-competition/#more-1863
http://edmonstonmd.gov/files/Greening_DecaturSt_inclAddendum_v1.0.pdf
http://www.landscapeirrigation.com/ME2/Audiences/dirmod.asp?sid=&nm=&type=Publishing&mod=Publications%3A%3AArticle&mid=8F3A7027421841978F18BE895F87F791&tier=4&id=38FD064F957F4EFAA4BE57F5E7838420&AudID=AC361F5928F54864BFCBBD93E5B8624D

Appendix J –Cycle Trail and Track Design Standards & Specifications
(normative)

Introduction

The Queenstown Lakes District Council administers over 180km of cycle trails and tracks. These trails and tracks are a valuable asset to the Lakes District and the purpose of this standard is to ensure greater consistency and quality in the development of all new trails. For simplicity, trails (as called in Wakatipu) and tracks (as called in Wanaka) will collectively be referred to as trails by this document.

The development of a cycle trail design standard is being driven by the increasing development of cycle trails in the Queenstown Lakes District and in particular trails developed as part of private land development projects as well as those created by volunteer organisations.

The Council has recently taken over ownership of numerous sections of cycle trail in both Wanaka and Queenstown and many of these have been built with significant design and construction defects which results in the ratepayer funding realignment and repair works. Council is looking to minimise this cost and ensure better quality trails are developed in the future to be fit for purpose.

This standard is intended to guide cycle trail designers and developers to achieve consistently high standards of cycle trail best suited to meet long term community needs (network connections and latent demand) and minimise ongoing maintenance costs to Council, as the trail owner.

The guide has been developed to closely mirror the New Zealand Cycle Trail (NZCT) “Cycle Trail Design Guide”, 2010 with minor changes to take into account changes in design and construction that have arisen during the course of the National Cycle Trail projects. The changes are in maximum gradients, surface finish and additional detail on trail geometry that was not dealt with by this previous standard.

The NZCT guide implemented and widely publicised the 1-6 trail grading system used by the mountain biking community. In terms of trails developed within the QLDC, these will be graded 1-3 with tracks graded 4-6 being purpose built mountain bike tracks and not cycle trails. Development of mountain bike tracks is outside of the scope of this standard.

Additionally, the Department of Conservation (DOC) also have track design guides. These mainly relate to walking track construction and are available on the DOC website. DOC has adopted the NZCT grading system of rating trails as 1-6.

Overarching Goal of this Design standard and Construction Specification

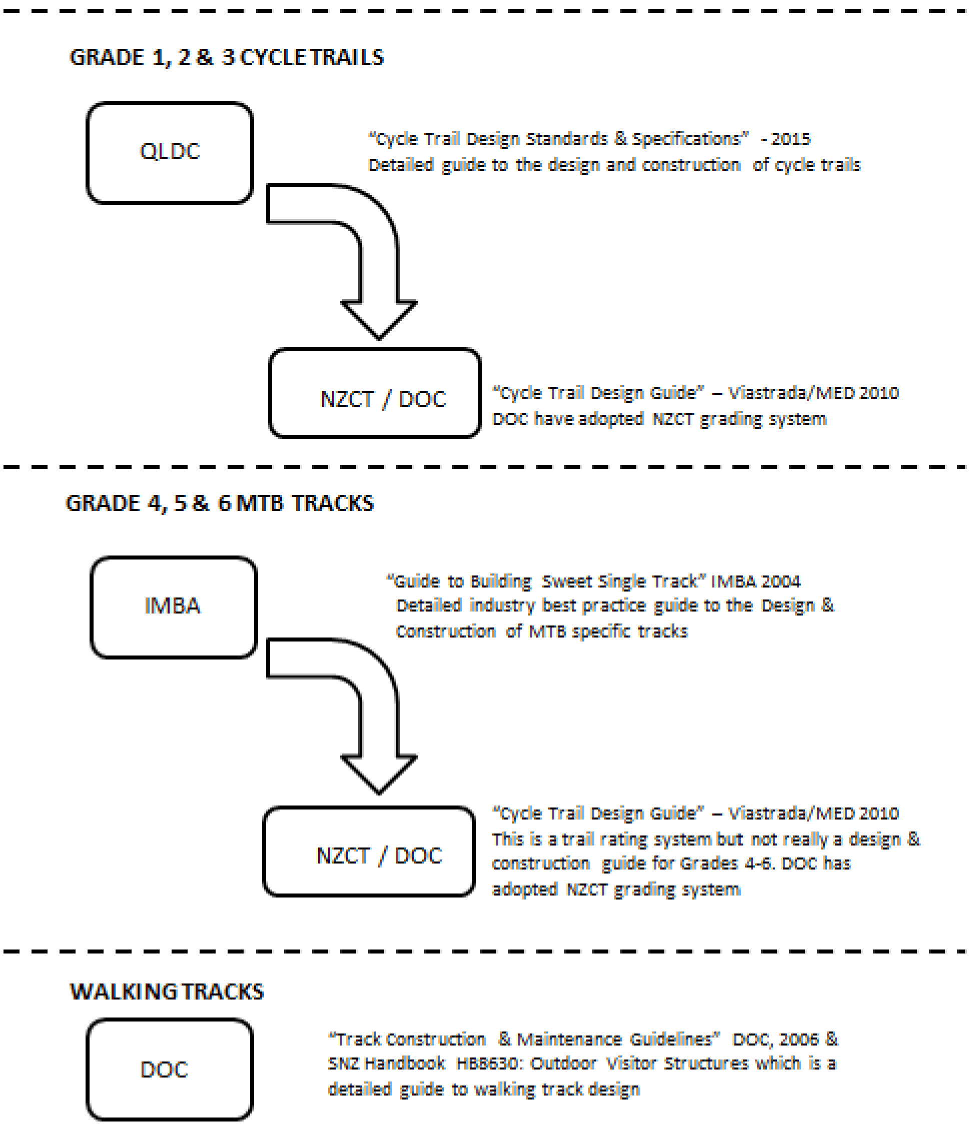
To guide land developers and trail designers to achieve a high quality cycle trail specifically designed and built to cater to the needs of the community(s) it connects and serves and that minimises future maintenance costs to Council.

Scope of this Guide

The design and construction of Grade 1-3 cycle trails. The design and construction of ‘mountain bike’ tracks (Grades 4-6) is very well covered by the IMBA “Guide to Building Sweet Singletrack” 2004 design guide (Refer references section). DOC’s track design guides are best suited for the design of walking tracks only.

The design and construction of trails suited to horses has not been considered as part of this guide.

Overview of Trail and Track Design Standards



Trail Grading & User Groups

The New Zealand Cycle Trail Project (NZCT) commissioned a design guide in 2010 as part of the nationwide cycle trail development project. Completed by Viastrada this guide is the best starting point in the identification of a cycle trail grading system. *(See Cycle Trail Design Guide 2010 – Ministry for Economic Development)*1.

Over the intervening 5 years we have refined this system and present the refined grading technical specifications as follows:

I. Grade 1 – Easiest; gentle grades up to 2 degrees (1: 28) with short sections <100m up to 3 degrees, wide (2.5m+) and smooth trail ideal for all user groups. No fall hazards. These are ideal for connecting communities and where families and novice cyclists are likely to be present.

II. Grade 2 – Easy; Some gentle hills up to a maximum of 4 degrees (1: 14), wide (2-2.5m) with some short (<50m) narrow sections of minimum width 1.5m, smooth surface with critical fall hazards within 2m of track edge fully protected. These are ideal for connecting communities

1 http://www.nzcycletrail.com/about/resources

and where families and novice cyclists are likely to be present but where Grade 1 gradients cannot be achieved due to terrain constraints.

III. Grade 3 – Intermediate; gradients 0-4 degrees typically, more regular hills acceptable up to a maximum 6 degrees (1: 10) where unavoidable terrain, width 1.2-1.5m and extended narrower sections of minimum width 1.2m. Critical fall hazards at track edge protected only. This is essentially an easy mountain bike track.

The majority of trails within the QLDC network are classed as Grade 1-2 with a few being Grade 3. Table 1 gives a breakdown of the various grades for existing local trails.

In order to provide the greatest accessibility to any new trails, every trail should be designed to meet Grade 1 or 2. Grade 3 should only be considered where the users are predominantly not commuters, families or novice cyclists and the trail is not forming part of a connective network to link communities or part thereof. In other words, not a critical linkage to the cycling network.

Comparison with NZCT/DOC Grading System

DOC has adopted the now widely used Kennet Brothers/NZCT trail grading system using numbers 1 to 6 to classify trails according to trail difficulty. Below is a brief overview of the difference to this standard:

- NZCT Grade 1 – Same except grades not allowed to be steep if ridden in one direction only.
- NZCT Grade 2 – Allows maximum grade of 6 degrees (leading developers to use this as a default grade), allows surface roughness like roots and rocks (not suited to rider group), topcourse aggregate of 30mm particle size (too course for good surface finish – Max 20mm)
- NZCT Grade 3 – Allows grades up to 5 degrees (too steep, likely to cause rutting) and maximum grades of 9 degrees (too steep for most riders, ruts badly)

In summary, this new standard responds to the desire of many trail developers to seek the shortest and steepest line for their trails. Setting lower grade limits and including trail geometry and cross fall details in the design specification is aimed at reducing the most common trail defects noted in this region.

Detailed Trail Grade Specifications

The minimum specifications for each trail grade can be expanded as follows:

Grade 1

- A minimum width of 2.5m allowing for side by side riding. This makes passing and overtaking easy, and provides sufficient width for novice riders to feel secure. The minimum width may be reduced to protect historic features, or for environmental or visual amenity reasons. Width also caters for 4wd vehicle access for maintenance purposes.
- Maximum prolonged gradient of 2 degrees (1:28). Maximum gradient of 4 degrees (1: 14)
- Maximum out-slope cross fall of 3% for straight sections of track.
- Corners shall have a minimum inner radius of 6.0m and in-slope gradient or cross-fall of 6-8% except hair pins which must not exceed Typical Detail Sheet R4030_E3_3 of 2.5m
- Minimum structure width of 2.0m clear. Clear means between the closest parts of the barriers.
- A clearly sign posted, well defined trail from beginning to end so visitors can easily find their way in both directions and during inclement weather
- A compacted, well bound smooth riding surface with suitable camber to provide a pleasurable and easy riding experience. Riders should never feel they are going to slide off the trail. Minimum compacted aggregate depth of 75mm
- All water courses to be culverted or bridged
- All areas of fall hazard (exposure) shall be protected with barriers that meet the building code.

- No stiles are to be used. All fences are to be crossed using cattle stops/bollards
- Sight lines – a minimum of 15m clear sight distance is to be achieved around all corners

Grade 2

- A minimum width of 2.0m but generally 2.5m wide allowing for side by side riding. This makes passing and overtaking easy, and provides sufficient width for novice riders to feel secure. The minimum width may be reduced to protect historic features, or for environmental or visual amenity reasons. Width also caters for 4wd vehicle access for maintenance purposes.
- Maximum prolonged gradient of 4 degrees (1:14) but where length >100m it must be broken with flat recovery sections 10m long minimum at 50-75m spacing's. Maximum gradient of 6 degrees (1: 10) for no more than 30m without a flatter recovery section of equal or greater length
- Maximum out-slope cross fall of 3% for straight sections of track.
- Corners shall have a minimum inner radius of 6.0m and in-slope gradient or cross-fall of minimum 6-8% (to be suited to the trail geometry to ensure slip free riding at design speed) except hair pins which must not exceed Typical Detail Sheet R4030_E3_3 of 2.0m
- Minimum structure width of 2.0m clear. Clear means between the closest parts of the barriers.
- A clearly sign posted, well defined trail from beginning to end so visitors can easily find their way in both directions and during inclement weather
- A compacted, well bound smooth riding surface with suitable camber to provide a pleasurable and easy riding experience. Riders should never feel they are going to slide off the trail. Minimum compacted aggregate depth of 75mm
- All water courses to be culverted or bridged
- Areas of significant fall hazard shall be protected with barriers that meet the building code. Areas of exposure where there is not a significant hazard may be protected with fencing, bunding, vegetation or signage
- No stiles are to be used. All fences are to be crossed using cattle stops/bollards
- A minimum of 10m clear sight distance is to be achieved around corners, or additional warning/speed calming measures may be required to avoid user conflict.

Grade 3

- A minimum width of 1.2m but generally 1.5m wide allowing for comfortable single file riding only. The minimum width may be reduced to protect historic features, or for environmental or visual amenity reasons over short (50m) sections. Width caters for quad bike access for maintenance purposes.
- Maximum prolonged gradient of 6 degrees (1: 10) for sections not longer than 100m with flat sections of minimum 25m length between. Maximum gradient of 9 degrees (1: 6) for no more than 30m without a flat recovery section of equal or greater length
- Maximum out-slope cross fall of 3-6% for straight sections of track.
- Corners shall have a minimum inner radius of 3m and in-slope gradient or cross-fall of minimum 8-15% (to be suited to the corner, speed and trail geometry) except hair pins which must not exceed Typical Detail Sheet R4030_E3_3 of 1.2m
- Minimum structure width of 1.2m clear. Clear means between the closest parts of the barriers to ensure quad bike access.

- A clearly sign posted, well defined trail from beginning to end so visitors can easily find their way in both directions and during inclement weather
- A compacted riding surface of either insitu gravels or imported gravel to provide an all-weather surface. Minimum depths to suit ground conditions
- Trail cross fall to provide an enjoyable riding experience for intermediate riders. Riders should never feel they are going to slide off the trail due to incorrect cross slope.
- Water courses may be crossed with fords or be culverted or bridged if required. Any areas of soft or boggy ground shall be made all weather to prevent mud and damage to the trail surface
- Areas of significant fall hazard shall be protected with barriers that meet the building code. Areas of exposure within 1m of the trail edge where there is not a significant fall hazard may be protected with fencing, bunding, vegetation or signage
- Stiles may be used but preference should be given to using Cattle stops for convenience and maintenance purposes. Where a stile is used a gate is required adjoining for maintenance use.
- A minimum of 5m clear sight distance is to be achieved around corners, or additional speed calming measures (trail alignment, sag, etc.) are required to avoid user conflict.

Cycle Trail Design Considerations

Step 1: Identify the User Group & Required Trail Grade

If the proposed trail is connecting communities and will form part of a larger network, then the minimum standard will be Grade 2 (Always design to achieve the best grade where possible).

The user groups for Grades 1 and 2 are as follows:

a) Families including small children

b) Novice riders who either have never ridden or ride infrequently

c) Cycle tourers and commuters*

d) Mountain bike riders

e) Accessibility users

Groups (a) and (b) require a safe enjoyable cycling experience that is accessible with limited/no cycling skill. The trail must be designed with the needs of the most discerning user group in mind. For the above this would be families and novice riders. Cycle tourers, commuters and mountain bikers have a higher degree of skill and experience making them able to handle less well formed trails[2].

Having identified the user group, the designer should aim to achieve the flattest grade possible to meet the highest Grading. This ensures the maximum utility and accessibility to the community irrespective of other aspects of the design.

Step 2: Design Alignment

The designer needs to consider how to fit the trail into the land to minimise gradients, minimise hairpins, control storm runoff and drainage, climb hills, design and integrate structures and achieve the required width and finish that creates or results in a desire line.

Desire Line

The designer needs to understand where the trail users are coming from (How do they access the trail) and going to (where will they leave the trail network) as well as how will the riders respond to the trail alignment in order to understand the desire line. Desire line refers to the preferred alignment for trail users and manifests itself in riders cutting corners or short cutting sections of trail they consider 'undesirable' when it has not been achieved.

An example of an error in desire line is making curves across a flat open section of terrain when a straighter piece of trail would suffice. Riders are likely to cut corners in this situation. Each section of trail should be considered from the rider's perspective to ensure that desire line is achieved as much as possible.

---

2 Commuter tracks require slightly different design considerations outside of the scope of this guide

Ultimately desire line can be hard to predict. A designer needs to consider this especially in open country where riders can see the destination.

Hair pins or Switchbacks

It is often necessary to use hair pins (corners of ~180 degrees) to negotiate steep terrain. The use of hairpins needs very careful consideration to avoid rutting, erosion damage and safety issues for novice or inexperienced riders.

Hairpins should be graded such that the longitudinal grade through the corner is no more than 2 degrees with the cross-fall sloped to the inside to match the speed of travel such that the corner at the design speed feels safe and secure without sideways slipping.

Hairpin radius should be as wide a possible within the terrain constraints but not less than the minimum specified in design drawing R4030_E3_3 attached in Appendix A.

The approach to a hairpin should provide enough sight distance for riders to slow down prior to the corner without locking their brakes and skidding. This requires that the approach gradient is quite flat (0-2 degrees) and the surface is well compacted. It is unacceptable to have a constant 4 degree grade into and through a hairpin as the approach will rut causing operational and maintenance issues. Designers may use a rolling-up grade dip (sag) to slow riders naturally prior to a corner. This reduces the likelihood of skidding and loss of control through the corner.

Curves, hills and Cross-fall

In hilly terrain, curves should follow the terrain. Additionally the terrain should be used to assist drainage with low points in gullies and higher points near ridges. This promotes drainage towards gullies.

The trail surface cross-fall should reflect the terrain and trail geometry. Out sloped corners (very dangerous) are to be avoided at all costs. When a corner is properly designed and built a rider feels well connected to the trail through adequate cross-fall for the design speed and side friction. Refer to the typical cross sections attached for guidance. There are no set rules, but the designer must ensure that the completed trail rides without inducing side slip or fear in the target user group.

Geotechnical Assessment of Trails

At the initial scoping stage it is desirable to undertake a desktop assessment of available information to pin point any possible areas of instability where a trail is proposed. This allows appropriate planning and funding to be included at the design stage. Additionally the designer should walk the trail alignment to confirm no obvious areas of instability

During the design stage known areas of instability should be addressed by specific design or alignments. If avoidable, this is the preferred option. However, as most trails are built on public land adjoining water ways, often the only option is to build over these areas.

As part of the following approval process, areas of instability should be clearly identified on the design plans together with site assessment and solutions. Council wish to avoid ongoing maintenance issues relating to instability in cycle trails and it is hoped such planning will reduce the incidence.

Design Approval by QLDC

Prior to any works commencing on the site, the trail designer shall submit the trail design plan, long section (if available – for large projects it is often not possible or cost effective to prepare detailed terrain models), typical cross section, trail design user group and outline of how the trail caters to the user group and fits the trail network together with construction specifications to QLDC for approval prior to commencing any trail works on site.

Additionally the designer shall ensure the proposed trail is marked out on site with flagging tape at no more than 20m intervals and staked in detail for hairpins and curves to ensure the proposed alignment is able to be assessed in detail. The assessment will include a minimum of alignment and gradient checks.

QLDC shall have the opportunity to inspect the trail alignment on site with the designer. Any amendments requested by the Council shall be addressed to Council's satisfaction prior to approval of the works.

While the approval process is designed to identify errors in the design and layout of the trail, it is not possible to anticipate every issue. Further, due to terrain constraints, vegetation cover and access, it may not be possible to assess and design every section of trail in a cost effective manner. Therefore, the design approval does not in itself reduce any liability on the trail developer to achieve the standards and riding requirements detailed in earlier sections of this standard.

Trail Construction & Completion

At the completion of works, the trail contractor and developer shall certify the works as complete and issue a completion certificate in the form of NZS 4404:2010 Schedules 1B & 1C. The Council shall then inspect the works to confirm the completed trail meets the needs of the user groups/community the trail serves. This shall include test riding the completed trail, measuring grades and cross falls and corner radius. The completion inspection is not solely a compliance check but a confirmation of achieving the needs of the trail user.

Where the trail is found to be deficient in terms of grades, alignment, cross fall or other defects (see defects section), the trail developer shall remedy the defect prior to Council signing the s224c certificate and/or taking over the trail asset. Alternatively the trail developer may enter into a cash bond for the value of the works in accordance with Council's bonding policy for land development works.

For trails involving structures that do not require a building consent the trail developer shall submit the following to Council:

- NZS 4404:2010 Schedule 1B (contractors completion)
- NZS 4404:2010 Schedule 1C certificate (Construction review)
- Typical design details for the structure

Where a structure requires a building consent, the trail developer shall supply Council's Parks Department a copy of the building consent documents including PS1, PS3, PS4 and Code Compliance together with design drawings and/or as-built drawings prior to sign off/acceptance of the asset. While this may be a double up on the BC process, often the design detail is not readily accessible and the purpose is to ensure the Parks Department has a complete set of documents for ongoing operation and maintenance.

Additionally all trails and structures including bridges, culverts, signs, bollards, cattle stops, fences etc. shall be accurately surveyed and an as-built plan prepared and submitted in accordance with Council's land development standards to detail all trail related assets being taken over by Council.

The Defects Period

Once the works have been signed off by Council as complete, the trail developer shall be responsible for a 12 month defects period. At the completion of the defects period, Council shall be advised and a final inspection undertaken. The final inspection shall assess the trail as if it were in the new as-built state. That is the trail developer shall be required to present the trail in an as-new condition at the end of the defects period.

If the trail requires changes to alignment to avoid or remedy rutting, surface erosion or desire line errors, the trail developer shall be responsible for such modifications at their cost prior to Council taking over responsibility irrespective of whether these were noted at the time of the design approval or completion inspection as often it takes time for errors in design and construction to manifest through use of the trail.

The following parameters shall be achieved for completed trails at the end of the defects period:

- The trail shall have good flow and speed control that does not result in rutting or surface erosion from skidding
- Finished surface shall be interlocking at the end of the defects period and free from loose gravel.
- The surface of the gravel and +0.5m either side of the formation edge shall be clear of all weeds. If there are weeds within the surface gravel, this shall be considered a defect and the developer shall be liable to remedy by mechanical removal.
- Within all the earthworked areas adjoining the trail, all noxious weeds shall be removed
- All verges shall be mown/cut to a maximum 350mm height up to +0.5m off the edge of the formation
- Any stormwater erosion shall be stabilised with rock protection or matting
- Adverse cross fall shall be rectified
- Any silting of culverts or debris in culverts or water tables shall be cleared
- Full design width shall be presented
- Vegetation shall be clear 1.0m beyond the edge of the trail and 2.5m above the trail

Trail Construction Specification – Grade 2

Attached as Appendix A is the standard Construction Specification for a Grade 2 Trail. The specification outlines the standard work methodologies required to complete a cycle trail to Council standards.

Where designers are forming a Grade 1 or Grade 3 trail, the specification shall be modified in accordance with the section "Detailed Trail Grade Specifications" to take account of differing maximum gradients, curve radius, surface and so forth.

Trail Construction – Typical Cross Sections & Details

Attached as Appendix B are typical cross section and detail plans ref R4030_E3_1-4. These provide design detail in relation to typical cross sections in different terrain, use of curves and hairpins and other typical details used in cycle trail construction but are not intended to cover every aspect of trail construction.

References

- International Mountain Bicycling Association (IMBA) “Guide to Building Sweet Single Track”
- Standards New Zealand NZS HB 8630:2004 – Tracks and Outdoor Visitor Structures
- “Cycle Trail Design Guide” 2010 Viastrada/MED, prepared for the New Zealand Cycle Trail Project
- QLDC Cycleway Maintenance Specifications c.2010
- Standards New Zealand NZS 4404:2004 – Land Development & Subdivision Engineering
- “Track Construction & Maintenance Guidelines” 2006, Department of Conservation

Appendix K –Three Waters Facility Asset Identification Specification

(normative)

1. APPLICATION

This specification applies to all water facility assets that will be vested in or are currently managed by Queenstown Lakes District Council.

2. PURPOSE

The purpose of this specification is to establish a framework of principles to be applied to the representation of three water facility assets in the Hansen Asset Management System (AMS) and operational documents.

A facility is defined as a plant or process that is distinctly separated from the distributed network assets. Facilities include, but are not limited to:

- Wastewater treatment plants
- Wastewater pump stations
- Water Supply treatment plants
- Water supply pump stations

There are currently no stormwater pump stations or treatment facilities within the QLDC network, it is intended that these will be included as and when required. Consideration of including other stormwater assets is underway and may be included in future versions.

It is intended that this specification will ensure that the assets can be accurately valued and effectively managed.

It should be noted that network (distributed) assets are entered into Hansen via GIS as per the QLDC As-Built Standard and are not subject to this specification.

3. RELATED DOCUMENTS

This specification should be read in conjunction with the following documents:

- QLDC As-built Standard
- QLDC Land Development and Subdivision Code of Practice (NZS 4404/2010 with QLDC amendments)

4. ASSET REPRESENTATION IN THE ASSET MANAGEMENT SYSEM

To facilitate the purpose of this document, the following will be required/generated for each asset within a facility:

UnitID – Unique ID generated by the Asset Management System (AMS) when the individual asset is created in the AMS environment.

Position ID – a descriptive ID of the function of the asset within the facility.

Asset Register Data – a list of the required asset specification data prior to its import into the AMS. See section 5.

Piping and Instrumentation Diagram (P&ID) - A diagram which shows the interconnection of process equipment and the instrumentation used to control the process1

UnitID

For facility asset types the UnitID is automatically generated by Hansen using a combination of the Asset Equipment Codes (see Appendix B) and the unique numeric identifier (compkey) generated in Hansen. E.g.

VLV		150203
Asset Equipment Type		Unique ID (Compkey)

Position ID

A facility is likely to contain one or more individual process areas depending on the design and sophistication of that plant.

The process ID is it to be generated by the designer or owner (where the asset is to be vested) by concatenating the following four elements separated by hyphens:

- Facility ID
- Process ID
- Asset Equipment Code
- Equipment Number

- **Facility ID**

Facility ID is generated by QLDC within Hansen and is a four character alpha code. This is created from two parts, the first being a two character code describing the facility type, followed by a two character code to identify the specific facility. A longer descriptive name can follow the 4 character code. The current allocated names are listed in Appendix A. E.g.

ST	SP		Shotover Ponds
Facility Type (Sewer Treatment)	Facility ID (Shotover Ponds)		Facility Descriptive Name

- **Process ID**

The appropriate two digit process area code is to be selected from one of the types listed in appendix B. New codes are required to be approved by QLDC prior to their use. E.g. 01 (Intake and Screening)

- **Asset Equipment Code**

The appropriate three character alpha asset equipment code is to be selected from one of the types listed in appendix C. New codes are required to be approved by QLDC prior to their use. E.g. SCR (Screen)

- **Equipment Number**

A three character sequential numeric ID to uniquely identify multiple occurrences of the same asset type within the facility/process. E.g. 001
This will result in a Position IDs as per the following examples:

Shotover ponds sewer treatment plant inlet screen one:

STSP	-	01	-	SCR	-	001
Facility ID		Process ID		Equipment Code		Equipment Number

Shotover ponds sewer treatment plant inlet screen two:

STSP	-	01	-	SCR	-	002
Facility ID		Process ID		Equipment Code		Equipment Number

Shotover ponds sewer treatment plant UV reactor one:

STSP	-	07	-	UVS	-	001

1 As defined by the Institute of Instrumentation and Control

Facility ID		Process ID		Equipment Code		Equipment Number

Asset Register Data
As per the QLDC Land Development & Subdivision Code of Practice an asset register is required to be provided to the adopted format / level of detail. The asset register shall include (but not be limited to) all process units, civil structures and buildings, earth structures, pipes and appurtenances, process tankage, mechanical and electrical equipment.
Individual assets shall be componentised by the expected design life and the physical location of the assets.

Asset costs are to be the actual cost applicable to each item plus any overhead allocation or installation costs that are included in the Contractor's Contract costs.

5. RESPONSOBILITIES

Designer
The designer or owner (where the asset is to be vested) is responsible for the creation of the Position ID, along with the reference of the Position ID within all appropriate documents including, but not limited to, design drawings, P&IDs, functional documents and asset schedules.

Construction Contractor
The construction contractor or owner (where the asset is to be vested) is responsible for the tagging of assets with the Position ID. All items that are assigned a Position ID shall be physically tagged on site using a system that does not suffer degradation due to environmental conditions such as sunlight or gaseous emissions. The tags for each asset shall be connected by use of a plastic cable tie, the tag itself shall be made from stainless steel and the tag number punched into it.

QLDC
To enable the generation of position IDs, QLDC will provide a facility ID following a request to the Asset Planning Team (infrastructureassetplanningteam@qldc.govt.nz).

6. IMPROVEMENT PLAN

- Improve definition and delineation of facility and network assets.
- Incorporate a Piping and Instrumentation Diagram (P&ID) standard.
- Improve the definitions around the level of componentisation.
- Consider inclusion of include Stormwater detention basins and/or soak pits.

7. REVIEW

This specification will be reviewed annually.

TABLE A – FACILITY NAMES The following are currently allocated facility names as at March 2016.

Water - Pump Stations	Water - Treatment	Water - Reservoirs	Wastewater - Pump Stations		Wastewater - Treatment Plants
WPAR-ANDERSON RD BST	WTBP-BEACON POINT	WRAP-ARTHURS POINT	SPA1-ALISON AVE #2	SPL4-LAKE HAYES #4	STHP-HAWEA PONDS
WPAT-ARROWTOWN	WTKH-KELVIN HEIGHTS	WRAR-ARROWTOWN	SPA2-KINGSTON STREET	SPL5-LAKE HAYES #5	STPP-PROJECT PURE
WPB3-ARROWTOWN BOOST	WTLE-LAKE HAYES EST	WRBP-BEACON POINT	SPA3-ALISON AVE #1	SPL6-LAKE HAYES #6	STSP-SHOTOVER PONDS
WPBF-BORE ARTHURS PT	WTLG-LUGGATE	WRF1-FERNHILL #1	SPAP-OXNBRDGE TUN RD	SPNS-NORFOLK STREET	
WPBG-BORE GLENORCHY	WTLH-LAKE HAYES	WRF2-FERNHILL #2	SPAT-ATLEY ROAD	SPOR-OUTLET ROAD	
WPBL-BALMORAL BOOST	WTRB-ROYS BAY	WRF3-FERNHILL #3	SPBM-ARTN-LK HAYS RD	SPP1-ALBERTTOWN #1	
WPBP-BEACON POINT	WTTM-TWO MILE	WRGB-GLENDHU BAY	SPBV-BAYVIEW RD	SPP2-ALBERTTOWN #2	
WPBV-BROADVIEW RISE	WTWI-WESTERN INTAKE	WRGF-GOLDFIELDS	SPCD-CEDAR DRIVE	SPP3-RIVERBANK RD	
WPCD-COREBRIDGE BORE		WRGR-GLENORCHY	SPCR-CEMETERY RD	SPPL-PARK ST LIFT	
WPF1-FERNHILL #1		WRHR-HAWEA	SPD1-DUNGARVON #1	SPPS-PARK STREET	
WPF2-FERNHILL #2		WRKH-KELVIN HEIGHTS	SPD2-DUNGARVON #2	SPRP-REMARKS PARK #1	
WPFD-FRANKTON RD		WRLC-LOMOND CRESCENT	SPDR-DOMAIN ROAD	SPSB-SUNSHINE BAY	
WPGB-GLENDHU BAY		WRLE-LAKE HAYES EST	SPEA-ESSEX AVENUE	SPT1-CHURCH RD	
WPGD-GLENDA DRIVE		WRLH-LAKE HAYES	SPEP-EELY POINT	SPT2-HARRIS PLACE	
WPHA-HAWEA		WRLR-LUGGATE	SPEW-EDGEWATER	SPT4-ALICEBURNDR #1	
WPHH-HIDDEN HILLS		WRMI-MOUNT IRON	SPF2-FRANKTON BEACH	SPT5-ALICEBURNDR #2	
WPHI-HIGHVIEW TCE		WRQ1-QTOWN HILL #1	SPFB-FRANKTON BEACH	SPTB-TUCKERS BEACH	
WPHT-HEATON PARK		WRQ2-QTOWN HILL #2	SPFF-FASTFLO BLOCK	SPW1-THREEPWOOD #1	
WPKH-KELVIN HEIGHTS		WRQR-QUAIL RISE	SPFS-FREDERICK ST	SPW2-THREEPWOOD #2	
WPL1-LAKE HAYES EST		WRRV-REMARKABLESVIEW	SPGO-GORGE ROAD	SPW7-THREEPWOOD #7	
WPLA-HAYES EST BST		WRWR-WESTERN	SPGR-GORDON ROAD	SPWA-WAN-LUGG HWY #1	
WPLC-LOMOND CRES			SPH1-HAWEA ESPLANADE	SPWL-WILLOW PLACE	
WPLG-LUGGATE			SPH2-SCOTTS BEACH	SPWP-WAIMANA PLACE	
WPLH-LAKE HAYES			SPHD-HIKUWAI DRIVE	SPMP-MARINE PARADE	
WPLW-QTOWN HILL #1			SPK1-LAKESIDE RD #1	SPMR-MCDONNELL RD	
WPMD-MARINA DRIVE			SPK2-LAKESIDE RD #2	SPNI-NICHOL STREET	
WPML-MIDDLETON			SPKP-KAWARAU PLACE		
WPPW-PANNERS WAY			SPL1-LAKE HAYES #1		
WPSC-Shotover Bore			SPL2-LAKE HAYES #2		
WPTM-TWO MILE			SPL3-LAKE HAYES #3		
WPWA-WANAKA AIRPORT					
WPWB-THREEPWOOD BST					
WPWW-WESTERN WANAKA					

TABLE B – PROCESS ID'S

The following are acceptable, as at March 2016, any addition to this list is required to be agreed with the QLDC Asset Planning Team prior to their use.

WW Treatment

01	General and Ancillary
02	Inlet and Screening
03	Biological Treatment
04	Clarifier
05	RAS / Sludge Return Line
06	Sludge Handling / Drying
07	Disinfection

WW Pump Stations

21	General and Ancillary
22	Inlet and Operational Storage
23	Emergency Storage
24	Electrical and Pumps
25	Outlet

WS Intake/Treatment

41	General and Ancillary
42	Bore / Inlet (Including Pumps)
43	Disinfection
44	Contact Tanks

WS Pump Stations (Network)

51	General and Ancillary
52	Bore / Inlet
53	Electrical and Pumps
54	Outlet

WS Storage

61	Inlet
62	Storage
63	Outlet

TABLE C – ASSET EQUIPMENT CODES

The following are acceptable, as at March 2016, any addition to this list is required to be agreed with the QLDC Asset Planning Team prior to their use.

Equipment Type	Description	Equipment Type	Description	Equipment Type	Description	Equipment Type	Description
ABL	Air Blower	FAN	Fan	LPU	Lightening Arrester	SCL	Scales
ACD	Air Conditioner	FIC	Flow Indicator Controller	LSH	High Level Switch	SCR	Mechanical Screen
AET	Aerator	FIN	Flow Indicating Transmitter	LSL	Low Level Switch	SIL	Acoustic Silencer
AIC	Analyser Indicator Controller	FIR	Flow Indicating Readout	LSN	Level Sensor	SLT	Sludge Storage Tank
AIV	Air Bleed Valve	FIT	Pipes and Fittings	LTM	Level Transmitter	SLV	Ball, Gate, Sluice Valve
ALD	Acoustic Door	FLC	Flowmeter Chamber	LTR	Level Transducer	SOL	Solenoid Valve
ANT	Antenna/ Arial	FLJ	Flexible Joint	MAC	Macerator	SPI	Speed Indicator
AOM	Analogue Output Module	FLM	Flowmeter	MET	Meter	SPN	Solar Panel
ASB	Assembly Kit	FLS	Flushing Connection	MHL	Manhole/ Lampholes/ Cleaning E	SPR	Sprinklers
ASM	Alarm System	FLT	Cartridge Filter	MIX	Mixer	STA	Soft Starter
AUT	Autosampler	FNK	Fuel Tank	MKV	Motorised Knife Gate Valve	STI	Strainer
BAT	backup Battery	FRE	Fire System	MOC	Moisture Controller	SUR	Surge Controller
BIN	Bin/Skip	FSW	Flow Switch	MOI	Moisture Monitoring Probe	SWB	Switchboard
BKP	Backflow Preventor	GCN	Generator Connection	MPR	Motor Protection Relay	SWR	Software
CAB	Cabinetry	GEN	Generator	MTC	Motor Control	TAP	Sample tap or similar
CAM	Camlock Coupling	GNC	Generator Controller	MTR	Motor	TAR	Tarriff Metering
CAZ	Chlorine Analyser	GRC	Grit Classifier	NRV	Non Return Valve	TEE	TEE
CBK	Chain Block	GRS	Grilles	PBT	Pressure Break Tank	TEL	Telemetry
CBL	Cabling	GRT	Grit Removal	PCM	Pump Chamber	TEM	Temperature Switch
CDB	Chlorine Doser	GSY	Generator Synchroniser	PHA	pH Analyser	TIC	Temperature Indicator Controll
CLD	Chlorine Leak Detector	HAM	Hammer Resister	PIC	Pressure Indicating Controller	TMA	Temperature Alarm
CLS	Chlorine Sensor	HAR	Harmonic Filter	PIP	Pipework	TME	Temperature Element
CML	Chamber Lid	HMI	Human Machine Interface	PLC	Programme Logic Controller	TRA	Pressure Transducer
CMP	Computer	HOS	Hose Reel/Hose	PLY	Polymer Tank	TRL	Trailer
CNP	Control Panel	HST	Hoist	PMC	Pump Control	TRN	Transformer
CNT	Centrifuge	HTR	Heater	PMP	Pump	TRR	Telemetry Radio
CNV	Conveyor	HUM	Humidifier	PPR	Pump Rails	TUM	Turbidity Meter
COM	Compressor	HYD	Fire Hydrant	PRG	Pressure Gauge	TUR	Telemetry Unit
CTL	Chlorine Trolley Load	IRR	Irrigation System	PRS	Pressure Switch	UPS	UPS
CWP	Chlorine Weigh Pads	ISO	Isolating valve Gate & Sluice	PRV	Pressure Reducing/Regulating V	UVS	UV System

Equipment Type	Description
DCT	Decanter
DIF	Diffuser
DNT	Decant Tank
DOM	DO Meter
DVT	Dose/Volume Timer
EDD	Electrical Dosing Drive
ELE	Electrical Controls
ELS	Electrical Services
EMS	Emergency Shower

Equipment Type	Description
ITH	IT Hardware
LAH	High Level Alarm
LAL	Low Level Alarm
LCU	Level Control
LEI	Level Indicator
LFB	Lifting Beam
LFS	Lime Hooper & Feeder
LMT	Limit Switch
LOV	Discharge Louvre

Equipment Type	Description
PSN	Pressure Sensor
PWS	Pressure Washer
RAI	Rain Gauge
REV	Reservoir
ROT	Rotameter
SAL	Satellite Dish
SAM	Sampler
SAT	Surge Anticipating Valve
SBT	SBR Tanks

Equipment Type	Description
VDD	Variable Dosing Drive
VIB	Vibration Switch
VNT	Ventilation
VSD	Variable Speed Drive
WBR	Water Blaster
WER	Weir/ Slide Gate
WWL	Wet Well Lid