Regional Infrastructure Technical Specification v2

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Version control

VERSION	DATE	REASON
V1.0	May 2018	Adopted version.
V2.1	April 2022	Document wide amendments (details supplied on request)
V2.2	August 2022	Minor updates and links to drawings and forms added
V2.3	January 2023	Links made to forms and drawings
V2.4	March 2024	Review HCC submissions, add in Waipā, Waikato DC and WRC submissions
V2.5	October 2024	Finalise staff submissions from HCC, Waipa, Watercare, Waikato DC & WRC.

GENERAL INFORMATION

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1.1. INTRODUCTION

The Regional Infrastructure Technical Specification (RITS) sets out the standards for design and construction of public infrastructure within the following Councils' boundaries:

Where the term 'Council' is used throughout this specification, this is deemed to refer to the relevant Council in which the infrastructural work is being carried out. Similarly, all references to 'District Plan', policies, bylaws etc. refer to Council.

1.1.1 The RITS

The philosophy underpinning the RITS is to:

a) Maximise the efficient use of infrastructural resources to ensure that any infrastructural development work is cost effective and appropriate for the long term.

b) Provide a means to achieve requirements set down in the District Plan, resource consent(s), or contract where specified.

c) Provide a means for alternative/innovative design and construction to be considered when undertaking infrastructure development or development works.

d) Provide context and support to urban and rural design when considering development works proposals.

e) Be a 'living' document that is easily updated as standards, construction or materials change as well as respond to matters amended in the District Plan via plan change processes or similar.

f) Be used for the design and construction of new infrastructure and for maintenance of existing infrastructure, including asset renewal, unless the standards are not compatible with the existing assets.

A number of Councils have some criteria that is specific and unique to that council such as information and requirements in the District Plan, and policies. RITS may not be a complete one stop shop and relies on practitioners, developers, and consultants following any specific Council requirements for compliance. In a development this is likely to be resource consent conditions, and in a council contract, it will be the special conditions.

Unless specifically noted, where there is doubt or conflict of information, the following is the hierarchy of precedence;

1. Council district plan, bylaws, policies, and guides
2. RITS
3. Standards noted at the front of each section and throughout this document
4. NZS4404:2004 – Land Development and Subdivision Infrastructure

The RITS is Council's acceptable technical specification. Some works will require specific design/specification i.e. large scale works, such as outlined in *Clause 1.2 Statutory requirements, standards and related documents* on page 11.

1.1.2 Scope

Any person undertaking infrastructure design and construction within Council's boundaries via either:

- Council's capital and/or operational works contracts or professional service agreements.
- Development works regardless of whether the infrastructure will be vested or could be vested to Council at a later date.
- Any other form of infrastructure development that will connect to Council's existing infrastructure system.

must use the RITS (in conjunction with any Council Guides, District Plans, bylaws, strategies, policies as well as any relevant standard and/or specification) as the means of designing, constructing, testing, and signing off development works within Council's boundaries unless prior acceptance from Council is obtained.

Council acknowledges the development of some infrastructure associated with the capital and/or operational works contracts will not be covered by the RITS. Examples of such works are reservoir construction, bulk watermains, wastewater interceptors, and other structures such as buildings.

In these cases, design and construction will be undertaken on an 'alternative design' basis involving development engineers and project managers, relevant codes and standards, and in accordance with accepted industry practice. This alternative design basis is outlined in *Clause 1.1.4.2 Alternative design* on page 11.

The RITS incorporates the following sections:

Table 1: Introduction to the sections of the RITS

SECTION	TITLE	CONTENTS
1	General information	This section: • Introduces the philosophy and use of the RITS. • Provides referencing and definitions. • Identifies statutory requirements. • Outlines the three waters management philosophy. • Describes the engineering acceptance process for subdivisions. • Provides generic specifications and guidance across all infrastructure groups for: – As-built and data standards. – Working in the transportation corridor. – Temporary traffic management. – General forms and checklists for subdivisions.
2	Earthworks	The earthworks and geotechnical section gives guidance on the requirements for assessment of land suitability and earthworks as part of a development. The development may include the construction of buildings, structures, roads, utilities, water courses and water bodies.
3	Transportation	This section builds on the transportation provisions of the District Plan and sets out requirements and guidance for the design and construction of roads and the transportation network that incorporate facilities for vehicles, pedestrians, cyclists, public transport, utilities, and landscaping.
4	Stormwater	This section sets out requirements for the design and construction requirements for swale/piped systems and stormwater treatment and detention devices.
5	Wastewater	This section sets out and details the technical requirements for the design and construction of wastewater systems. It covers the design of up to, and including, DN225 pipes.
6	Water supply	This section sets out requirements for the design and construction of drinking water supply systems. It covers the design of water pipes up to, and including, DN250mm diameter.
7	Landscape	This section sets out requirements for the design and construction of landscapes and plantings.
8	Acceptable products	This section sets out the requirements for products to be considered for acceptance for use within Council's boundaries.

1.1.3 Implementation of the RITS

The RITS is governed by the requirements of the Local Government Act 2002 (LGA). The administration of the RITS is undertaken by Waikato Local Authority Shared Services (WLASS) T/A Co-Lab and is a controlled document.

1.1.3.1 RITS reviews

An initial review of the RITS was undertaken in 2022/23 and will be followed by two yearly reviews thereafter (commencing in July 2026).

Users will be invited to submit suggestions for improvement prior to each review. Any user of the RITS has the ability to suggest improvements. All suggestions should be made in writing, preferably using the suggestion form on the Co-Lab website (www.colabsolutions.govt.nz) or sent to the Co-Lab Co ordinator (rits@colabsolutions.govt.nz).

All suggestions will be considered prior to the next scheduled review unless the suggestion is considered to be urgent. The originator will be advised of the decision made regarding their suggestion.

1.1.4 Design philosophy statements and alternative design

1.1.4.1 Design philosophy

All designs submitted to Council for acceptance must be accompanied by a design philosophy statement[1] as detailed in *Clause 1.6.2.1 Supporting documentation* on page 32.

1.1.4.2 Alternative design

Council supports and encourages innovation to address climate change, meet the intended specifications/designs which add value, and consider whole of life asset costs.
Alternative designs/specifications can be submitted provided the alternative specification meets or exceeds the RITS and addresses any operational and maintenance aspects. The alternative specification must include all relevant supporting information to enable assessment by Council and be described in the design philosophy statement.

As noted previously, Council may have specific design guides and policies, so it is important to check these, and also check for any new documents and emerging policy changes.

Where a designer identifies a solution/product that is not currently accepted, an application should be made to Council for the item to be considered. See *Clause 8.3 New product acceptance process* on page 367. Application and discussions for alternative products should occur at an early state in the design process. A key consideration for Council will be the impact on performance, operations, and ongoing maintenance requirements as part of whole of asset lifecycle assessment.

1.2. STATUTORY REQUIREMENTS, STANDARDS AND RELATED DOCUMENTS

1.2.1 Statutory requirements

Infrastructure design and construction will be carried out in accordance with Council's District Plan, strategies, bylaws and/or policies. These can be found on Council's website.

The provisions and standards in the RITS need to be read in conjunction with:

- Building Act 2004 (Building Act).
- Health Act 1956 (amended July 2022).
- Health and Safety at Work (General Risk and Workplace Management) Regulations 2016.
- Health (Drinking Water) Amendment Act 2007.
- Health (Drinking Water) Amendment Act 2019.

[1] Note this may not be required for smaller developments (2 or less lots).

- Land Transfer Act 1952.
- Local Government Act 2002 (LGA) and Local Government Act 1974 (LGA 1974).
- Local Government Official Information and Meetings Act 1987 (LGOIMA).
- Property Law Act 2007.
- Regional Council's Regional Plan.
- Regional Council's Regional Policy Statement.
- Reserves Act 1977.
- Resource Management Act 1991 (RMA).
- Resource Management (National Environmental Standard for Sources of Human Drinking Water) Regulations 2007.
- Unit Titles Act 2010.
- Waste Minimisation Act 2008
- Water Services Act 2021.
- Waikato River Settlement Act 2010.

Note- Legislative review is in progress as part of Resource Management and 'Local Water Done Well'. This will inform the Acts listed above

This is not an exhaustive list of statutory standards, Acts/legal instruments and plans.

1.2.2 Relationship with the District Plan

The RITS is a document that sits outside the District Plan. If, when considering development applications, conflict occurs between standards outlined in the District Plan and the RITS, the District Plan takes precedence.

1.2.3 Te Ture Whaimana and Te Mana o Te Wai

Te Ture Whaimana is the primary direction-setting document for the Waikato River and its catchments, which includes the lower reaches of the Waipa River. The strategy encompasses the vision for a future where a healthy Waikato River sustains abundant life and prosperous communities who, in turn, are all responsible for restoring and protecting the health and wellbeing of the Waikato River, and all it embraces, for generations to come. It states 13 objectives relating to restoration of Waikato River and the relationship of iwi with the river. It is critical that infrastructure has the right specifications and locations to meet performance standards necessary to ensure that the health and well-being of the river is protected and can be restored over time. As such Te Ture Whaimana is a direction setting document for the RITS.

Te Mana o te Wai is a concept that puts the well-being and health of our rivers, lakes, aquifers and estuaries at the centre of how we manage our freshwater. It imposes a hierarchy of obligations prioritising the health and well-being of water first. The second priority is the health needs of people (such as drinking water) and the third is the ability of people and communities to provide for their social, economic and cultural well-being. The RITS intends to give effect to Te Mana o te Wai through requiring infrastructure that can deliver on health and safety of the river, and the people who use three waters infrastructure and meets quality standards now and over appropriate infrastructure life cycles.

1.2.4 Building Act and Code

The Building Act is the leading statue under which building development is undertaken to ensure that buildings are safe, sanitary and have suitable means of escape from fire. The building regulations enacted by the Building Act provide the requirements for building control in the form of the New Zealand Building Code which contains objectives, functional requirements and performance criteria that building works must achieve.

The Building Code should guide all private infrastructure. There is reference in this RITS to the Building Code in relation to:

a) Use of water sensitive techniques including grey water re-use, green roofs and soakage.

b) Private pipes, especially those servicing multi-unit properties.

c) Private ways and shared access ways.

d) The construction of safety fences, walls, structures and rails.

e) Rubbish & Recycling provisions

1.2.5 Relevant standards and other documents

1.2.5.1 NZS 4404 Land Development and Subdivision Infrastructure (NZS 4404)

Council recognises New Zealand Standard 4404 and has used this as a basis for these specifications. The RITS refers to NZS 4404 and its content throughout and therefore it is recommended the RITS is considered in conjunction with NZS 4404. In situations where there is conflicting information, the following outlines precedence

1. Acts
2. District Plan
3. Regional Plan
4. Council policies and bylaws
5. RITS
6. National Standards (except NZS4404)
7. NZS4404, unless agreed with Council

1.2.5.2 Standards

There are many documents that must be read in conjunction with RITS. A list of relevant standards and other references, including specifications, guidelines and other publications is provided at the front of each section. However, it is not an exhaustive list and users of RITS must check for up to date information on the relevant documents that sit outside RITS.

1.2.5.3 Bylaws and policies

There are a number of references in the RITS to bylaws, strategies and policies. These can be found on Council's website. From time to time, these documents will be updated, so users must check with Council.

1.2.5.4 Environmental plans

Iwi/tāngata whenua environmental plans and/or environmental management plans are required to be complied with and referenced within the catchment of the development or contract works. Refer to the Regional Council website and Iwi and Hapū Resource Management Plans (boprc.govt.nz) for a list of relevant plans.

1.2.5.5 Document hierarchy

Where any conflict exists between any Australian and New Zealand Standard or other Standard referred to in the RITS, then the specific requirements of the RITS take precedence.

1.3. ACKNOWLEDGEMENTS, ABBREVIATIONS AND DEFINITIONS

1.3.1 Acknowledgements

Co-Lab acknowledges Hamilton City Council who provided the template for the 2018 RITS.

1.3.2 Abbreviations

A list of abbreviations used throughout the RITS is referenced below:

Table 2: Abbreviations

ABBREVIATION	TERM	DEFINITION
ARI	Average recurrence interval	Sometimes known as 'return period'. It is the average number of years that it is predicted will pass before an event of a given magnitude occurs. For example, a 50-year ARI event would on average happen every 50 years.
ATWOSH	Acceptance to Work on the State Highway	
ASD	Approach sight distance	
BB	Back boundary	
BPO	Best practicable option	In relation to a discharge of a contaminant means the best method for preventing or minimising the adverse effects on the environment.
CAR	Corridor access request	The process by which utility organisations gain acceptance to work within the transportation corridor through an application under the National Code of Practice for Utilities Access to the Transport Corridors.
CPTED	Crime prevention through environmental design	A crime prevention philosophy based on the premise that '*proper design and effective use of the physical environment can produce behavioural effects that will reduce the incidence and fear of crime, thereby improving the quality of life*[2]'.
CBR	California bearing ratio	The load-bearing strength of subgrade is measured by the CBR test.
CLM	Contaminant load model	Used to determine contaminant concentrations predicted for the existing and proposed land-use scenarios.
CMP	Catchment management plan	A plan that considers the full hydrological catchment or sub-catchment and is specific to stormwater.
COC	Certificate of Compliance	
Co-Lab	Co Lab Solutions	A council-controlled organisation owned in equal parts by twelve councils to promote shared services between local authorities across the Waikato and Bay of Plenty regions.

[2] Crowe, 1991, Crime Prevention Through Environmental Design: Applications of Architectural Design and Space Management Concepts.

ABBREVIATION	TERM	DEFINITION
Cop-TTM	Code of practice for temporary traffic management.	See Definitions below. refer to https://www.nzta.govt.nz/roads-and-rail/code-of-practice-for-temporary-traffic-management/
CSDC	Comprehensive stormwater discharge consent	Specifies consent conditions for multiple discharges/catchments.
DN	Nominal Diameter	Nominal internal diameter under the pipe manufacturing standard.
DWG	Drawing file	
DXF	Data exchange	
EMP	Edge marker post	
EPO	Environmental protection overlay	
ESC	Electrical Safety Certificate	
ESRI	ESRI ArcGIS shape	
FB	Front boundary	
GRP	Glass reinforced plastic	
HAIL	Hazardous activities and industries list	
ICMP	Integrated catchment management plan	A plan that considers the effects of the full hydrological catchment for stormwater and plans for water, wastewater and stormwater.
IQP	Independently qualified person	
LB	Left boundary	As looking from the roadside
L/s	Litres per second	
LV	Limit lines to viewpoint	
M	Metres	
M^3/day	Cubic metres per day	
MBIE	Ministry of Business, Innovation and Employment	
MDPE	Medium density polyethylene	
MfE	Ministry for the Environment	
MOTSAM	NZTA manual of traffic signs and markings	
MM	Millimetres	
NCP-UOATC	National Code of Practice for Utility Operators Access to the Transport Corridor	
NES	National environmental standard	
NZECP	New Zealand Electrical Code of Practice	
NZGS	New Zealand Geological Society	
NZRF	New Zealand Roadmarkers Association	
NZTA	New Zealand Transport Agency	Responsible for the management and operations of the State Highway network and allocation of central Government transportation funds. Now known as Waka Kotahi.
NZTM	New Zealand Transverse Mercator	

ABBREVIATION	TERM	DEFINITION
OGPA	Open graded porous asphalt	
ONF	One Network Framework	Refer to the definition below.
PE	Polyethylene	
PPH	Parts per hundred	
PSV	Polished Stone Value	
PTZ	Pan Tilt Zoom	
PVC	Polyvinyl chloride	
RAMM	Road assessment and maintenance management	A computer-based system that helps to manage the maintenance and renewal of all transportation assets.
RB	Right boundary	
RCC	Road corridor coordinator	Sometimes referred to as the Traffic Management Coordinator or TMC
RITS	Regional Infrastructure Technical Specification	Sets out the standards for design and construction of public infrastructure within Council's boundaries.
RM	Rising main	A pressure main through which wastewater is pumped.
R2Z	Road to Zero	Refer to Definitions section below
ROW	Right of way	A piece of land for vehicular access and with rights as defined in the Property Law Act 2007.
RPZ	Reduced pressure zone device	Also known as a backflow prevention device
RRPS	Road reserve planting strategy	
RSMA	Road Safety Manufacturers Association	
RTS	Road and Traffic Standard	
SISD	Safe intersection sight distance	
SMA	Stone mastic asphalt	
SSA	Safe Systems Audit	Refer to Definitions section below
SW	Stormwater	
TA	Territorial authority	Refer to the Definitions section below.
TC	Traffic controller	
TMP	Traffic management plan	
TTM	Temporary traffic management	
USEPA	United States Environmental Protection Agency	Provides guidance on water quality maximum concentrations for Council's receiving environments.
VPD	Vehicle movements per day	-
WIA	Water impact assessment	Assesses how the proposal is consistent with or otherwise complies with the recommendations, measures and targets of any relevant ICMP.
WSD	Water sensitive design	An inter-disciplinary design approach for land-use planning and land development scenarios in both greenfield and brownfield applications, with specific focus on stormwater and freshwater management.
WQV	Water quality volume	The treatment volume used to assess efficiencies of existing devices and to determine sizing requirements for proposed devices. It is

ABBREVIATION	TERM	DEFINITION
		calculated using the Regional Council guideline for stormwater management devices (or equivalent document).
WW	Wastewater	

1.3.3 Definitions

In this RITS, unless inconsistent with the context, the following will apply:

Table 3: Definitions

TERM	DEFINITION
Access/inspection point	A place where access may be made to a connection for inspection, cleaning or maintenance as defined in the Building Code.
Access way (or Accessway)	As defined in Section 315(1) of the LGA 1974.
Applicant	The person or company that submits the fully completed application to Council for the purposes of receiving Council's consent to subdivide land.
As-built plan	A plan that depicts the final installed configuration and highlights any departures from the accepted design.
Backflow	The unplanned reversal flow of water, or mixtures of water and contaminants into the water supply system.
Berm	A piece of land between the carriageway and the road legal boundary. These areas are generally the grassed areas between the road and the property boundaries and contain items such as footpath, signs, streetlights, accessways, drainage, services, bunds, trees, landscaping and street furniture.
Bus lane	A lane reserved by a marking or sign installed at the start of the lane and at each point at which the lane resumes after an intersection, for the use of buses and cycles, mopeds and motorcycles, unless either or both are specifically excluded by the signs.
Carriageway	An area of road provided for the movement of vehicles and cycles or parking of vehicles. Usually the sealed area between kerbs, (Refer to the district plan cross sections and RITS drawings).
Cement lining	An internal lining of a pipe, often sacrificial, to extend the life of the pipe from corrosive environments. Typically used to line the inside of steel pipes to protect from corrosion.
Code of practice for temporary traffic management (CopTTM)	This was replaced by NZTA's 'New Zealand guide to temporary traffic management' 2023 has signs and forms, and examples of traffic management plans.
Collector/arterial roads	Roads that generally have high levels of traffic and are usually the main traffic thoroughfares that link to other areas within a town or to other communities. These can sometimes be multi lane roads, and may have traffic signals and separated pedestrian thoroughfares. Refer to the NZTA One Network Road Classification and Council Road Hierarchy.
Connection (wastewater and stormwater)	Also known as a lateral. A pipeline branch which has no terminal manhole structure which terminates in a private area for the purpose of connecting a premise.
Connection (water supply)	Also known as a service pipe. The section of water pipe between a watermain and the point of supply.
Contractor	The company engaged to undertake the physical works on behalf of Council only and does not relate to an applicant/developer's contractor. The contractor's responsibilities must be defined by the general conditions of contract for the works.

TERM	DEFINITION
Council representative/officer	A person appointed by Council.
Cycle lane	A longitudinal strip within a roadway reserved by a marking or sign for the use of cycles.
Cycle path	A path that is physically separated from the roadway that is intended for the use of cyclists, but which may also be used by pedestrians if a shared path. This includes a cycle track formed under Section 332 of the LGA 1974.
Detention	A storage system used to temporarily hold stormwater for gradual release (see Retention).
Developer	The company or person who has been granted or holds planning consent for the land being subdivided or is responsible for the consent application. The developer must ensure that only suitably qualified and experienced professionals are appointed to undertake the design and supervision of the development works.
Developer's representative	A suitably qualified professional appointed by the developer to represent them, including registered engineer and geo-professional (see definition below).
Disconnection	The physical cutting and sealing of any customer connections at the point of discharge or supply.
Drain (private)	Refers to the private wastewater or stormwater systems that connect the premise at the point of discharge. This section of drain is owned and maintained by the customer or group of customers.
Embedment	The material surrounding the pipe and which is composed of the following zones: • Bedding – the zone between the foundation and the bottom of the pipe. • Haunch support – the part of the side support below the spring line of the pipe. • Side support – the zone between the bottom and top of the pipe. • Overlay – the zone between the side support and either the trench fill or embankment fill.
Exemption declaration	Road safe systems audits are required unless an exemption declaration is accepted.
Fill	One of more of the following: • Embankment fill – fill material placed over the overlay for the purpose of creating an embankment. • Trench fill – fill material placed over the overlay for the purpose of refilling a trench. • Foundation – a naturally occurring or replacement material beneath the bedding.
Footpath	A portion of any road, pedestrian accessway, also see shared path, or public reserve that is laid out or constructed by authority of Council primarily for pedestrians and may include the edging, kerbing and channelling thereof.
Geo-professional	A suitably qualified and experienced geotechnical engineer, engineering geologist or hydrologist holding membership with Engineering NZ or equivalent professional body, including a current professional indemnity insurance policy acceptable to Council.
Greenfield development	Development within Council's growth cells characterised by creating of new sections, roading and associated servicing infrastructure. Means subdivision and/or urban development of previously undeveloped rural land.

TERM	DEFINITION
Groundwater drainage	Subsoil drainage system to manage the water content within soils.
Gully trap	Fitting designed to prevent foul air escaping from the drainage system and used to receive the discharge from private internal waste pipes.
Household 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.
Infill development	Redevelopment of urban land through either subdivision or building consent.
Infiltration	Groundwater entering a public sewer or private drain through defects such as poor joints and cracks in pipes or manholes. It does not include inflow.
Inflow	Water discharged into private drains from non-complying connections or other drain laying faults. It includes stormwater entering through illegal downpipe connections or from low gully traps.
Infrastructure	Infrastructure assets are stationary systems (or networks) that serve defined communities where the system as a whole is intended to be maintained indefinitely to a specified level of service by the continuing replacement and refurbishment of its components. For example, transportation networks, parks and recreation facilities, water systems (water supply, wastewater and stormwater), flood protection and land drainage, and solid waste facilities.
Interceptor	Strategic gravity wastewater pipe with an external diameter of 525mm or greater.
Land drainage system	The flow of stormwater and groundwater focussing on the control of peak surface water runoff, sediments and water quality for such discharges and their reticulation under urban conditions.
Level of serve	The expected performance level of infrastructure.
Local authority	A regional council or territorial authority as defined in the LGA 2002.
Local roads	Roads that generally have low traffic volumes, and are usually in residential, commercial or industrial areas. Refer to the Councils' road hierarchy and with NZTA One Network Framework (ONF).
Manhole	Service opening which allows access for inspection, cleaning or maintenance of a public wastewater or stormwater system.
Means of compliance	The method by which the requirements of the District Plan may be complied with. It implies that there may be other methods which may meet the requirement, but which may be subject to specific consideration or acceptance.
Natural hazard	Any atmospheric, earth or water related occurrence (including earthquake liquefaction, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire or flooding) the action of which adversely affects or many adversely affect human life, property or other aspects of the environment.
One Network Framework	A classification system which provides a shift in focus to people, place and movement. Separates roads into either rural or urban and categorises roads based on the use, form and function.
Owner	The owner of the land being subdivided (may or may not be the developer).
Parking bays	The parking spaces and associated manoeuvring areas of a road or proposed road (as defined by the kerb) which are accessed directly from the road.
Pedestrian access ways	A path that generally connects pedestrians to other roads/ footpaths; These do not include paths on reserves.
Pedestrian mall	A specified road or part of road that Council has declared a pedestrian mall as set out in Part 336 of the LGA 1974 thereby prohibiting or restricting the driving, riding or parking of any vehicle, or the riding of any animal on all or any portion of the pedestrian mall either generally or during particular hours.
PE or epoxy lining	Trenchless underground relining and rehabilitation of existing pipes/utility service
Point of discharge	The boundary between the public sewer and private drain normally at the boundary of the property.

TERM	DEFINITION
	Where a public sewer or stormwater system passes through private property the connection point is the upstream end of the pipe fitting which forms the junction with the public sewer or stormwater pipes.
Point of supply	The point on the water pipe leading from the watermain to the premises which marks the boundary of responsibility between the customer and Council irrespective of property boundaries.
Potable	In relation to drinking water means water that does not contain or exhibit any determinants to any extent that exceeds the maximum acceptable values (other than aesthetic guideline values) specified in the drinking-water standards applicable at the time.
Primary design flow	The estimated runoff selected to provide a reasonable degree of protection to the surrounding land.
Primary system (stormwater)	The primary stormwater system is to accommodate a specified design rainfall event appropriate for the zone as defined in *Clause 4.2.3 System design* on page 191. It may include (but not limited to) wetlands, ponds, lakes, rain gardens, swales and filters, pipelines, inlet/outlet structures and soakage areas.
Principal main	A watermain of a minimum of 100mm internal diameter (DN100) fitted with fire hydrants.
Private road	Any roadway, place or arcade laid out or formed within a district on private land, whether before or after the commencement of Part 315 of the LGA 1974, by the owner thereof
Private treatment device	Stormwater treatment device located on private land and maintained by the private owner.
Private way	Has the meaning ascribed to it in Section 315 of the LGA 1974. **private way** means any way or passage whatsoever 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 such way or passage as aforesaid which at the commencement of this Part exists within any district A private way is designed to provide vehicular and/or pedestrian access to a public street and may comprise separately owned entrance strips subject to rights of way or a separate lot (access lot) which is jointly owned and used by adjacent lots.
Producer statement	Refer to MBIE and Engineering NZ websites.
Professionals	Suitably qualified and experienced persons capably of undertaking the various activities associated with the planning and design phases of the project.
Prohibited characteristics	Trade waste discharged containing the physical and chemical characteristics which Council has determined must not be discharged into the public sewer system.
Public treatment device	Stormwater treatment device vested to, and maintained by, Council. Usually providing treatment for large catchments.
Resource consent	An authorisation given to certain activities or uses of natural and physical resources required under the RMA 1991 by Council and/or Regional Council.
Restricted flow supply	A type of water supply connection where a small flow is supplied through a flow control device and storage is provided by the customer to cater for demand fluctuations.
Restrictor	A flow control device fitted to the service pipe to limit the flow rate of water to a customer's premises.
Retention	A retention system is designed to hold the stormwater for soakage or another use (also see Detention).
Ridermain	A watermain of a minimum of 50mm internal diameter (DN50) but less than DN100.
Road	Means all land comprising formed and unformed roads as defined in Section 315(1) of the LGA 1974.

TERM	DEFINITION
	road means the whole of any land which is within a district, and which— (a) immediately before the commencement of this Part was a road or street or public highway; or (b) immediately before the inclusion of any area in the district was a public highway within that area; or (c) is laid out by the council as a road or street after the commencement of this Part; or (d) is vested in the council for the purpose of a road as shown on a deposited survey plan; or (e) is vested in the council as a road or street pursuant to any other enactment;— and includes— (f) except where elsewhere provided in this Part, any access way or service lane which before the commencement of this Part was under the control of any council or is laid out or constructed by or vested in any council as an access way or service lane or is declared by the Minister of Works and Development as an access way or service lane after the commencement of this Part or is declared by the Minister of Lands as an access way or service lane on or after 1 April 1988: (g) every square or place intended for use of the public generally, and every bridge, culvert, drain, ford, gate, building, or other thing belonging thereto or lying upon the line or within the limits thereof;— but, except as provided in the Public Works Act 1981 or in any regulations under that Act, does not include a motorway within the meaning of that Act or the Government Roading Powers Act 1989
Road controlling authority	The party that controls the road and is responsible for its operation and maintenance. This is typically the New Zealand Transport Agency for State Highways and the territorial authority for other public roads.
Road culvert	A structure that allows water to flow from one side of the road to the other Typically embedded so as to be surrounded by soil, a culvert may be made from a pipe, reinforced concrete or other material.
Road opening notice	See 'CAR' in abbreviations above.
Road to Zero	National strategy to reduce death and serious trauma
Root protection zone	Means the minimum area required to ensure a tree's health and safety is safeguarded.
Rural water supply area	An area formally identified by Council as an area serviced by a reticulated water supply system that is intended to supply water for specified purposes via restricted flow supplies and/or on-demand supplies but usually without firefighting capability (Refer to Council's Water Supply Bylaw).
Safe Systems Audit	Process to ensure that any design/road/path/cycleway is constructed to ensure the risk of death and serious harm is identified and the means to reduce/eliminate has been advised and actioned.
Secondary flow path	The path taken by stormwater runoff in excess of the primary design flow capable of providing protection to the surrounding buildings for a 'once in 100 year' return period rain event for commercial, industrial and habitable residential floor levels.
Service lane	Any land laid out or constructed either by the authority of Council, the Minister of Works and Development or, on or after 1 April 1988, the Minister of Lands for the purpose of providing the public with a side or rear access for vehicular traffic to any land. Means land dedicated as service lane which is used from time to time for the vehicular servicing of adjacent properties.
Service pipe	See 'Connection'.
Service vehicles	Vehicles that are used to service the needs of the residences and undertake operation and maintenance activities on the infrastructure within the road corridor such as: rubbish trucks, road sweepers, recycling trucks, line marking trucks and resealing trucks.
Sewer/public sewer	See 'wastewater system'.
Shared path	An off-road path shared by cyclist and pedestrians
Shared zone	A length of road that is intended to be used by both pedestrians and vehicles where pedestrians have the right of way over vehicles as set out in the Land Transport (Road User) Rule 2004, Clause 10.2.

<table>
<tr><th>TERM</th><th>DEFINITION</th></tr>
<tr><td>Shoulder</td><td>The portion of the side of the road that is not normally trafficked and resides between the solid white edge line and the edge of seal.</td></tr>
<tr><td>Special vehicle lane</td><td>A lane defined by signs or markings and restricted to a specified class or classes of vehicle and includes a bus lane, a transit lane, a cycle lane, multiple occupancy lanes and a light-rail vehicle lane.</td></tr>
<tr><td>Subdivision</td><td>As described in Section 218 of the RMA 1991.

Part 10
Subdivision and reclamations

218 Meaning of subdivision of land
(1) In this Act, the term subdivision of land means—
(a) the division of an allotment—
(i) by an application to the Registrar-General of Land for the issue of a separate record of title for any part of the allotment; or
(ii) by the disposition by way of sale or offer for sale of the fee simple to part of the allotment; or
(iii) by a lease of part of the allotment which, including renewals, is or could be for a term of more than 35 years; or
(iv) by the grant of a company lease or cross lease in respect of any part of the allotment; or
(v) by the deposit of a unit plan, or an application to the Registrar-General of Land for the issue of a separate record of title for any part of a unit on a unit plan; or
(b) an application to the Registrar-General of Land for the issue of a separate record of title in circumstances where the issue of that record of title is prohibited by section 226,—
and the term subdivide land has a corresponding meaning.</td></tr>
<tr><td>Supply pipe</td><td>The section of pipe between the point of supply and the customer's premises through which water is conveyed to the premises. This pipe is owned and maintained by the customer.</td></tr>
<tr><td>Survey plan</td><td>As described in Section 2 of the RMA 1991.

survey plan has the meaning set out in the following paragraphs, in which cadastral survey dataset has the same meaning as in section 4 of the Cadastral Survey Act 2002:
(a) survey plan means—
(i) a cadastral survey dataset of subdivision of land, or a building or part of a building, prepared in a form suitable for deposit under the Land Transfer Act 2017; and
(ii) a cadastral survey dataset of a subdivision by or on behalf of a Minister of the Crown of land not subject to the Land Transfer Act 2017:
(b) survey plan includes—
(i) a unit plan; and
(ii) a cadastral survey dataset to give effect to the grant of a cross lease or company lease</td></tr>
<tr><td>Territorial authority</td><td>A city council or a district council named in Schedule 2 of the LGA 2002.</td></tr>
<tr><td>Trade waste</td><td>Is any liquid, with or without matter in suspension or solution, that is or may be discharged from a trade premises to Council's wastewater system in the course of any trade or industrial process or operation, or in the course of any activity or operation of a like nature and may include condensing or cooling water or stormwater which cannot be practically separated.</td></tr>
<tr><td>Transit lane</td><td>A lane reserved for the use of the following (unless specifically excluded by a sign or markings installed at the start of the lane):
• Passenger service vehicles
• Motor vehicles carrying not less than the number of persons (including the driver) specified on the sign
• Cycles/mopeds
• Motorcycles.</td></tr>
<tr><td>Transportation corridor</td><td>All roads as defined above and includes all land from boundary to boundary (including the berm and carriageway).</td></tr>
</table>

TERM	DEFINITION
Tree protection zone	Minimum protection of existing trees in a work site is by erecting temporary fencing in a circle with a radius equal to the maximum crown extension (drip line) or 4 metre radius from the trunk, whichever is greatest.
Trunk wastewater pipe	A gravity wastewater pipe with an internal diameter of 225mm to 450mm which forms part of Council's wastewater system.
Trunk watermain	A strategic watermain 250-375mm diameter inclusive.
Urban water supply area	An area formally designated by Council as an area serviced by a reticulated water supply system with a firefighting capability, that is intended to supply water to customers via on-demand supplies. Refer to Council's Water Supply Bylaw.
Vested	Any assets that are intended to be owned and maintained by Council
Wastewater (sewage)	Water or other liquid, including waste matter in solution or suspension, discharged from a premises to the wastewater system.
Wastewater reticulation main	A gravity wastewater pipe with an internal diameter of 150mm which forms part of Council's wastewater system.
Wastewater system	The collection, treatment and disposal of wastewater and trade wastes, including all wastewater pipes, pumping stations, storage tanks, wastewater treatment plant, outfall and other related structures operated by Council and used for the reception, treatment and disposal of wastewater and trade wastes.
Watercourse	A watercourse is a natural or artificial channel that a flowing body of water follows. These include rivers, streams, branches and canals. If it is navigable, it is a waterway.
Water efficiency measure	A water sensitive technique that has been confirmed as appropriate for specific catchments or developments in general. Specific water sensitive techniques that are generally considered appropriate include (but not limited to) water re-use tanks, detention, permeable surfaces, soakage and bio retention. Appropriate water sensitive techniques may also be identified within ICMPs and WIAs prepared for catchments or individual developments respectively.
Water-sensitive techniques	A variety of methods that aim to achieve better outcomes for water related issues. They include many techniques referred to under other names: • Low impact design (LID) • Low impact urban design (LIUDD) • Sustainable urban drainage systems (SUDS) or 'natural', 'green' and sustainable'.
Water supply system	All those components of the system between the point of abstraction from the natural environment and the point of supply. This includes, but is not limited to: • Wells • Infiltration galleries • Intake structures • Open raw water storage ponds/lakes • Falling mains • Treatment plants • Treated water reservoirs • Trunk mains • Service mains • Ridermains • Pump stations • Valves • Hydrants

TERM	DEFINITION
	• Scour lines • Service pipes • Boundary assemblies • Meters • Backflow prevention devices • Tobies.
Water supply authority	As defined in Council's Water Supply Bylaw.
Works	Works must generally be defined as work for which this RITS is being used and must have the definition of 'Contract Works' as defined in NZS3910:2013.
Work Safe	New Zealand's primary workplace health and safety regulator

1.4. THREE WATERS MANAGEMENT

Pressure on water resources in the region is increasing due to a growing population and associated concentration of activities and industry. This pressure affects demand for water resources and three waters infrastructure (drinking water, wastewater and stormwater).

Well managed land-use planning is critical in minimising conflicts between infrastructure and land development to sustain water quality and quantity for future generations. It will also assist with the efficient and effective removal of waste and stormwater while protecting and enhancing the natural environment.

Council is required to give effect to a number of national and regional legislative drivers, industry standards and Council's own policies and plans.

1.5. RESOURCE CONSENTS

As a territorial authority, Council manages significant resource consents from the Regional Council for conducting its responsibilities under various Acts and legislation. To ensure compliance with these consents Council must impose its own standards and conditions on development within its boundaries.

Other key influences include:

Table 4: Influencing policies and strategies

INFLUENCE	SPECIFIC REQUIREMENTS
Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010	The overarching purpose of the Waikato River Settlement is to restore and protect the health and wellbeing of the respective rivers for future generations. These Settlements are supported by the 'Vision and Strategy for the Waikato River: Te Ture Whaimana o Te Awa o Waikato'. One of the strategies from the Vision and Strategy is to *"ensure that cumulative adverse effects on the Waikato River and activities are appropriately managed in statutory planning documents at the time of their review".* In order to ensure that the cumulative adverse effects on the Waikato River are managed, developments that require water, wastewater or stormwater connections will need to submit an ICMP or WIA.

Water Services (Drinking Water Standards for New Zealand Regulations 2022	Infrastructure must be designed and constructed to: • Ensure that the water system is functional. • Ensure the required quality and quantity of water is supplied to all customers and Council's Ministry of Health grading is not compromised.
Regional Policy Statement (May 2016)	Objective 3, 3.1.2: Policy 2 3.4 Efficient Use of Water requires integrating land-use and infrastructure planning. This objective may be met by the development of ICMPs and WIAs.

1.6. ACCEPTANCE FOR DESIGN CONSTRUCTION

1.6.1 Council contracts

For Council contracts refer to the relevant contract documentation for construction commencement. Contract documentation may refer to this RITS.

1.6.2 Development works to be vested

The developer is ultimately responsible for all requirements and processes including:

a) Interpreting the requirements of the resource consent, including any related Regional Council resource consent(s).

b) Employment of a competent and suitably qualified engineer for all design works.

c) Submitting engineering plans and landscaping plans (where appropriate for Road Reserve or parks landscaping) and liaising with Council staff throughout the engineering plan acceptance process.

d) Accepted resolution of items raised in any Safe Systems Audit

e) Construction monitoring of the physical works and signing off that the work has been completed to the required standards

f) Submission of as-built and associated documentation prior to vesting.

Developers are strongly encouraged to consult with Council on all infrastructure design, including landscaping, at an early stage of the development.

The following figure sets out the acceptance process:

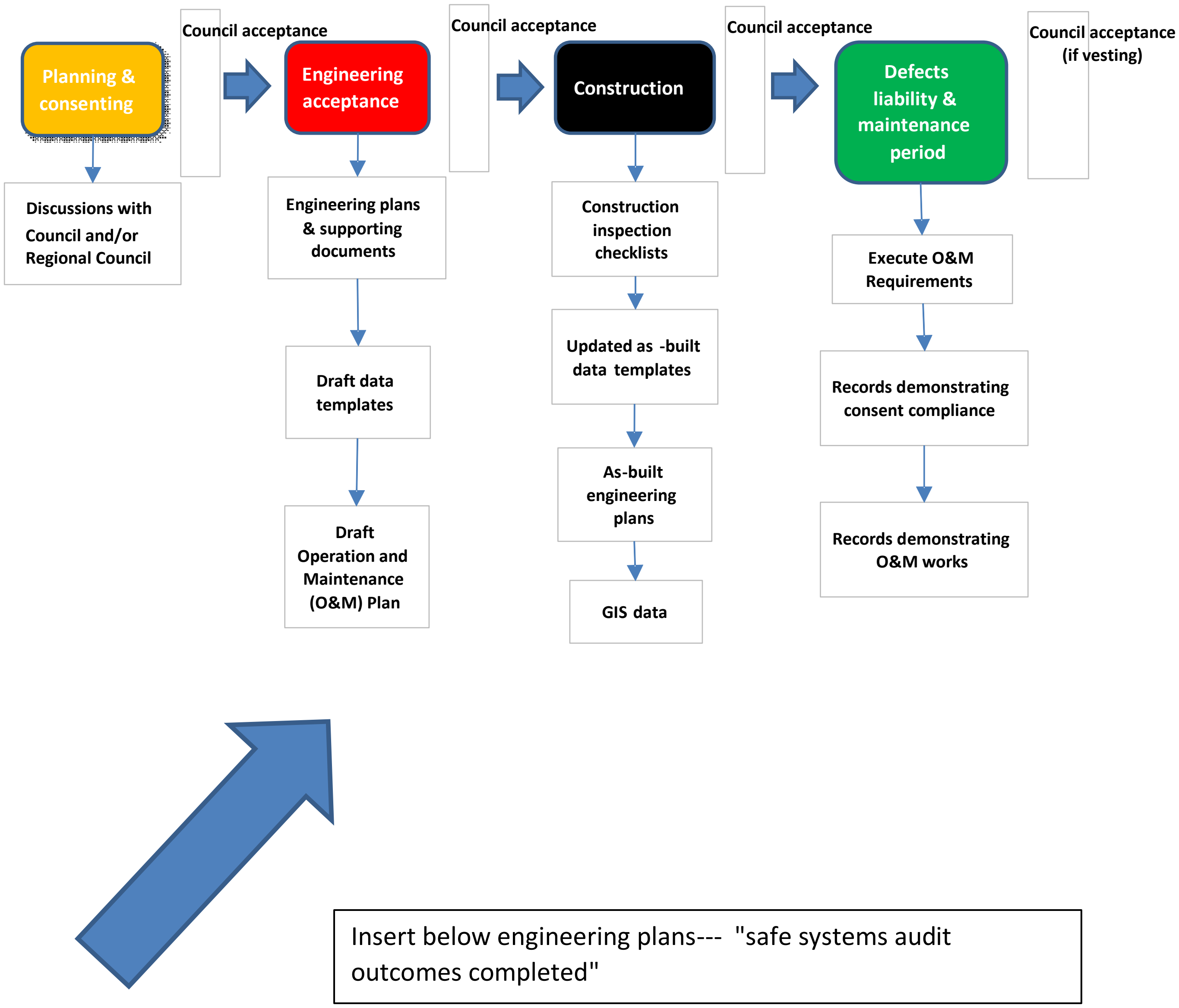

Figure 1: Acceptance process

1.6.2.0 Design philosophy statements and engineering plans

All engineering plans must be accompanied by a design philosophy statement which describes the proposed infrastructure and its relationship to the RITS. Any alternative design solutions must be described in the design statement.

The design philosophy statement and engineering plans will be supported by the information summarised in *Table 7: Supporting documentation for acceptance* on page 33.

Acceptance of engineering plans and calculations is required before construction commences.

The following individual engineering plans must be submitted for acceptance (see *Table 6: Engineering plan requirements* on page 28 for full plan requirements).

Table 5: Engineering plan descriptions

PLAN	DESCRIPTION
1. Locality plan	Showing information sufficient to locate the subject site relative to existing features such as roads, waterways and already developed land etc.
2. Earthworks plan	Showing what earthworks are proposed (cut and fill contours) and any associated drainage requirements and highlighting any areas of slope stability concerns.
3. Road layout	Including parking arrangements, footpaths, cycleways, road marking, signs, vehicle crossings and street lighting (both existing and proposed).
4. Stormwater management system	Showing downstream and upstream systems, connections, disconnections, stormwater treatment, detention devices and overland flow paths, for both existing and proposed works.
5. Wastewater reticulation	Showing downstream and upstream systems, connections, disconnections and pump stations, for both existing and proposed works.
6. Water reticulation	Showing downstream and upstream systems, connections and disconnections, for both existing and proposed works.
7. Landscaping plans	Where applicable, landscaping plans must be overlaid on to road layout plans to identify conflicts.
8. Staging plan	Where the development is likely to be constructed in stages, a plan showing the pattern and chronology of the land development must be submitted. The staging should have been determined as part of the resource consent application process.
9. Drawings of all standard details	Include drawings of all standard details to be used in the physical works, such as kerb and channel profile, cobblestone laying patterns, typical cross section showing footpath, berms, kerb and channel and pavement layers, three waters and landscaping. For ducts, a location diagram with measurements from reference points to the ends of the ducts and to any angles in the alignment.

Engineering plans should be submitted in their entirety to ensure prompt processing. The plans should clearly demarcate the extent of development that they refer to, private assets and include any common features such as property boundaries.

Staged submission of detailed engineering plans may be considered where an overall concept plan (with supporting calculations) is submitted. Fully compliant and permanent ‘end treatments’ are to be designed at the stage boundaries for water, wastewater, stormwater, roading and landscaping.

Table 6: Engineering plan requirements

	PLAN VIEW	LONG SECTIONS	OTHER
Earthworks	• Original contours • Final contours • Overland drainage pattern • Cuts and fills • Provision for control of silt transport		
Transportation	• Design centreline and meterage, or route position reference where there are changes to existing roads • Changes in surfacing material or age (e.g. concrete, surfacing joins), changes in pavement design • Horizontal alignment of kerb and channel including traffic facilities, with differing symbology for different kerb and channel types • Stormwater secondary flow paths • Horizontal alignment of footpaths • Horizontal alignment of cycleways/ lanes/shared paths • Parking and bus bays • Location of vehicle crossings (where known) • Locations of ducts and other below ground features • Location of streetlight columns, with differing symbols for different light or column types • The size, location and depth of all cables • Traffic signal details • Location of landscaping areas and street trees	• Existing ground levels at no greater than 0.5m intervals • Proposed final centre line levels • Cuts and fill • Grades (including footpaths/cycleways/shared paths) • Vertical curve and horizontal alignment elements information • Location of catchpits or any other stormwater treatment devices • Location of intersecting roads • Location and level of pipelines/services	• Cross sections • Proposed roads • Typical cross sections showing pavement designs • Existing ground contour extending at least 3 metres into adjacent land • Road marking and signage • Location and alignment of all road markings • Separate construction drawings must be provided for retaining walls, bridges and underpasses • Staging Plans

	PLAN VIEW	LONG SECTIONS	OTHER
	• Location of all street furniture including tactile pavers, bollards, handrails, guardrails • Traffic islands • Stormwater treatment devices within the road corridor • Road marking		
Stormwater	• Horizontal alignment of all pipelines relative to property boundaries or kerb lines as appropriate and tie-in to existing services • Easements • Location of all manholes • Labels of all manholes • Ground and invert levels of new and existing manholes • Location of all conveyance, detention and treatment devices • Location of any open drain • Position of all property connections relative to property boundaries and the depth at the property boundary • Secondary flow paths including their easements • Site plan showing property boundaries, finished land level contours (maximum one metre interval), catchment and sub-catchment boundaries used in stormwater flow calculations together with label annotations providing an link to the stormwater runoff calculations (preferably show the stormwater	• Existing ground levels • Proposed ground levels • Pipe depths, inverts and grade • Pipe type, size and class • Existing and proposed pipelines, cables and ducts crossing the alignment • Invert levels of all pipelines connecting to new and existing manhole • Labels of all manholesInlet, outlet and hydraulic information for all treatment and detention devices • Hydraulic grade line for the designed storm event.	

	PLAN VIEW	LONG SECTIONS	OTHER
	drainage system on this drawing as well) • Construction plan details for stormwater treatment and detention devices. Plan view to include contours at 0.5 metre interval and elevation view to show normal, discharge and overflow levels • Location of catchpit, leads and manholes • Location of culverts and drainage, subsoil drainage and other drainage structures e.g. soakage devices • Insert detailed diagram for assets that sit in close proximity and include with as-builts • Distinguish Asset Ownership; private vs. public		
Wastewater	• Horizontal alignment of all pipelines relative to property boundaries or kerb lines as appropriate and tie-in to existing services • Location of all manholes • Labels of all manholes • Ground and invert levels of new and existing manholes • Location of all structures (including pump stations) • Position of all property connections relative to property boundaries • Show finished land level contours (not greater than 1 metre intervals and include RL labels on contours)	• Existing ground levels • Proposed ground levels • Pipe depths, inverts and grade • Pipe type, size and class • Existing and proposed pipelines, cables and ducts crossing the alignment • Invert levels of all pipelines connecting to new and existing manhole • Ground levels of new and existing manholes • Labels of all manholes •	• Pump station (including rising main and overflow) storage tank. • Show all relevant details to enable the design to be audited and the structure constructed • Construction drawing of pump station structure • Rising main plan and long section (including air and scour valves) • Water and electrical services to the pump station • Show the provision for pump station overflow storage in both plan and elevation views

	PLAN VIEW	LONG SECTIONS	OTHER
	• Insert detailed diagram for assets that sit in close proximity • Distinguish Asset Ownership; private vs. public		
Water	• Horizontal alignment of all pipelines relative to face of kerb, or boundary as appropriate, and tie-in to existing services • Location of all valves • Location of all hydrants and building sites to be provided with fire protection • Pipe type, size and class • Position of all property connections relative to property boundaries and the depth at the property boundary • Location of all flushing valves • Insert detailed diagram for assets that sit in close proximity • Distinguish Asset Ownership; private vs. public	• Existing and proposed pipelines, cables and ducts crossing the alignment • Pipe depths where it is planned for the pipeline to be at a different depth to that specified in the RITS • Long sections are required for pipelines of DN250 and larger • The long section must show existing and proposed pipelines, cables and ducts showing the alignment	
Landscaping	• Landscaping plan with plant locations and planting typologies, specimen and amenity tree locations • Furniture • Toilets • Playgrounds • Walkways/cycleways final contours • General arrangement plan, e.g. concrete type, boardwalks, bridges		

) **Layout of engineering plans**

All engineering plans must have provision to be signed and dated as accepted by Council i.e. two spaces measuring 80mm by 40mm clear for electronic stamping per plan.

a) **Engineering plans – submitting documentation**

Engineering plans should be presented and submitted as per *Clause 1.9 As-built plans* on page 41.

b) **Acceptance of engineering plans**

Prior to acceptance of engineering plans it may be necessary to amend drawings. It may also be necessary for accepted drawings to be amended due to unforeseen site conditions.

Amended drawings must be:

i) Submitted with an accompanying document transmittal note or consultant's form.

ii) Appropriately revision controlled.

c) **Changes to accepted engineering plans**

The accepted engineering plans may only be amended after consultation with Council and subsequent reacceptance. In all cases, the changes must be documented, and the amendments shown on the accepted engineering plans.

1.6.2.1 Supporting documentation

In addition to the engineering plans, the information presented in the table below is required prior to, during and after construction.

An erosion and sedimentation control plan will be required for all developments where runoff from a construction site can enter into either Council's stormwater system or an open watercourse.

A health and safety plan must be provided and accepted by Council if any works are in the public area i.e. roads, parks etc.

Table 7: Supporting documentation for acceptance

SECTION	CONSTRUCTION STAGE		
	PRIOR TO	DURING	POST
Geotechnical information	• Geotechnical report • Contaminated site validation report • Earthworks and fill design report	• Construction monitoring	• Geotechnical completion report • Site contamination validation report • Statement of professional opinion (adapted from NZS 4404 Schedule 2A) • Final contour plan identifying areas of fill
Transportation	• See *Clause 3.8 Quality Systems* on page 173 • For traffic signs see *Clause 3.7 Traffic Signals* on page 165 • Road pavement design calculations including results of preliminary soil testing • Acceptance for sub-soil drainage discharge (if appropriate) • Completed lighting design • Road safe system audits must be provided unless Council accepts an 'exemption declaration', resolution • Design and access statement – see *Clause 3.2.6 Design and access statement* on page 101 • Producer statement for design of structures (PS1 and PS2 if applicable)	• Construction monitoring – see *Clause 3.8 Quality Systems* on page 173 • For traffic signals, see *Clause 3.7 Traffic Signals* on page 165	• See *Clause 3.8 Quality Systems* on page 173 • For traffic signals, see *Clause 3.7 Traffic Signals* on page 165 • Producer statements for the construction of structures (PS3) along with recommended maintenance schedules • Producer statements for the construction of private ways • CoC or ESC signed by an authorised person for electrical work • Post construction road safe systems audit • Applicable warranties and guarantees for assets including streetlight components and coatings

SECTION	CONSTRUCTION STAGE		
	PRIOR TO	DURING	POST
	• Temporary traffic management plan for any work being undertaken within the existing road corridor • Acceptance of all engineering plans – see *Table 6: Engineering plan requirements* on page 28		• As-built plans – see *Clause 1.9 As-built plans* on page 41 • Quality forms – see *Three waters asset attributes* on page 52 • As-built data forms - *Landscape (parks and facilities) asset data forms* on page 52 • O&M plans for assets such as rain gardens, and other stormwater treatment devices where the appropriate levels of maintenance or operational requirements are not self-evidentPost Construction Safe Systems Audit must be provided, and outcome resolutions agreed with Council (unless Council accepts an 'exemption declaration'),
Stormwater	• ICMP, CMP or WIA • Detailed catchment runoff calculations showing for each sub-catchment the formula input factors used in the calculations • Upstream and downstream effects • Detailed pipeline flow capacity analysis • For stormwater treatment and detention devices, detailed analysis demonstrating the	• Site supervision	• CCTV inspection and report • Final operations and maintenance manuals for stormwater treatment and detention devices • As-built plans – see *Clause 1.9 As-built plans* on page 41 • Asset attributes spreadsheets – see *Three waters asset attributes* on page 52.

SECTION	CONSTRUCTION STAGE		
	PRIOR TO	**DURING**	**POST**
	design performance in respect of stormwater quantity and quality as appropriate, including completed relevant sections of the stormwater management device datasheet • Proposed operations and maintenance manuals for stormwater treatment and detention devices • Proposed landscaping plan for stormwater treatment and detention devices • A stage/storage/discharge table		
Wastewater	• ICMP or WIA • Wastewater flow estimates supported by the estimates of population equivalents for each catchment together with catchment boundaries and catchments areas • Pipe flow calculations showing pipe capacity and flow velocity for average dry weather flow, peak daily flow and peak wet weather flow • Pump station calculations justifying the selection of wet well size, storage, pump selection and rising main hydraulics	• Site supervision	• CCTV inspection and report • As-built plans – see *Clause 1.9 As-built plans* on page 41. • Asset attributes spreadsheets – see *Clause 1.9 As-built plans* on page 41 • Pump station test results and sign off documentation

SECTION	CONSTRUCTION STAGE		
	PRIOR TO	DURING	POST
Water	• IMCP or WIA • Fire flow calculation	• Site supervision	• As-built plans – see *Clause 1.9 As-built plans* on page 41. • Asset attributes spreadsheets – see *Clause 1.9 As-built plans* on page 41 • Pressure tests • Fire hydrant flow test • Coliform tests
Landscaping	• Statement of design intent and design objectives • Plant schedule • Existing tree and vegetation plan • Maintenance schedule for weeding and replacement planting during the defects liability period	• Site supervision	• As-built plans – see *Clause 1.9 As-built plans* on page 41. • As-built data forms - see Appendix 4: Landscape (parks and facilities) asset data forms.

1.7. SITE DEVELOPMENT/CONSTRUCTION

1.7.1 Commencement of work

1.7.1.1 Council contracts

For Council contracts, refer to contract documentation on construction commencement.

1.7.1.2 Development works to be vested

For developments, the following must apply:

a) Once engineering acceptance has been granted, the developer must inform Council of the intention to commence construction works. No engineering works can commence on any subdivision or development until all acceptances (resource consents, engineering and others) have been obtained.

b) Due to the size and complexity of the development (but generally 10 or more lots), a pre-construction meeting may be required. At the pre-construction meeting, Council auditing procedures will be discussed and provisional dates and notification lead time for verification tests will be discussed. Where construction proceeds in stages, a separate pre-construction meeting must be held for each stage.

1.7.2 Site works

1.7.2.1 Council contracts

For Council contracts, refer to the conditions of contract and specifications for construction auditing requirements.

1.7.2.2 Development works to be vested

For subdivisions, the following must apply:

a) Developers are advised that the onus rests with them to ensure that works are to a standard acceptable to Council.

b) Developers are advised to retain the services of a suitably qualified or professional person(s) to verify the works

c) Developers should carry out regular audits of the construction and maintain records of audits which need to be submitted to Council on application for 224(c) or works sign off.

d) In addition to the construction monitoring carried out by the developer, Council may also audit the works.

e) Auditing requirements for types of works are covered in the various sections.

f) Council reserves the right to enter the work site at any time for auditing, inspecting or checking purposes.

1.7.3 Standard audits

The following are key milestones that the developer must notify Council of to enable any audit to be carried out if required:

- Commencement of works.
- Prepared earthworks and subsoil drainage prior to filling.

- Completed earthworks and prepared subgrade for carriageway, footpath, cycleway and walkway.
- Commencement of stormwater, wastewater (including pump stations) and/or water reticulation.
- Finished sub-base construction.
- Prior to commencement of carriageway surfacing.

Audits will be carried out within one working day of notification if possible. Work must not proceed until the audit has been satisfactorily completed. When work has been interrupted or delayed, Council must be notified before it is recommenced.

1.7.4 Quality of work

1.7.4.1 Council contracts

For Council contracts, refer to the conditions of contract and specifications for construction auditing requirements.

1.7.4.2 Development works to be vested

For subdivisions, the following must apply:

a) The developer is responsible for ensuring that the engineering works constructed by their contractors are carried out according to these specifications, accepted plans and best work practices.

b) Council staff are not responsible for quality assurance; that is the developer's role.

c) The developer is responsible for satisfactory completion of any quality system checklists required (refer to the individual sections for requirements). Where the quality checklists require the presence of a Council representative, then the developer must make such arrangements as required. At least 24 hours' notice should be given.

d) General procedures/requirements and quality assurance forms are provided for use during construction; however, Council will accept developers/contractors/agents own quality assurance forms that convey similar information.

e) Copies of completed checklists (found in the relevant sections) must be forwarded to Council as the works progress.

1.7.5 Stop work notices

Any person or persons carrying out 'onsite' works as part of any Council accepted development must cease such work, or part thereof, immediately upon receipt of a verbal instruction which will be accompanied by a written stop work notice issued as soon as possible, by Council or an authorised agent specifying restrictions.

The developer has the right to appeal to Council to override or amend a stop work notice. A copy of Council's written decision will be recorded on Council's resource consent or project file. Work may recommence when Council advises this in writing.

1.7.6 Emergencies

If a situation is observed that is likely to endanger the safety and/or the security of the public, public or private property, or the operation of any public facility, the developer or contractor will be instructed to undertake immediate remedial action to alleviate the danger and secure the site. Any such work or supply of materials will be at the developer or contractor's expense.

1.7.7 Onsite testing

Any work that requires testing in the presence of a Council officer must be pre-tested and proved satisfactory by the developer prior to the witnessed testing. If the work does not meet the standard, then an additional fee will be charged for the second and any subsequent visit to re-measure or re-test the work.

Specific testing regimes are set out in the relevant sections. Subsequent work dependent on a satisfactory test result must not be undertaken until compliance has been demonstrated.

1.7.8 Connection to existing services

Council, or an authorised agent, must undertake the physical works to provide all connections from Council's operational water supply, wastewater, and stormwater systems. This may be undertaken by the developer, but only with written agreement with Council. The new services must be tested and shown to meet all requirements prior to the connection being made.

1.7.9 Stormwater quality

Stormwater quality is governed by the requirements of the developer's discharge consent conditions, compliance with the Regional Plan rules, an accepted ICMP, CMP and consistency with Council's own comprehensive stormwater consents.

The developer is responsible for ensuring that mechanisms exist both during construction and at completion within the stormwater systems to prevent water-borne litter, such as paper and plastics, and gross sediments from entering the downstream system. Attenuation and quality treatment will be required. Engineering design plans must demonstrate how this is achieved.

The outcome will be that the design of the system will need to achieve the following as a minimum (more stringent requirements may be included within the CMP, ICMP or discharge consent):

a) Avoid or minimise the discharge of any substance that is likely to cause the production of conspicuous oil or grease films, scums or foams, or floatable suspended materials in stormwater receiving water bodies.

b) Avoid or minimise the discharge of suspended solids that cause conspicuous changes in colour or visual clarity, smothering of benthic organisms by sediment or make the receiving waters unsuitable for contact recreation.

c) Avoid or minimise discharges that are likely to adversely affect aquatic ecosystems and cause the following effects in stormwater receiving waters after reasonable missing and consideration of the background levels:

- i) Dissolved oxygen levels to fall below 80% of saturation.
- ii) pH to fall below 6 or exceed 9.
- iii) Suspended sediments to smother benthic organisms.
- iv) Undesirable biological growths.
- v) Water temperature to change by more than 3^0C or exceed 25^0C.
- vi) Turbidity levels to exceed 25 NTU between the months of August and December.
- vii) Ammoniacal nitrogen concentrations to exceed 0.88 grams of nitrogen per cubic metre.

viii) Other contaminant concentrations to exceed the United States Environmental Protection Agency's '*National Recommended Water Quality Criteria, criteria maximum concentration*' (USEPA, 2009).

1.7.10 Stormwater catchpits

Regular inspections of stormwater catchpits within and adjacent to the site works must be carried out to ensure that stormwater contaminants do not enter into the stormwater system. All methods necessary to prevent sediment and other contaminants entering the catchpits must be employed.

Inspections should also consider the weather particularly when impending storms are known, and accepted if the geotextile is cleaned/ or replaced if it prevents the pit from working at all. The geotextile must be removed as soon as the site is stabilised.

1.8. COMPLETION AND PRACTICAL COMPLETION

1.8.1 Quality systems

Works clearance will not be considered until all certificates and quality assurance forms are complete and as-built plans/datasheets are received and accepted. Refer to *Table 7: Supporting documentation for acceptance* on page 33 for a list of requirements and the relevant activity sections for the required forms. The developer/contractor must also submit, where required, completed producer statement forms and any specific testing results.

1.8.2 Council contracts

For Council contracts refer to the condition of contract, specifications and NZS 3910 or NZS 3916 for practical completion and final completion requirements.

1.8.3 Development works to be vested

Works clearance is reached when the works described in the conditions of consent have been constructed in accordance with the accepted plans and the RITS. Any recommendations from the road safe systems audit(s) must also be implemented and agreed with Council (refer to Clause 3.2.5 Safe Systems Audit on page 103) before works clearance is reached. A works clearance will be issued when all infrastructure conditions have been met, subject to any bonds and defects liability periods. The 224(c) certificate can then be issued (assuming all non-engineering conditions have been met). Completion is when all defects that have arisen during the defect's liability period have been corrected. The developer is not liable for fair wear and tear.

1.8.4 Defects liability period

Works carried out during the development will be subject to a defect's liability period of 12 months; however, in specific circumstances, e.g. stormwater/landscape planting, this is likely to be increased to 24 months. The defects liability period commences from the date of issue of the 224(c) certificate (developments) or practical completion certificate (contracts).

Any works that are completed after the date of the issue of the 224(c) certificate will be subject to an extension of the defects liability period for 12 months following the completion of those delayed works.

1.8.5 Bonds for uncompleted works

Council may consider accepting bonds to cover works that are uncompleted at the time of application for the 224(c) certificate.

Bonds may be required for works that are damaged or maybe damaged by ongoing works, for example where staged developments utilise part of a road for construction traffic where 224c has been previously issued.

The value of the bond will be set at one and a quarter (1¼) time the estimated cost of the works for developments involving 10 or more lots/dwellings and twice (2) the estimated cost of the works for smaller projects. In some circumstances however, such as planted stormwater devices that may have a long construction phase or a higher risk of failure, the bond may be increased to twice (2) the estimated cost of the works. The estimated cost of the works must be as agreed between the parties or, in the absence of agreement, as estimated by Council. All costs associated with the provision of a bond will be the responsibility of the developer.

A time for the work uncompleted will be specified. If the work is not completed within time the developer may apply for an extension. Only one extension for time will be considered and the application must set out grounds for the request. Once the specified time period has expired, including any extension granted, Council will arrange for the work to be done. Funds for the work, including administration, will be charged against the bond amount. Any remaining funds after payment of all costs will be refunded to whoever provided the bond.

It is the developer's responsibility to inform Council that the work is completed and to request an audit as a pre-requisite for the bond release. This request must be accompanied by certification stating the outstanding work has been completed to the required standard. There is a charge for this audit at the level set out in Council's fees and charges. Where a developer fails to request their bond release and Council in unable to locate them, Council may retain the bond money.

Refer to the RMA, section 222 and section 224(c)(iii) in relation to bonds.

1.9. AS-BUILT PLANS

1.9.1 General

Upon completion of construction and prior to issue of work clearance/practical completion, copies of as-built plans showing details as constructed and certified as correct by the developer/contractor must be submitted to Council. The plans will show all of the details as required by *Table 6: Engineering plan requirements* on page 28. These plans are required to update Council's records and for archiving purposes.

Separate plans are required for:

- Road corridor (including plans for lighting, traffic signals and cables). all services, any assets to be vested and clearly distinguishing assets which are private
- Earthworks (finished contours).
- Landscape works - parks and facilities (where not included in landscaping plans).

- Stormwater, wastewater and water supply networks (including all stormwater treatment and detention devices and pump stations, overland flow paths and depths, easements where applicable. a).

For small developments refer to *Clause 1.9.8 Threshold matrix for as-built information* on page 46.

Plans presented in fulfilment of this requirement must be shown as 'As-Built' in the amendments part of the drawing title block and signed off as 'accepted for issue' by a person having responsibility for the quality assurance aspect of the as-built information.

General information to be shown on as-built plans includes:

a) All attributes identified in *Standard symbols* on page 50.

b) Name of company and person who prepared the as-built plans.

c) Drawing title with project name or subdivision name (including subdivision stage number if applicable).

d) Unique drawing number.

e) Council contract number (for Council projects only).

f) Council project ledger code (for Council projects only).

g) Plan revision.

h) Date when signed.

i) Lot boundaries as submitted to Land Information New Zealand (LINZ) including legal descriptions in the case of subdivisions.

j) Lot numbers and house numbers.

k) Datum reference.

l) Origin benchmark reference, reduced level and coordinates.

m) Scale bar.

n) North arrow.

o) Legend.

p) New assets (and tie-in to existing assets).

q) Existing assets (notated with Council's asset reference/identifier).

r) Abandoned or removed assets.

s) Plans for wastewater, stormwater and water supply must use the line formats and symbols indicated in *Standard symbols* on page 50.

Note: Occasionally privately owned assets need to be shown on as-built plans. Such assets must be clearly labelled 'Private asset type' e.g. Private SW Manhole.

List of specific assets, their attributes to be shown on plans together with example as-built drawings are contained in the appendences of this section. Construction plans are not acceptable as as-built plans.

1.9.2 Drawing standards

Drawings must be A3 size and must be scalable using the following scales:

Table 8: Drawing standard scales

TYPE	ORIENTATION	1:1000	1:500	1:250	1:100	1:50
Plan and long section	Horizontal	✓	✓	✓		
	Vertical				✓	✓
Cross sections	Horizontal				✓	
	Vertical					✓

In all cases the plan size must be appropriate for the level of detail shown. In particular use of 1:1000 scale is to be confined to site plans, roading and three waters layout plans.

1.9.3 Datums and units of measurement

Only metric units are to be used in as-built data. Principally these are millimetres (mm), metres (m), litres/sec (L/s), cubic metres/day (m^3/day). All levels are to be in terms of the NZVD 2016 and to two (2) decimal places.

Geographic coordinates must be:

a) New Zealand Geodetic Datum 2000 (NZGD2000).

b) Projection:

i) New Zealand Transverse Mercator (NZTM) or

ii) Mt Eden Circuit 2000.

Coordinates should be presented in standard six (6) digit format (east coordinate followed by north coordinate) to two (2) decimal places e.g. 305718.97, 643728.35. Accuracy of coordinates must be for X, Y within +/-0.1m, Z within +/-0.01m.

1.9.4 Areas of filling

The areas of filling must be shown by contours with the depth of fill in the form of lines, joining all points of equal depth, or by contours showing original ground levels and finished ground levels.

1.9.5 Other utility services

In applying for works completion, the developer/contract must submit the appropriate checklists from all other utility system operators confirming that they have received the required as-built information.

1.9.6 As-built plans and data attributes

The following files and data attributes are required to facilitate the easy transfer of data into Council's asset management system. Electronic spreadsheets (.xls or .xlsx), listing various attributes of assets constructed, and as-built data forms, are listed in the appendices and available from the Co-Lab website. Three waters attribute data templates are listed in *Three waters asset attributes* on page 52.

Note: Levels are to be in metres (m) and in terms of NZVD 2016.

1.9.6.1 Transportation as-built data sheets

Quality forms and as-built data sheets for transportation are available on the Co-Lab website.

1.9.6.2 Landscape works (parks and facilities)

Quality forms and as-built data sheets are available on the Co-Lab website. Where construction or land development works involve landscaping to be owned/managed by Council an as-built plan of landscaping works must be provided to Council showing the following details:

a) Location and extent.

b) Types of materials.

c) Botanical and common name and location (measured position in the berm) of street trees.

d) Names, grades, number, planting density of traffic island planting, ongoing life of asset details and maintenance plans

1.9.6.3 Asset value

Council is legally required to maintain an asset valuation register for all infrastructure assets. The asset value is calculated as:

Equation 1: Asset value calculation

$$AssetValue = AssetDirectCost + \left(\sum IndirectCosts\ x\ \frac{AssetDirectCost}{\sum AssetDirectCosts}\right)$$

whereby:

a) Asset direct costs include materials and installation/construction costs.

b) Indirect costs include items such as professional fees for design and construction supervision, resource consents, insurance and traffic control.

Note: All values must be exclusive of GST.

1.9.6.4 Files

DXF files

DXF format files are to be supplied containing the points and line-work connecting the assets together in the following format:

i) File format: DXF release 2021 (AC1023).

ii) Project: Mount Eden Circuit 2000.

iii) All long sections must be provided as a PDF.

Separate files are required for the three asset groups and a fourth file is required for the property boundary and road information.

Table 9: DXF files

DXF FILE NAME	DXF FILE CONTENT
BD.dxf	Road centrelines, property and road boundary, vectors, lot numbers.
SW.dxf	Stormwater assets
WS.dxf	Water supply assets (main, valve, hydrant, water meter etc.)
WW.dxf	Wastewater assets (manhole, main, service line etc.)

The following must apply:

iv) Each pipe must be represented by a single continuous line i.e. the pipe centreline.

v) Feature location X, Y, Z coordinates are to match the requirements identified in the relevant section.

vi) Each pipe must run continuously between manholes and other junctions (and broken at manholes or junctions).

vii) Each .DXF file must only contain information (line work, point data and polygon) that is relevant to the construction work or project as reflected on the As-Built Plan.

viii) The pipe is not to be broken by service connections or laterals.

ix) All point assets such as manholes, valves, hydrants must be snapped to their associated pipe and vice versa.

x) Each pipe (including service connections) must be captured in the direction of flow, except in the case of watermains and ducts.

xi) Each DXF file must have only one asset type in it for each asset group, e.g. water or wastewater or stormwater, and separate layers should be used for each asset e.g. water pipe layer, water valve layer, stormwater manhole layer etc. Do not include property boundaries, road labels, text, tables etc.

xii) All symbology such as manholes should be 'exploded' prior to saving as a DXF file.

xiii) All stormwater management devices must be represented by a polygon outlining the device footprint, the treatment catchment and the hydrological catchment draining to the device.

b) ***SHP files***

SHP format files are to be supplied containing the points and line-work connecting assets together in the following format:

i) File format: ESRI SHP (with '.shp' suffix).

ii) Projection: Mount Eden Circuit 2000 or NZTM.

Separate files are required for the three asset groups and a fourth file is required for the property boundary and road information.

Table 10: SHP files

SHP FILE NAME	SHP FILE CONTENT
BD.shp	Road centrelines, property and road boundary, vectors, lot numbers.
SW.shp	Stormwater assets
WS.shp	Water supply assets (main, valve, hydrant, water meter etc.)
WW.shp	Wastewater assets (manhole, main, service line etc.)

The following must apply:

iii) Each pipe must be represented by a single continuous line i.e. the pipe centreline.

iv) Feature location X, Y, Z coordinates are to match the requirements identified in the relevant section.

v) Each pipe must run continuously between manholes and other junctions (and broken at manholes or junctions).

vi) The pipe is not to be broken by service connections or laterals.

vii) Each SHP file must only contain information (line work, point data and polygon) that is relevant to the construction work or project as reflected on the As-Built Plan.

viii) All point assets such as manholes, valves, hydrants must be snapped to their associated pipe and vice versa.

ix) Each pipe (including service connections) must be captured in the direction of flow, except in the case of watermains and ducts.

x) Each SHP file must have only one asset type in it for each asset group, e.g. water or wastewater or stormwater, and separate layers should be used for each asset e.g. water pipe layer, water valve layer, stormwater manhole layer etc.

xi) All stormwater management devices must be represented by a polygon outlining the device footprint, the treatment catchment and the hydrological catchment draining to the device.

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1.9.7 Submitting as-built data

As-built requirements for subdivisions must be sent as electronic files to the email address specified by Council and include in the subject heading: subdivision consent number, subdivision name and stage number (if applicable). In the case of Council contracts, send the data to the engineer as instructed in the contract documents.

1.9.8 Threshold matrix for as-built information

For small developments (up to 2 lots) the provision of separate as-built plans and attribute data for each service with SHP or DXF files are not justified. Therefore, the following matrix has been developed to guide when each type of data presentation is required. If the data presented is not clear, Council may still request additional information.

Table 10: Threshold matrix for as-built information

	DEVELOPMENT SIZE			
	SMALL (<2 LOTS)	**MEDIUM (3-10 LOTS)**	**LARGE (>10 LOTS)**	**CONTRACT**
Separate plan for each service	No	Yes	Yes	Yes, unless specified otherwise in contract documents
SHP or DXF files	Please supply if available	Yes	Yes	As above
Note: DXF files must identify individual reticulation assets, lines or points.				
Asset attribute spreadsheet files	No, include information on plans, no coordinates required	Yes	Yes	As above
Roading as-built data	Yes	Yes	Yes	As above
GST invoice on vesting	Yes	Yes	Yes	As above
PDF plan size	A3	A3	A3	A3

1.10. TRAFFIC AND PEDESTRIAN SAFETY

The developer must take all reasonable measures to protect the public from adverse effects of the work. Particular attention should be paid to the erection and maintenance of temporary fencing, especially in areas of potential ponding. Signs must be erected warning of danger within the site area. These protection measures must be shown in the accepted health and safety plan.

Where any work is in or affects any part of the carriageway, footpath, cycleway, walkway, vehicle access, service lane, carpark or other area that the public has the right of access to, the developer/contractor must maintain safe, readily negotiable passage across or around the work site for all types of traffic, including pedestrians, mobility scooters, and cyclists. Access to public and private property must be maintained at all times unless prior arrangements, acceptable to all parties, have been made.

1.11. CORRIDOR ACCESS REQUESTS

All excavation and trenching work carried out within the road corridor must be carried out in accordance with the National Code of Practice for Utilities Operators Access to the Transport Corridors (NCP-UOATC) and the NZTA's 'New Zealand guide to Temporary Traffic Management'. See https://www.nzta.govt.nz/assets/Roads-and-Rail/nzgttm/docs/New-Zealand-guide-to-temporary-traffic-management.pdf. Any works must have reference to trees and landscape planting.

Any person or business planning to dig up part of the road/berm as part of a project (including smaller projects such as installing a new driveway, laying water pipes or holding an event) must have an accepted corridor access request (CAR). If work is being carried out on private property or business property but needs to use some of the road reserve, refer to Council's website for the process and consider whether a CAR is required.

A CAR application can be made by going to beforeudig.co.nz or submitica.co.nz for excavations and utility installations or corridoraccess.co.nz for non-excavations and events. Applicants will need to register, fill in the application form including a sketch or plan of the location and works and click 'submit'. A traffic management plan (TMP) will also need to be submitted when applying for a CAR. This can be done at the same time as the application. To find out more about TMPs visit Council's website.

Fees are applicable for applications from utility operators for access to Council's transport corridor in accordance with the NCP-UOATC. The latest fees can be found on Council's website.

Where works are proposed that affect roads from an adjoining district council or a state highway, the developer/contractor must obtain additional acceptances from that authority.

1.11.1 Works access permits

The local conditions of Council apply to all work access permits issued with Council's boundaries in accordance with the NCP-UOATC. A copy of the local conditions can be found on Council's website.

1.12. REPAIR OF DAMAGE

The developer/contractor is solely responsible for all damage to both public and private property that may result from their operations and must satisfy Council that they have made proper reinstatement. Should no satisfactory efforts be made by the developer/contractor within 1 month Council may seek another contractor to carry out the reinstatement to the full requirements of Council. All costs resulting from the work will be charged or deducted from any monies due, or which may become due, to the developer/contractor.

1.13. TRAFFIC MANAGEMENT

1.13.1 Temporary traffic management

Temporary traffic management (TTM) must be established on every site where work is to be undertaken within the transportation corridor where a public road or footpath is affected either directly by the works or the contractor's access to or from a site.

1.13.2 Traffic management plans

A traffic management plan (TMP) must be prepared and implemented in accordance with the CoP-TTM. This plan must be prepared by a qualified Temporary Traffic Management Planner/ site management specialist and submitted to Council via beforeudig.co.nz or submitica.com for excavations or corridoraccess.co.nz and submitica.com for events for acceptance. A copy of the accepted TMP must be held onsite and be available for viewing.

TMPs for complex projects or those that cover an extended time period may need several layout plans for various stages of the work. Revised or additional TMPs should be submitted if there is a significant change in circumstances.

1.13.3 Generic TMPs

For work that is repetitive and has a minor effect on traffic, contractors are encouraged to submit generic TMPs for each typical work activity. Once accepted these plans may be implemented throughout the Council area (other than state highways). The STMS or traffic controller (TC) must ensure the TTM is appropriate for the site and make any adjustments to the generic TMP that are necessary. All generic TMPs are to be reviewed and submitted for re-acceptance at a maximum of 12 monthly intervals and at any other time a significant change is identified as necessary.

1.13.4 Site specific TMPs

For any site where either a reduction in the number of traffic lanes on arterial roads is proposed, a major intersection such as a roundabout or signals is involved, or there is no suitable generic TMP applicable a site specific TMP must be prepared and submitted for acceptance at least five (5) days for minor work, or 15 days for major works before work commences via beforeudig.co.nz or submitica.com

1.13.4.1 State highways

When the contractor is planning to carry out an activity within the state highway road reserve (boundary to boundary) an Acceptance to Work on the State Highway (ATWOSH) application and an accompanying TMP is required to be submitted for acceptance to the NZTA Network TMC.

1.13.4.2 Arterial roads

Apart from emergency works, no work that interferes with traffic flow on any arterial or collector roads is to be carried out during the peak traffic periods (see below) or during major public events without specific acceptance from Council's Road Corridor Manager

Table 11: Peak traffic periods

DAY	AM	PM
Monday to Friday	7.30 to 9.00	3.00 to 5.30

1.13.5 Temporary road closures

The developer/contractor for public works may apply for temporary closure of a road or part therefore in order to carry out the works.

The application must demonstrate that either the closure is essential to allow the works to be built or run safely or the closure will allow the works to be completed more efficiently, considering the direct construction costs, the costs of delays to road traffic and the costs of increased travel distance.

If permission for a temporary road closure is given, the contractor must prepare and submit for acceptance a TMP that includes:

a) A suitable detour around the closure.

b) Access for public having legitimate purpose or business in the affected area.

c) Access to public and private property unless arrangements suitable to all parties have been made.

d) Immediate access to any emergency services and provisions to curtail or cease work if necessary.

e) Suitable arrangements for the regular refuse and recycling collections, either by allowing the collection vehicles to access the site or taking the refuse and recyclables to one end of the job for collection. Any wheeled bins and recycling crates must be returned to the location they were collected from.

f) Alternative routes for public bus services affected 8 weeks prior notification including temporary bus stops.

g) Two (2) weeks advance notification to all affected parties including onsite signage (VMS) prior to the closure, letter to residents, public notices via the weekly road works reports and press/media releases.

The Road Corridor Manager will arrange further publicity for significant closures. Events will require 42 days public notification in accordance with the LGA.

1.13.6 School sites

Special attention is to be paid to works outside or adjacent to school or preschool institutions. Ideally such works will be undertaken outside school hours and no footpath closures will occur. No work must be undertaken on school days within 200 metres of a school between 30 minutes before or after the school bell in the mornings and afternoons. Consultation with the school should be undertaken to determine the start and finish times of the school as they vary.

Many schools have a 30/km/hr speed zone. TMPs for work within these areas must incorporate the speed restrictions as necessary. The variable speed limits are subject to the Land Transport Rule: Setting of Speed Limits.

Provision for the continued operation of any school patrols must also be considered in consultation with the school, and if necessary, provisions for alternative safe crossing facilities will need to be included within the TMP.

1.13.7 Bus routes

If a work site is on a regular bus route (including school buses) and is likely to disrupt bus operations the contractor must ensure the Regional Council and bus route operator(s) are advised of the works at least:

a) 72 hours prior to commencement for minor interruptions or

8 weeks prior to commencement for major interruptions that may require an alternative route or bus stops.

The contractor must cooperate with making any changes needed to minimise adverse impacts on the bus services.

1.13.8 Cyclists and pedestrians

The contractor must ensure that both pedestrians and cyclists have safe access past the site where required. In particular:

a) No TTM signs are to be placed in marked cycle lanes or block footpath access.

b) Provision must be made for pushchairs, mobility scooters etc. including kerb ramps if there is no suitable crossing.

c) Particular care must be taken near schools, preschools, and retirement villages.

d) The surface must be equivalent to the existing smoothness and passable in all weather conditions.

e) Diverting pedestrians across the road to the opposite footpath is NOT an acceptable solution (unless there is no reasonably practical alternative in which case measures to safeguard pedestrians crossing the road must be provided such as temporary traffic signals).

1.13.9 ‘Special’ parking areas

If ‘special’ parking areas such as marked bus stops, taxi stands, loading zones, mobility parks or metered parking bays are affected by the works these must be identified in the TMP and suitable alternative facilities provided if required by Council.

1.13.10 Audits

Council may carry out random audits of any site. In situations that involve traffic management, audits will be in accordance with CopTTM procedures and the results will be forwarded to the developer/contractor. Any site scored as ‘dangerous’ will be immediately closed until the necessary improvements have been made. As required by CopTTM a notice of non-conformance will be issued for a dangerous site. The onsite TC or STMS will be advised about any site scored as ‘needs improvement’. The improvements are required to be implemented by the next working day.

1.14. STANDARD SYMBOLS

See drawing Standard Symbols

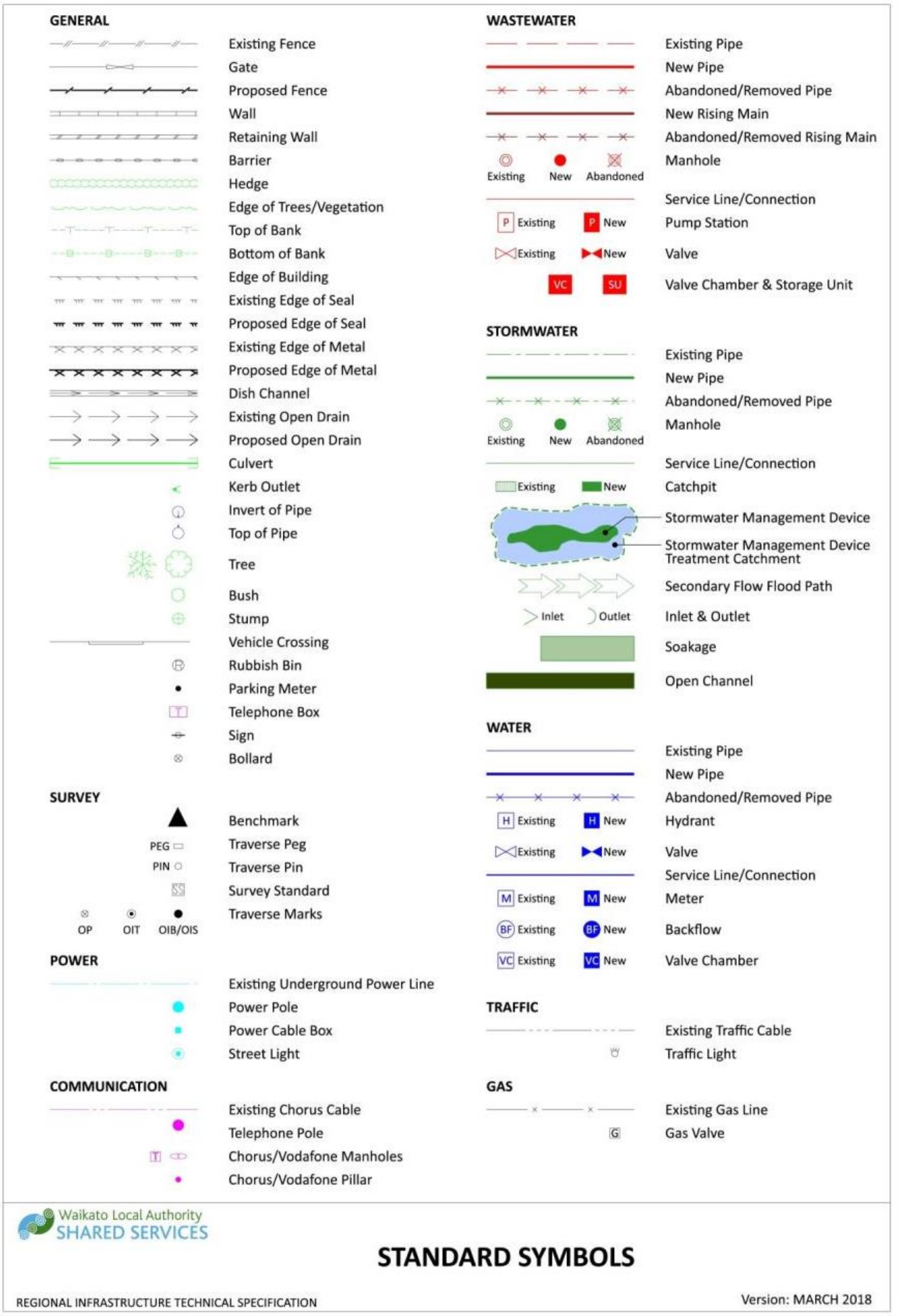

Figure 2: Standard symbols

1.15. EXAMPLE AS-BUILT DRAWINGS

These are available on the Co-Lab website using the links below.

CATEGORY	TITLE
Wastewater	Wastewater As Built Plan
Water Supply	Water Supply As Built Plan
Stormwater	
Stormwater	Wetland as-built plan
Stormwater	Wetland as-built long section plan

1.16. THREE WATERS ASSET ATTRIBUTES

These are available on the Co-Lab website using the links below. The Asset Attribute datasheets should be populated as formatted (do not modify the template).

CATEGORY	TITLE
Stormwater	Stormwater pipes
Stormwater	Stormwater management device
Stormwater	CCTV
Wastewater	Wastewater
Wastewater	CCTV
Wastewater	Plants
Water Supply	Water
Water Supply	Plants

1.17. LANDSCAPE (PARKS AND FACILITIES) ASSET DATA FORMS

These are available on the Co-Lab website using the links below. The Asset Attribute datasheets should be populated as formatted (do not modify the template).

CATEGORY	TITLE
Landscapes	New Assets
Landscapes	Assets Removed
Landscapes	As-built drawings

EARTHWORKS AND GEOTECHNICAL REQUIREMENTS

SECTION 2. EARTHWORKS AND GEOTECHNICAL REQUIREMENTS

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Appendix 1: Statement of Professional Opinion

2.1. INTRODUCTION

2.1.1 Scope

For consistency of approach, the earthworks and geotechnical requirements for any land development project conducted in accordance with the RITS, must also consider *Part 2: Earthworks and Geotechnical Requirements* of New Zealand Standard NZS 4404:2010[3] as well as the requirements given in this Section.

This Section follows the same overall format of NZS 4404:2010 and provides further specific requirements for land development projects to be completed in accordance with the RITS. Where there is any doubt or inferred conflict between the requirements of NZS 4404:2010 and additional requirements of this Section, the RITS must be used, unless written confirmation is provided by Council for a specific land development project.

The geotechnical professional[4] involved in assessing the earthworks and geotechnical requirements for a land development project in accordance with the RITS, must also be familiar with NZS 4404:2010.

Objectives

The main objectives of this Section are three-fold:

a) Ensure that earthworks requirements and geotechnical assessments submitted in support of consent applications are completed by geotechnical professionals and meet the minimum requirements for demonstrating the suitability of the site for the proposed development at the appropriate stage, i.e., land-use change, resource consent and building consent.

b) Assist Council to fulfil their obligations as set out in national legislation, regional policies/plans and district plans, to confirm earthworks requirements and geotechnical assessments have been completed by geotechnical professionals appropriate to the complexity of the site and scope of the proposed land development project.

c) Ensure the earthworks and geotechnical requirements of all land development projects are constructed and certified by geotechnical professionals in accordance with relevant standards and consent requirements.

To meet the above objectives, all but the simplest of land development projects will benefit from the early and continued involvement of geotechnical professionals.

2.1.2 Referenced Documents

Earthworks and geotechnical engineering encompass a wide range of issues that may need to be considered for any land development project. This includes several specialist areas for which national and international best practice guidelines have been published. Geotechnical professionals advising on land development projects are expected to be familiar with, and skilled in applying, the best practice guidelines.

Following the Canterbury Earthquakes of 2010-2011, and the wider realisation that land and buildings can be severely affected by earthquakes, the New Zealand Geotechnical Society (NZGS), in cooperation with the Ministry of Business, Innovation & Employment (MBIE) and other organisations, have produced a set of Earthquake Geotechnical Engineering Modules. These are aimed at assisting geotechnical professionals to

[3] New Zealand Standard NZS 4404 (incorporating Amendment No.1). Land Development and Subdivision Infrastructure. 2010.
[4] ***Geotechnical Professional*** is defined in NZS 4404:2010 as "A chartered professional engineer (CPEng) or an engineering geologist with recognised qualifications and experience in geotechnical engineering, and experience related to land development".

identify ground hazards resulting from earthquakes and provide appropriate mitigation approaches to improve the resilience of buildings and infrastructure.

These guidance documents represent state-of-the-practice for geotechnical design in New Zealand and geotechnical professionals preparing earthworks requirements and geotechnical assessments in accordance with the RITS and users are expected to have a working knowledge of these documents and capability of applying the recommended approaches and procedures.

The latest version of the best practice guidelines listed below are deemed to form part of the RITS and should be followed, where appropriate. Further references relating to specific earthworks and geotechnical hazards are included where applicable.

- Earthquake Geotechnical Engineering Module 1 – Overview of the guidelines.
- Earthquake Geotechnical Engineering Module 2 – Geotechnical investigations for earthquake engineering.
- Earthquake Geotechnical Engineering Module 3 – Liquefaction hazards.
- Earthquake Geotechnical Engineering Module 4 – Earthquake resistant foundation design.
- Earthquake Geotechnical Engineering Module 5 – Ground improvement of soils prone to liquefaction.
- Earthquake Geotechnical Engineering Module 5a – Specification for ground improvement.
- Earthquake Geotechnical Engineering Module 6 – Earthquake resistant retaining wall design.

Where any part of the RITS is deemed to contradict or otherwise be in conflict with the best practice guidelines, then the RITS must be followed.

If the geotechnical professional considers the best practice guidelines are not appropriate in a particular situation, for instance, due to the unique properties of the soil at a specific site, the geotechnical professional must outline the reasons for departing from the best practice guidelines and detail the alternative approach adopted. Any departures from the best practice guidelines are expected to be supported by an equally rigorous and verifiable assessment procedure(s).

It will often be beneficial to present the results of an assessment using both the best practice guidelines and alternative approaches and detail the reasons and potential significance of the differing outcomes.

Several standards and other guidance documents relevant to earthworks and geotechnical assessments are included in Section 5. This is not intended to be an exhaustive list of all relevant standards and guidelines routinely utilised by geotechnical professionals but provides an indication of the importance that is placed on following best practice.

2.1.3 Relevant Legislation, Regulations and Standards

In assessing consent applications for land development projects, Regional Councils, Territorial Authorities and Building Consents Authorities must comply with the following:

- Resource Management Act (RMA, 1991).
- Waikato Regional Policy Statement: Te Tauaki Kaupapahere Te-Rohe O Waikato.
- Waikato Regional Plan.
- Bay of Plenty Regional Policy Statement: Nga Tikanga Whakahaere Nga Rawa O Te Taiao.
- Bay of Plenty Regional Plan.
- Bay of Plenty Regional Natural Resource Plan.
- District Plans.
- Building Act 2004.

- Building Regulations 1992.
- Building Code and associated Compliance Documents.
- National Standards.

Geotechnical professionals preparing earthworks requirements and geotechnical assessments for land development projects are expected to be familiar with, and comply with, all relevant legislation, regulations, and standards. Compliance with these requirements should be demonstrated in the reporting of earthworks requirements and geotechnical assessments.

2.2. GEOTECHNICAL SITE EVALUATION AND REPORTING

2.2.1 Preliminary Site Evaluation

At commencement of any land development project, applicants are encouraged to discuss the proposal with the relevant council / authority to help identify at an early stage the potential level of complexity of the project with respect to earthworks and geotechnical requirements (Section 2.2). This will help establish an appropriate level of geotechnical investigation, assessment, and reporting by geotechnical professionals as part of the preliminary site evaluation and subsequent assessment phases. This process will also help identify where the early involvement of an independent peer reviewer is deemed appropriate for larger developments and/or complex sites.

To assist understanding the potential complexity of the proposed land development project, it is important that comprehensive and up to date topographical information is obtained for the site. This should be provided along with preliminary plans with an indicative proposed final landform, including site infrastructure, and building lots, cut and fill areas and any requirement for retaining structures (walls and/or reinforced slopes), and any on-site disposal of stormwater or effluent wastewater. This will be preliminary information only but will assist the geotechnical professional develop the scope of the geotechnical assessment appropriate to the level of perceived complexity. The final development should take account of the geotechnical conditions identified to minimise the potential impact of any natural hazards present (see Section 2.8).

2.2.2 Level of Complexity

To assist the applicant, their technical advisors and consenting authorities, the level of complexity of the proposed development with respect to the geotechnical conditions should be assessed at the beginning of a land development project. This will help applicants; their technical advisors and consenting authorities understand the required level of geotechnical input required on the project and ensure the overall approach and design is undertaken in full knowledge of the geotechnical constraints identified.

As the project advances, and further information becomes available, the level of complexity should be reviewed and updated, as necessary. If the level of complexity increases, as a result of identification of challenging geotechnical conditions and/or changes to the proposed development scope, it should be recognised that the experience and qualifications of the geotechnical professional, along with the scope of investigations, assessment and reporting, will need to respond to that change.

Table 13 provides a preliminary basis for assessing the Level of Complexity at the beginning of a land development project. This is expected to be determined by the applicant and their technical advisors in consultation with the consenting authorities. The metrics presented in Table 13 are not intended to be applied rigorously but provide an indication of which level a land development project may fall.

Table 13 : Levels of Geotechnical Complexity

Level of Complexity	Nature of land development project	Proposed Earthworks / Retention	Potential Ground Hazards Present
Level 1 Low	Small-scale residential subdivision (1 to 3 Lots) or commercial / industrial development (<2,000m^2 land area). Typically, on flat to gently sloping sites (<10°). Residential construction in accordance with NZS 3604 / NZS 4229 permitting standard foundations. Importance Level 1 and 2 buildings.[5] Sites complying with 'Good Ground' in accordance with NZBC Clause B1. Deep groundwater level (>4m below existing or proposed ground level). No history of geotechnical issues in the surrounding area.	Minimal earthworks or retention required (<0.6m cut or fill, retaining walls less than 1.5m high with no surcharge loading). No ground improvement works required.	No more than one potential ground hazard present (as listed in Table 2.3, or other identified by the geotechnical professional).
Level 2 Medium	Medium-scale residential subdivision (≤30 Lots) or commercial / industrial development (<10,000m^2 land area). Typically, on flat to moderately steeply sloping sites (<26°). Residential construction in accordance with NZS 3604 / NZS 4429, permitting standard foundations or Specific Engineering Design of Foundations and/or ground improvement. Importance Level 1 to 3 buildings.[1] Any infrastructure serving an Importance Level 3 or 4 facility. Sites generally not complying with 'Good Ground' in accordance with NZBC Clause B1. Shallow groundwater table (<4m below existing or proposed ground level). Located on or immediately adjacent to a known active geothermal area or including historic geothermal bores. History of geotechnical issues in the surrounding area.	Moderate level of earthworks and/or retention required (<3.0m cut or <1.5m fill, cantilever or gravity retaining walls less than 3.0m high with or without surcharge loading). Basic ground improvements (non-specialist techniques) utilising standard published specifications.	No more than three potential ground hazards present (as listed in Table 15, or other identified by the geotechnical professional); or more than one of the following: - excessive ground settlements - slope stability (static and seismic) - active geothermal conditions - expansive soils - potential for liquefaction-induced lateral spreading - seismicity – ground rupture / faults* (see table notes) - presence of limited (site coverage / depth) existing uncontrolled fill[6]
Level 3 High	Large-scale residential subdivision (>30 Lots) or commercial / industrial	Significant earthworks and/or retention required (>3.0m cut or	More than three potential ground hazards present (as listed in Table 2.3, or other

[5] Importance Levels in accordance with NZS 1170.0.
[6] Fault Avoidance Zone (FAZ) present on the site, but no development proposed within the FAZ.

Level of Complexity	Nature of land development project	Proposed Earthworks / Retention	Potential Ground Hazards Present
	development (>10,000m^2 land area). Typically, on flat to steeply sloping sites (>26°). Residential construction in accordance with NZS 3604 / NZS 4429, permitting standard foundations or Specific Engineering Design of Foundations (SED) and/or ground improvement. Importance Level 1 to 4 buildings.[1] History of geotechnical issues in the surrounding area. Any infrastructure servicing an Importance Level 4 facility. Contains a Fault Avoidance Zone or within 200m of a mapped known active fault (see table notes). Sites generally not complying with 'Good Ground' in accordance with NZBC Clause B1. Very shallow groundwater table (<1m below existing or proposed cleared ground level). History of geotechnical issues in the surrounding area.	>1.5m fill, retaining walls greater than 3.0m with or without surcharge loading, anchored walls or slopes). Ground improvements requiring specialist techniques.	identified by the geotechnical professional); or any one of the following: - liquefaction-induced lateral spreading - seismicity – ground rupture / faults** (see table notes)[7] - presence of extensive (site coverage / depth) existing uncontrolled fill[#8]

The geotechnical professional must self-certify as to their relevant experience and competence to undertake the geotechnical assessment, noting the specific geotechnical hazards and agreed Level of Complexity. This must be confirmed on the Statement of Professional Opinion on the Suitability of Land for Subdivision (Form 1A) and Statement of Professional Opinion on the Suitability of Land for Building Construction (Form 1B).

2.2.3 Geotechnical Professional and Independent Peer Review

The experience and qualifications of the geotechnical professional undertaking the assessment must be commensurate to the level of complexity involved. Table 14 provides an indication of the anticipated experience and qualifications of the geotechnical professionals undertaking the assessment and review, for different Levels of Complexity.

Table 14: Minimum levels of experience and qualifications for geotechnical professionals.

Level of Complexity	Qualifications of practising geotechnical professional	Relevant experience in Geotechnical Engineering (years)[9]	Requirement for Independent Peer Review[4]
1 - Low	Prepared by geotechnical engineer or engineering geologist[2]	>1	Not required
	Reviewed by Chartered Geotechnical Engineer or Chartered Engineering Geologist[3]	>6	

[7] Fault Avoidance Zone (FAZ) present on the site, development proposed within the FAZ.
[8] Where the uncontrolled fill is not to be completely removed from site as part of the development proposals.
[9] Where special soils or geotechnical hazards are present at the site, the geotechnical professionals should have experience of working in similar soils and geotechnical hazards.

Level of Complexity	Qualifications of practising geotechnical professional	Relevant experience in Geotechnical Engineering (years)[9]	Requirement for Independent Peer Review[4]
2 - Medium	Prepared by geotechnical engineer or engineering geologist[10] Reviewed by Chartered Geotechnical Engineer or Chartered Engineering Geologist[11]	>2 >6	Possible, depending on number and severity of potential ground hazards present. To be agreed with consenting authority. Likely to be required for IL3/IL4 Buildings[4]
3 - High	Prepared by geotechnical engineer or engineering geologist[10] Reviewed by Chartered Geotechnical Engineer or Chartered Engineering Geologist[11]	>3 >10	Likely to required, depending upon the experience of the originating geotechnical professional.[12]

Depending upon the assessed level of complexity and experience of the geotechnical professional undertaking the assessment, a technical review may be required by Council. Reviews will be undertaken by one of a panel of geotechnical professionals identified by Council.

For sites with a high level of complexity, it is assumed that an independent peer reviewer will be engaged early in the process to ensure the geotechnical investigation, assessment and reporting are completed in an efficient manner by obtaining general agreement between the geotechnical professional and independent peer reviewer throughout all stages of the project.

Where an independent peer reviewer has been engaged and evidence is provided confirming the findings of that review agree with the geotechnical professional completing the assessment, a separate technical review by the consenting authority may not be required. This will, however, depend on the scope of the independent peer review completed.

2.2.4 Geotechnical Considerations

Each site will have specific geotechnical considerations, dependent upon both the nature of the ground conditions and the size and complexity of the proposed development.

To assist applicants, their technical advisers and consenting authorities understand the typical range of geotechnical issues that may affect a particular land development project, Table 15 lists the principal common geotechnical hazards present within the region. This is not an exhaustive list but is intended to provide assurance to applicants and consenting authorities that the primary geotechnical issues have been considered in the assessment.

Table 15: Potential Geotechnical Hazards.

Potential Geotechnical Hazards	
1.	Weak foundation soils (risk of local bearing failure and/or excessive settlement)
2.	Excessive ground settlements (loading of high compressibility soils)

[10] Geotechnical field technicians can be expected to provide reporting of factual results, but interpretation of the data should be undertaken by a geotechnical engineer or engineering geologist.
[11] Chartered Geotechnical Engineer or Chartered Engineering Geologist may include CPEng (Geotechnical) or PEngGeol through Engineering New Zealand or equivalent.
[12] Evidence of the scope of the independent peer review engagement and final report must be provided to the Territorial Authority. Where a Producer Statement – PS1 – Design is required, the independent peer reviewer must provide a Producer Statement - PS2 - Review covering the same. The independent peer reviewer must have equivalent or greater competence than the originating geotechnical professional. Evidence to this affect must be provided to the Territorial Authority, if requested.

Potential Geotechnical Hazards	
3.	Shallow groundwater table (<4m below existing or proposed ground level)
4.	Retaining structures and surcharge (existing and proposed)
5.	Slope stability (static and seismic conditions), including debris runout
6.	Rockfalls
7.	Presence of existing non-engineered fill
8.	Existing and/or proposed engineered fill
9.	Existing and/or proposed cuts / ground lowering
10.	Existing and/or proposed stabilised slopes (MSE, soil nails etc.)
11.	Land erosion (coastlines, river/stream banks, lakeshore)
12.	Internal erosion (groundwater movement through erodible soils)
13.	Surface erosion (exposed erodible soils, particularly during construction)
14.	Geothermal hazards (gas emissions, eruptions, abandoned bores, subsidence due to depressurisation of a geothermal aquifer, corrosive soils)
15.	Expansive soils
16.	Collapsible soils
17.	Seismicity – ground rupture / faults
18.	Seismicity – liquefaction and lateral spreading
19.	Seismicity – cyclic softening of ‘clay-like’ soils
20.	Seismicity – tectonic subsidence
21.	Inundation (surface and/or groundwater flooding)
22.	Ground contamination (soil and groundwater)
23.	Ground soakage for stormwater disposal
24.	On-site effluent disposal
25.	Tsunami / seiches
26.	Volcanic eruptions
27.	Subsidence
28.	Active or former mining (including quarries)
28.	Others (please specify)

Some of the hazards listed are not geotechnical in origin, but their potential impact on the geotechnical requirements of a land development project should be included as part of the geotechnical assessment. Common examples include, but are not limited to:

- modelled surface water flooding resulting in a minimum finished floor level (FFL) set higher than that required under Clause E1 – Surface Water Flooding resulting in the need for additional fill placement, which may impact static or liquefaction-induced ground deformations.
- assessments completed in accordance with National Environmental Standards (NES) identifies site contamination that requires some form of treatment / mitigation measures.

Any geotechnical works proposed should consider the potential impacts on adjacent property and structures. Common examples include, but are not limited to:

- placement of fill that could lead to ground settlement or displacement on adjacent properties.

- temporary excavations or permanent ground lowering leading to ground deformations on adjacent properties and/or structures.
- impact of temporary and/or permanent works on groundwater regimes extending beyond the immediate site.
- earthworks, stabilised slopes and retaining structures that could lead to a reduction in the stability of adjacent land.

Several local and regional councils hold spatial natural hazard information, typically available as layers on GIS web-based mapping sites. Whilst these should be referenced and given due consideration by the geotechnical professional, the high-level data are primarily intended for strategic-level planning purposes and should not be relied upon for site-specific geotechnical assessments.

Where a hazard listed in Table 15 is assessed not to be relevant at a particular site, for the avoidance of doubt, a brief comment confirming the basis for that assessment should be provided in the geotechnical assessment. This will allow the applicant and consenting authority to quickly focus on the site-specific hazards. It is suggested that a table similar to Table 15 is provided at the front-end of any geotechnical assessment, confirming which hazards are not considered further and why, and where in the report (relevant section) further information regarding each assessed hazard can be found. Any additional site-specific hazards not included on Table 2.3 should be included in this summary.

An important component of the geotechnical assessment will be to identify which of the hazards listed in Table 15 (or others) are pertinent to the site being investigated and move quickly to focus on those assessed site-specific hazards.

The summary of geotechnical hazards deemed to be absent / present from a specific site may be collated by Councils to form a database which, in time, may be used to develop and/or update existing hazard mapping across the region.

The level of assessment and proposed treatment of each hazard identified should be commensurate to the stage of the development. Geotechnical assessments completed in support of a Resource Consent should focus primarily on matters relating to Section 106 of the RMA 1991; whereas Building Consent applications will need to satisfy relevant clauses of the Building Act, Code and Regulations.

It should be clear from the geotechnical assessment which aspects are covered and those that are to be further addressed in subsequent assessments. For instance, identification of the liquefaction and lateral spreading hazard would generally be provided at Resource Consent stage, along with confirmation that the consequences of the hazard can be appropriately managed. Where mitigation measures are to be employed as part of the site development, such as area-wide ground improvement works for site infrastructure[13] and/or individual lots, these should be included as part of the assessment supporting the Resource Consent application and detailed on the accompanying engineering plans and specifications. Where the hazard is to be further addressed at the Building Consent stage, i.e., for an individual building, the requirement for further investigation, assessment and mitigation should be identified at Resource Consent application stage and included in the Geotechnical Completion Report (GCR). Potential mitigation measures may be provided as part of the assessment completed for Resource Consent, but these will typically need to be confirmed or modified at the Building Consent stage once final details of the building or structure are known.

Where the extent of a geotechnical hazard can be further refined between phases of a land development project, i.e., through monitoring of groundwater levels for liquefaction assessments, these should ideally be established as part of the assessment undertaken at the time of the Resource Consent, reviewed and updated in the Geotechnical Completion Report (GCR), and where possible, continued to aid assessments required for Building Consents.

[13] This will be required where site infrastructure, such as roads, reserves and services (to be vested in Council), as well as electricity transformers, gas regulators, telecommunications and similar structures.

2.2.5 Geotechnical Assessment

The purpose and scope of the geotechnical assessment should be appropriate to the stage of the proposed development, i.e., land-use plan change, resource consent, building consent, and the assessed level of complexity. Any identified natural hazards or other significant geotechnical considerations should be dealt with at the phase of the development that is best able to manage the hazard efficiently and effectively.

Where geotechnical assessments of limited scope are prepared, such as for an assessment of bearing capacity for a proposed house or suitability for on-site soakage or effluent disposal, these should reference previous geotechnical assessment reports covering all geotechnical hazards, and that the findings of that previous assessment have been considered.

Many of the natural hazards and other geotechnical considerations listed in Table 2.3 can be more efficiently investigated, assessed and any required mitigation works designed and specified at the Resource Consent stage, and implemented during the subdivision development and recorded in the GCR. This will typically be more effective and economic than relying on such works being implemented in a piecemeal fashion on individual lots at the Building Consent stage.

For instance, early identification of the presence and extent of soft, highly compressible soils at a site where filling is required to achieve a minimum finished floor level for surface flooding or drainage purposes, can be more comprehensively managed during subdivision development, including both the site infrastructure, and building lots, rather than on a lot-by-lot basis at Building Consent stage. Liquefaction and lateral spreading hazards may be best dealt with at the resource consent stage, as there are considerable economies of scale in completing the investigations, assessment, design and implementation of mitigation measures to protect site infrastructure and future buildings.

All land development projects will require an assessment of the potential for site contamination. This will typically include undertaking a review in accordance with the MfE NESCS14 (issued under Section 43 of the RMA 1991). This assessment requires specialist skills and assessment procedures that are distinct from those routinely applied for geotechnical assessments.

It is generally preferable to undertake the NESCS in advance of, or concurrent with the geotechnical assessment as the findings of the contamination study may dictate how the geotechnical investigation and assessment proceeds. Where this is not possible, the assessments should be run concurrently but with the desk-top phase and site inspection phase preceding any fieldwork to identify potential hazards to the intrusive investigations.

Where the findings of a preliminary site investigation (PSI) reveal the potential for site contamination, it is critical that the geotechnical professional works closely with the project contamination specialist. This should include planning of the geotechnical investigation (alongside any required detailed site investigation for contamination), through concept and detailed design and construction, to ensure consistency of the approach taking account of soil contamination issues alongside geotechnical considerations.

2.2.6 Geotechnical Investigations

The scope of geotechnical investigations must be sufficient to address the typical range of geotechnical considerations presented in Table 2.3 and be proportionate to the stage and scale of the land development project.

[14] Ministry for the Environment. Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

Strict guidelines on the minimum number, depth and type of site-specific investigations used in the assessment are not appropriate, but where minimum requirements are specified in other documents, such as NZS 3604:2011 for the assessment of 'Good Ground' for individual house assessments, these must be complied with strictly at the appropriate stage.

Module 2 of the earthquake geotechnical engineering practice guidelines prepared by MBIE / NZGS[15], provide recommendations regarding the depth, spacing and types of investigations that are appropriate at different stages of a land development project, particularly for liquefaction assessments. Since the BOP / Waikato region is affected by active seismicity, compliance with this guidance is required.

Whilst the guidelines were developed as a reference guide for earthquake geotechnical engineering in response to the Canterbury Earthquakes and subsequent recommendations of the Canterbury Earthquakes Royal Commission, the depth, spacing and techniques also represent good practice for general (non-earthquake related) geotechnical investigations.

Further guidance on the scope and value of comprehensive geotechnical investigations are provided in the MBIE Practice Advisory 17[16].

Investigation techniques should be appropriate to the soils and rocks encountered. For instance, if the geotechnical professional considers that penetration testing of pumiceous soils may not be reliable, alternative investigation methods should be used. It is not appropriate for penetration tests to be the primary investigation technique adopted by the geotechnical professional and the efficacy of the results subsequently dismissed as unreliable or overly conservative.

The depth and location of investigations must take account of the proposed development, including earthworks and final landform. For instance, shallow investigations in areas of significant cut or fill operations will provide little information required for geotechnical assessment and future design. Investigations should be undertaken in areas where significant cut / fill earthworks are proposed, noting that these may often form the least accessible areas of a site.

Groundwater is a critical factor for many geotechnical considerations. Geotechnical investigations and subsequent monitoring should identify groundwater levels at the time of investigation and highlight any potential seasonal or longer-term variability and associated consequences. Groundwater levels and pressures should be related to the proposed landform as well as the existing conditions.

It should be noted that many investigation types will not accurately identify the local groundwater conditions and should not be relied upon (such as hand augers in low permeability materials, where significant groundwater ingress may not occur during the short period that the investigation hole remains open). Deployment of open standpipes or piezometers (as appropriate) within bored holes and/or dissipation tests completed during cone penetration tests (CPTs) are encouraged[17]. Where there is a potential for perched or multiple groundwater levels, these should be identified and monitored. As noted above, groundwater levels / pressures should continue to be monitored following site investigations through to site development to confirm assumptions made regarding groundwater conditions where these are critical to the geotechnical assessment / design.

It is assumed that any geotechnical assessment will consider any readily available existing geotechnical investigation data available close to the site. This may include previous reports for the site or adjacent

[15] Earthquake Geotechnical Engineering Module 2 – Geotechnical investigations for earthquake engineering. 07 November 2016.

[16] Ministry of Business, Innovation and Employment. Practice Advisory 17: Well-planned ground investigations can save costs. ISBN: 978-0-947497-63-7.

[17] The additional time and cost of completing dissipation tests within permeable layers during CPTs to establish equilibrium pore water pressures is minimal and provides significant improvements to the data interpretation and subsequent analysis.

properties available from local councils, the New Zealand Geotechnical Database (NZGD) and regional scale studies / assessments (such as regional groundwater levels, landslide or liquefaction susceptibility mapping).

Operators completing field investigations and geotechnical professionals interpreting the results should be aware of the testing procedures and be competent in interpreting the results and limitations of the differing techniques.

Investigation techniques must be completed in accordance with good practice, including requirements of regional and district plans, with reference to drilling in geothermal areas, potentially contaminated ground and/or where intercepting groundwater aquifers. See for instance Section 3.8 of the Waikato Regional Plan and Chapter 6 of the Bay of Plenty Regional Natural Resources Plan.
Geotechnical professionals and investigation contractors are encouraged to use the New Zealand Ground Investigation Specification[18] to raise the quality and consistency of geotechnical investigations completed.

Geotechnical investigation techniques appropriate to some of the special soil types present within the Waikato region are detailed in the relevant sub-clauses in Clause 3.

Investigations should be logged in accordance with NZGS (2005).

2.2.7 Reporting

There are several different types of geotechnical report, which serve different purposes at varying stages of a project. These include geotechnical desk-study reports, geotechnical factual reports (sometimes referred to as geotechnical investigation reports), geotechnical assessment reports (or geotechnical design reports) and geotechnical completion reports. The title of the report is less important, although consistent terminology is to be encouraged, but it is crucial that the scope and purpose of the report are clearly stated.

Both factual information, obtained as part of the geotechnical desk-study and ground investigation (including any laboratory testing and monitoring results), and the interpretation of that information with respect to the geotechnical considerations, must be provided for any stage of the proposed land development project. This information may be presented in separate reports or combined into a single geotechnical assessment report. Where separate reports are prepared, the desk-study and factual reports should be included in the appendices to the geotechnical assessment report. The final geotechnical assessment report should then be included in the appendices to the geotechnical completion report.

Where separate reports are prepared relating to specific hazards, such as rockfall, fault rupture, or geothermal, these should also be included in the geotechnical assessment report appendices. Where the findings of an NESCS assessment impact the geotechnical assessment, this should also be referenced and may be included in the appendices.

Geotechnical reports should include all relevant information obtained as part of the geotechnical assessment. Sufficient factual and interpretative information must be presented to demonstrate how conclusions and recommendations of the geotechnical assessment have been arrived at.

Where more than one report is prepared, for instance, at different stages of the land development project, the contents and conclusions of previous reports must be referenced and confirmed or updated, as necessary.

Reports should be presented in a clear, logical and concise format. The report text should be kept as brief as possible, with all relevant factual data and detailed technical information and analysis provided in an appendix.

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[18] New Zealand Geotechnical Society. New Zealand Ground Investigation Specification. 28 April 2017.

Whilst the volume of material included will vary, depending upon the complexity of the site, size and stage of the proposed development, the following are likely to be required for all geotechnical assessment reports:

- Executive summary (primarily for larger or more complex sites).
- Scope and purpose of the report (relevant stage of the development).
- Site location and description (including history of the site, topography, drainage features).
- Proposed development (including any staged approach).
- Sources of information (including published information and other site-specific reports).
- Regional geological and geomorphological setting.
- Geotechnical investigations (including previous investigation on or surrounding the site and the site-specific field and laboratory testing).
- Ground and groundwater conditions encountered and interpreted material properties.
- Three-dimensional conceptual ground model, including groundwater conditions, illustrated using annotated geological sections.
- Geotechnical engineering considerations: i.e., identification and discussion of relevant hazards from Table 14 (or others identified).
- Recommendations: i.e., options for managing geotechnical hazards identified, further investigations and assessments required during subsequent stages of the development.
- Summary and conclusions.
- Applicability.

Where additional or ongoing monitoring data is collected, for instance regarding groundwater levels at a site, this should be included as addenda to the report.

Material parameters for soil and/or rock should be based on a combination of detailed engineering descriptions, in-situ and laboratory testing, and where applicable, experience in similar local soils. Where limited or no appropriate in-situ or laboratory testing has been completed, specific examples of similar local soils must be provided when the design references experience in similar materials. It is not sufficient to simply state ‘based on past-experience’.

2.2.8 Proposed Development

Any earthworks and geotechnical assessment completed for a land development project must confirm the scope of the proposed development for which the assessment has been completed.

This should include the extent of the proposed development area, any planned or likely earthworks required (cuts, fills, retaining walls), the location of proposed building platforms, roading and other infrastructure (buried and overhead services, stormwater retention ponds etc.), and any likely temporary works required.

It is important this information is included within the geotechnical assessment report and drawings to demonstrate these have been appropriately considered as part of the review. This will help ensure that any subsequent changes to the proposed development can readily be identified and the applicability of the earthworks and geotechnical assessment confirmed, or additional evaluation completed, as necessary.

Generally speaking, land development projects should take account of the geotechnical conditions, as well as other landform features, when determining the overall layout and utilisation of the site. Early identification of geotechnical constraints should inform the overall development proposals to minimise risks and mitigate natural hazards, for instance, by avoiding construction of sensitive structures and/or infrastructure in areas underlain by poor ground conditions.

The extent of earthworks proposed for a development can significantly impact on the scope of the geotechnical investigation and assessment completed (see Clause 2.2.6), including the level of complexity and professional input required.

2.3. DESIGN

2.3.1 Design factors

Clause 2.3 of NZS 4404:2010 highlights several design factors that are to be considered, including low impact design, drainage and choice of landform. These are consistent with the overall requirements of NZS 4404:2010 and should be followed.

2.3.2 Groundwater and pore water pressures

The presence and movement of groundwater typically plays a critical role in the overall performance of the ground and any structures constructed on or within the ground. Particular attention must be given to establishing the presence and movement of groundwater and associated pore water pressures at a site, including potential variations in the short- to long-term, and any perched water tables. This is particularly important where geotechnical considerations that are critically affected by the assumed groundwater conditions are identified as being present at a site, such as for slope stability assessments, or the presence of liquefiable, highly compressible and/or expansive soils.

An understanding of the potential groundwater regime should be assessed in relation to the surrounding topography and hydrological features, i.e., rivers, streams (surface and subterranean), lakes and sea levels. Reference to groundwater conditions encountered on adjacent sites with similar ground conditions may assist in this evaluation but should not form the only information relied upon.

Intrusive investigations and subsequent monitoring should be completed to identify equilibrium conditions. Installation of standpipes or standpipe piezometers at the time of geotechnical investigations is recommended, with ongoing monitoring of groundwater levels completed up until and during construction. Where assumed ground water levels and pressures are critical to geotechnical considerations identified at a site, monitoring should ideally continue to assist geotechnical assessments required for Building Consent applications.

The absence or level of free-standing water in an investigation hole that remains open for a short period cannot be relied upon to confirm the equilibrium groundwater conditions.

It may be appropriate to consider more than one groundwater level depending on the situation being assessed and sensitivity analyses should be completed.

The basis for the assumed groundwater conditions at a site should be clearly stated. Where a detailed understanding of the groundwater conditions and potential future variability has not been confidently established, sensitivity assessments should be completed, and moderately conservative groundwater levels (minimum and maximum) adopted.

Where on-site soakage for disposal of stormwater is proposed (or not restricted), the potential impacts of this on groundwater levels and pressures, and potential for groundwater mounding[19], must be included in the

[19] Groundwater mounding can occur close to stormwater management structures designed to infiltrate stormwater runoff. Concentrating recharge in a localised area may lead to groundwater mounding with the potential to affect foundations and/or amenity of garden areas.

assessment. Where the use of on-site soakage and/or effluent disposal fields is not considered appropriate due to slope stability considerations, this must be clearly stated in the report.

Some councils include minimum requirements in relation to the depth of the water table relative to the building platform level, i.e., Rotorua Lakes Council requires that for habitable buildings the building platform level is to be a minimum of 1.0m higher than the mean annual groundwater level. Mitigation measures, such as subsoil drains, may be necessary to ensure compliance with these rules, and should be identified during the initial geotechnical assessment and preferably included as part of the subdivision development (rather than on a lot-by-lot basis).

2.3.3 Stability assessments

When undertaking a land development project on sloping sites, or sites located adjacent to active water courses where erosion could lead to instability, the geotechnical assessment must include a detailed slope stability review.

The assessment should include all phases of the land development project and future use of the site, including under existing conditions (as a baseline), temporary works during construction phases, static and during earthquakes. For long-term static conditions, an average or normal groundwater level should be considered in addition to extreme groundwater levels and seepage as may be expected as a result of persistent and/or heavy rainfall (storms).

Different factors of safety (FoS) are typically applied to stability assessments to indicate an acceptable level of risk. Suggested FoS for use in differing design scenarios are provided in Table 3.1. These do not need to be followed rigorously but are considered appropriate where a comprehensive geotechnical investigation has been completed, permitting a detailed conceptual ground model to be developed, including good definition of the soil and rock layering, material properties and the groundwater regime. This would typically require a number of deep investigation holes including in-situ testing, monitoring of groundwater conditions and laboratory testing of good quality samples.

Use of the FoS presented in Table 16 would then be appropriate when assessed using detailed limit equilibrium or finite element analysis, usually analysed using commercially available slope stability software packages such as developed and licensed by GEO-SLOPE International Ltd, Rocscience Inc. or Plaxis. Many geotechnical professionals are proficient in the use of such programs, allowing for ease of validation if required as part of a technical review. Other commercially available packages or in-house software may be equally applicable but may require greater validation effort.

Sensitivity analysis, varying critical input parameters such as material properties, groundwater conditions and soil layering, will provide further assurance of the suitability of the adopted FoS.

Where FoS lower than those proposed in Table 16 are to be adopted, the geotechnical professional must provide justification for this approach. Territorial Authorities would be expected to require a greater level of independent technical review under these circumstances.

Where less comprehensive investigations have been completed to define the ground model and/or less rigorous analysis procedures are undertaken, as may be acceptable for preliminary assessments or smaller sites where there is no history of slope instability, greater caution with higher FoS would be anticipated.

Table 16: Proposed factors of safety for different slope stability scenarios.

RESIDENTIAL / COMMERCIAL / INDUSTRIAL / INFRASTRUCTURE DEVELOPMENTS[20]	
	Factor of Safety (FoS)
Normal ground water condition[21]	1.5
Extreme (worst credible) groundwater condition[22]	1.3
Seismic condition for SLS[23] level of shaking	1.3
Seismic condition for ILS[23] level of shaking	1.1
Seismic condition for ULS[23] level of shaking[24]	1.0
LOW RISK AREAS SUCH AS PARKS AND BUSH RESERVE LAND	
Normal ground water condition[21]	1.3
Extreme (worst credible) groundwater condition[22]	1.2
Seismic condition for SLS[23] level of shaking	1.2
Seismic condition for ILS[23] level of shaking	1.1
Seismic condition for ULS[23] level of shaking[24]	1.0

For residential subdivisions, the stability assessment should establish that a building platform is available on each proposed lot and where necessary, define where on the site the allocated building platform is located and any associated building restriction lines. The anticipated maximum building loads should be included in stability assessment.

The location of the proposed building platforms and associated building restriction lines should be clearly included on plan drawings and the slope stability analysis plots. This should include allowance for debris runout where this is considered a significant hazard to the building or other site infrastructure.

Any earthworks, slope stabilisation / retaining walls and/or slope drainage necessary to achieve the stable building platform, should be clearly identified on site plans and sections, not just on the outputs of slope stability analyses. Restrictions on any future cut or fill operations on the slope, without further analysis, must be clearly stated in the report.

Details of the necessary earthworks, slope stabilisation/ retaining walls and/or slope drainage should be specified. Where these measures are to be put in place during development of the subdivision, they must be included on the engineering plans and specifications, and the works certified and reported in the Geotechnical Completion Report. Where the slope stabilisation measures are to be constructed as part of a Building Consent, this must be clearly recorded in the GCR and will need to be confirmed (or modified) as part of the specific engineering design by a geotechnical professional at the time of Building Consent.

Where on-site soakage for disposal of stormwater is proposed (or not restricted), the potential impacts of this on groundwater levels and pressures must be included in the assessment. Where the use of on-site soakage and/or effluent disposal fields is not considered appropriate or is to be restricted to certain areas of the site due to slope stability considerations, this must be clearly stated in the report.

[20] Excludes any water retaining structures, including but not limited to dams and flood banks.
[21] Should include the expected range of annual seasonal variations.
[22] Potential range of groundwater levels over the design life of the building.
[23] SLS, ILS and ULS refer to Serviceability, Intermediate and Ultimate Limit States (see Section 3.10).
[24] A factor of safety less than 1.0 may be acceptable where estimated seismically-induced ground deformations are limited to acceptable levels for ULS performance requirements. Pseudo-static techniques adopted for estimating potential slope displacements must only be used where it can be demonstrated that there is not expected to be any significant loss of strength of the foundation soils.

2.3.4 Foundation stability

There are several factors that impact the stability of foundations. These may be separated into those aspects that result from the direct loading of the ground from the building or structure foundations and the wider site conditions and external forces.

The local strength and stiffness of the ground immediately below foundations will determine the ultimate bearing capacity and allowable bearing pressures, which must also take account of the potential for localised settlement for different size, shape and depth of foundations. Determination of “Good Ground' and adoption of an ultimate bearing capacity and allowable bearing pressure of 300 kPa and 100 kPa, respectively, for the standard foundation types and dimensions given in NZS 3604:2011, deal only with this aspect of foundation design.

External forces impacting foundation stability, include (but are not limited to):

- static settlement resulting from imposed loads other than from foundations (weight of fill; groundwater pressure changes, shrink/swell of soils in response to moisture changes).
- ground deformations resulting from slope stability or movement of retaining walls or stabilised slopes.
- presence of tomos, geothermal activity or settlement of existing non-engineered fill at depth.
- liquefaction, lateral spreading, and cyclic softening in response to earthquake loads.

When assessing the stability of foundations, both direct loading and external forces need to be considered when assessing the risks and providing foundation recommendations.

Other than when simply confirming ‘Good Ground' in accordance with NZ Building Code Clause B1 - Structure, geotechnical assessments should avoid providing single ultimate bearing capacity values without defining the size, shape and depth of footings (and any inclined/eccentric loads). Allowable bearing pressures should take account of potential ground settlement with due consideration to the strength and stiffness of the soils, not simply relying on the ultimate bearing capacity multiplied by a strength reduction factor. Such assessments should be undertaken in accordance with Verification Method 4 of the New Zealand Building Code Clause B1 – Structure (B1/VM4).

To avoid over-conservatism in foundation design, it should be noted that standard house foundations often do not require 300 kPa ultimate bearing capacity. Identification of actual ultimate bearing capacity and allowable bearing pressures (where the soil conditions do not meet the requirements for ‘Good Ground') in geotechnical assessments will assist in avoiding over-design of foundations.

Ground improvement to increase the strength and stiffness of foundation soils should focus on where the foundation loads are to be applied. It will rarely be necessary to replace weaker soils across the entire building footprint, but more localised around load bearing zones.

2.3.5 Special soil types

The BOP and Waikato regions include some special soil types that are not widely distributed across other areas of New Zealand; but are rarely unique to these regions. These are primarily associated with past volcanic activity, in particular the presence of volcanic airfall deposits, which are present ‘in-situ' and in reworked or redeposited forms.

These include pumiceous deposits, which typically behave differently to similar sized particles composed of ‘hard', quartz-dominated sediments. Often the sand and gravel sized particles are highly porous with low unit weights and crushing resistance and may be made up of silt-sized agglomerations which readily breakdown to their constituent minerals when remoulded.

These soils often have natural moisture contents higher than their liquid limits and are highly sensitive to disturbance. Their engineering properties are therefore often very different to quartz-dominated materials.

Allophanic soils are common across both the BOP and Waikato regions. These soils can be challenging to work with when disturbed from their in-situ state. Where allophanic soils are suspected as being present at a site, laboratory testing should be undertaken to confirm the presence of allophanes and appropriate treatment / mitigation adopted, as necessary.

Common geotechnical investigation techniques and empirical correlations may not be appropriate in such soils, and conventional treatments, including re-use of the soils for earthworks operations, can be problematic.

In more localised areas across parts of the region, hydrothermally altered soils occur within and around the periphery of geothermal areas (see Clause 2.3.7) .

Diatomaceous silts are present in substantial areas around the margins of the Rotorua Lakes[25], although the extent of the soils is not well-defined and due to their mode of deposition, can be highly variable both laterally and vertically over short distances.

The volcanically derived silts are re-deposited as lake sediments. In response to historic lake level fluctuations, many existing and former streams incised deep channels which were subsequently infilled with low-energy lake sediments. As lake levels rose, these buried channel sediments are typically covered by a limited depth of re-deposited pumiceous silts, sands and gravels washed down from the surrounding elevated areas, which can disguise their presence at depth when only shallow geotechnical investigations are undertaken.

Due to their young age and shallow burial, the soils are lightly over-consolidated or even normally consolidated where groundwater levels are close to the ground surface or close to the edge of the present lake.

The silts are typically very soft to soft, becoming firm with depth, and highly compressible. Whilst the organic content is relatively low, occasional highly organic lenses / layers occur. Whilst these soils appear and behave similar to other young, unconsolidated silts with low shear strength and high compressibility, subtle differences are apparent, and rates of consolidation can be higher than equivalent non-diatomaceous soils.

In terms of the competence of geotechnical professionals involved in working with these special soil types, there is no clear substitute for local experience (or experience of similar soils elsewhere).

For any land development project where a significant volume of sensitive, volcanic airfall deposits, hydrothermally altered materials or thick deposits of soft to very soft diatomaceous silts are present, the site should be considered Level 2 or higher in terms of the Level of Complexity. Under these circumstances, Territorial Authorities may be expected to require a greater level of independent technical review.

2.3.6 Volcanic activity

The Taupo Volcanic Zone (TVZ), extending from White Island to Mt Ruapehu, includes several volcanic centres within the BOP/Waikato regions, including:

• Rotorua	• Maroa
• Okataina	• Whakamaru
• Kapenga	• Taupo

[25] Dellow, G.D., 2010. Distribution and engineering properties of young lake sediments in Rotorua District, GNS Science Consultancy Report 2010/81. 13p.

- Reporoa
- Tongariro
- Mangakino

These represent several volcanic hazards, including ashfall, lava flows, lahars and pyroclastic flows, in addition to the associated active geothermal areas (see Clause 2.3.7).

Within the Rotorua District, active caldera volcanoes are limited to the Okataina Volcanic Centre (OVC) located between Rotorua and Kawerau[26]. The extent of this hazard zone is included as a layer on the Rotorua Lakes Council Geyserview webapp[27]. Whilst no specific assessment or mitigation is strictly required, it is considered appropriate to identify where sites are located within this hazard area, as this may not be well understood by developers and other stakeholders.

For land development projects located close to the OVC, the hazards should be presented in terms of near-vent eruptions that could lead to complete devastation in those areas or more distal locations where considerable damage is possible. Near-vent eruptions are largely restricted to the Haroharo and Tarawera vent zones located between Lake Tikitapu and Lake Rotoma and between Waimangu and the Puhipuhi hills, respectively. Considerable damage is expected beyond the immediate vent zones.

Following a large-scale explosive eruption within the OVC, ash falls of 100mm or deeper could affect a large area extending from Tauranga, Rotorua, Taupo, Gisborne and Whakatane (Nairn, 2002[28]).

2.3.7 Geothermal considerations

The BOP and Waikato regions, contain most of the geothermal areas in New Zealand. These represent an ongoing potential hazard to land development projects in terms of impact on future buildings and site infrastructure (roads, reserves, buried services); in addition to the likely presence of hydrothermally altered soils (see Section 3.5). It should be noted, however, that geothermal and hydrothermal features represent a significant resource and need to be protected from the potential deleterious effects of poorly planned land development projects.

Any land development located on or close to a known geothermal area are subject to specific rules and regulations, as set out in regional and district plans, policy statements and bylaws.

Clients engaging geotechnical assessments should recognise that developments within or close to a geothermal area represents unique conditions that require specialist knowledge, including in respect to geotechnical assessments. Not all geotechnical professionals are expected to have a detailed knowledge of the issues resulting from land development within active geothermal areas and specialist advice may be required.

Geotechnical professionals undertaking assessments within or close to active geothermal areas of the Waikato region should be familiar with the regulations contained in regional and district plans and policies around development on or close to known active geothermal areas. It is recommended that developers and their technical advisors communicate with Councils in the early stages of a land development project located on or close to known active geothermal areas as Council staff may have detailed historical knowledge of the issues specific to that area.

[26] Scott, B.J., 2010. Rotorua District Council Hazard Studies, Part 1: Volcano and geothermal Hazards. GNS Science Consultancy Report 2010/67. 31p.
[27] http://geo.rdc.govt.nz/Spatial/?viewer=GeyserView.
[28] Nairn, I.A. 2002. Geology of the Okataina Volcanic Centre: sheets part U15, part U16, part V15 & part V16, scale 1:50,000. Institute of Geological & Nuclear Sciences Geological Map 25.

Specialist investigation techniques, including for monitoring of elevated temperatures, acidity and gases are required. The investigation and monitoring should identify the extent and severity of the geothermal activity in relation to background or ambient conditions. This information can then be used to manage and/or mitigate the hazard and preserve the geothermal feature by adopting the approaches detailed below.

It should be noted that conventional geotechnical assessments, for instance in relation to bearing capacity, settlement, liquefaction and other hazards, may not be appropriate to geothermally altered soils. This should be noted, and engineering judgement applied with a degree of conservatism where alternative well-established assessment techniques are not available.

Since geothermal systems and features are typically relatively stable over long periods, mitigation can often be achieved by adoption of a suitable set-back from known features. Good practice solutions should be adopted to minimise disruption to the natural heat flow and gas flux from the ground, for instance, using porous materials away from buildings and low porosity materials immediately below and surrounding buildings. Where buildings or site infrastructure is located on or close to active geothermal areas, the risk of elevated temperatures and geothermal gases / acidic conditions, requires specific materials, design and installation, and will likely require greater maintenance.

Failure of geothermal wells and soakage holes, both active and abandoned, present a particular hazard for changing patterns of gas flux and heat flow, and should be carefully identified.

Records of active geothermal areas should be obtained from regional and district councils, including the presence of existing and former geothermal bores.

Table 17 lists the known active geothermal areas in the Rotorua district:

Table 17: Known active geothermal areas within the Rotorua district.

Ātiamuri Geothermal Field	Reporoa Geothermal Field
Horohoro Geothermal Field	Rotoma-Soda Springs (Tikorangi) Geothermal Field
Hot Water Beach Geothermal Field	Rotorua Geothermal Field
Humphrey’s Bay Geothermal Field	Taheke Geothermal Field
Lake Okataina Springs Geothermal Field	Te Kopia Geothermal Field
Lake Rotokawa Geothermal Field	Tikitere (Hells Gate) Geothermal Field
Lake Rotoiti Centre Basin Geothermal Field	Waikite Geothermal Field
Ngākuru Geothermal Field	Waimangu-Rotonahana Geothermal Field
Ngatamariki Geothermal Field	Waiotapu Geothermal Field
Ōhākī Geothermal Field	Whāngairorohea Geothermal Field
Ōrākeikōrako Geothermal Field	

Once a site has been identified as being located within or adjacent to a geothermal area, a suitably qualified and experienced geotechnical professional should be engaged, and early discussions held with the regional council and/or city/district council.

Investigations of sites located on or adjacent to known geothermal areas should include measurement and monitoring of temperatures, acidity and common geothermal gases. Due to the often-localised nature of geothermal features at the ground surface, the required density of intrusive investigations and/or use of geophysical testing techniques, is likely to be higher than for non-geothermal areas.

Due to the unique conditions associated with development in geothermal areas, the Territorial Authority may be expected to require a greater level of independent technical review of geotechnical assessments.

Any land development project located on or close to an active geothermal area or containing historic geothermal bores, should be treated as Level 2 or higher in terms of the Level of Complexity.

2.3.8 Compaction standards for fill material

For most land development projects constructed in accordance with RITS, earthworks control should be conducted in accordance with NZS 4431. The geotechnical professional should confirm the levels of compaction required and the types and frequency of testing for specific fill types where those vary from NZS 4431.

NZS 4431 is applicable to residential developments but may be used for bulk earthworks associated with commercial and industrial developments, if considered appropriate by the geotechnical professional, with appropriate amendments as required. Where special fill types or differing levels of compaction and testing are required, these must be specified by the geotechnical professional.

Plateau tests may be used in conjunction with a method or end-product specification. These must be completed for each type of material to be used for earthworks. The plateau tests must be fully documented, including a detailed description of the fill type, testing results, plant / equipment used and the number of passes for the types of earthworks plant to be used for the earthworks must be specified. It is expected that near full-time supervision of earthworks by the geotechnical professional will be required where a method specification is adopted.

Ground improvement works typically require greater levels of compaction and verification than bulk earthworks covered by NZS 4431, and may require specialist plant, equipment, and contractors. The geotechnical professional must clearly delineate areas of ground improvement from the general bulk earthworks. Typically, a site-specific specification will be prepared by the geotechnical professional for any proposed ground improvements. Where ground improvements are designed in accordance with MBIE Module 5, specification and testing of those works should be completed in accordance with MBIE Module 5a. IANZ-accredited testing organisations are required for verification testing of ground improvement works.

Any land development project requiring significant bulk earthworks (exceeding permitted volumes under the Regional or District Plans), where cut and/or fill depths exceed 0.6m, or any sites requiring standard ground improvement works should be treated as Level 2 or higher in terms of the Level of Complexity. Where specialist ground improvement works are proposed, the site must be considered Level 3.

2.3.9 Erosion, sediment and dust control

Any site works must be completed in accordance with RITS and an approved erosion and sediment control plan (ESCP). During the period of earthworks and reinstatement no run-off, silt, sediment, dust or other materials must be permitted to discharge off-site that could damage or disturb neighbouring properties, public roads, drains or waterways. This must be achieved by installing and maintaining appropriate erosion, sediment and dust controls in accordance with the Regional Council guidelines[29,30] and any specific consent requirements. A guideline is available to assist in the preparation of erosion and sediment control plans[31].

[29] Environment Bay of Plenty Regional Council. Erosion and sediment control: Guidelines for Soil Disturbing Activities. Guideline 2010/01.June 2010. https://www.boprc.govt.nz/media/29555/Guideline-100624-ErosionandSedimentControl.pdf
[30] Environment Waikato Technical Report No.2009/02. Erosion and sediment control: Guidelines for Soil Disturbing Activities. January 2019. http://waikatoregion.govt.nz/assets/WRC/WRC-2019/TR0902.pdf.
[31] www.waikatoregion.govt.nz/assets/PageFiles/2947-earthworks/1/Erosion-and-sediment-control-plan-preparation-guideline.pdf

Control of dust must be in accordance with the MfE (2016)[32].

2.3.10 Seismic considerations

The Bay of Plenty and Waikato regions are amongst the most seismically active areas of New Zealand, with the area around Rotorua and Taupo having the highest concentration of known active faults. All land development projects must therefore include an assessment of the risks from earthquakes, including ground rupture / deformation where faults extend to the ground surface, strong ground motions and secondary effects, such as soil liquefaction and lateral spreading, slope instability and deformation and tsunami.

Ground motions adopted for geotechnical assessments must be established in accordance with NZS 1170.5 and the Earthquake Geotechnical Engineering Modules, as appropriate to the design case being considered. These must be established for Serviceability Limit State (SLS) and Ultimate Limit State (ULS) appropriate to the site subsoil class (see Clause 2.3.12), and must take account of topographic amplification effects, where appropriate.

It is recommended that the sensitivity of the earthquake ground motions between the SLS and ULS levels of shaking on the site response / performance expectations is highlighted by the geotechnical professional, including presentation of analysis for an Intermediate Limit State (ILS) as defined in MBIE, 2017[33]; particularly in respect of potential liquefaction and slope stability hazards.

2.3.11 Active faults

Several known active faults occur within the Bay of Plenty and Waikato regions. These are identified on the New Zealand Active Faults Database maintained by GNS Science[34]. These have typically been mapped at a scale of 1:250 000. However, GNS Science and other specialist organisations have mapped fault traces in some areas of the Bay of Plenty and Waikato regions in greater detail. The results of this mapping are typically included on regional and district/city council natural hazard mapping layers and often include proposed Fault Avoidance Zones (FAZs). Where this has been completed, the geotechnical professional should be familiar with both the mapping and the accompanying report and the stated accuracy and limitations of the mapping.

Where such mapping has been undertaken, the FAZs consider uncertainties associated with the mapping, the complexity of the fault and assumptions regarding the likely zone of deformation around the fault trace, and often include the recommended minimum 20m offset proposed in the MfE guidelines[35].

FAZs based on such mapping by specialist organisations takes account of a broad understanding of the overall fault and associated features. This depth of understanding may not be possible for a more localised assessment for an individual land development project site. Therefore, in general, the mapped FAZ should be adopted as the minimum unless an extensive assessment has been completed by a suitably qualified geologist or engineering geologist experienced in geomorphological fault mapping. Ideally, any proposed changes to the interpreted fault trace should be discussed with GNS or other organisations who completed the original mapping, to seek feedback and clarification regarding the suggested changes, particularly where this may impact other properties / infrastructure beyond the immediate land development project site (and may warrant a Plan Change review).

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[32] Ministry for the Environment. 2016. *Good Practice Guide for Assessing and Managing Dust.* Wellington: Ministry for the Environment.
[33] Planning and engineering guidance for potentially liquefaction-prone land. Resource Management Act and Building Act aspects. Ministry of Business, Innovation and Employment.
[34] https://data.gns.cri.nz/af/
[35] *Planning for Development of Land on or Close to Active Faults*. A guideline to assist resource management planners in New Zealand. Report prepared for Ministry for the Environment by Janine Kerr, Simon Nathan, Russ Van Dissen, Peter Webb, David Brunsdon and Andrew King. 2003.

The MfE guidelines propose a risk-based approach to development within or close to FAZs, taking into consideration the estimated recurrence interval (RI), fault complexity and building importance category (BIC). This risk-based approach should be followed, but the planning provisions for different combinations of RI / fault complexity and BIC, must follow the Territorial Authority rules (included in the relevant district plan).

A fault rupture assessment would typically be completed as a separate exercise from the main geotechnical assessment, but the results of which are incorporated into the overall geotechnical assessment report and recommendations.

Any land development project within a fault avoidance zone or where a site-specific fault mapping assessment has been completed, should be treated as Level 3 in terms of the Level of Complexity. Any associated independent peer review required as a result of the Level 3 classification, may be restricted to the fault hazard component of the geotechnical assessment.

2.3.12 Site subsoil class

The site subsoil class, as defined in NZS 1170.5, must be determined for the site. The basis for this classification must be detailed. This should be established as part of the initial geotechnical assessment. The basis for any subsequent proposed change to the site subsoil class, for all or part of the site, must be detailed. This is expected to be supported by more comprehensive geotechnical investigations than completed for the initial classification.

Where the site subsoil class cannot be confirmed with a high degree of confidence, either due to the variable nature of the ground conditions and/or limited extent of the site-specific ground investigations completed, sensitivity analysis should be completed for both classes for geotechnical and structural design purposes.

2.3.13 Liquefaction and lateral spreading assessments

In order to work towards a consistent assessment methodology and categorisation, with the associated benefits of knowledge transfer and efficient standardised solutions, national best practice guidance documents[36] relating to the assessment and categorisation of liquefaction-prone land should be followed for liquefaction assessments within the BOP and Waikato regions. Geotechnical professionals undertaking such assessments should have a good working knowledge of the best practice guidance documents and the recommended analysis methods.

Categorisation of the liquefaction vulnerability of land is based on the severity of liquefaction-induced ground damage that is predicted to occur at various intensities of earthquake shaking, with the degree of ground damage estimated using quantitative or qualitative methods (as appropriate).

The level of assessment of liquefaction hazard varies according to the likelihood, severity, and exposure to ground damage as the purpose of the assessment becomes more site-specific. Different levels of assessment are required for areas of land likely to be more prone to severe liquefaction hazard, such as low-lying land underlain by young deposits with a high groundwater table, compared to hilly areas underlain by rock and/or a deep groundwater table. The level of assessment will also increase for land-use plan change, resource consents for large subdivisions and specific design of individual building foundations for a building consent.

Where a liquefaction hazard is identified at a site, a detailed assessment is required to determine the risk of lateral spreading for the existing and proposed landform. Where a liquefaction, and particularly a lateral spreading, hazard is identified, the final landform should be modified to mitigate the hazard to the extent

[36] Refer to Section 1.9 for relevant published best practice guidelines.

feasible. Where this is not possible, the final landform should avoid exacerbating the hazard (within the site and beyond) unless mitigation measures are to be included at the subdivision development stage to protect site infrastructure and not place a significant burden on designs for individual lot developments at Building Consent stage.

Past experience of the performance of structures in an area is a valid approach for assessing the suitability of new structures, however, this is only appropriate where the ground conditions are demonstrated to be equivalent and the proposed development are similar; i.e. a concrete slab foundation supporting large footprint dwelling with heavy masonry veneer with heavy roof and the ground level raised by placement of fill, cannot be compared to a small, lightweight structure constructed on shallow piled footings with no filling.

There have been few large earthquakes in the region within living memory and therefore past experience in terms of liquefaction / lateral are not appropriate for SLS or ULS events.

Liquefaction assessments typically focus on identifying appropriate foundation solutions for individual buildings. Whilst this is a primary objective, consideration of the impact on the site infrastructure (roads, overhead and underground services, reserves, urban landscaping) should also be assessed, particularly where these structures are to vest in the local councils and these structures are critical to post-disaster recovery (such as wastewater or water supply stations). This allows foundation solutions to be considered and resilient infrastructure detailing.

The overall potential for liquefaction and lateral spreading should be investigated and assessed, with definition of potential mitigation options, at the time of Resource Consent application. Where feasible, mitigation works should be incorporated into the subdivision development works and detailed in the Geotechnical Completion Report.

2.3.14 Liquefaction assessments in pumiceous soils

Most case histories of liquefaction events around the world, which form the basis for the simplified procedures used to assess liquefaction triggering, occurred in deposits dominated by ‘hard’ grains (predominantly quartz). The volcanic airfall deposits common throughout the BOP and Waikato regions (see Clause 2.3.6) comprise varying proportions of pumiceous grains, which can behave differently to the more common ‘hard’ grains.

It is acknowledged that the methods developed from the database of case histories dominated by ‘hard’ grains may not be as directly applicable for volcanically derived soils with a high pumice content[37]. This reflects both the potential inability of standard geotechnical investigation techniques to accurately assess the relative density of pumiceous soils, such as the standard penetration test (SPT) or cone penetration test (CPT), and the highly angular and porous nature of the individual grains.

Whilst there is case history evidence of liquefaction of pumiceous soils in New Zealand, recent research has indicated that alternative assessment procedures may provide a more realistic assessment of the potential for liquefaction triggering within pumiceous soils, such as techniques based on the shear wave velocity of the deposits. These field/laboratory-based studies suggest that the cyclic resistance ratio (CRR) of highly pumiceous soils may be higher than for the equivalent apparent in-situ strength/stiffness of hard-grained soils, but ongoing research also suggests that liquefaction-induced ground deformations may be higher in pumiceous soils when compared to hard-grain deposits.

It is unlikely that the ongoing research in this area will provide definitive conclusions around the susceptibility of pumiceous soils to liquefaction triggering and associated ground deformations or procedures for analysis that can be routinely applied by geotechnical professionals. A good understanding of the potential consequences of liquefaction triggering on site infrastructure and structures buried within or on liquefiable land

[37] Earthquake Geotechnical Engineering Module 3 – Liquefaction hazards. May 2016.

is, as for hard-grained soils, unlikely to be developed purely from laboratory research or limited scale field testing. Predicting the likely consequences of liquefaction in hard-grained soils was developed over several decades and are strongly based on observations of past large-scale liquefaction-inducing earthquakes from around the world.

When completing liquefaction assessments in the BOP and Waikato regions, it is important to identify the presence and nature of pumiceous soils and make estimates as to the proportion of pumiceous grains within the overall soil profile or specific layers. Where the proportion of pumice grains indicates the procedures recommended in the best practice guidelines may not be appropriate, alternative methods may be considered. Alternative procedures should provide an equivalent or higher level of rigour as the best practice guidelines, i.e., it is not appropriate to revert to a lower-level assessment. The justification for using alternative procedures and the details of those analysis should be well-documented in the geotechnical assessment report.

It is noted that the relatively low ground motions required for an SLS assessment in the BOP and Waikato regions rarely result in consequential liquefaction triggering for Importance Level 2 structures. Liquefaction triggering is, however, often predicted at ULS levels of shaking with cyclic stress ratios (CSR) significantly larger than the CRR. A slight under-estimate of the CRR of volcanically derived soils may therefore not have a significant impact on the overall likelihood of liquefaction triggering at SLS and ULS levels of shaking but will have a greater impact for intermediate limit states.

It is generally acknowledged that the best practice procedures are likely to provide a cautious assessment of the liquefaction triggering hazard. The best practice guideline procedures may therefore be considered an acceptable assessment procedure. Where alternative procedures are adopted, the council may be expected to require a greater level of independent technical review.

Where regional liquefaction studies have been completed, these must not limit the results of a site-specific assessment. However, it will be beneficial to reference the results of the site-specific assessment with that of the broader assessment, detailing the likely sources of any notable differences in outcomes of the independent assessments.

2.3.15 Rockfall hazards

Where a potential rockfall hazard is identified at a site, a detailed assessment must be undertaken by the geotechnical professional. This would typically require a detailed site inspection by a suitably qualified geologist or engineering geologist with experience of rockfall hazard assessments, topographical survey of potential source and run-out areas, and in many cases, use of commercially available rock fall modelling software (such as Rocscience Inc. RocFall), where possible using existing evidence of existing rock falls to calibrate the modelling.

The assessment may be qualitative or semi-quantitative but should be sufficient to allow a risk to life from rock falls to be estimated relative to the often adopted 1 in 10,000 annual risk to life (refer to GNS reports completed for the Port Hills following the Canterbury Earthquakes of 2010-2011).

Where an unacceptable risk to life is assessed, mitigation measures must be established and fully documented. Where suitable design guidance is available for the proposed mitigation works, this should follow good practice guidelines such as that published by MBIE, 2016[38].

Any such mitigation works should be designed, specified, constructed and certified by the geotechnical professional at the earliest stage of the development, i.e., as part of the Resource Consent and subdivision development. Rockfall protection measures should only be left to be completed at the Building Consent stage

[38] Rockfall: Design considerations for passive protection structures. October 2016. Ministry of Business, Innovation and Employment.

where it is not possible to complete at an earlier stage and only affects a small part of the site and no infrastructure.

A rockfall hazard assessment would typically be completed as a separate exercise from the main geotechnical assessment, but the results of which are incorporated into the overall geotechnical assessment report and recommendations.

Where identified, land use activities within the area affected by rockfall should be clearly identified and restricted to minimise the impact on people and infrastructure.

Any land development project requiring a rockfall hazard assessment, should be treated as Level 3 in terms of the Level of Complexity. Any associated independent peer review required as a result of the Level 3 classification, may be restricted to the rockfall hazard component of the geotechnical assessment.

2.3.16 Expansive soils

The potential for expansive soils to be present at the site must be completed by the geotechnical professional, based on laboratory testing and sound engineering judgement supported by reasonable enquiry.

Where there is a potential for expansive soils to be present, laboratory testing of soil samples taken from within the top few metres of the proposed foundation level must be completed to confirm the liquid limit and linear shrinkage (in accordance with NZS 3604 definition of 'Good Ground').

If expansive soils are identified, an assessment of the hazard posed should consider both the properties of the soil and the environmental conditions that can contribute to changes in water content of the soil, i.e., water conditions and their variations, and stress conditions.

There is no direct measure of expansiveness of soils, such that expansive behaviour is based largely on comparisons, measured under known conditions. Whilst there are several methods available, there are no universally reliable methods, such that engineering judgement will ultimately be required to inform the risk posed and appropriate mitigation measures.

Due to the difficulties associated with determining the expansiveness of soil, a simpler and robust assessment of the volume change potential (VCP) based on the plasticity index, in accordance with NHBC (2020)[39], may assist in guiding the risk posed by expansive soils. Use of a 'modified plasticity index' is appropriate where the soil contains a significant proportion of coarse particles (>425µm).

For the above reasons, use of the Acceptable Solution for slab-on-ground foundations in expansive soils (NZS 3604:2011, Clause 7.5), is not recommended.

2.3.17 Earthworks

Details of the proposed extent, or likely extent, of earthworks for a land development project should be considered as part of the geotechnical assessment. This should be included at both resource consent and building consent stage to satisfy requirements of the RMA and Building Code.

This is particularly important for the assessment of the slope stability of sites, where cut / fill / retaining works are likely to be required, but also where filling is required that may lead to significant total or differential settlements under static conditions and as a result of liquefaction and/or cyclic softening.

[39] National House Building Council Standards (2020). Chapter 4 – Foundations.

Where cutting is proposed, the impact on the stability of slopes, retaining requirements, foundation conditions at the subgrade level (cleared ground level), or impact on any assumed non-liquefiable crust for liquefaction assessments, should be outlined.

Engineered fill (of different types), should be selected, placed and compacted in accordance with a standard specification (NZS 4431 or equivalent) or a site-specific specification. Regardless of whether the New Zealand Standard is adopted, or a site-specific specification is developed, fill compaction requirements and acceptable testing methods / frequency must be clearly stated for each type of fill to be used. This must be treated as integral to the design and submitted along with the geotechnical assessment report supporting the resource or building consent application for acceptance by the consenting authority. The adopted specification, compaction and testing requirements must be referenced in relation to test results when compiling the Geotechnical Completion Report (Section 4.1).

The earthworks scope should cover both individual lots and site infrastructure (roads, underground services, pump stations, above ground services, stormwater detention areas etc.).

The likely source of materials should be identified whether it is imported or reworked on-site materials. Specific requirements for different fill types must be provided, i.e., engineered fill for foundations, for ground improvement, retaining wall backfill, fill for reinforced slopes, low permeability fill for water retention or landscaping fill.

Where parameters of engineered fill are adopted in stability / bearing capacity / seepage analysis etc., those parameters should be established by laboratory testing and confirmed during construction. It is not appropriate to simply base these on past-experience or site testing using MDD or penetration resistance, unless conservative parameters have been adopted, particularly for the special soil types that commonly occur in the district.

Where uncontrolled fill has been identified on site, a higher level of investigation is likely to be required to appropriately identify the variability of the fill materials, in terms of strength, compressibility and other geotechnical parameters, unless it is proposed to remove all uncontrolled fill. Where that uncontrolled fill is a possible source for engineered fill, testing will be required to confirm its suitability and parameters achieved, in addition to any requirement for environmental / contamination testing.

2.3.18 Completion testing

Upon completion of all earthworks and once the proposed building platforms for residential development have been established, a minimum of two hand auger holes must be completed on each lot, unless otherwise agreed with the consenting authority in advance. Tests must be carried out on all lots whether any cut or fill earthworks have been completed or not.

These must extend to a minimum depth of 2m below finished ground level and must be logged in accordance with NZGS 2005. Hand shear vane testing and dynamic cone penetration (‘Scala’) testing, depending upon the soil type, must be conducted to the full depth of the hand augers. The coordinates and ground elevation must be recorded and provided on a plan and table in the GCR (see Section 4.1). Groundwater levels must be recorded on the logs and included in the summary table.

These tests are intended to confirm the ground model detailed in the geotechnical assessment report and earthworks design and provide useful preliminary information on potential requirements for shallow foundation solutions to be included in the GCR. They are not intended as a substitute for the normal shallow testing requirements of NZS 3604:2011 that will be required in support of a Building Consent application.

2.3.19 Retaining structures and stabilised slopes

Construction of earth retaining structures does not require a building consent provided it is less than 1.5m high and does not support any surcharge or any load additional to that of the retained ground, i.e., from sloping ground and/or loads from vehicles, buildings etc. within the zone of influence behind the wall. However, regardless of whether a building consent is required, retaining walls must comply with the requirements of the NZBC. Clause B1 – Structure states 'Buildings, building elements and siteworks must withstand the combination of loads that they are likely to experience during construction or alteration and throughout their lives'.

Simple cantilevered retaining walls can be designed in accordance with Verification Method VM/4, but for any other retaining systems (walls or stabilised slopes), alternative design solutions will be required by the geotechnical professional. Where possible, established guidance documents should be utilised for design of more complex retaining structures, such as CIRIA C760[40], NZTA Bridge Manual[41] and MBIE Module 6[42].

The global stability of the land impacted by the inclusion of a retaining structure and/or stabilised slope must be assessed in addition to the internal stability of the retaining structure / stabilised slope itself.

For all but the simplest retaining structures, specific geotechnical investigations will be required to determine the appropriate type and detailed design requirements of the retaining structure and assess global stability.

2.3.20 Site infrastructure

As detailed in the preceding sections, all geotechnical assessments completed for a land development project must consider the impact of the geotechnical considerations for both the site infrastructure (buried and overhead services, road pavements, reserves etc.), and future development of buildings / structures on individual lots.

Any requirement for resilient design of site infrastructure should be agreed with the council and utility company early in the land development project, particularly in respect of any critical infrastructure.

Through early-identification of such hazards, simple and cost-effective solutions can be considered early in the land development project planning, such as locating important infrastructure away from hazard-prone areas, where lower value reserve areas could be located.

2.4. FINAL DOCUMENTATION

2.4.1 Geotechnical completion reports

The requirement for a geotechnical completion report (GCR) will depend upon the size and complexity of the land development project. Where significant earthworks are required, including any ground improvements for site infrastructure and/or future building platforms, a separate, standalone, GCR will be required. For large developments that are completed in stages, separate GCR's will be required at completion of each stage. Where site works are of a more limited nature, an update to the geotechnical assessment report compiled for consent may be used as the basis for the GCR.

[40] Guidance on embedded retaining wall design. CIRIA C760. London, 2017.
[41] New Zealand Transport Agency Bridge Manual. Third Edition. 2013. Amendment 3 (2018).
[42] Earthquake Geotechnical Engineering Module 6 – Earthquake resistant retaining wall design. 31 May 2017.

The scope of the GCR should be confirmed with the consenting authority at the time of resource consent and engineering conditions. This should include agreement as to whether an independent technical review of the GCR will be required by the consenting authority. Where this is deemed appropriate, early engagement of the reviewer will likely assist in streamlining this process.

Typically, the geotechnical professional preparing the geotechnical assessment for consenting will be required to undertake construction observation and monitoring of the construction and prepare the GCR. Where a different geotechnical professional is to be engaged for site construction and preparation of the GCR, the consenting authority should be advised.

The GCR allows many of the assumptions and recommendations provided in previous geotechnical assessments to be confirmed or updated, including invaluable information and recommendations for the controlled future development of the site.

Information likely to be required for a GCR includes, but may not be limited to:

- Scope and purpose of the report.
- Description of the consented works, including copies of original engineering plans and conditions.
- Summary of all agreed amendments (if any) to the consented works (engineering plans and conditions) and reasons for those changes.
- Reference to all previous geotechnical assessment reports, drawings, and specifications, highlighting any aspects that were to be further investigated or confirmed during construction (included in GCR appendices).
- As-built drawings, including final contours and cut/fill depths, location and construction details of all retaining walls / stabilised slopes, shear keys, location/depth and types of subsoil drains including outlets and rodding points, location/depth/type of all buried services and associated structures, backfilled erosion and sediment control features, details of any ground improvement works completed for site infrastructure and building platforms; location of approved building platforms, building restriction lines, areas identified for on-site soakage and wastewater disposal (OSET).
- Locations, levels and types of all geotechnical investigations and monitoring locations conducted prior to and during the site works and any monitoring instrumentation[43].
- Location, type, volume and source of all bulk and special fill types used, along with plans indicating the location/elevation of all fill testing locations.
- Results of all fill and subgrade testing undertaken, along with calibration certificates for all testing equipment and same for quality assurance testing by an independent accredited testing organisation (where engaged).
- Technical sheets, certificates and warranties for any materials supplied and producer statements for any specific structures, i.e., retaining walls, stabilised slopes, ground improvement works.
- A Statement of Professional Opinion on the Suitability of Land for Building (Form 1B), as provided in Appendix A. This should include a breakdown of any restrictions / limitations with respect to future development of the site, including for instance:
    - minimum finished floor levels for future buildings and structures.
    - requirements for specified foundation types, specific engineering design of foundations or suitability for standard foundations in accordance with NZS 3604 (where appropriate).
    - the assessed site subsoil class in accordance with NZS 1170.5.
    - location of approved building platforms, building restriction lines, approved locations for on-site soakage and wastewater disposal.
    - restrictions on future earthworks (unless subject to specific engineering design).

[43] Investigations should be set-out to within ±1m horizontally and ±0.1m vertically.

  - any restrictions on future works adjacent to existing structures, such as retaining walls, buried services, ground improvement.

- Pertinent information relating to future development on each lot must be provided in a summary table for ease of reference. The scope of this summary table with depend upon the conditions relevant to the specific development, but the following headings are likely to be required for most land development projects:
  - Lot number and size.
  - Site elevation range.
  - Earthworks depths (cut / fill).
  - Retaining walls, stabilised slopes or other structures and any associated setbacks.
  - Relevant geotechnical investigations.
  - Ground improvements undertaken.
  - Subsoil drains installed.
  - Interpreted mean groundwater level and potential seasonal variability (depth and elevation).
  - Identify which geotechnical considerations (from Table 2.3) are present on each lot.
  - Minimum Finished Floor Levels.
  - Inclusion of Building Restriction Lines on the lot.
  - Whether site meets criteria for 'Good Ground' in accordance with NZS 3604:2011.
  - Requirement for Specific Engineering Design (SED) of Foundations.
  - Possible foundation solutions (with or without ground improvements) for suspended timber floors and/or concrete slab-on-ground options (as appropriate).
  - Suggested maximum and/or minimum future cut / fill depths.
  - Whether further deep geotechnical investigations are considered necessary (other than shallow investigations in accordance with NZS 3604:2011) and for what purpose.

Compilation of the GCR should be undertaken throughout the site development works, as specific works elements are completed and discussed at progress meetings with the consenting authority.

Where any structures have been built as part of the site development works, such as retaining walls requiring a building consent or stabilised slopes, the relevant Producers Statements (PS1, PS2 (where required), PS3 and PS4) must be included in the GCR appendices.

2.5. STANDARDS AND BEST PRACTICE GUIDELINES

The following referenced documents are in addition to those given in the preceding sections. These represent a small sample of commonly used documents, and it is not intended as an exhaustive list. Geotechnical professionals are expected to use and reference other materials as appropriate to the design situation.

NZS 1170.0 2002. Structural design actions – Part 0: General principles.

NZS 1170.5 2004. Structural design actions – Part 5: Earthquake actions – New Zealand.

NZS 1170.5 Supp 1:2004. Structural design actions – Part 5: Earthquake actions – New Zealand. Commentary.

NZS 4404:2010. Land development and subdivision infrastructure.

NZS 4431:1989. Code of practice for earth fill for residential development.

NZS 4402:1986. Methods of testing soils for civil engineering purposes – Soil tests. Parts 1 to 7.

NZS 3604:2011. Timber-framed buildings.

NZS 4429:2013. Concrete masonry building not requiring specific engineering design.

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

New Zealand Geotechnical Society Inc. Guideline for handheld shear vane test. 2001.

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).

Waka Kotahi New Zealand Transport Agency. Bridge manual (SP/M/022) Version 3. May 2013.

Ministry for the Environment. Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

Ministry of Business, Innovation and Employment. Practice Advisory 17: Well-planned ground investigations can save costs. ISBN: 978-0-947497-63-7.

New Zealand Geotechnical Society. New Zealand Ground Investigation Specification. 28 April 2017.

Planning and engineering guidance for potentially liquefaction-prone land. Resource Management Act and Building Act aspects. Ministry of Business, Innovation and Employment.

Planning for Development of Land on or Close to Active Faults. A guideline to assist resource management planners in New Zealand. Report prepared for Ministry for the Environment by Janine Kerr, Simon Nathan, Russ Van Dissen, Peter Webb, David Brunsdon and Andrew King. 2003.

Rockfall: Design considerations for passive protection structures. October 2016. Ministry of Business, Innovation and Employment.

UK National House Building Council Standards (2020). Chapter 4 – Foundations.

Guidance on embedded retaining wall design. CIRIA C760. London, 2017.

Environment Bay of Plenty Regional Council. Erosion and sediment control: Guidelines for Soil Disturbing Activities. Guideline 2010/01.June 2010. https://www.boprc.govt.nz/media/29555/Guideline-100624-ErosionandSedimentControl.pdf

Environment Waikato Technical Report No.2009/02. Erosion and sediment control: Guidelines for Soil Disturbing Activities. January 2019. http://waikatoregion.govt.nz/assets/WRC/WRC-2019/TR0902.pdf.

www.waikatoregion.govt.nz/assets/PageFiles/2947-earthworks/1/Erosion-and-sediment-control-plan-preparation-guideline.pdf

ASTM D5778-12. Standard test method for electronic friction cone and piezocone penetration testing of soils. 2012.

Dellow, G.D., 2010. Distribution and engineering properties of young lake sediments in Rotorua District, GNS Science Consultancy Report 2010/81. 13p.

Scott, B.J., 2010. Rotorua District Council Hazard Studies, Part 1: Volcano and geothermal Hazards. GNS Science Consultancy Report 2010/67. 31p.

Nairn, I.A. 2002. Geology of the Okataina Volcanic Centre: sheets part U15, part U16, part V15 & part V16, scale 1:50,000. Institute of Geological & Nuclear Sciences Geological Map 25.

FORM 1A: STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR SUBDIVISION

Development:

Owner/Developer:

Location:

I, *(Full name)*

of *(Name and address of firm)*

hereby confirm that:

I am a geo-professional as defined in clause 1.2.2 of NZS 4404:2010 and was retained by the owner / developer as the geo-professional on the above development.

Site investigations have been carried out under my direction and are described in my report.

I am aware of the details of the proposed scheme of subdivision and of the general nature of proposed engineering works as shown on the following drawings:

-
-
-
-
-

(Insert reference to all drawings including dates of latest amendments)

I confirm that I have considered the level of complexity, which I believe to be Level _________. I confirm that I am suitably qualified and experienced to undertake the geotechnical assessment for this level of complexity.

In my professional opinion, not to be constructed as a guarantee, I certify that the proposed works give due regard to land slope and foundation stability considerations and that the land is suitable for the proposed subdivision, providing that:

–
–
–
–
–

(Continue on additional page if required)

This professional opinion is furnished to the Council and the owner/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 dwelling.

Signed: **Dated:**

Council's property file/LIM has been reviewed for relevant information. ☐

FORM 1B: STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR BUILDING DEVELOPMENT

Development:

Owner/Developer:

Location:

I, *(Full name)*

of *(Name and address of firm)*

hereby confirm that:

I am geo-professional as defined in clause 1.2.2 of NZS 4404:2010 and was retained by the owner / developer as the geo-professional on the above development.

The extent of my inspections during construction, and the results of all tests carried out are described in the Geotechnical Completion Report:

In my professional opinion, not be construed as a guarantee, I certify that:

1 That earth fills shown on the attached Plan No. _____________have been placed in compliance with the Regional Infrastructure Technical Specification.

2 The completed works give due regard to the requirements of S71, S72 and S73 of the Building Act 2004

3 The filled ground is suitable for the erection thereon of residential buildings requiring / not requiring specific engineering design in terms of NZ Building Act 2004 and NZ Building Regulations 1992, and related documents, providing that:

-
-
-

(Continue on additional page if required)

4 The original ground not affected by filling is suitable for the erection thereon of residential buildings requiring / not requiring specific design in terms of NZ Building Act 2004 and NZ Building Regulations 1992, and related documents, providing that:

–
–
–

(Continue on additional page if required)

This professional opinion is furnished to the Council and the owner/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 dwelling.

Signed: **Dated:**

Council's property file/LIM has been reviewed for relevant information. ☐

TRANSPORTATION

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3.1. SCOPE

This section sets out the requirements for the design and construction of transportation corridors within the Council's boundaries that are, or will be, managed by or vested to Council. It can also be usedl for private roads. It is also to be used for maintenance of existing infrastructure, including asset renewals, unless the standards are not compatible within the existing assets.

3.2. GENERAL

3.2.1 Objective

The objective is to work towards a hierarchical network of transportation corridors that align with the NZTA One Network Framework (ONF), that respond to land use and landform, provide a safe and convenient transport for all road user modes, provide access to adjacent property, travel choices, are well connected, safe to use and provide corridors for utility services. They must be consistent in their design standards to provide uniform guidance to users and be designed and built to provide at the least whole of life cost to the community, consistent with the desired level of service.

3.2.2 Reference documents

Details of documents referenced in this section follows. This is not an exhaustive list. Standards, guides and manuals are constantly in revision or new ones created. Council also have some specific guides and policies that are not listed here.

Table 128: Standards and legislation

STANDARD/REFERENCE DOCUMENT	TITLE
AS 1141.32:2008	Methods for sampling and testing aggregates – weak particles (including clay lumps, soft and friable particles) in coarse aggregates
AS 2144:2014	Traffic signal lanterns
AS 2353:1999	Pedestrian push-button assemblies
AS 259.5:1993	Parking facilities – on street parking
AS/NZS1158 Set	Lighting for roads and public spaces set
AS/NZS 2276.1:2004	Cables for traffic signal installations – multicore power cables
AS/NZS 2276.2:1998	Cables for traffic signal installations – feeder cable for vehicle detectors
AS/NZS 2276.3:2002	Cables for traffic signal installations – loop cables for vehicle detectors
AS/NZS 2312.1:2004	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings with 2004 amendments – part 1: paint coatings
AS/NZS 2312.2:2004	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings with 2004 amendments – part 2: hot dip galvanising
AS/NZS 3000:2007	Electrical installations (known as Australian/New Zealand wiring rules)
AS/NZS 3845.1:2015	Road safety barrier systems and devices
AS/NZS 4819:2011	Rural and urban addressing

STANDARD/REFERENCE DOCUMENT	TITLE
ASTM C309:2011	Specification for liquid membrane-forming compounds for curing concrete
BS 381C	Colour chart for paints
BS 812-114:1989	Testing aggregates, Method for determination of the polished-stone value
NZS 3104:2003	Specification for concrete production
NZS 3109:1997	Concrete construction
NZS 3116:2002	Concrete segmental and flagstone paving
NZS 3910:2013	Conditions of contract for building and civil engineering construction
NZS 4121:2001	Design for access and mobility – buildings and associated facilities
NZS 4402.4.1.1:1986	Test 4.1.1 NZ standard compaction test
NZS 4402.4.1.3:1986	Test 4.1.3 NZ vibrating hammer compaction test
NZS 4404:2010	Land development and infrastructure
NZS 4407:2015	Methods of sampling and testing road aggregates
NZS/AS 1657:1992	Fixed platforms, walkways, stairways and ladders – design, construction and installation

Table 13: NZTA standards, specifications and guidelines

SOURCE	TITLE
NZTA	New Zealand guide to temporary traffic management April 2023
NZTA	Guidelines for public transport infrastructure and facilities
NZTA	Infrastructure risk rating (IRR) manual
NZTA	Land transport (road user) rule 2004
NZTA	Land transport rule – traffic control devices 2004 (with amendments)
NZTA	Manual of traffic signs and markings (MOTSAM) - (only remaining sections that have not been replaced by Traffic Control Devices Manual
NZTA	Road safety audit procedures for projects (Transfund 2004), interim update 2013
NZTA	Supplement to 2004 Austroads pavement design guide (2007)
NZTA	Traffic Control Devices Manual
ONF	One Network Framework

Table 20: NZTA guides

SOURCE	TITLE
NZTA	Pedestrian planning and design guide (2009)
NZTA	Cycling network Suite
NZTA	Making roads motorcycle friendly
NZTA	Speed management guide
NZTA	Speed management toolbox and appendices
NZTA	Safe Systems Audit Guidelines

Table 1421: NZTA traffic notes

SOURCE	TITLE
NZTA	Light vehicle sizes and dimensions: street survey results and parking space requirements

Table 1522: NZTA manuals

SOURCE	TITLE
NZTA	Bridge manual SP/M/022 (2013)
NZTA RTS 14	Guidelines for facilities for blind and visually impaired pedestrians (2015)
NZTA RTS 18	NZ on road tracking curves for heavy vehicles (2007) (soon to be replaced by new standards)

Table23: NZTA specifications

SOURCE	TITLE
NZTA B/2	Construction of unbound granular pavement layers
NZTA B/5	In-situ stabilisation of modified pavement layers
NZTA C/20	Erection and maintenance of traffic signs, chevrons, markers and sight rails
NZTA F/1	Earthworks construction
NZTA F/2	Pipe subsoil drain construction
NZTA F/5	Corrugated plastic pipe subsoil drain construction
NZTA M/1	Roading bitumen
NZTAM/4	Basecourse aggregate
NZTAM/6	Sealing chip
NZTAM/7	Line marking pain
	Notes to line marking paint specifications (M/7)
NZTA M/10	Asphaltic concrete
NZTA M/12	Raised pavement markers specification
NZTA M/14	Edge marker posts
NZTA M/17	W-section bridge guardrail specification
NZTA M/20	Long lifeline marking materials specification
	Notes to long lifeline marking materials specification (M/20)
NZTA M/23:2022	Bridge approaches and specification for road safety barrier systems
	Appendix A: List of compliant road safety hardware for accepted products (with interim acceptance)
NZTA M/24	Audio tactile profiled road marking specification
NZTA M/26	Specification for lighting columns
	Appendix A: Type accepted passively safe lighting columns
NZTA M/30	Specification and guidelines for road lighting design
NZTA P/3	First coat sealing

SOURCE	TITLE
NZTA P/4	Resealing
NZTA P/9	Asphaltic concrete paving construction
NZTA P/11	Open grade porous asphalt
NZTA P/12	Pavement marking specification
	Notes to pavement marking specification (P/12)
NZTA P/15P	Fabrication and assembly of standard guardrails and handrails for highway bridges
NZTA P/2	Reflectorised pavement marking specification
NZTA P/43	Specification for traffic signals
NZTA T/1	Benkelman beam deflection measurements
NZTA T/8	Road marking applicator testing specification
NZTA T/12	Long life pavement marking material applicator testing

Table24: Austroad guides

SOURCE	TITLE
Austroads guide to road design	Part 3: Geometric design
	Part 4: Intersections and crossings
	Part 4A: Un-signalised and signalised intersections
	Part 4B: Roundabouts
	Part 4C: Interchanges
	Part 6A: Pedestrian and cyclist paths
Austroads guide to pavement technology	Part 2: Pavement structural design
Austroads guide to traffic management	Part 10: Traffic control and communication devices
Austroads pavement design for light traffic	

Table25: Other documents

SOURCE	TITLE
Clay Brick and Paver Institute Australia	Clay Paving Design and Construction
MfE	Crime prevention through environmental design (CPTED)
	Health and Safety at Work Act 2015
UK Dept for Transport	Manual for Streets 2007
	NZ Building Code
NZ Roadmarkers Federation (NZRF)	Manuals industry ‘best practice’
	Electricity Regulations 2010
	Electricity (Safety) Regulations 2010
	NZ electrical code of practice for electrical safe distances (NZECP 34:2001)

SOURCE	TITLE
	Electricity Act 1992
Auckland Transport	Auckland Transport Engineering Design Code of Practice (ATCOP)
Auckland Transport	Engineering Design Code – Cycling Infrastructure
Hamilton City Council	Regional Special Conditions to NZTA P43 Specification

3.2.3 Guidelines

In designing the layout of a transportation corridor the following issues must be considered:

a) Future proofing the transportation network by climate change adaptation/mitigation and emissions reduction

b) Zoning and likely use of the adjacent land.

c) Landform and geological and cultural features.

d) Connections to existing transport corridors.

e) Linkages to other developments and amenities.

f) Relationship to the concept for the total area and any masterplan

g) Recognition of the One Network Framework classification hierarchy.

h) Council's District Plan.

i) Council guidelines, strategies, master plans and policies

j) Public transport requirements.

k) Service/utility corridors and the impact the development will have on the capacity of the utilities in the adjacent areas.

l) Protection of unique features.

m) Pedestrian needs.

n) Cyclist needs.

o) Needs of mobility or visually impaired persons.

p) Stormwater collection, treatment and disposal.

q) Access by vehicles needing to service the area e.g. refuse collection, street cleaning.

r) Risk, reliability and redundancy.

s) Green space and vegetation.

t) Whole of life costs for the operation and maintenance of the asset including ease of cleaning, procurement and replacement of infrastructure when vandalised, damaged or at the end of its design life.

u) Mitigation of adverse effects of traffic:

- i) Volume.
- ii) Speed.
- iii) Manoeuvrability.
- iv) Function.
- v) Parking.
- vi) Safety.

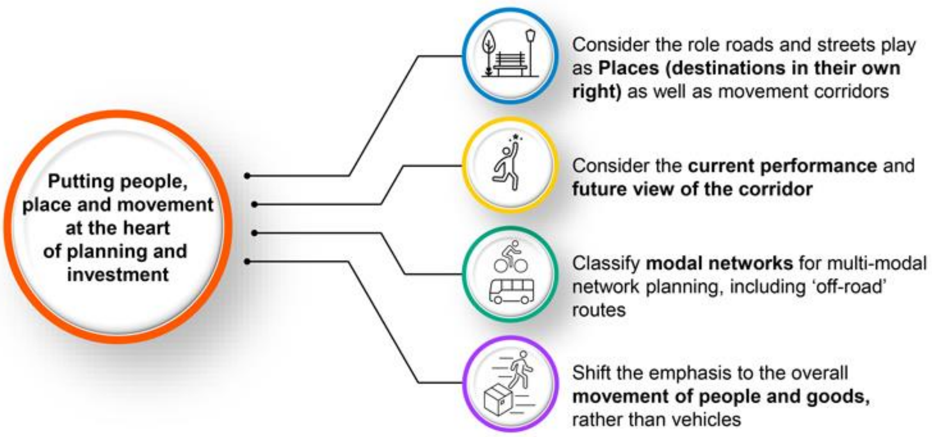
vii) Noise, air and water pollution.

viii) Carbon emissions

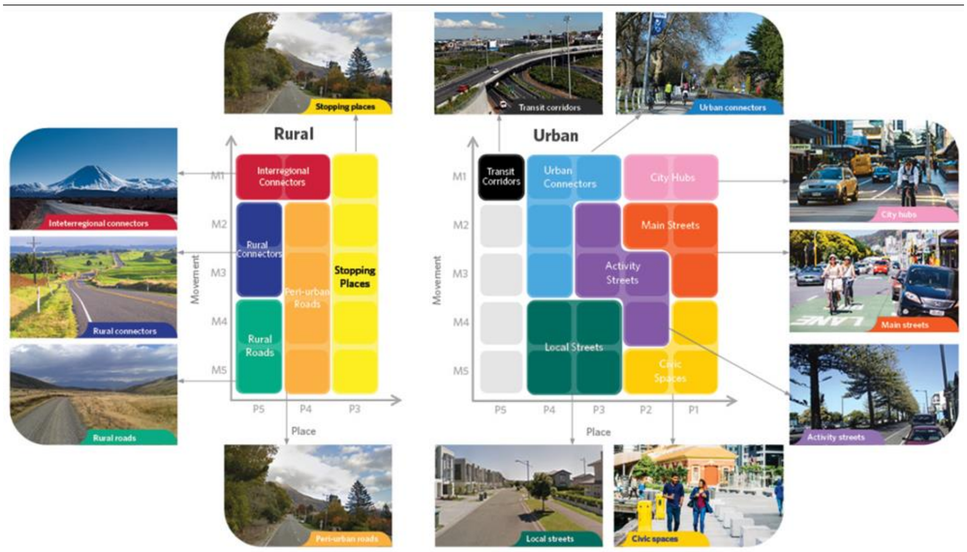
3.2.4 Functions of a transportation corridor

A transportation corridor provides a space for interaction between people for a range of purposes and access to land uses so that movement between places can occur. The three primary functions of a transportation corridor are movement of people and goods; place context; and utility corridor.

All Councils are working towards the implementation of the One Network Framework (ONF). It provides a means of hierarchy allowing land use and transport planning to be integrated and with a national consistency. The ONF provides a shift in focus to people, place, and movement.



The ONF has 7 urban street classifications and 5 rural classifications.



For detailed information refer to NZTA's online guidance and documentation (https://www.nzta.govt.nz/planning-and-investment/planning/one-network-framework/overview/)

3.2.4.1 Movement

Linking places with transportation infrastructure that provides for a range of transport modes to move people and goods efficiently.

3.2.4.2 Place context

Creating public spaces for people to interact, exercise and enjoy where appropriate. There are some transportation corridors where such activities would create health and safety issues.

3.2.4.3 Utility corridors

Providing corridors that network utility operators can use to service their customers (e.g. telecommunications, fibre, electricity, three waters and gas networks).

3.2.4.4 Transportation corridor hierarchy

In lieu of adoption of ONF refer to Councils' transportation corridor hierarchy. These can be found in the District Plan. Early engagement with Council staff is recommended to confirm specific hierarchy requirements of roads.

3.2.4.5 Network connectivity

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

a) Shorter travel distances, noting that council may have strategies that have specific travel distance definitions

b) An integrated multimodal transport network that prioritises the safe movement of people and goods.

c) Increased opportunity for communities to interact e.g. socialise, play together etc.

d) Improved access to public transportation, cycling and walking networks and access to destinations such as schools, amenities and employment. Some Councils have travel time/ connectivity strategies such as Hamilton City Council's 20-minute City Concept

e) A safe and inclusive transport network that provides genuine travel choice

Development design must ensure connectivity to properties and roads that have been developed, or that have the potential to be developed in the future. The design must ensure the maximum walking distances in the following table from a lot to a collector or arterial road.

Table26: Maximum walking distances from a lot to a collector or arterial road

TYPE	MAXIMUM WALKING DISTANCE
Rural road	No maximum distance. The design should maximise future connectivity to a suburban network.
Suburban	400m. A shorter distance can be considered near centres and major public transport routes.
Urban	300m.
Centre	200m.

Provision of safe and accessible crossing points across collectors and arterials will also be necessary to ensure that network connectivity between blocks is maintained.

3.2.5 Road Safe Systems Audit

Proposals for new roads, intersections or facilities/features that will be vested in Council must generally be subject to NZTA Safe System Audit guidelines (2022) for projects at detailed design and post construction stages, unless Council decides that these are not required.

The ‘exemption declaration’ must be submitted as part of the application process to be considered by Council. An ‘exemption declaration’ may be completed for any or all stages of the project if in the opinion of a suitably qualified road safety auditor an audit is not necessary, and Council will then consider and decide whether to accept it or not.

Safe System audits must address the needs of all road users, including the needs of pedestrians, cyclists, motorcyclists, wheeled recreational vehicles and disabled/elderly users. Where appropriate, the requirements of these groups may demand specific audit procedures.

For developers, It is important to note that not all safety risks are identified during design stages and safety risks are sometimes identified during construction or at the post construction stage safe systems audit. Plan acceptance does not negate the requirement to address these safety outcomes. It is important that Safe systems professionals are engaged early in the design process to help steer the design outcomes and reduce the likelihood of costly changes to design later down the track.

Recommendations from the audit report(s) must be implemented before the 224 certificate is issued or the contract works accepted for practical completion.

Councils will not accept residual risk outcomes from Safe Systems Audits that are serious or significant. Moderate risks outcomes should be addressed to reduce safety risks. In all cases outcomes from Safe systems audits are to be agreed with Council

3.2.6 Design and access statement

A design and access statement must be submitted with the application for design acceptance. The statement must cover all relevant aspects of this RITS and specifically address:

a) Road dimensions and layout.

b) Movement and place functions in support of ONF and in consideration for the delivery of an integrated multi-modal transport network, that is not just walking and cycling, but also Public Transport Priority and micro-mobility. This is to ensure the development is not isolated from the rest of the network.

c) Connectivity and how it will be achieved for all road user types.

d) How safe and appropriate speeds will be achieved and managed through safe systems design and in accordance with NZTA’s ‘speed management guide’, councils’ speed management plan and the design speed environment.

e) The closure of any ‘serious and critical’ issues identified in the road safe systems audit, and how other safety issues arising are going to be/ have been, addressed.

f) Parking, passing and loading provisions.

g) Criteria used in determining visibility distances and splays.

h) Safety barrier requirements and considerations that have been made for alternative treatments.

i) Impact on existing street features such as street furniture, pedestrian refuge facilities, bus stops and shelters for visual consistency and also potential increase in usage.

j) Any new parking restriction that will be required in order for the proposed design to operate safely e.g. no stopping.

3.3. ENGINEERING DESIGN

3.3.1 General

Roads must be designed with reference to the transportation function classification table contained in the District Plan and NZS 4404, section 3.3. However, all references within section 3.3 (NZS 4404) to table 3.2 of the same document must be taken instead to refer to the table in the District Plan. In all cases of conflict, the district plan, then RITS, take precedence over NZS4404.

3.3.1.1 Speed environment

Refer to Council's speed management plans, NZTA's 'Speed Management Guide' and Austroad 'Guide to Road Design', part 3: geometric design

Council has road cross sections contained in the District Plan. To achieve the desired speed outcomes, additional speed management facilities maybe be required to ensure that the speed environment is self-explaining. Self-explaining speed environments can be managed by physical and psychological devices such as narrowed movement lanes, reduced forward visibility, parking, slow points, build outs, chicanes, planting and landscaping, street furniture and art works.

The Austroad '*Guide to Road Design*', part 3: geometric design provides suitable guidance for designing to a design speed Reference can also be made to the ~~and the~~ NZTA speed management guide toolbox and appendices.

If it proposed that a street is a mixed space, refer to 'Auckland Transport – Engineering Design Code – Cycling Infrastructure version 1 – point 2.2 URSDG' for speed versus traffic volume for guidance.

3.3.1.2 Special character zones or specific TLA requirements

Where special character zones (residential, heritage, natural etc.) are identified in the District Plan, or specific requirements relating to street furniture etc. exist, there may be associated local variations to the RITS, specific Council plans, policies or local design guides. Early engagement with Council to determine specific requirements is advised.

3.3.2 Corridor alignment, width and cross section components

Horizontal alignment of transport corridors must be based on terrain and the design speed applicable to the road function. Vertical alignment of residential roads should ensure that inclines can be negotiated during all weather conditions and sight distances are adequate for safety. The gradient must be considered as a planning factor when selecting locations for shopping centres, service centres, or footpaths.

Refer to Austroad 'Guide to Road Design', part 3: geometric design

The minimum centreline radius for industrial roads, residential collector and sub-collector roads is 80m. The minimum centreline radius for local residential roads is 15m, however, curve radii will be influenced by the design vehicle tracking. Design vehicle tracking curves must be used and demonstrate that vehicles do not cross the centreline or utilise the kerb channel to travel at the posted speed limit.

Unless specified in the District Plan/strategies/policies, refer to table 22 for the design vehicle. Refer to Austroad 'Guide to Road Design', part 3: geometric design for curve widening guidance

3.3.2.1 Lane widening

Extra lane widening may be applied to the carriageway to ensure that design vehicles are able to negotiate the curve within their lane. In such cases, the maximum curve lane widening is 300mm. Anything greater must ensure there will be no reduction in berm facilities.

Table27: Design vehicle for curve widening

ROAD CLASSIFICATION	DESIGN VEHICLE
Arterial, collector and industrial roads[45]	19 semi-trailer
Local residential roads and lanes (excluding industrial zones)	11.5m rigid

RTS 18:2005 is not to be used for vehicle tracking purposes.

For local roads which have or are likely to have a public bus service, the design vehicle is a 13.5m bus (this must be confirmed with council).

3.3.2.2 Visibility

The road centreline radius and the road width also affect the visibility along the road, particularly on the inside road boundary of the curve. As such, in addition to carriageway widening, there is a need to also check that horizontal and vertical visibility meets the road design speeds both on the inside of the horizontal curve and at vehicle entrances and access ways. Achieving this may result in a need to increase the berm width by adjusting the road corridor width.

In some cases where there is no other option available, sight distances maybe required to cross property boundaries, so in these situations, easements will be required. This is to ensure that the sight distances are kept in perpetuity. The easements will restrict things like building locations, as well as hedge, vegetation, and fence heights

3.3.2.3 Carriageway crossfall

Minimum crossfall is 3% (1:33) for chip seal surfaces, 2% (1:50) for asphaltic concrete surfaces and 4% (1:25) for unsealed surfaces. The maximum crossfall is 1:25, with the exception of where vehicles and pedestrians operate in shared zone environments. In shared zone environments, the carriageway crossfall must comply with footpath requirements. A single crossfall can be used on private accessways and only considered on public roads where there is no other opportunity to achieve normal crossfall. In all cases, council approval is required.

3.3.2.4 Super elevation

[45] As defined in the District Plan.

Maximum combined super elevation is 5.88% (1:17). Consideration of road grade, stormwater and crossing pedestrians' is required Super elevation should be used on radius curves on roads with operating speeds >50km/h.

3.3.2.5 Gradients

Minimum gradient is 0.4% (1:250). Maximum gradient on arterial, collector and industrial roads is 8% (1:12) Maximum gradient on residential roads is 12.5% (1:8). Steeper gradients may be acceptable for shorter lengths of road in hilly country or low overall speed environments, subject to acceptance by Council . However, consideration of steep grades is to be taken into account in the design of adjacent footpaths and approaches to intersections.

3.3.2.6 Vertical curves

Vertical curves must comply with the requirements of Austroads '*Guide to Road Design*', part 3: geometric design, section 8.6 vertical curves. Where a side road meets an intersection, the vertical curve must end at least 10m from the limit line on residential local roads, and 19m on a collector, arterial or industrial road so that the side road has a platform grade < 3% for vehicles waiting to turn.

3.3.2.7 Cross-section

Typical road widths are provided in the District Plan. Preservation or capitalisation of some natural feature of a landscape or existing specimen tree(s) may dictate an irregular shaped road width . Certain carriageway and berm geometrics, utility services and stormwater swales, may require that the road width be increased to accommodate features that are not included in the District Plan. As an example, stormwater treatment devices that are located within the road reserve will require the reserve width to be increased over and above what is shown in the District Plan, and are not inclusive. This is to ensure that the cross section is not compromised and that utilities/carparking remain as shown (see 3.3.2.8) Early engagement with Council is advised to discuss specific features that are being proposed. Options have been developed if the District Plan requirements don't match the site. Urban Road Widths
. Rural Road Widths.pdf

3.3.2.8 Rural road boundaries

All rural road reserve boundaries must be fenced. Livestock fencing requirements are contained in *Clause 7.3.12.2 Livestock fencing* on page 357.

3.3.2.9 Parking and loading

Allowance for on road parking, and loading activities must be provided in accordance with the District Plan, Council Parking Plan. The National Policy Statement on Urban Development states that council can't require off street parking. The intent is to discourage reliance on cars and this is supported, however there are situations where carparking may be required. Also refer to drawing Parking Spaces

3.3.2.10 Cycle facilities

Cycle facilities must be provided in accordance with the requirements set out in the District Plan and/or cycle/biking plan/strategy and must be marked in accordance with the '*Traffic Control Devices Manual*' and the drawings contained in this RITS. Early engagement with Council is encouraged to identify cycle routes.

The gradients of cycle paths must be such that it encourages ongoing use. Refer to the Auckland Transport's 'Engineering Design Code - Cycling Infrastructure' version 1 – Table 10 gradients.

3.3.2.11 Shoulder widths

Shoulder widths on rural roads need to be assessed for each project, based on the speed environment of the area, terrain and activities. For high-speed environments where high non-motorised use is expected, shoulder widths may need to be increased to optimise overall road safety. Refer to the District Plan links at APPENDIX 3A links and the RITS drawings in 3.3.2.7. Early engagement with Council is encouraged.

3.3.3 Formation width

Formation width must be sufficient to contain the functions described in *Clause 3.3.2.8 Rural road* boundaries on page 104. Where topography dictates, the formation width should extend beyond the carriageway edge by 500mm, with batters providing a smooth and safe transition to the adjacent building lot grades. Refer to Urban Road Widths. Transportation if there are no appropriate District Plan drawings.

3.3.4 Structures

Where structures retaining private lots are required, these must be fully located on the lot, not within the road reserve and will remain privately owned and maintained.

3.3.5 Visibility

The driver sight distance requirements relate to the road classification function and vehicle speeds. Accessway visibility and location requirements is contained in the District Plan, but if it is not then refer to NZTA RTS 6. Visibility splays and envelopes may require the road boundary to be set back (refer to Transportation drawing: Cross section details typical berms

The location of items placed in the road corridor must consider the impacts to ensure visibility is not impeded. Trees must not be planted in the visibility spray; and only road assets such as lighting columns and road signs are considered low impact on visibility, whereas fences, barriers and utility items require careful consideration. More detail on requirements for planting within visibility splays is given in the landscape section. Horizontal and vertical sight distance along a road must be designed in accordance with Austroads '*Guide to Road Design*', part 3: geometric design, considering the wet surface coefficient. The stopping sight distance measured round a curve must be along a line 1.5m into the lane width from the inside kerb or outside of a parked vehicle if there is on road parking. The developer must submit with the engineering plans the criteria used in determining the visibility distances.
The consideration of visibility should also include pedestrians and cyclists. Refer *to Council's requirements or in its absence, the* Auckland Transport's 'Engineering Design Code – Cycling Infrastructure' version 1 figures 13: Lateral Clearances on horizontal curves; figure 14: Approach clear space – driver gives way to cyclist.

3.3.6 Berms

Berms must be provided between the edge of the carriageway and the road legal boundary to accommodate footpaths, road signs, road lighting, underground services, utility service cabinets, landscaping, stormwater treatment and control, and grass areas (refer to Transportation drawing: Location of services in transport corridor

Council may have specific policies with regard to berms and landscape provisions which could take precedence over the information contained in this clause.

Berms must be of adequate width to:

a) Achieve safe clearances between the carriageway edge and any obstacle (minimum 600mm for urban and 1500mm for rural areas).

b) Allow running of utility services and placing of street lighting poles within the berm.

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.

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

f) Allow sufficient width to allow for adequate growth of the plants/trees and ease of their maintenance.

g) Allow for use of a lawnmower for general maintenance; narrow grass strips less than 650mm wide should be avoided.

h) Ensure that there is unimpeded kerb access to ensure safe kerbside waste collection (minimum of 2500mm x 1000mm space for presentation and collection of rubbish and recycling).

The minimum width of berm must be in accordance with the District Plan except for private ways (refer to Transportation drawing: Standard urban residential private ways and shared services. Berm crossfall must typically be 4% (1:25), and must be able to be easily mown by the adjacent property owner. Engineering drawings should identify any variances from the typical crossfalls. The berm crossfall and the footpath cannot be negatively impacted by the vehicle crossing grade (refer to Transportation drawing: Cross section details typical berms On rural roads berm crossfall is to be a maximum of 25% (1:4) starting at the outside edge of the carriageway shoulder (sealed or unsealed) or surface water channel.

3.3.7 Survey marks

Survey marks must be installed in a separate, purpose-built concrete slab, clear of vehicle and pedestrian facilities.

3.3.8 Cut/fill batters

To be read in conjunction with Section 2: Earthworks and Geotechnical Requirements.

Urban roads

Cut and fill batters for roads must generally be constructed outside the transportation corridor (refer *Clause 3.2.6 Design and access statement* on page 101).

A maximum grade of 1:5 starting at the road boundary. Where circumstances dictate a steeper grade is necessary, and it is longer than 10m, a geotechnical assessment of the slope must be provided together with specific access design (refer to Section 2: Earthworks and Geotechnical Requirements). Any retaining wall designed to support the road or footpath must be constructed within the transportation corridor and will likely require a building consent. Where Council considers the stability of any planned embankment is in doubt, a stability analysis of the slope under saturated conditions may be required.

3.3.8.1 Rural roads

Rural batters for cuttings and embankments must usually be constructed inside the transportation corridor. Batters less than 750mm high must be cut at 1:4 and must be topsoiled and grassed (refer to *Clause 7.3.4 Soil* on page 350 and *Clause 7.3.6 Grassing, sowing and turfing* on page 351). Batters 750mm high and above must be cut at 1:2 and must be protected from face erosion by hydro-seeding or similar (refer to *Section 7 Landscapes* on page 336).

Batters 4.5m high and above must be assessed by a geotechnical professional. In undertaking this check and determining the appropriateerosion protection the geotechnical professional must take into account:

a) The type of soils present in the cutting.

b) The degree of possible erosion and its effect on long term stability, the safety of road users and adjacent property owners.

3.3.9 Intersections

3.3.9.1 Intersection and alignment design

All intersections must be designed in accordance with Austroads ‘Guide to Road Design’, parts 4 and 4a.

Generally, roads should intersect with roads in the same class or those immediately above. T-junctions are preferred to cross intersections particularly for local roads. The angle of the intersection should be 90º although a minimum of 70º can be used when justified by other constraints and with agreement of Council. Multi-leg intersections may require control by roundabouts, or traffic lights. Intersections on curves, particularly on the inside of curves other than large radius curves, >500m are to be avoided.

All road intersections in residential areas should have a kerb radius at intersections of 6m, but subject to meeting the design vehicle swept path requirement. An alternative and reduced kerb radius may be considered to enhance pedestrian facility in low-speed environments (<50km/h) and is subject to acceptance by Council. All intersections in industrial areas should have a minimum kerb radius of 13.5m subject to the meeting the design vehicle swept paths and with corner with splays of 6m or subject to specific design. Intersections in > 50km/h areas must have the lot corners splayed by a minimum of 4m along both boundaries, although these may be dispensed with, in low design speed environments provided that there is adequate provision for pedestrians and utility services.

Corner boundary splays must be subject to specific design in higher speed environments to ensure safe visibility at intersections. If cycleway infrastructure is required, use council’s and in their absence, refer to Auckland Transport ‘Engineering Design Code – Cycling Infrastructure’ version 1 Approach to clear space – driver gives way to cyclist section 06 – intersection’

3.3.9.2 Arterial road intersections

For intersections with arterial roads the engineering plan long sections must include the following information:

a) Design speed.

b) Design vehicle.

c) Distance from limit lines to viewpoint (LV).

d) Approach sight distance (ASD).

e) Safe intersection sight distance (SISD).

f) All radii.

The SISD must be determined with an object of height 0.6m. Reference can also be made to Austroads '*Guide to Road Design'*, parts 4, 4a and 4c.

~~Providing the above information on the drawings enables Council to observe general design consideration such as sight distance. Meeting sight distance requirement is not an exhaustive test of the efficiency or safety off the intersection. Including the information does not negate the designer's requirement to undertake all necessary assessments, considerations, efficiencies and safety of the intersection, such as safe gap acceptance and the effects of peak and free travel flows.~~

3.3.9.3 Intersections with State Highways

In the case of roads intersecting or joining State Highways, consultation must be undertaken with the NZTA with regard to appropriate standards prior to commencing design.

3.3.9.4 Grades at intersections

Gradients within 30m of intersections must be:

a) For local roads, less than 3% (1:33)

b) For collector and arterial roads, less than 2% (1:50).

A plateau at least 10m long from the limit line at the above min grades is to be provided on the side road at any intersection on a residential local road, and 19m on a collector, arterial or an industrial road.

3.3.9.5 Channelisation at intersections

All side roads that have direct access to a collector or arterial road (existing or proposed as defined by the District Plan and/or structure plan) must be channelised using either kerb extensions and/or a central throat island at the intersection with the collector or arterial road so that the width is no greater than 8m. Side roads with <12 dwellings do not require channelisation.

3.3.9.6 Priority controls

All priority intersections must fulfil the requirements of the Land Transport Rule: Traffic Control Devices 2004, associated NZTA traffic control devices manuals, and the NZTA 'Pedestrian Network Guidance'.

3.3.9.7 Intersection spacing

Refer to the District Plan first, and if there are no requirements, use the following;

Minimum permitted spacing between adjacent intersections on different categories of road are set out in the table below. All distances are measured along the centreline of the major road between the centrelines of the intersecting roads.

Table28: Minimum intersection spacing

	LOCAL ROADS	COLLECTOR OR ARTERIAL ROADS	INDUSTRIAL ROADS
Same side	60m	90m	200m
Opposite side	30m	45m	100m

In all cases a right/left stagger is preferred. If crossroads are unavoidable, a roundabout or traffic lights is required for all but low volume local roads.

3.3.9.8 Road/rail intersections

At grade road/rail level crossings are not permitted.
New or altered intersections, access points, pedestrian and cycle paths in the vicinity of a rail crossing are subject to a Level Crossing Safety Impact Assessment in accordance with KiwiRail's requirements and require the formal approval of KiwiRail. Any changes to an existing rail crossing requires the acceptance by KiwiRail.

3.3.10 Roundabouts

In non-urban locations, roundabouts may be required at intersections where 'stop' or 'give way' controls do not provide adequate capacity, level of service or traffic calming. Roundabouts are not permitted where their prime purpose is to provide a landscaping opportunity. Roundabouts must be designed in accordance with Austroads' 'Guide to Road Design', part 4b: roundabouts and NZTA Safe interventions Toolkit.

Traffic signals are the preferred method for urban areas. Signals provide facilities to safely manage pedestrian and cyclists at grade, where-as roundabouts require careful planning for these road users and are likely to require separate pedestrian/cycling facilities such as grade separation.

Table29: Minimum roundabout design criteria

ROAD TYPE	CENTRAL ISLAND DIAMETER[46]	CIRCULATING WIDTH		LV DISTANCE
Local (access) road	16m	Single land	7.0m	5.0m
Collector (primary and secondary) road	20m	Single lane	7.0m	9.0m
		Dual lane	10.5m	
Arterial (primary and secondary) or industrial area	24m	Single lane	7.0m	9.0m
		Dual lane	10.5m	

Visibility is an important factor to ensure safety standards are met. Refer to Austroads' 'Guide to Road Design', part 4b, criteria 1 and 2 for sight distance are both mandatory requirements. Achievement of criterion 3 is desirable.

Minimum criterion may be reduced if:

a) Physical constraints such as a building/structure prevent practical implementation of minimum design criterion.

b) Roundabout can be shown to form a traffic control device as part of a local area traffic management scheme.

To be accepted, supporting evidence showing that the design will meet capacity, safety, level of service, and turning movements of intended vehicles, including motorcycles must be supplied.

The engineering plans must show the visibility splays for each approach of the roundabout, landscaping details, signage, road marking, and state the:

c) Design speed, both approach and circulating.

d) Design vehicle and turning path.

e) LV distance.

[46] Including a 2m concrete collar.

f) Central island diameter.

g) Circulating width.

h) Level of service.

Provisions for pedestrians and cyclists to ensure their safety when negotiating the roundabout. Refer to Auckland Transport 'Engineering Design Code – Cycling Infrastructure' version 1 – Approach clear space – driver gives way to cyclist section 06, 6.2 Roundabouts.

In all cases a copy of the safe systems audit and closure of agreed outcomes with the RCA must be included.

3.3.11 No-exit roads, cul-de-sacs, service lanes and private ways

3.3.11.1 No-exit roads

It is recognised that maximising the development potential of the land available is desirable and balancing the layout form, function, travel distances, access within development and good connectivity with the rest of the network requires the developer and Council to work together to ensure good outcomes for all.

'No-exit' roads should not be provided where through roads and connected networks can be designed. Where no-exit roads cannot be avoided, they should ensure connectivity for pedestrians and cyclists plus have no-exit signage.

Public no-exit roads and lanes must provide for road turning at the end of the road for an appropriate vehicle as described in NZTA's Standard '*RTS 10'*. No-exit roads shorter than 60m may provide reduced turning facilities but must cater for 11m rigid trucks (e.g. waste collection). The design of turning facilities for light vehicles in urban areas must be in accordance with AS 2890.5. See Figures 3.3 and 3.4 of NZS 4404 for acceptable solutions.

Turning heads will be required at the end of all rural no-exit roads in accordance with Austroads' '*Rural road design*'. An on-road turning area may provide for parking or landscaping/hard standing in the centre of the turning area. The minimum kerb gradient around turning heads must be 1:200. Appropriate drainage must be provided.

3.3.11.2 Cul-de-sac design

The design of cul-de-sac turning areas must be in accordance with Transportation Drawing: cul de sac head or NZS 4404 except in commercial or industrial areas where the minimum radius must be 15m to accommodate the turning movements of service vehicles. The maximum long or cross section slope in turning heads is 1:17 with the desirable matching normal camber. All urban roads must have kerb and channel with associated stormwater collection and disposal systems provided on all cul-de-sac heads to the tangent point.

Staged road construction will require temporary cul-de-sacs to be built.

For rural roads, Council may require kerb and channel with associated stormwater collection and disposal systems to be provided on cul-de-sac heads where conventional shoulder/berm surface runoff is unable to be achieved to Council's satisfaction.

3.3.11.3 Service lanes

The minimum carriageway width permitted is 3.5m. Service lanes are to have concrete edging both sides and stormwater is to be collected and disposed of. Specific geometric and pavement design is required, as covered in *Clause 3.3.12 Road pavement* on page 111 and Council's formation requirements as set out in the District

Plan. Carriageway surfacing is to be asphalt conforming to the specifications in *Clause 3.3.13.2 Asphaltic concrete surfacing* on page 113 and *Clause 3.4.9.8 Asphalt surfacing* on page 148.

3.3.11.4 Private ways

a) General

Kerb and channel for urban residential and industrial private ways is to be in accordance with:

i) Transportation drawing: Vehicle crossing and pedestrian cutdown set out.

ii) Transportation drawing: Vehicle crossing profiles

iii) Transportation drawing: Kerb and channel profiles

Stormwater must not discharge across the vehicle crossing from the private way to the public road.

Vehicle crossings to private ways must be designed and constructed in accordance with Clause 3.3.19 on page 121 and Transportation drawing: Standard residential urban private ways

Surfacing requirements must be in accordance with *Clause 3.3.13 Road surfacing* on page 113, *Clause 3.4.9.8 Asphalt surfacing* on page 148. and *Clause 3.4.9 Footpaths, cycle paths and vehicle crossings* on on page 146.

b) Urban residential private ways

Urban residential private ways are to be in accordance with the District Plan (see also drawings Transportation: Standard Urban Residential Private Ways Urban Access Ways;. Urban Access WayTurning Bay

The minimum permitted inside radius of curves must be 9.0m. The gradient must not exceed 12% (1:6). safety provisions to ensure vehicles can safely pass each other required by Council must be provided. A passing bay must be provided at every 50m of private ways when they are >8% grade and 75m on those <8%

c) Industrial private ways

Industrial private ways are to be in accordance with the District Plan, with the minimum carriageway width for an industrial private way serving a single lot to be 4m. For an industrial private way serving two or more lots the minimum carriageway width is 6.4m. However, the width of the carriageway must safely accommodate the vehicle tracking swept curves for the design vehicle expected in the proposed development. The minimum carriageway width must accommodate a 12.6m rigid truck. .Berm widths each side are to be 1.8m minimum. The minimum permitted inside radius of curves is 12m.

d) Rural residential private ways

For rural residential private ways serving ≤ 4 lots and ≤ 250m in length, the total minimum permitted sealed carriageway width is 3.5m, with the total width of the private way a minimum of 7.0m.

For rural residential private ways serving ≥ 5 lots or ≥ 250m length, the total minimum permitted sealed carriageway width is 4.0m with the total width of the private way a minimum of 7.5m. A passing bay must be provided as in b) above. See drawing Rural Access Ways

3.3.12 Road pavement

Pavements must be provided to all roads such that vehicle loads may be carried without distress in all weathers for at least the design life with only normal routine maintenance and periodic re-surfacing required. Pavements must generally be flexible granular pavements with thin surfacing layers, however where this is not sufficient or a more innovation solution can be implemented, it may be accepted by Council. Stabilisation additives are not permitted in new pavement construction unless specifically agreed to by Council.

3.3.12.1 Pavement design

A pavement design must use the methodology of Austroads' 'Guide to Pavement Technology, part 2' and the 'NZ Supplement to the Austroads Pavement Design Guide'. Designs for local roads may also use Austroads' 'Pavement Design for Light Traffic'. All pavement designs are to be undertaken by a suitably experienced and qualified professional.

Use of alternative materials such as recycled aggregates is encouraged. The use of stabilisation agents may be considered by Council for the subgrade, but not for granular pavement layers.

Traffic generation from the development and any adjoining road must be included in the design. Traffic generation from various activities can be derived from NZTA Research Report 453 and from the District Plan. For developments which have activities/specific industries not contained in published data, the use of 'like for like' activities, already in operation can be used, providing observation data is presented to support the design.

The effects of the development construction and the subsequent developments are often overlooked in pavement designs and the effect of intense short periods of construction traffic can often lead to significant HCV traffic impacts occurring within 12 months or soon thereafter of the road construction, leading to premature pavement degradation.

The pavement design must include traffic generation from the construction of the roads especially where there is a staged construction, and the completed road is then used for subsequent construction for the rest of the stages.

The construction activities at a rate of 10 HCV movements per residential lot, are also to be included in the design, and any specific assessment for industrial and commercial locations. The design must include growth factor assessment and a pavement life of 25 years.

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The design report must provide the following information:

i) results of soils investigations
ii) design assumptions and figures
iii) material specifications
iv) engineering drawings clearly locating all services in relation to the pavement, stormwater drainage and in particularly subsoil and roadside provisions drainage
v) quality assurance measures for construction
vi) lifecycle carbon emissions.

Table30: Pavement layer thickness for local residential roads (excluding the effects of construction traffic)

ROAD TYPE	SUB-BASE	BASECOURSE
Cul-de-sac	N/A	150mm GAP 40
Local road (<80 residential lots)	125mm GAP 40	100mm NZTA M/4 AP40
Local road (>80 residential lots to a max 300 lots)	125mm GAP 40	125mm NZTA M/4 AP40

These are the minimum requirements and are based on an in-situ subgrade having a soaked CBR of 15 over the full depth, but are subject to any design considerations and construction traffic. If the in-situ subgrade does not achieve this strength then it may be improved by undercutting to a minimum depth of 600mm and replacing with an imported subgrade of pit sand, brown rock or other material supplied then compacted to achieve the required CBR value.

If a subgrade of 600mm depth and CBR 15 is not practicable, a specific design will be required as per Specific Design a) above.

b) Unsealed pavements require a specific design and must be acceptable to Council, with the minimum standards (excluding the effects from construction traffic) and based on a subgrade CBR >15

Unsealed pavements must be compacted with a minimum compacted thickness of 300mm of well graded, granular material with a minimum soaked CBR of 20. The maximum particle size must be no greater than 100mm. This pavement material must have sufficient fines to ensure that it does not unravel under the action of traffic. A material typically used on district unsealed roads is a high grade granular rock but will vary depending on locality. A 50mm minimum compacted thickness wearing course must then be constructed using GAP 20. The standard camber of unsealed pavements must be 1:20-1:17.

3.3.13 Road surfacing

All carriageways must be surfaced with either a chip seal or asphaltic concrete but must be consistent with adjoining surfaces. Concrete will generally not be accepted but may be considered on a case-by-case basis. Asphaltic concrete (type to be accepted by Council) is required on sites that are subject to high stresses caused by vehicle manoeuvres such as industrial roads, roundabouts, urban arterial roads, all cul-de-sac turning circles and any other location that is identified in the design report. On cul-de-sac heads, asphalt must be applied until the carriageway becomes a constant width.

3.3.13.1 Chip seal surfacing

The first coats must be a two coat 3/5 chip seal for most residential roads. A further coat of chip seal must be applied no later than 12 months after the first coat and as part of the project cost. If the second coat seal is going to be applied more than 12 months later, the defects liability period must be extended. Other chip seal designs may be considered and accepted by Council.

3.3.13.2 Asphaltic concrete surfacing

Asphaltic concrete may be used as an alternative surfacing to chip seal. There are stricter requirements for pavement stiffness if asphalt is to be used. Selection of an appropriate mix for arterial and industrial sites is to be agreed with Council. For further details and requirements see *Clause 3.4.7.5 Asphaltic concrete* on page 145.

Alternative asphaltic concrete products, such as stone mastic asphalt (SMA) or open graded porous asphalt (OGPA), may be used with Council acceptance.

3.3.13.3 Concrete block paving

Concrete block pavers must not be used without specific acceptance from Council. The concrete block pavers must comply, and laying must be in accordance with NZS 3116 'Concrete segmental and flagstone paving'.

Cycleway surfacing

For cycleway surfacing options refer to Auckland Transport's 'Engineering Design Code – Cycling Infrastructure version 1 – Approved surfaces'

3.3.14 Road drainage

3.3.14.1 General

All roads, footpaths and cycleways must be provided with facilities for the collection and disposal of both stormwater and subsoil water suitable to cope with the stormwater level of service for the area. Refer to *Table 52: Design level of service* on page 199.

The preferred location of stormwater treatment devices is within its own reserve. Treatment devices that are proposed to be included within a road corridor such as planted storage /proprietary devices are to be accepted by Council. In these cases, if not shown on the district plan cross sections, additional road corridor width to accommodate these facilities must be provided.

Design must consider the following factors:

a) Groundwater recharge through soakage systems, such as in areas of peat soils.

b) Quality of water discharged to receiving environments either directly or via connection to an existing piped network.

c) Requirements of the Regional Council.

d) Overland flow paths. Generally urban and industrial roads should be lower than adjoining land and rural roads higher than surrounding farmland.

e) Water discharged from adjoining land (including current and future land use).

f) Public safety.

g) Minimising of future maintenance requirements.

h) Capacity of any existing piped network.

i) Cyclists.

j) Reduction of peak discharge rate.

k) The depth of water in secondary flow paths should not exceed the flotation depth of vehicles of 150mm (see *Clause 3.3.14.10 Secondary flow provisions* on page 117).

l) Careful planning of stormwater flow paths/levels, particularly side drains/swales, so that stormwater does not infiltrate into the road pavement subgrade or pavement layers, adjacent properties (unless part of the identifiable overland flow path) or adjacent footpaths and cycleways.

3.3.14.2 Kerb and channel, vertical kerb and island kerb

All profiles are to be founded on a subgrade with a CBR of at least 15.

Where pavement depth is greater than 150mm, the profile must be laid on a minimum of 75mm of compacted GAP 40. For kerbs with tight radii (<5 metres), or a carriageway narrower than standard, heavy duty kerb and channel must be used. Refer to Transportation drawing: Kerb and channel profiles

a) Urban and residential roads

Kerb and channel must be provided on both sides of the carriageway in all urban areas unless swales and raingardens are proposed, subject to Council acceptance. Refer to *Clause 3.3.14.11 Swales and stormwater sensitive discharge techniques* on page 117. Kerb and channel will only be required on one side of the road with a single crossfall. Mountable kerb and channel is not permitted in urban locations.

Subsoil under-channel drains must be provided along all kerb lines including medians, roundabouts and traffic control islands as shown on Transportation drawing: Location of subsoil drainage except where it can be demonstrated that they are not necessary (e.g. where the underlying soil has a high porosity or at high points in the topography). Additional subgrade may be required. All subsoil drains must discharge into the stormwater system.

b) Industrial roads

Any road, street or lane constructed within an industrial zone (as specified in the District Plan) must be designed to meet the geometric standards for arterial roads, and incorporate heavy duty kerb and channel in accordance with Transportation drawing: Kerb and channel profiles

c) Rural roads

Kerb and channel are required where necessary to control stormwater runoff and to prevent localised scouring of earthworks or other nuisance flows. Kerbs can also help with delineation on some curves to aid night time travel. Generally, it may be considered for construction adjoining cut and fill batters s. Subsoil drains must be installed adjoining all cut batters.

To ensure the required facilities for all road users and pedestrians is provided along with network connectivity, careful consideration is required in locations where roads run parallel to different zoning boundaries such as areas where one side is residential, and the other is rural. At a minimum, each side must align with the cross-section requirements of the District Plan. In some situations, topography and other site constraints may require footpaths and services to be placed from one side to the other. Early engagement with council is advised

3.3.14.3 Dish channels and depressed kerb and channel

Dish channels are not to be used in carriageways. Where drainage is required for bus or parking bays, a depressed kerb and channel is to be used. The design profile should be the same as commercial channel crossings shown on Transportation drawing: Vehicle crossing profiles. For dish channels within footpaths or accessways, these are to be founded on subgrade with a CBR not less than 7. Refer to profiles in Transportation drawing: Kerb and channel profiles

3.3.14.4 Slot drains

Slot drains are not to be used in greenfield developments. However, they may be accepted for use in brownfield areas. The use of surface channels and catchpits may be acceptable if changes to the carriageway and berm profiles cannot achieve satisfactory breakover profiles. Slot drains will not be accepted to accommodate a steep gradient on private property. Refer to Transportation drawing: Concrete vehicle slot crossings

3.3.14.5 Catchpits

Catchpit spacing and location must consider the following criteria and have a specific design to ensure it caters for the design storm event:

a) Catchpit design must have a maximum:

TYPE	MAXIMUM
Gross area drained (carriageway, berm and footpath)	900m^2
Area of carriageway drainage	450 m^2
Spacing	90m
Stormwater from private houses connect to kerb and channel	60m

b) Preferred location of catchpits are:

i) At intersections, at the kerb line tangent point.

ii) Upstream of pedestrian crossing points or cycle crossing cutdowns.

iii) At changes of gradient on steep roads.

iv) Cul-de-sac heads.

v) Mid lot, to avoid vehicle and pedestrian crossing points or cycling crossing cutdowns.

c) A double catchpit is required:

i) At the lowest point in a sag vertical curve.

ii) At the ends of a cul-de-sac where water falls to the end.

iii) On all channels where the gradient is steeper than 5% (1:20).

d) Catchpits in swales require a specific design

e) Catchpit grates must be cycle-friendly designs as per Stormwater drawing: Double sump catchpit design

f) Catchpits must be of the type referred to in *Clause 4.2.10 Catchpits* on page 216.

g) All catchpits must be able to be retrofitted with an insert for the capture of litter and leaves. The stainless steel baffle and fixings must be installed on the outlet pipe, perpendicular to the pipe as shown in the drawings.

3.3.14.6 Batter drains

Batter drains must be located a minimum of 500mm into an adjacent lot and outside of the transport corridor. Refer to Transportation drawing: Location of subsoil drainage

3.3.14.7 Subsoil drains

Unless specified otherwise or accepted by Council, piped subsoil drainage must be provided to protect the road subgrade and pavement from deterioration or loss of strength caused by a high-water table and as part of swale stormwater systems. The design must be in accordance with NZTA specifications F/2 and F/5. Refer to section 3.3.19.3 of NZS 4404 for more details.

All piped subsoil drains must discharge by gravity into a suitable component of the public stormwater system or accepted discharge point. For typical details of subsoil drains see Transportation drawing: Location of subsoil drainage

3.3.14.8 Sub-drain outlet

Subsoil and batter drain outlets must be to catchpits or manholes. In rural situations, where no catchpit is available, the outlet must be anchored.

3.3.14.9 Side drains and water tables

Rural roads must have normal crossfall to side drains/water tables formed on each side of the carriageway except where the road is on an 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 and do not increase of stormwater discharge in existing drains/ flow paths unless accepted by Council.

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

The discharge of stormwater must not create a new discharge flow onto properties unless it has been identified as a specific flow path, and in all cases it is not allowed to cause damage to the receiving property. This discharge of concentrated stormwater must be in a 'secondary flow path' easement and be subject to the acceptance of affected property owners. Natural or non-concentrated stormwater must be shown to be neither diverting catchments nor significantly changing peak flows or flow patterns.

Where side drains and water tables can't safely channel the stormwater flows, kerbs, catchpits and piped reticulation must be constructed.

3.3.14.10 Secondary flow provisions

Section 4on page 183

In accordance with Section 4 Stormwater, *Clause 4.2.3.5 Secondary design requirements* on page 196 and 4.2.4, a primary piped stormwater reticulation is to be supported by a secondary stormwater system for the 100-year return period storm (1% ARI). The secondary stormwater system must ensure that the flow does not impact private property.

The design of roads that facilitate stormwater overland flow within the carriageway require a design methodology that does not result in ponding areas greater than 150mm deep in a 1% ARI, or flow depths greater than 150mm depth over a width of 1.5m of the road from kerb lip and a velocity greater than 1.0m/s, For more information on overland flow path design, refer to *Clause 4.2.3.5 Secondary design requirements* on page 196.

3.3.14.11 Swales and stormwater sensitive discharge techniques

Berms, swales, rain gardens and other low impact stormwater sensitive discharge must be of a sufficient width to allow for adequate growth of any plants and ease of maintenance. Refer to Section 4 on page 183 for specific guidance on stormwater devices.

Placement of any stormwater treatment and management infrastructure within the road reserve must take into account the provision of space for utilities, active mode transport / footpaths (and the potential for falls into devices), visibility once plants reach maturity, ease of maintenance and are likely to require an increase in road corridor widths in addition to those shown in the District Plan. Unless specifically accepted by Council, swales must not be located in the centre of the road. Also refer to Auckland Transport's 'Engineering Design Code – Cycling Infrastructure version 1 table 15: edge clearances'

The top level of design storage must be at least 150mm below road subgrade level to prevent road stormwater infiltrating the road pavement, and must not impact or drain into any subsoil drain.

The preference is that all stormwater treatment devices/storage etc are located in a specific reserve unless accepted by Council. In all cases, and unless shown in the District Plan, stormwater treatment facilities such as rain gardens etc are in addition to the features shown in the District Plan and so will require the road corridor width to be increased. Maintenance requirements are to be clearly detailed. Early engagement with Council is advised.

Primary flow swales in urban areas are not acceptable unless part of a planted treatment device maintained by Council.

In rural areas vehicle, pedestrian and cycle crossing points need to be defined and provided for as part of the swale design and construction. Consideration should be given to provision of traversable side slopes for safe passage of errant vehicles in the event of a crash.

3.3.14.12 Road culverts

Catchment discharge must be designed in accordance with Section 4 on page 183 and any applicable Regional Council rules and consent conditions. Refer to the NZTA's 'Bridge Manual' (SP/M/022) for waterway design at bridges and culverts. All culverts parallel to the road must have compliant traversable culvert safety ends installed to eliminate culvert end and headwall snagging hazards. Refer to NZTA's 'Specification M23: Road Safety Hardware (including interim acceptances'.

3.3.15 Parking

3.3.15.1 General

The transportation corridor should be designed to accommodate the parking requirements contained in the District Plan and council's parking management plan. Alternative widths and layouts may be suitable where provision for parking in defined areas is clear of the through traffic. Where on-road cycle lanes are immediately adjacent to this parking/passing area, additional width must be provided in accordance with NZTA's 'Cycling Network Guidance '. Parking bay pavement must be constructed to the same standard as the road. Crossfall requirements are the same as for the carriageway.

3.3.15.2 On-road parking in the transportation corridor

The provision of on-road parking is valued by motorists. For the parking requirements of a given road corridor, refer to the District Plan. See Transportation drawing: On street parking dimensions and set out for the layout of road parking areas. Parking provisions for motorcycles must be considered in areas where activities in adjacent properties are likely to generate high on-street parking demand for this type of vehicle. For inset parking bays, the minimum radius for the kerb lines in the parking area must be 5m.

The parking areas must be located so that any lot access (this is usually applied for at Building/Land Use Consent and after 224c has been issued) does not impact or reduce the available parking provisions.

3.3.15.3 Cul-de-sac parking

To facilitate for the safe turning of traffic including service trucks and emergency vehicles, Council may consider proposals for parking in central islands in cul-de-sac heads, but they must be easy and cost efffecitve to maintain. Early engagement with the Council is advised.

3.3.15.4 Mobility parking

Mobility parking spaces must be designed in accordance with NZS 4121, '*Design for Access and Mobility – Buildings and Associated Facilities*'. A pedestrian cut down, or preferably the pavement brought up level with the footpath, immediately adjacent to the mobility parking space must be provided to facilitate safe and easy egress to and from the footpath. Mobility spaces must have a blue coloured surface and have the required line marking to define the space in accordance with the specifications set out in *Clause 3.3.22 Traffic control devices: line marking and signs* on page 131 and Transportation drawing: Location of services in transport corridor

3.3.16 Footpaths, pedestrian accessways, walkways, shared paths and cycleways

Footpath provisions are contained in the District Plan, council's Design guides/policies/strategies, NZTA public transport/ Cycling Network Guidance or in the absence of detail, refer to table 3.2 in NZS 4404.

3.3.16.1 Location, width, crossfall and grade

Except where otherwise allowed for in the District Plan, footpaths must be provided on both sides of the road and located in the centre of the berm. See Transportation drawing: Location of services in transport corridor. Footpaths must have the minimum clear width between obstructions such as signs and service poles.

In locations with high concentrations of pedestrians (e.g. shopping areas, outside schools and leading to schools, hospitals, halls or other places of public assembly) footpath widths require specific design in consultation with Council. Additional width must be provided or other wheel stop' treatments included to ensure that the minimum path widths are maintained where angle parking adjacent to the footpath is anticipated.

Footpath crossfall must typically be 1% (1:100) sloping towards the kerb and channel. Crossfall on footpaths in high pedestrian areas such as shopping centres must be < 1% (1:100) .

Care must be taken when designing longitudinal road grades as steep grades may be suitable for vehicles, however the impact on pedestrians may require changes to the footpath alignment to ensure the grade is traversable by all users. Where footpath gradients are steeper than 8% (1:12), a non-skid surface must be provided. The maximum gradient for any footpath must be 12.5% (1:8), otherwise alternatives such as a 'zig-zag' must be used. Steeper gradients are acceptable, unless topography or other significant site constraints leave no options, but council acceptance will be required. Where gradients are between 8% and 12.5%, plus exceed 9m in length, a 1.2m square flat section must be provided at 9m intervals.

Footpaths must not be depressed or raised by vehicular crossings[47] unless adjacent to the kerb. Refer to Transportation drawing: Cross section details typical berms

[47] The crossing area must be built to the appropriate crossing specification.

Footpaths must have a continuous surfacing treatment across the vehicle crossing. New footpaths must be constructed in concrete unless specified otherwise in a plan, strategy, policy or other document endorsed by Council. No coloured additives must be used.

3.3.16.2 Pedestrian cut downs

Unless the crossing is located on a Raised Safety Platform, pedestrian cut downs must be provided at all road intersections and pedestrian crossing facilities. The crossings must be sited to facilitate desirable pedestrian, wheelchair and mobility scooter movements across the road and where possible drainage facilities must be sited to reduce the flow of stormwater in the channel at the crossing point.

Pedestrian cut downs must satisfy NZTA's 'Pedestrian Planning Guidance' with particular care taken to ensure:

a) There is no vertical up stand at the face of the kerb and channel within the pedestrian cut down.

b) Longitudinal and transverse gradients of the footpath and road adjacent to the pedestrian cut down are minimised in order to facilitate ease of access by users, especially for those in wheelchairs.

c) Break over angles for mobility devices through the crossing point do not create facilities that are unsafe for or not traversable by these devices. Refer to Transportation drawing: Vehicle crossing profiles and Transportation drawing: Pedestrian crossing point location at intersections

3.3.16.3 Pedestrian accessways

Accessways may be provided to link one road to another in order to improve pedestrian and cyclist access. These are to be provided as a last resort where they cannot be eliminated through revised road layouts. These are not a substitute for good design.

Accessways must be located on land that will be vested to council. Early engagement with council is advised. Pedestrian accessways must be designed in accordance with NZS 4404, section 3.3.11.1. In addition, they must also include:

a) A sealed shared footpath/cycleway that is a minimum of 3.0m wide with appropriate signage and markings. If it is necessary to incorporate steps into the accessway, a ramp must also be provided that is suitable for use by wheelchairs, mobility scooters and cyclists. Refer to *Clause 3.3.16.1 Location, width, crossfall and grade* on page 119 for grades appropriate to these users.

b) Barriers may be required to manage speeds and potential conflict points. Access control devices may be required to manage access, speeds, and potential conflict points. Refer to the NZTA's Access Control Devices on Paths Design Guidance Note.

3.3.16.4 Walkways

Rural residential subdivisions should consider connectivity to the wider network, and any provision for pedestrian access along grass berms must be considered like any other footpath provision with regards to users, grade, width and ease of maintenance.

3.3.17 Facilities for vision impaired pedestrians

Facilities for visually-impaired pedestrians (i.e. TGSI – tactile pavers) must be installed in accordance with NZTA's 'Specification RTS14: Guidelines for Facilities for Blind and Vision-Impaired Pedestrians' at:

a) Crossing points on arterial or collector roads, including all local road crossings, including raised safety platforms, pedestrian throat islands, refuge islands and median islands.

b) paths on local roads where there is a cumulative total >100 residential lots upstream of the intersection of 2 local roads.

c) Railway crossings.

d) Signalised intersections and signalised pedestrian crossing.

e) Zebra crossings.

f) Other areas of high pedestrian activity such as shared zones, pedestrian malls, shopping centres, government buildings with public access and bus stops.

Refer to Transportation drawing: Tactile paving for vision impaired for minimum requirements.

3.3.18 Cycle facilities

Cycling facilities must be provided in accordance with the District Plan, any other route identified in a structure plan, cycling plan, or any council guideline/policy or strategy. Such facilities may be a marked on-road cycle lane, a shared off-road cycleway/footway or a dedicated cycleway.

Provision for cyclists should be in line with Austroads' 'Guide to Road Design, Part 6a: Pedestrian and Cycle Paths' and the NZTA's 'Cycling Network Guidance'. Also refer to the Auckland Transport 'Engineering Design Code – Cycling Infrastructure' and Hamilton City Council's *Biking and Micromobility Code of Practice*

Off-road facilities designed for use by cyclists, either exclusively or shared with pedestrians must have a minimum width in accordance with the District Plan, or at least 3m if not otherwise stated. Off-road cycleways or shared paths must have a maximum gradient of 12.5% (1:8) and have a minimum lateral clearance of 700mm and minimum overhead clearance of 2.5m from any fixed object (including trees). For shared paths, the design provisions for footpaths noted earlier (with the exception of widths) such as longitudinal grade, level platforms etc take precedence.

Cycle lanes or cycleways must be surfaced with either concrete or asphaltic concrete. Interlocking block pavers are not suitable

On-road cycle lanes must be marked to NZTA's 'Traffic Control Devices Manual', Transportation drawing: Typical cycle advance stop lines layout and Transportation drawing: On-road cycle lane connection to off road shared path.

3.3.19 Vehicle crossings/entrances

3.3.19.1 General

The vehicle crossing design must allow vehicles to safely enter and exit the property and without scraping the underside of the vehicle. The vehicle must be able to enter and exit without needing to cross the centre of the road because the turning circle is too small.

Pedestrians have right of way over crossing vehicle crossings, and careful consideration is to be given to pedestrians/cyclists from entering and exiting vehicles. The minimum sight distance is 5m measured along the footpath from the edge of the vehicle crossing on the side being measured and 2m within the property boundary

Council has entrance way applications that are usually part of the building consent process. It is therefore important that the design considers the potential lot access point so that they will not compromise or reduce any on road parking, utility services, including poles, street trees and other roading assets.

3.3.19.2 Residential vehicle crossings

The crossing must be shaped to prevent stormwater from the public road running down the driveway onto private property. Likewise no stormwater from an adjacent property must be allowed to discharge across the berm to the carriageway. A freeboard of 200mm at the boundary must be provided (i.e. height above the channel or pavement edge) to contain stormwater within the road reserve unless it can be shown that such a condition is impractical and stormwater will not enter property vehicle crossings/driveways during a 1% ARI storm event.

Vehicle crossings must be provided between the edge of the carriageway and the road boundary at the entrance to all private ways, lanes and to any lot at the subdivision or development stage.

The maintenance of the vehicle crossing is the responsibility of property owners, however some work may be required as part of councils maintenance operations such as resealing or improvement works on the road frontage that will require council to make slight changes at the road edge. Any work of this nature will be at cost to council and the property owner will be notified in advance of these works. Any public footpath across the vehicle entrance is maintained by council.

The vehicle crossings must be installed as part of the development on the western or southern side of the lot. Where there is some doubt on the location because there are multiple access points at the subdivision or development stage, the crossing can be left to be constructed at the building consent stage.

The number and location of vehicle crossings must be in accordance with the requirements of the District Plan.

Vehicle crossings must be designed to enable the 99th percentile car to use them to ensure break over angle does not cause grounding any part of the vehicle. Also refer to Transportation drawing: Vehicle crossing and pedestrian cutdown set out

Pavement design must be adequate to carry the expected load over its design life, including heavy vehicles during construction. Refer to Transportation drawing: Vehicle crossing profiles and Transportation drawing: Cross section details for footpath, vehicle crossings and depressed kerb and channels

Vehicle crossing must be designed in accordance with the District Plan or refer to Transportation drawing: Vehicle crossing and pedestrian cutdown set out.

Vehicle crossings must not interfere with the profile of the footpath or the berm except that minor filling may be permitted between the property boundary and the footpath.

Retaining walls or structures are not permitted to encroach onto the berm and no lowering of the berm is permitted.

Pedestrians have right of way over crossing vehicle crossings, and careful consideration is to be given to pedestrians/cyclists from exiting vehicles. The minimum sight distance is 5m measured along the footpath from the edge of the vehicle crossing on the side being measured and 2m within the property boundary

3.3.19.3 Commercial and industrial vehicle crossings

All lots in areas zoned for commercial or industrial activity and all developments in other zones for commercial or industrial activities must have an industrial standard crossing. Dimensions and construction details are provided in Transportation drawing: Vehicle crossing profiles and Transportation drawing: Cross section details for footpath, vehicle crossings and depressed kerb and channels

For wide commercial vehicle crossings in areas where footpaths are provided, consideration must be given to reinforcing the priority of the footpath over the crossing. Use of different surfacing types and colours or other measures may be appropriate.

3.3.19.4 Rural vehicle crossings/entrances

Vehicle crossing must be provided between the surfaced road edge and the lot boundary at a defined and formed access point to every rural lot. The design should ensure that uphill entrances are designed so that any debris does not flush onto the sealed road surface and create a danger to cyclists and motorcyclists. The crossing must be sealed to the road boundary and to a standard not less than that of the adjacent road surface. If the access slopes up from the road, the crossing must be sealed to a minimum distance of 10m from the edge of the carriageway. Concrete entrances are not recommended due to maintenance issues arising during rehabilitation works on chip seal roads which invariably lead to level changes and subsequently costly works.

The design, including visibility and sight lines, must be in accordance with the District Plan. See Transportation drawing: Rural entranceways - residential, light and heavy commercial for dimension and construction details.

The crossing must not obstruct any drainage facilities with the berm and any existing drain must be piped under the crossing.

Pipes and end treatments must be sized appropriately for the catchment intercepted but must be a minimum of 300mm diameter with compliant traversable culvert safety ends to minimise safety risk, eliminate culvert end and headwall snagging hazards. Refer to NZTA's 'Specification M23: Specification for Road Safety Hardware (including interim acceptances)'.

The drain may be moved closer to the boundary to allow the vehicle crossing to be shaped as necessary to ease access into and out of the adjacent property. Rural crossings must be designed so that access is available for the largest vehicle that is likely to access the site and for the control of stormwater and debris run-off.

3.3.19.5 Bus stops and shelters

Bus stops must be provided on all bus routes, both existing and planned. The bus routes are determined by the Regional Council's public transport unit. During the design phase, the location and design criteria for bus stops must be confirmed with Council and the Regional Council's public transport operations manager. Early engagement with Council is recommended.

Bus stops and shelters must be designed to Council's Public Transport Design Guidelines or NZTA's 'Public Transport Design Guidance: bus stop' May 2023 with the following amendments or emphases.

Numbering refers to clause numbers in the NZTA document.

Table31: NZTA guideline amendments or emphases

CLAUSE #	AMENDMENT OR EMPHASIS
2.1.2	Bus bays must cater for 13.5m buses. Articulated buses are not currently in use in the Waikato. Appropriate road use controls must be applied to allow buses to move safely and conveniently into and out of the stop such that the bus can stop parallel to and close to the kerb.

CLAUSE #	AMENDMENT OR EMPHASIS
2.2	All bus stops must be fully accessible. New bus stops must have a kerb height between 150mm to 180mm at the lip of channel above the road surface, over the full length of the bus stop. The kerb height must allow the ramp from the bus to sit at a grade of 1:12 (max). Existing bus stops must be sited such that houses along the route are within 400m of a bus stop.
3.2	New bus stops must be sited such that houses along the route are within 400 of a bus stop.
4.1	Litter bins are required only at 'signature' stops. Real time information displays are to be mounted on a separate pole. 'Standard' type bus stops must be used on the outward journey where there is no Orbiter route transfer or stop. 'Regular' type bus stops must be used on the inward journey and where there is an Orbiter route transfer or stop. 'Signature' bus stops must be used at very high usage locations as determined by Council
4.4	The bus stop sign must be attached to a standalone pole with RP-5 parallel to the road and a supplementary sign perpendicular to road (facing the pedestrian) If a bus stop pole is being installed on the Orbiter route, a 2.4m pole must be installed to cater for the Orbiter sign (supplied by Waikato Regional Council). This is for Hamilton City Council only. Signs must be located sufficiently back form the kerb line to avoid being hit by a bus and in a location to avoid nuisance to footpath users and bus patrons. Bus shelters must be installed at all inward bus stops and all Orbiter journey bus stops. Priority for installation of shelters at existing bus stops includes: • Use by vulnerable users (school children, elderly or those with wheelchairs or mobility scooters). • Exposure to weather elements (rain, wind, sun). • The shelter design including size, shape, location and materials must be as agreed with Council. Generally, shelter colour must be consistent with existing shelters. See: – Transportation drawing: Standard 3.5m bus shelter foundation detail – Transportation drawing: Bus shelter and minibus shelter – Transportation drawing: Bus stop seat no shelter. • Seats and leaners must be provided where appropriate at the direction of Council.
5	Bus stops must have a suitable bus tracking path into and out of the bus stop. Desirably, an 18m entry taper and a 9m exit taper. These areas cannot have vehicles parking in them at any time, but can consist of intersections, driveways, crossings and cycle lanes. Bus boarders (half and full) should be considered in circumstances where parking is in high demand, speed limit is at or below 50km/h or where traffic calming measures are deemed desirable.

3.3.20 Road lighting design

3.3.20.1 General

This section sets out the requirements for the design, construction, acceptance, auditing, upgrade and maintenance of Council's road lighting network.

Council recognises that the correct level of road lighting is important for the safety and well-being of the community and this RITS provides the guidelines to achieve the following elements of good lighting design:

a) Enable safe and convenient movement of vehicles, pedestrians and cyclists.

b) Minimise glare, spill lighting and sky glow.

c) Reduce the likelihood of criminal activity at night using CPTED principles.

d) Reduce energy consumption.

e) Reduce maintenance costs.

This RITS represents the minimum standards that are acceptable to Council. It is a requirement that any new lighting installations must:

f) Meet the minimum performance standards referred to in this document.

g) Provide lighting to meet the requirements of AS/NZS 1158 series.

h) Recognise the need to maintain the level of lighting within design levels at minimum cost.

i) Utilise equipment that will be available for the foreseeable future such that replacements and spares will be readily available.

j) if the decision of consent outlines environmental concerns regard wildlife or significant environs (i.e. bats and/or lizards), the design must take into consideration these and consider the impact to meet the Wildlife Act 1953 requirements.

These guidelines are not meant to provide a template for the physical road lighting design, but rather to identify and help to meet the design objectives related to the implementation of energy efficient lighting and effective maintenance processes. They are supplementary to the standard 'AS/NZS 1158: Lighting for Roads and Public Spaces'. Where a conflict exists between any Standard and the specific requirements outlined in this RITS, the RITS prevails.

All new lighting must be LED and only the luminary products listed in Section 8 are acceptable. Refer to *Section 8 Acceptable products* on page 365.

3.3.20.2 Specifications, regulations and codes of practice

The work must be undertaken in compliance with all statutory requirements including and not limited to the relevant standards and other documents listed in *Clause 3.2.2 Reference documents* on page 94.

3.3.20.3 Scope

Road lighting must be provided on all urban roads (walkways/cycleways) and service lanes that are, or will be, under the control of Council. See *Clause 3.3.20.18 Walkway/cycleway lighting* on page 128 for walkways/cycleways. All lighting must be designed and installed in accordance with AS/NZS 1158. Designs must use equipment and materials as noted in this RITS to ensure whole of life costs for Council are kept to a minimum. Refer to *Section 8 Acceptable products* on page 365.

3.3.20.4 Design brief

In general, new lighting must blend in with adjacent road lighting, complement the neighbourhood character and, as far as is reasonably practicable, minimise the impact on the neighbouring properties and environment with regard to aesthetics, glare and spill light. In rural areas where design speeds are greater than 80km/h, slip-base frangible accepted lighting columns must be used.

3.3.20.5 Designer

The lighting design must be carried out by qualified and experienced professionals. The designer must:

a) Be conversant with AS/NZS 1158 standard and this RITS.

b) Have at least $1m professional indemnity insurance.

c) Provide a design statement.

3.3.20.6 Lighting categories

Refer to Council's roading hierarchy or the ONF to ensure details have been correctly determined before proceeding with any lighting designs.

Category V (vehicles) is applicable to arterial roads (high volume of vehicular traffic) on which the visual requirements of motorist are dominant. It should also provide a safe environment for pedestrians/cycle traffic at night and discourage criminal acts. The lighting category must be selected using the charts in AS/NZS 1158.1.1.

Category P (pedestrian area lighting) is applicable to:

a) Collector and local roads (road reserves).

b) Walkways.

c) Cycle ways.

d) Public activity areas.

e) Outdoor carparks.

The major purpose of Category P lighting is to assist pedestrians to orient themselves and detect potential hazards. The lighting may also be used to discourage crime and the principles of CPTED should be considered. For example, the layout and design of urban areas can either discourage or encourage feelings of safety for users.

Discouraging designs poor lighting or dark narrow alleyways. Encouraging designs include well-lit footpaths and bus/train stops, open parks (observable from surrounding streets) etc.

If the decision of consent outlines environmental concerns regard wildlife or significant environs (i.e. bats and/or lizards), the design must take into consideration these, and consider the impact to meet the Wildlife Act 1953 requirements

The following table provides an informative guide to determine the road hierarchy. It must be read in conjunction with AS/NZS 1158.1.1 and AS/NZS 1158.3.1 in order to determine the appropriate lighting category.

Table32: Road hierarchy

ROAD HIERARCHY	TRAFFIC COUNT / ADT	LIGHTING CATEGORY
Arterial (primary and secondary)	> 6,000	V1, V2, V3
Collector (primary and secondary)	3,000 – 6,000	V4
Collector (primary and secondary), industrial, local (access)	1,000 – 3,000	P3
Local (access), cul-de-sac	< 1,000	P4

3.3.20.7 Energy efficiency

The lighting design must maximise the spacing between columns by optimising mounting height, luminaire type and lamp output.

The following are guidelines for typical lighting schemes with satisfactory energy efficiency outcome. It is Council's expectation that the lighting designer will evaluate other elements of installation geometry and select the most energy efficient option.

Table33: Guidelines for typical lighting schemes

LIGHTING CATEGORY	MOUNTING HEIGHT (M)	LED WATTEGE (W)	WIDTH (M)
Category P	6 – 8	20 – 60	18 – 24 (road reserve width)
Category V	8 – 12	60 – 180	10 – 20 (carriageway width)

3.3.20.8 Column location

Column location is subject to vehicle speed limits.

For residential areas, columns must be located generally in accordance with the following criteria:

a) Columns should be positioned in the grass berm, a minimum of 1m behind the front face of the kerb. All columns in a section of road must have the same offset from the kerb.

b) Columns must be sited on the boundary line between two properties and at least 1m clear of any driveway or accessways.

c) In new subdivisions and developments, lighting column positions must be located first to provide the correct lighting levels in accordance with AS/NZS 1158. Only then should trees be located. Trees must not be within 8m of any lighting column. This measurement is taken from the trunk of the tree.

d) Column offset and location for intersections, bends, road humps and roundabouts is to be comply with relevant requirements of AS/NZS 1158.

e) Pole clearances from overhead low/high voltage conductors must comply with requirements of NZECP 34.

3.3.20.9 Traffic management devices

Design the lighting of traffic management devices to support the purpose of the device and to meet the requirements of the relevant AS/NZS 1158 Standard for Category V or Category P lighting.

3.3.20.10 Pedestrian refuge islands

All mid-block pedestrian refuge islands are to be lit by dedicated lights if the current road lighting levels are not providing the required lux levels of the selected lighting category as specified in AS/NZS 1158. Dedicated lighting for pedestrian refuge islands is shown on:

a) Transportation drawing: Pedestrian belisha and warning globe detail.

b) Transportation drawing: Pedestrian belisha and floodlighting

c) Transportation drawing: Pedestrian facilities in islands

3.3.20.11 Pedestrian underpasses

Pedestrian underpasses must be lit to an appropriate 'P' lighting category. All luminaries must be resistant to vandalism with an impact rating of IK08 or better. All wiring must be concealed with no cabling in surface mounted conduits. Circuits must be designed so that the underpass lighting provides a 24 hour power supply independent of the street light circuit. LED lighting must be used.

3.3.20.12 Pedestrian crossings

a) Pedestrian crossing lighting must be designed to '*AS/NZS 1158, part 4: Luminaires with specific photometric distribution*' must be used. Belisha beacons or reflective orange discs and white supplementary floodlighting are required at all crossings. The general layout of lighting for pedestrian facilities is shown on Transportation drawing: Pedestrian belisha and warning globe detail and Transportation drawing: Pedestrian belisha and floodlighting

All pedestrian lighting poles specified to be 'fold-down' poles must have the following:

b) Hinge located 150mm from existing ground level.

c) Be electrically safe whilst folded.

d) Latches and safety catch in accordance with Transportation drawing: Fold down traffic signal pole

A lockable switch to enable the lights to be operated during the day time may be required when school patrols are likely to operate at the pedestrian crossing.

3.3.20.13 Flag lighting

Lighting of an isolated intersection on an otherwise unlit route with an AADT of >1,000, must be evaluated/designed in accordance with AS/NZS 1158, parts 1.1 and 1.3, and NZTA's 'Specification M30: Road Lighting Guidelines'. Additional consideration must be given to roads that are designated for traffic detours from main highways.

3.3.20.14 Amenity lighting

Lighting for decorative purposes (e.g. up-lights, feature lights) is not generally permitted in new subdivisions.

3.3.20.15 Under veranda lighting

Where under veranda lighting is a Council asset, the impact on such lighting must be considered during any demolition or development work on the building must be carried out in a such way that existing under veranda lighting in the vicinity must remain connected and operational. As-built drawings of new or altered connections must be submitted to Council. Any replacement of under veranda lighting must use LED fittings.

3.3.20.16 Private road lighting

Lighting on private roads or ROW is preferred, however will only be permitted if the luminaires are on a separate metered circuit and a charging agreement is set up with owners and a power supply company. These lights will not be Council's asset and the maintenance of these lights will be the owner's responsibility. The installation of privately owned road lights will not be permitted on public road reserves.

3.3.20.17 Carpark lighting

For pedestrian safety and security, all outdoor public carparks (off street parking) must be illuminated in accordance with AS/NZS 1158 requirements for Category P.

3.3.20.18 Walkway/cycleway lighting

The minimum requirement is a light at each end of the walkway/cycleway to illuminate the end sections. These lights can be located in the adjacent road reserves provided that they:

a) Operate as a 'good neighbour'.

b) Are mounted at a sufficient height to prevent vandalism.

For walkways/cycleways that are not straight or fail to meet CPTED requirements, additional lighting will be required.

3.3.20.19 Design drawings and records

In order to demonstrate compliance and to allow accurate construction, all engineering drawings and other documents must show the following information:

a) The extent of the works showing existing and proposed roads and pedestrian areas

b) Proposed and existing significant road features (e.g. kerbs, property boundaries, planting, trees, traffic management devices, bus stops, pedestrian refuge islands and driveway locations)

c) The road lighting layout showing the following:

- i) Luminaire manufacturer, model and optic.
- ii) Outreach length and tilt angle.
- iii) Column manufacturer and type.
- iv) Luminaire mounting height.
- v) Column spacing.
- vi) Column to kerb offset.

d) The lighting design details including:

- i) Design statement.
- ii) Computer calculations (LTP analysis information required by AS/NZS 1158).
- iii) Luminaire photometric data (in IES or CIE format) including their origin and maintenance factor.
- iv) If applicable, site visit records/notes regarding the vicinity of HV/LV overhead conductors.
- v) Manufacturers' warranty period.

3.3.20.20 Design life

Lighting equipment, including columns, outreach arms, luminaires, LED lamps and coatings, must be new and must have the minimum design lives as set out in NZTA Specifications M26 and M30.

3.3.20.21 Manufacturer's warranty period

Minimum required manufacturer's warranty period from the on-site installation must be as set out in NZTA Specifications M26 and M30. The warranty must be transferable to Council upon vesting.

3.3.20.22 Accepted columns

For V (arterial/collector) category roads, all columns must have the following:

a) Galvanised, non-painted steel octagonal columns, compliant with NZTA Specification M26 and M26A.

b) Either curved or elliptical outreach arms.

c) A corrosion protective coating in ground sections, extending 100mm above the finished ground level.

d) Be ground planted unless shear base installation is specifically required by Council.

For P category (local roads), all columns must have the following:

e) A steel column, finish must be galvanised and coloured black.

f) Comply with NZTA Specification M26.

g) Cost of the proposed column to be no greater than 2.5 times the cost of equivalent galvanised steel octagonal column.

h) A lead-in time that is no greater than 6 weeks.

i) Have either curved or elliptical outreach arm. Arch type are not permitted (bracket attached to top of luminaire).

j) An opening for access to control gear no small than 100 x 150mm fitted with a suitable waterproof cover or door. The opening must be positioned 500-1200mm above ground level. The cover must be secured by temper proof bolts.

k) A corrosion protective coating in ground sections, extending 100mm above the finished ground level.

l) Be ground planted unless shear base installation is specifically requested by Council.

3.3.20.23 Accepted luminaires

Luminaires must be of the LED type and must comply with the requirements of NZTA Specification M30. Only the luminary products listed in Section 8 are acceptable. Refer to *Section 8 Acceptable products* on page 365.

Council will accept only luminaire units from the NZTA Specification M30 acceptance list which meet the following criteria:

a) Lead-in time for luminaire is no greater than 6 weeks.

b) Lead-in time for spare parts is no greater than 3 weeks.

c) Maximum total weight is no greater than 12kg.

d) Initial lumen to system wattage ratio is 90 or greater.

e) Power factor must be 0.9 or greater.

f) An adjustable tilt/mechanism of +5 degrees or -10 degrees in incremental steps of 5 degrees is desirable

g) 3,000 Kelvin luminaires to be used on both P and V category roads.

h) Contains a 7-pin NEMA socket

In Hamilton City, any LED lighting being installed within a 1km radius of the Hamilton Observatory adjacent the Zoo shall be installed with a Light Control Unit – the T-Light Galaxy LCU – and requires specific acceptance by Council prior to installation.

Note that this deviates from that specified in NZTA Specification M30 but acceptance has been given by the NZTA for their use. Refer to M30 for the latest list of accepted luminaires.

3.3.21 Special vehicle lanes

Where special vehicle lanes are required, they must have appropriate signage, road markings and coloured surfacing.

Special vehicle lanes include the following:

a) Bus and electric vehicle lanes.

b) Transit lanes – urban.

c) High occupancy vehicle (HOV) lanes.

d) Cycle lanes.

3.3.22 Traffic control devices: line marking and signs

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

Designs must satisfy the:

a) Land Transport (Road User) Rule.

b) Land Transport Rule: Traffic Control Devices 2004.

c) NZTA Traffic Control Devices Manual.

d) NZTA Pedestrian Network Guidance.

e) NZTA Cycling Network Guidance – Planning and Design Guide.

All proposed road markings, signs and other traffic control devices must be shown on the plans and accepted by Council.

3.3.23 Feature entrance walls, berms and street furniture

The designer is to ensure that the resulting visual impact of walls, structures, street art, street furniture etc. achieve good urban design visual outcomes. Refer to the District Plan and any relevant policy and structure plan documents. Early consultation with Council is encouraged.

3.3.23.1 Street furniture

Seats, litter bins and other street furniture must be designed and placed in accordance with any requirements of Transportation: Corridor hierarchy tables and Transportation: Asset data forms. Furniture used must be the same specification and compatible with existing street furniture, unless an alternative is specifically accepted by Council.

3.3.23.2 Feature walls

Feature walls are not permitted within the transportation corridor.

3.3.23.3 Berm furniture

With the exception of accepted litter bins, seats, fences and bollards, structures or features which are not part of signage or traffic control are not permitted in the transportation corridor unless as part of a structure plan or in accordance with any relevant Council arts or any Urban design/Streetscape policy. Prior to installation and design, consultation is required with Council to ensure safety of road users is not compromised.

3.3.24 Safety barriers

3.3.24.1 Pedestrian and cycle barriers

Where a footpath or other public access bounds or is adjacent to a steep bank, wall, culvert or other such feature, safety barriers for pedestrian and cyclists are necessary. All barriers must comply with the design requirements of *'AS/NZS 1657 Fixed Platforms, Walkways, Stairways and Ladders – Design, Construction and Installation'* and, where relevant, the *'New Zealand Building Code, clause F4'*.

3.3.24.2 Vehicle barriers

Alternative engineering measures that improve the information that road users receive from the road environment must be considered prior to the installation of a roadside barrier include, but are not limited to:

a) Relocation or modification of hazardous objects.

b) Marking of hazardous objects.

c) Road geometry and pavement surface.

d) Pavement markings.

e) Reflective raised pavement markers.

f) Street lighting.

g) Permanent warning signs.

h) Chevron sight boards.

i) Frangible sight rail.

j) Ground modelling and planting.

Where safety barriers for vehicles in urban areas are necessary, they must comply with the design requirements of NZTA M23. Early engagement with Council is recommended should there be any bespoke treatment proposed that is not covered in NZTA M23.

3.3.25 Fencing

Refer to *Clause 3.4.12 Pedestrian barrier rails and handrails* on page 156 or *Table 110 Fence types* on page 336 for fencing requirement styles.

3.3.26 Trees and landscaping

Refer to *Section 7 Landscapes* on page 336 for details on trees and landscaping in transportation corridors.

3.3.27 Structures and underpasses

3.3.27.1 Bridges and large culverts

For any project where a bridge is proposed, the bridge concept plan must be discussed and agreed with Council before detailed design commences. Bridges and culverts may require separate resource and building consents. All bridges and culverts must be designed in accordance with 'NZTA Bridge Manual (SP/M/022)'.

Early engagement is essential if bridge or large culvert structures are proposed

Particular features that are to be considered/covered in the design must include, but are not limited to:

a) **Widths/lengths**

All bridges and culverts must be designed with a width to accommodate movement lanes, cycle and pedestrian needs of the road in accordance with the District Plan.

b) **Safety barriers**

The design of the structure must provide for the installation and fixing of all suitable barriers to cater for the needs of pedestrians, cyclists and vehicles, including the interaction between the various modes.

c) **Batter slope protection**

All culverts must have anti-scour structures to protect batter slopes, berms and carriageways.

d) **Clearance over traffic lanes**

Where passing above traffic lanes, bridges must have a full clearance height of 5.2m. The bridge must be signed to highlight the maximum safe design vehicle height.

e) **Foundations**

All bridges and culverts must be founded to resist settlement or scour. Abutments must be designed to ensure bank stability and provide erosion or scour protection as applicable.

f) **Provision for services**

The provision of the structure for use as a service corridor must be included in the design. This must include consultation with utility providers to ascertain their current and future needs.

g) **Waterway design**

Refer to *Section 4 Stormwater* on page 183.

h) **Inspection and maintenance**

The design must include provision of any necessary access facilities to and within the structure in order to undertake inspection and maintenance activities.

i) **Provision for lighting**

Lighting should be considered in areas likely to be used at night by the public or where lighting will be poor during the day and the public might feel uncomfortable.

All of the above features must be documented in the design and access statement submitted at the same time as the engineering plans.

3.3.27.2 Pedestrian underpasses

Pedestrian underpasses may be required in locations where high traffic and risks to pedestrian safety has been identified and may be required as part of a structure plan walking/cycling strategy/policy. Underpasses will be required to have adequate width and height and access provisions which allow full use of pedestrians, mobility scooters, wheelchair access, visually impaired pedestrians and cyclists. The underpass is to have minimum internal dimensions of 4m (width) and 2.5m (height).

Underpasses will provide sufficient natural and artificial lighting so as not to create un-desirable dark place, designs must take into account stormwater disposal, and pumping stations are not permitted due to on-going maintenance issues.

Careful consideration to visual design outcomes is required. The design of wing walls, underpass structure, stairs, ramps etc. is to result in good urban design visual outcomes and compliance with CPTED principles.

Pedestrian underpass walls to be painted in 'Hit Grey' or other colour required by Council, and lighting must be in accordance with the requirements set out in *Clause 3.3.20 Road lighting design* on page 124.

3.3.27.3 Stock underpasses

This is a 'work in progress' by Co-Lab, but council may have requirements that must be considered before any design work is undertaken.

3.3.27.4 Retaining walls

Retaining walls which are required for the road will likely require a building consent. Any retaining wall designs must be undertaken by a suitably qualified and experienced engineer.

Retaining walls that are required for private property must be located outside the road reserve and are subject to any building or land use consent requirements.

Retaining walls that are to be vested must not be constructed using materials that can easily be de-constructed such as cavity and adhesive type walls. Instead, they must be interlocking components held with bolts, screws or cast concrete.

3.3.28 Traffic signals

Traffic signal installations are to be designed in accordance with 'Austroads Guide to Traffic Management, Part 10: Traffic Control and Communication Devices'. Refer also to *Clause 3.7 Traffic Signals* on page 165.

3.3.29 Traffic calming devices

In order to achieve the desired design speed environment, traffic calming devices may be required within the transportation corridor. The *'Austroads Guide to Traffic', the 'Traffic Control Devices Manual'* and NZTA 'Speed Management Guide' - Toolbox and Appendices should be used to guide development of these devices.

Standard details are provided for the following devices:

a) Roundabouts – mini asphaltic concrete. See Transportation drawing: Roundabout details

b) Raised pedestrian ramp. See Transportation drawing: Asphaltic concrete tapered raised pedestrian ramp and Transportation drawing: Asphaltic concrete full width raised pedestrian ramp.

3.3.30 Electronic signs and other Intelligent Transport Systems (ITS)

The design of electronic signs must be in general accordance with NZTA P32 'Specification for Electronic Warning Signs on State Highways' and must also comply with the 'Traffic Control Devices Manual' and Council's policies and bylaws.

All electronic signs and ITS must have the following capabilities:

a) Remote device status, with fault monitoring.

b) Remote manual activation and deactivation and firmware updates.

c) Logs stored for a minimum 6 months (e.g. of on/off times, activations, deactivations).

d) Data logging/reporting (e.g. volumes and speeds).

e) Calendar capability for scheduling on/off times (e.g. for electronic school speed signs).

f) Compatible with Council's system for remote management and data retrieval.

All proposed plans, locations, hardware, device type, sign capability and performance must be accepted by Council prior to installation.

3.3.31 Over-dimensional and HPMV vehicle routes

Council may specify over-dimensional/HPMV vehicle routes in its transportation/traffic bylaws. When completing any improvements or changes to infrastructure the clearance requirements for over-dimensional vehicles (and consideration of any HPMV loading) must be taken into account and consultation undertaken with the Heavy Haulage Association to confirm appropriate provisions are provided.

3.4. CONSTRUCTION

This section covers the methods, specifications and materials to be used when constructing transportation assets.

3.4.1 Pavement materials

Council may have differing aggregate requirements to other RITS member councils, and these will need to be confirmed prior to design. All materials must be accepted by Council prior to their use.

3.4.1.1 Pit sand

Imported sand used in the formation of the lower sub-base pavement, footpaths, shared paths and paved areas, must be 'run of pit' sand, free of organic matter and well graded. It must be made up of clean particles of silica or hard stone containing minimal silts, clays and pumices. This also applies to the pit sand if used as imported subgrade for concrete work.

3.4.1.2 GAP aggregates

The GAP aggregate must comprise crushed aggregate and must be free of all non-mineral matter. The crushing resistance must be no less than 110kN when the aggregate is tested according to NZS 4407 Test 3.10 'The Crushing Resistance of Coarse Aggregate under a Specified Load'. An aggregate must be considered to have met the requirement if the sample produces less than 10 percent fines when loaded so that the specified peak load is reached in 10 minutes. In this case, the test must follow the standard method in all other respects. If the aggregate passes the test, it must be reported as having a crushing resistance 'greater than (the load specified)'.

The aggregate must have a quality index of AA, AB, AC, BA, BB, CA or CB when tested according to NZS 4407 Test 3.11 'The Weathering Quality Index of Coarse Aggregates'.

The sand equivalent must not be less than 25 for carriageway pavement metal when the aggregate is tested according to NZS 4407 Test 3.6 'The Sand Equivalent'. Where GAP20 is to be used on the footpath, the sand equivalent must not be less than 25 when tested according to NZS 4407 Test 3.6 'The Sand Equivalent'.

a) Grading limits

When tested according to NZS 4402 Test 2.8.2 'Subsidiary Method by Dry Sieving', or Test 2.8.1 'Preferred Method by Wet Sieving' where aggregates contain clay or other fine material causing aggregation of the particles, the grading of the aggregate must fall within the respective envelope defined in the table below.

Table 34: GAP aggregate grading limits

	PERCENTAGE PASSING		
TEST SIEVE	**GAP 65**	**GAP 40**	**GAP 20**
63.0mm	100		
37.5mm		100	
19.0mm	40 - 65	63 - 81	100
9.5mm		40 - 60	52 - 76
4.75mm		25 - 45	33 - 57
2.36mm		16 - 35	20 - 44
1.18mm		9 - 27	12 - 35
600 micron		5 - 20	7 - 25
300 micron	10 max	1 - 15	4 - 20
150 micron		10 max	12 max
75 micron		7 max	8 max

b) Grading shape control

The weight in each fraction must lie within the limits defined in the table below.

Table 35: GAP aggregate grading fraction limits

FRACTIONS	PERCENTAGE OF MATERIAL WITHIN THE GIVEN FRACTION	
	GAP 40	**GAP 20**
19.00 – 4.75mm	25 – 49	-
9.50 – 2.36mm	14.36	19.45
4.75 – 1.18mm	7 – 27	11 – 35
2.36mm – 600 micron	5 – 22	6 – 26
1.18mm – 300 micron	3 – 18	3 – 21
600 – 150 micron	1 – 13	2 – 18

3.4.1.3 Granular rock fill material

This material is a non-specific rock aggregate intended for use as a subgrade improvement layer. This sub-base material must have minimum soaked CBR of 20 and a nominal maximum size. The material must be suitably graded, moderate to highly weathered quarry rock with sufficient fines to aid compaction. A minimum of 10 percent by dry mass must be un-weathered (blue) material to ensure a high level of durability. The source of supply of all materials must be nominated and the material must be tested to ensure the CBR requirement can be achieved, and test results must be provided.

The suitability of the material will be assessed on its grading, crushing and weathering resistance and clay content relative to its use. Evidence of the material's suitability will be required for acceptance by Council prior to its use.

3.4.1.4 NZTA M/4

This material must comply in all respects with NZTA M/4 specification.

3.4.2 New pavement construction

3.4.2.1 Subgrade layer

Use of stabilisation additives in the subgrade is subject to specific design and Council acceptance (see *Clause 3.3.12 Road pavement* on on page 111) as follows:

a) The subgrade layer must be constructed to meet the requirements of the pavement design and NZTA's 'Specification F/2: Earthworks Construction'. Where possible, the natural in-situ material must be used in construction of the subgrade by implementing compaction or other methods of modification to meet the required subgrade strength. Where the in-situ material is unsuitable to be used as subgrade, or is otherwise excluded from use, it must be replaced by imported subgrade material. The imported subgrade material for the pavement must be fit for purpose and must be subject to acceptance by Council before use. Options may include 'run of the pit' sand, selected quarry run rock or other material accepted by Council. The suitability of alternatives will need to be demonstrated.

b) This subgrade material, whether in-situ or imported, must be compacted to a depth of not less than 600mm. It must be placed in layers not exceeding 150mm (compacted thickness) and as close as practicable to the optimum moisture content. The material must be compacted to the specified CBR value. Measurement of CBR value must be by CBR in-situ tests or, in the case of non-cohesive material, by a suitable calibrated Scala Penetrometer test.

c) For cohesive soils, the Scala Penetrometer test may be used as a measure of uniformity. Irrespective of the CBR and Benkelman Beam results, the standard of compaction must not be less than 95 percent of the optimum dry density of the material as specified in NZS 4402 Test 4.1.1 or Test 4.1.3.

d) The entire surface of the compacted subgrade must be made smooth, firm and uniform, by blading, grading and rolling, approximating the crossfall required on the final surface. The reduced level of any point must be within the limits 0mm above to 20mm below the designed or nominated level, as established by stringing. The surface must be finished so that all points are within 15mm below a 3.0m straight edge laid at any point on the surface. See Clause 3.8.2 on page 173 for testing requirements.

e) Compaction must cease if the material shows signs of excessive weaving or heaving and must not recommence until the problem has been resolved.

f) If the compaction of the subgrade layer does not meet the required criteria then the following options are available for consideration:

- i) The council contractor may opt to carry out further compaction to achieve the required level of compaction OR
- ii) Council may choose to replace not less than 100mm compacted depth of the subgrade layer with sub-base metal. Once compacted, the surface must be trimmer to grade and retested to prove the required strength has been achieved OR
- iii) The contractor may, subject to the acceptance of Council, opt to correct the non-compliance of the subgrade by means of one of the following remediation methods:

- The use of geogrid and/or geofabric.
- Stabilisation of the subgrade.
- Stabilisation of the sub-base aggregate.
- Stabilisation of the basecourse aggregate.
- Or a combination of the above.

It should be noted that acceptance by Council of the application of one or more of the above options does not relieve the developer/contractor of the responsibility for attaining the required final pavement strength.

Note: Extended exposure of the subgrade to wet weather causes degradation of the subgrade's performance, the entire surface of the subgrade should be protected to ensure it is smooth, compacted, firm and uniform.

3.4.2.2 Recovered material

Recovered material may be specified for use as the sub-base layer for the construction of a new pavement, subject to prior acceptance by Council. Where recovered material is to be used and there is a shortfall, the recovered material must be placed first with the imported aggregate to make up the shortfall placed on top, subject to suitable depths of each being achievable for effective compaction. Recovered road pavement for reuse must have a grading curve within or close to (+/-3% at any sieve size) the grading of the specified sub-base aggregate. Recovered material is to be reclaimed in such a way that no contamination with clay occurs. No seal or asphalt from the old pavement must be included in the recovered material to be used. Other than the recovered materials consequential characteristics, the pavement layer must be prepared as specified.

3.4.2.3 Sub-base layer

NZTA's 'Specification B/2: Construction of Unbound Granular Pavement Layers' must apply except where modified by the following:

a) The sub-base layer must be constructed to the final shape shown on the accepted construction drawings.

b) No sub-base layer material must be placed until the subgrade has been satisfactorily completed and accepted by Council.

c) The reduced level of any point on the surface of the sub-base layer must be within the limits 10mm above to 10mm below the designed or nominated level as established by stringing.

d) The surface must be finished so that all points are within 15mm below a 3m straight edge laid at any point on the surface.

e) The sub-base (and basecourse if applicable) beneath the kerb and channel must extend at least 400mm beyond the back of the kerb. See Transportation drawing: Terminology.

3.4.2.4 Basecourse layer

NZTA's 'Specification B/2: Construction of Unbound Granular Pavement Layers' must apply except where modified by the following:

a) The basecourse layer must be constructed to the final shape shown on the accepted construction drawings.

b) No basecourse layer material must be placed until all previous pavement layers have been satisfactorily completed and accepted by Council.

c) The tolerances and testing requirements as described in *Clause 3.8.2 Testing guidelines* on page 173 for testing requirements.

3.4.3 Ripping and cement stabilisation

Construction of any stabilised pavement layers must be in accordance with NZTA's '*Specification B/5: In-situ Stabilisation of Modified Pavement Layers*'. Council acceptance is required for use of stabilisation techniques. See *Clause 3.3.12 Road pavement* on page 111.

3.4.4 Testing

The pavement layers must be tested and each layer accepted by Council before construction of subsequent layers begins. For details of the testing and tolerances required, see *Clause 3.8.2 Testing guidelines* on page 173.

3.4.5 Concrete works

This section covers all concrete work for footpaths, shared paths, various kerbing, kerb and channel, catchpits and vehicle crossings. These must all be formed to the dimensions shown in the following drawings:

a) Transportation drawing: Vehicle crossing and pedestrian cutdown set out

b) Transportation drawing: Vehicle crossing profiles

c) Transportation drawing: Kerb and channel profiles

d) Transportation drawing: Cross section details for footpath, vehicle crossings and depressed kerb and channel

e) Transportation drawing: Concrete vehicle slot crossings

3.4.5.2 Formwork

Where not covered in this RITS, formwork must generally comply with the requirements of NZS 3109. Wherever necessary, formwork must be used to support and confine the concrete and shape it to the required dimensions. Joints and linings must be sufficiently tight to prevent loss of water from the concrete.

All timber for formwork must be of an acceptable quality and type. For kerbs and channels, formwork must be ex 400mm material provided that 15mm timber or other suitable material may be used on short radius curves. Formwork must be of a sufficient depth to fully support vertical faces. Where it supports exposed surfaces, formwork must be long lengths dressed smooth on one face and both edges. Timber strips for chamfers must be machined all around to be true to shape and form and they must be kept in good order. Alternatively, the chamfer or bullnose may be formed with a specific floating tool or dressed fillets.

Forms must be designed to be easily removable without damaging the green concrete and must be kept thoroughly clean and oil or wax dressed to prevent adhesion of concrete or rust staining. Forms for curved kerbs must be brought to a true curve by springing the timber evenly. The shape, strength, rigidity, mortar tightness and surface smoothness of re-used forms must be maintained at all times. Warped or bulged timber is not permitted. Timber which has been used must have the surfaces which are to be in contact with the concrete thoroughly cleaned and treated before being used again.

3.4.5.3 Concrete mix and proportions

Concrete mixes must be proportioned to be workable, capable of being thoroughly consolidated by the means of compaction available and to provide the specified strength of concrete. The concrete may be either ordinary grade, high grade or special grade as defined in NZS 3109. The concrete used must be either mixed on the site or supplied ready-mixed. In every case, the concrete production must be in accordance with 'NZS 3104: Specification for Concrete Production'. The strength of the concrete as defined in NZS 3109 must be 28-day cured in-place minimum strength 20MPa for all the above works.

3.4.5.4 Placing concrete

The contractor must give due notice to Council of the time it is intended to place any concrete, and no concrete must be placed until acceptance has been obtained from Council.

Concrete must not be placed on frozen ground, nor must it be placed in unfavourable conditions which may be detrimental to the quality and finish of the concrete. Unfavourable conditions must be deemed to include:

a) Low temperatures (below 5°C with temperature descending, or below 2°C with temperature ascending)

b) Excessively hot, dry conditions

c) Excessively wet conditions

d) Or any conditions making it impractical to work and finish the concrete adequately.

Immediately before placing the concrete, the foundations must be lightly dampened, and formwork must be cleaned out. In all cases surplus water must be removed before concrete is placed. The concrete must be placed so the coarse aggregate does not separate from the fines, and it must be thoroughly worked and consolidated into all parts of the formwork, so that no voids or cavities are left. All concrete must be handled from the mixer, or from the agitator truck mixer, to the place of final deposit as rapidly as practicable by methods which prevent segregation. Unless otherwise accepted, in no case must more than 30 minutes elapse between discharge of concrete from the mixer/agitator truck and final placement. Under no circumstances must partially hardened concrete be placed in the work.

Where a channel is finished with a sand/cement mortar coat, the mortar must be placed within 2 hours of placing the concrete, provided that when hot, dry conditions are prevailing the allowable time must be reduced to 1 hour. If for any reason a delay of more than 2 hours occurs, an acceptable PVA bonding agent must be used to ensure the mortar is adequately bonded to the concrete.

Before fresh concrete is placed upon or against any concrete which has already hardened, the surface of the hardened concrete must be thoroughly scabbled, cleaned and cleared of all laitance, lose or foreign material.

3.4.5.5 Reinforcement

All reinforcement other than ties and stirrups must be deformed unless otherwise detailed. The length of lapped splices (without hooks) must be not less than 32 bar diameters in length. Steel reinforcement at the time the concrete is placed must be free from loose, flaky rust, mud, oil or other coatings that will destroy or reduce the bond. Reinforcement must be accurately placed, adequately supported and secured against displacement before or during concrete placement. The minimum cover to all main reinforcing steel must be 50mm unless otherwise specified.

3.4.5.6 Curing of concrete

Strict attention must be paid to adequate curing which is an important factor in attaining the required strength for the concrete. Immediately after placement, concrete must be protected from premature drying, excessively high or low temperatures and mechanical damage and must be maintained with minimal moisture loss for the necessary curing period and hardening of the concrete. In hot, dry weather sprinklers or damp covers will need to be used.

All concrete surfaces not in contact with formwork must be cured by the application of a curing compound conforming to *'ASTM C309: Specification for Liquid Membrane – Forming Compounds for Curing Concrete'*.

In cold or wet weather concrete must be protected from the elements during the curing period by covering with sheets of PVC or alternative acceptable material.

3.4.5.7 Machine laid kerb and channel

Contractors who intend to construct the kerbs and channels by using an extrusion machine will be required to use ready mixed concrete from a certified plant. The concrete provided must be designed so that after placement it will accurately retain its shape and present a good surface. Certification of the concrete supplied is required. No subsequent cement washing will be permitted. The machine must be capable of providing well-compacted concrete with the absence of trapped air. The machine must not be used to pour curves with radii less than 5m. For these curves the contractor must use formwork as specified. A properly shaped screed must be used in forming cutdowns.

3.4.5.8 Finished work

Methods must be used that will provide a smooth, clean and even surface on the exposed faces of all concrete work. These methods must also put the required finish directly on the structural concrete without the use of mortar renderings, provided that if specific prior acceptance by Council is obtained, the mortar must consist of not more than 2 parts of acceptable sand to 1 of cement. It must be nominally 6mm in thickness and must be placed before the initial set of the concrete and within 2 hours of placing the concrete.

Alternatively, a mortar layer to the above consistency may be applied in conjunction with the laying of the kerb and channel if the kerb and channel is laid by machine and the machine is designed for such use.

The top and face of the kerb and channel surface must be floated over with a steel tool before the mortar has finally set. No depressions which may hold water will be permitted.

The surface finishes of all kerb and channel, whether machine laid or hand laid, must be uniform in colour, texture and shape.

3.4.5.9 Contraction/expansion joints

Contraction/expansion joints must be formed or cut along the kerb at a maximum spacing of 3.0m. The slot must penetrate the concrete by not less than 50mm and the mortar dressed over the cut face. The contractor must ensure that cold joints are accurately marked so that the subsequent saw cut is in the cold joint. Should cracking occur adjacent to the saw cut a minimum section of 1.5m of kerb and channel must be removed and re-cast.

3.4.5.10 Backfilling against concrete work

Backfilling against the kerb and channel or any other concrete must take place as soon as practicable after the concrete has reached sufficient strength, with particular emphasis at curves, corners, intersections and pedestrian kerb crossings but not prior to 36 hours after pouring. Care must be taken to ensure that no damage is done to the path, crossing, kerb and channel or other concrete structure when placing and compacting the backfill.

3.4.5.11 Surface finish (footpath, shared paths and vehicle crossing areas)

All final path and vehicle crossing surfaces must be true to the lines and levels specified and 'broom' finished. Design considerations aside, the final surface must not vary by more than 5mm when checked with a 3m straight edge. No finished surface must hold water.

3.4.6 Road stormwater drainage (kerb, channel and catchpits)

3.4.6.1 Kerb and channel

Prior to work commencing the lengths of kerb and channel that are to be removed must be marked on the site and agreed with Council.

3.4.6.2 Saw cutting

Prior to removal the kerb and channel must be cut vertically and at right angles to the alignment to ensure a clean break. The existing sealed surface must be cut parallel to and at a distance of 500mm, or greater if required, from the existing channel lip. The seal must also be cut perpendicular to the kerb from the vertical saw cut to the parallel seal cut.

If the kerb and channel to be removed abuts any berm seal (e.g. sealed footpath), the sealed surface must be saw cut within 5 days, at a distance behind the kerb face suitable for reinstatement. Refer to Transportation drawing: Cross section details associated kerb and channel reinstatement within existing pavement

3.4.6.3 Excavation to pavement depth

After saw cutting, the kerb and channel and pavement must be excavated to the proposed pavement depth or deeper if required. The sides of the excavated area must be trimmed to be as near as possible to vertical. Care must be taken to ensure that undermining and/or over break does not occur during excavation. All waste material including the old kerb and channel must be removed from the site and appropriately disposed of.

3.4.6.4 Subgrade preparation

The exposed subgrade (at the required depth) must be tested using a standard Scala Penetrometer, or where improvements are made, separate lab testing/Densometer may be required. Refer to *Clause 3.8.3 Testing methods* on page 175. The prepared subgrade must be compacted to the CBR specified. If the material fails this initial test it must either be:

a) Further compacted if the material is suitable to improve the CBR value, or

b) Excavated and removed from the site then backfilled with pit sand and compacted to subgrade level.

All pit sand backfill must be compacted in lifts of not more than 100mm. The subgrade area either in-situ or imported must be trimmed and shaped to accommodate the specified lines and levels given and compacted to provide uniform support for the pavement course.

All tree roots found in the subgrade or pavement area during excavation must be removed (subject to Council arborist acceptance) and are to be severed 0.5m behind the back or front of the kerb and be removed off site. Any root greater than 50mm in diameter must be cleanly saw cut. No such roots must be cut without the prior acceptance of Council if they are within the dripline of the tree.

Note: Extended exposure of the subgrade to wet weather causes degradation of the subgrade performance, so the entire surface of the subgrade should be protected to ensure it is smooth, compacted, firm and uniform.

3.4.6.5 Kerb and channel foundation

Kerb and channel must be founded on compacted pavement material as designed with a minimum 75mm depth of basecourse. The surface of the GAP40 must be smooth and uniform, suitable for the placing of the kerb and channel concrete and extended beyond the back of kerb by at least the depth of GAP40.

3.4.6.6 Kerb and channel placing

Refer to *Clause 3.3.14.2 Kerb and channel, vertical kerb and island kerb* on page 114 for details on concrete placement.

3.4.6.7 Joining to carriageway

After the kerb and channel concrete has reached sufficient strength, the carriageway must be married into the existing carriageway (with banding) and new kerb and channel lip. If not already achieved during the kerb base construction, the carriageway must be excavated to the existing subgrade and at least 200mm deep at the channel face. The excavation base must be flat and level up to the edge of the saw cut seal. All excavated faces must be vertical.

The subgrade must be compacted to a CBR of at least 15. The pavement layers must be placed on the prepared subgrade in layers not exceeding 150mm and compacted to achieve the required design CBR.

3.4.6.8 Kerb and channel in new pavement

In accordance with *Clause 3.4.5.7 Curing of concrete* on page 141, except all references to carriageway protection and reinstatement, must not be required for this activity.

3.4.6.9 Catchpits

Refer to *Section 4 Stormwater* on page 183 for details. Section 4 also shows a list of the permitted precast components. The construction specifications are also described.

Catchpits must be accurately positioned so that the grade and kerb block fit neatly into the kerb and channel. Rectangular pits must be oriented with the longer side parallel to the kerb. Grates are to be cycle friendly. See Stormwater drawings: Catchpit Back Entry Details
Double Catchpit Design
Vertical Entry Catchpit

3.4.6.10 Subgrade drainage

Refer to Transportation drawing: Location of subsoil drainage for details. NZTA's *'Specification F/2: Pipe Subsoil Drain Construction'* and *'F/5: Corrugated Plastic Pipe Subsoil Drain Construction'* must apply.

Where subsoil drains are required, as shown on Transportation drawing: Location of subsoil drainage or directed by Council, they must be placed behind the kerb unless shown or directed to be in front of the kerb. The subsoil drains must consist of an accepted filter drainpipe, 100mm to 150mm diameter or equivalent, in a trench backfilled with an accepted filter material around the conduit. The conduit must have a grade not less than 1:200 to discharge into the catchpit, or other suitable outlet accepted by council. It must have proprietary rodding/clean access points.

The subsoil drains must be laid below the natural subgrade to ensure no water infiltrates the pavement layers, unless subgrade improvements are proven to be 'waterproof'.

3.4.6.11 Additional subsoil drainage

Where directed, any permanent wet spot in the subgrade must be drained to the subsoil drain. Where the wet area is below the level of the subsoil drain, it must be drained by connecting to the nearest stormwater system.

3.4.6.12 Other requirements

NZTA F/2 filter material must not be used as a filter material in close proximity to HDPE slotted pipe. Unless otherwise designed and accepted by Council, pea-metal must be for backfilling around HDPE slotted pipe. Where backfilling a subsoil drain with filter material the minimum cover must be 100mm. Where a strip drain is accepted, backfill is to be permeable sand. The invert of subsoil pipes at the catchpit must not be less than 100mm above the invert of the catchpit outlet.

3.4.7 Road surfacing construction

The relevant NZTA specifications listed in Clause 3.2.2 Reference documents apply to road surfacing procedures and materials. Exceptions to the specifications include:

a) All references to the basis of payment contained within the specifications are deleted.

b) Reference to the contractor's obligation with respect to the foreshortening of the maintenance requirements of the seal coat (NZTA P/3 and P/4) is deleted.

Application rates, cutback percentage and the percentage of adhesion agent is to be specified by the developer/contractor and forwarded to Council with design calculations for acceptance at least 24 hours prior to application. For both first and second coat chip seal, the bitumen application must extend over the lip of the kerb and channel, but not by more than 25mm.

3.4.7.2 Waterproofing first coat chip seal

Refer to NZTA P3 for details.

Also refer to *Clause 3.4.7.4 Removal of surplus chip* below.

3.4.7.3 Chip seal resealing

This treatment must be applied on carriageways to produce a uniform texture on surfaces that have an existing seal coat and potentially repair patches.

Prior to resealing all surfacing and pavement effects must be repaired. The resealing must not be applied until 28 days after asphalt patching or levelling has been completed, or the basecourse repairs have been two-coat sealed.

The second coat chip seal must be carried out 12 months after the waterproofing first coat and must consist of spraying 180/200 penetration grade bitumen. The bitumen must be cut back to suit, include 1 p.p.h adhesion agent and be applied at the rate of 1.3 litres/m² residual (measured at 15°C). The chip layer must consist of the supplying, spreading and rolling of Grade 5 chip. If required by Council, a dry locking coat of Grade 5 or 6 chip must then be supplied and applied at a rate of 300m²/m³.

3.4.7.4 Removal of surplus chip

When the sealed surface is to be opened to traffic, all surplus chip must be removed within 48 hours of the completion of rolling. For sites that are not open to normal traffic, chip sweeping may be delayed but must be completed before opening the road to normal traffic. All surplus chips must be removed from grass berms, driveways, parking areas and footpaths. Follow up sweeps will be required to ensure that all loose chip is collected and removed from the site for a period of one month following chip application.

3.4.7.5 Asphaltic concrete

All asphalt concrete surfacing must be designed by a suitably qualified and experienced professional and laid in accordance with NZTA's 'M10 2020 Specification for Dense Graded Asphaltic Concrete.'

Where design traffic volumes in residential areas are less than 80 lots (exclusive of development construction traffic and lot construction traffic), and there are no additional turning stresses created by intersections, a single coat Grade 5 membrane seal must be used with a residual bitumen application rate of 1 L/m².

Where traffic volumes are higher or there are greater stresses, a waterproofing chip seal must be applied to the prepared basecourse surface in accordance with *Clause 3.4.7.2 Waterproofing first coat chip seal* on page 144. The asphaltic concrete must be placed no sooner than 14 days after the application of the waterproofing chip seal. Asphaltic concrete paving must consist of the supply and spraying of a tack coat with a quick breaking bituminous emulsion at an application rate of 0.3 litres/m² and the supply, spreading and rolling of asphaltic concrete or an alternative mix as accepted by Council.

For residential roads with less than 300 houses/units (exclusive of development construction traffic and site construction traffic), or have greater stresses due to intersections, the default asphalt design is an NZTA M10 AC10, with a minimum thickness of 35mm.

For commercial/industrial, collector or arterial roads, or any roads that have > 3,000 vpd (exclusive of construction traffic and lot development traffic) a specific design must be accepted by Council.

High turning stresses from HCVS have a detrimental effect of AC surfacing particularly DG grade surfacing. In all cases the design must consider construction traffic volume and mix of traffic during construction (particularly where the road is to be used during a staged development) and during construction of the various lots. This must be clearly identified in the design. In some cases, the surfacing may be subject to an extended defects liability period especially for staged developments where the road is being used by construction traffic or there is risk of damage over and above normal wear and tear.

The asphaltic concrete must ramp to transition back to the adjacent existing surfaces as illustrated in Transportation drawing: A/C overlay v-ramp detail

3.4.7.6 Block paving – carriageway

Block paving is not acceptable on roads to be vested, however imprinted asphalt/slurry surfacing to create patterns/ urban form may be accepted by Council. For other areas where block paving is proposed the following is required

a) Bedding course for block paving

All bedding course must be laid in accordance with either Clay Paving Design and Construction or 'NZS 3116: Concrete Segmental and Flagstone Paving' and comply with Transportation drawing: Cross section details for footpath, vehicle crossings and depressed kerb and channel

b) Laying of paving blocks

All paving blocks must be laid in accordance with NZS 3116.

c) Edge restraints

Refer to Transportation drawing: Timber edging details for chip seal, asphalt and block paving for details of the type of edge restraint. Edge restraints must be one of the following:

- Kerb and channel.
- Traffic island kerb.
- Concrete separating strip.
- Paving blocks on edge cast in concrete.
- Timber edging.

All pavers must be cut using a power saw unless specified otherwise.

3.4.7.7 Line marking reinstatement

Line marking must be applied within 48 hours of applying surfacing or in the case of ship seal within 48 hours of the surface being swept. If the road is not open to the public, this may be delayed but it must be carried out before the road is opened. A re-mark may be required prior to vesting, depending on wear and deterioration of the marking and monitored during defects liability period.

3.4.8 Berms

Berms will typically be grassed but may be landscaped if it is impracticable to maintain as grass. All berms and landscape planting design and implementation within the road reserve must be in accordance with Transportation drawing: Cross section details typical berms, *Clause 7.3 Construction* on page 348 and *Clause 7.4 Defects liability* on page 357.

Berms that are to be grassed must:

a) Have a minimum subgrade of CBR 7.

b) Have a minimum compacted depth of topsoil of 75mm.

c) Be seeded in accordance with *Clause 7.3.6 Grassing, sowing and turfing* on page 351.

d) Be free of debris and perennial weeds.

Berms are to be mown during the defects liability period as well as prior to take over by Council.

3.4.9 Footpaths, cycle paths and vehicle crossings

This section outlines the work required to construct, reinstate or repair footpaths, vehicle crossings and away-from-road cycle paths.

3.4.9.1 Alignments, lines and levels

The edge lines of kerbs, footpaths, shared paths and vehicle crossings must be perfectly straight between tangent points, and on curves must sweep round without kinks, flats or angles in a smooth, true arc to the radius shown or directed.

Design levels and alignments must be strictly adhered to and the grade from level peg to level peg must be even, provided always that at changes of grade the angle between the grades must be eased so as to form a vertical curve or other form of smooth transition. The entire berm area must fall at an even grade where possible from the property boundaries to the kerb and channel.

3.4.9.2 Breakout, removal and disposal of existing berm features

All existing berm features that are to be removed must be broken up and lifted out to reduce damage to the surrounding features. The outer limits of these features must be saw cut, except in the case of paving blocks or grass verges, before removing to provide a tidy interface between existing and replacement work.

Where salvaging of materials (e.g. catchpits, gratings, frames, stormwater piping) is specified, care must be taken to ensure that as little damage as possible is done to materials. Such units must be neatly stacked on the site such that they do not obstruct any footpath, vehicle crossing or roadway until they are taken off site. All materials not for reuse must be removed from the site and appropriately disposed of.

3.4.9.3 Subgrade preparation

Excavation must be to the pavement depth as shown on Transportation drawing: Cross section details for footpath, vehicle crossings and depressed kerb and channel. The width of all excavation must be no wider than necessary to construct or reinstate the various berm features. Where excavation adjoins existing berm features or carriageways, care must be taken not to undermine the existing surfacing while material is being removed. The sides of the excavated area must be trimmed to as vertical as possible without being unstable or causing undermining.

3.4.9.4 Subgrade preparation

The exposed subgrade (excavated to trial subgrade level or pavement depth) must be tested by using a Scala Penetrometer for compliance with the following CBR values:

a) In footpath, cycle paths and traffic island infill CBR value >10

b) In vehicle crossing and kerb and channel areas CBR value >15

If the material fails this test then:

c) The existing subgrade must be further compacted to improve the CBR value or if this is not practicable.

d) The unsuitable material must be excavated, removed from the site, replaced with pit sand and compacted up to the trial subgrade level.

When undercutting of the subgrade is required (the second option above) the excavation depth and extent must be instructed by Council. As a minimum, it is to extend 100mm past either side of the edge boards, or the outer limits of the construction area.

Note: Small pockets of material may require treatment rather than the entire subgrade area.

All pits and backfill must be compacted in lifts of not more than 100mm. The subgrade area, either existing or reinstated, must be trimmed, shaped and compacted to provide uniform support for the pavement course. All tree roots found in the subgrade or pavement area during excavation must be removed. They must be severed at least 200mm outside the excavation area, removed from the site and disposed of. Any root greater than 50mm in diameter is to be cleanly sawn. No such roots within the drip line of the tree must be cut without the prior acceptance by Council.

Note: Extended exposure of the subgrade to wet weather causes degradation of the subgrade performance so the entire surface of the subgrade should be protected to ensure it is smooth, compacted, firm and uniform.

3.4.9.5 Timber edging for asphalt and paving block

All footpaths, cycle paths and vehicle crossing edges must be contained by either a concrete kerb or edging, or by treated timber edge boards which must form part of the finished work. Edge boards must be held firmly in place with wooden pegs (50 x 25mm) or battens nailed to the outer edge at no greater than 1.0m centres and at every joining board. The pegs must be a minimum length of 225mm or longer to be driven down into solid unyielding ground. Batter stakes may be used as pegs driven down into firm ground and trimmed to the correct length. All pegs must sit 15 to 25mm below the top level of the edge boards.

Edge boards must be joined with 400mm long boards (either edge board offcuts or 75 x 25mm timbers) which span the joint evenly and are nailed firmly in place at the rear of the edge boards. The top of the joining boards must sit 15 to 25mm below the top level of the edge board. The spacing of wooden pegs must be adjusted so that a peg is positioned alongside every joining board. Refer to Transportation drawing: Timber edging details for chip seal, asphalt and block paving

All timber edging must be backfilled outside the construction area as necessary to protect the timbers from being damaged or distorted during the preparation and compaction of the pavement course. All edge boards must be set out using string lines and must be true and straight at the completion of the work. All edge boards and pegs will use H4 or H5 treated timber. If directed by Council, existing timber edging in good condition must be adjusted for level, repegged and incorporated in the new footpath or vehicle crossing. At all times, excavation for timber edging replacement, installation or adjustment must be the minimum required to provide adequate workspace. Where the path edge adjoins existing kerb, the top of the kerb must be treated as the top of the edge board.

3.4.9.6 Pavement basecourse

The pavement basecourse must be constructed of bedding sand and/or GAP metal and be compacted to a pavement depth conforming to Transportation drawing: Cross section details for footpath, vehicle crossings and depressed kerb and channel

For asphalt footpaths and cycle paths, the final pavement surface must have a tight stone mosaic surface with no loose aggregate suitable for the application of a tack coat and an asphaltic layer. A skin of GAP 20 may need to be added to GAP 40 areas and compacted into place to achieve this. All pavement courses must be compacted to refusal in lifts of not more than 100mm.

3.4.9.7 Concrete surfacing

Concrete surfacing must be carried out in accordance with *Clause 3.4.5 Concrete works* on page 139.
Where concrete paths are to be constructed steeper than 1:8, a permanent non-skid surface must be provided (broom finish or similar). For grades >1:8, and where the footpath is adjacent to the road, ramp platforms or a zig zag design (refer to previous design section requirements) is required. For cross section detail, refer to Transportation drawing: Cross section details for footpath, vehicle crossings and depressed kerb and channel

In concrete paths, crack control lines must be formed or cut at vehicular crossing/footpath edges and along the path at a maximum spacing of 5.0m. All crack control lines must be 25mm deep.

The use of a concrete surface / exposed aggregate finish on public roads must be specifically accepted by Council prior to construction.

3.4.9.8 Asphalt surfacing

All asphalt must be designed by a suitably experienced professional and laid in accordance with NZTA's M10 2020 Specification for Dense Graded Asphaltic Concrete '

The prepared pavement must be swept to remove all loose metal and debris prior to the application of a tack coat. The tack coat must be applied to all surfaces where the asphalt material will be placed and generally at an application rate of 0.25 litres/m².

For entrance ways, asphalt mix must be laid to the compacted depths show on Transportation drawing: Rural entranceways - residential, light and heavy commercial or '. Vehicle Crossing & Pedestrian Cutdown Set Out The final surface must be flush with the top of the edge boards and graded uniformly between. Depressions or irregularities that may cause water to pond will not be accepted in the finished surface.

3.4.9.9 Asphalt overlay

Where an asphalt smoothing or overlay is proposed, a specific design is required by a suitably experienced professional in accordance with NZTA M10 2020 Specification for Dense Graded Asphaltic Concrete

The existing surface must be swept to remove all loose metal and debris prior to the application of the tack coat. AC10 must be used to smooth irregularities up to a compacted depth of 20-50mm and AC20 must be used for compacted depths of 50mm and greater, with the final AC surface as per the design.

3.4.10 Private ways

All private ways must be designed by a suitably experienced professional and take into account all factors such as traffic type, grade, subgrade strength, stormwater treatment such as swales / flow paths etc Complete form 'Confirmation of design, supervision and construction' Transportation: Privateway design confirmation

Transportation: Privateway Construction Materials

3.4.10.1 Urban

All urban private ways must be:

a) Concrete

For concrete pavements:

i) The minimum depth of concrete is 125mm for private ways serving 2-4 household units.

ii) The minimum depth of concrete is 150mm for private ways serving 5-10 household units.

Concrete is to be placed on a sub-base of 75mm of compacted GAP 20 on a compacted subgrade with CBR ≥10. For subgrade criteria <15 CBR, subgrade improvements are to be made to bring the subgrade strength up to a CBR of 15.

b) Other

Pavement may be interlocking block pavers. Refer to *Clause 3.4.7.6 Block paving – carriageway* on page 145 for specifications.

Stormwater must not discharge across the vehicle crossing from the private way to the public road. Vehicle crossings to private ways must be designed and constructed in accordance with *Clause 3.3.19 Vehicle crossings/entrances* on page 121 and Transportation drawing: Vehicle crossing and pedestrian cutdown set out

3.4.10.2 Rural

All rural residential private ways must have:

a) Pavement GAP 40 minimum depth 150mm.

b) Subgrade minimum CBR 15 continuous over a depth of 600mm. For subgrade criteria <15 CBR, subgrade improvements are to be made to bring the subgrade strength up to a CBR of 15.

c) The pavement must be sealed with 3/5 two coat seal in accordance with *Clause 3.4.7 Road surfacing construction* on page 144.

3.4.11 Road signs

3.4.11.1 Scope

This section covers the specifications for the supply and installation of all road signs, noting Waipā District Council's requires green background signs in Te Awamutu township (only) if applicable.

3.4.11.2 Standards

All signs are to be constructed and installed in accordance with the relevant specifications detailed in *Clause 3.2.2 Reference documents* on page 94, in particular the 'Traffic Control Devices Manual', NZTA P24:2020 Specification for Permanent Traffic Signs, and the following:

a) Signs must be Class 1100 wide observation angle (VIP or equivalent) reflective sheeting.

b) The face of all signs must be rivet less.

c) The back of all signs must be coloured 'aircraft grey' No. 693 as referred to in BS381C, or similar, with a semi-gloss finished unless otherwise stated. 'Slate grey' (in accordance with the NZTA specifications) is an acceptable alternative.

d) All signs are to have an aluminium substrate.

e) Regulatory, warning, street name plates and information signs must be Class 1100 reflectorised sheeting.

f) Parking signs must be non-reflective.

g) Where the option exists for square or radius corners, radius corners must be supplied.

3.4.11.3 Attachment

Signs must be attached to posts or overhead gantries using Signfix or equivalent brackets as accepted in per *Section 8 Acceptable products* on page 365. The contractor must be responsible for determining sign mounting requirements.

3.4.11.4 Poles

Steel poles are to be either NB 56 or NB 65 poles appropriate to the type and size of sign required and in accordance with *Table30: Pavement layer thickness for local residential roads* on page 113. Poles are to be powder coated white. All poles are to be capped with power coated top caps to match the pole.

Timber poles must be 100 x 100mm H4 dressed framing grade 1 or 2, pre-painted using one undercoat and two topcoats of high gloss exterior white paint.

3.4.11.5 Site installation details for posts and poles

Where installation and/or reinstatement work is required within a sealed surface, the surface must be saw cut around the perimeter of the excavation. The replacement surfacing must be of a material and placed to match the existing surrounding surfacing.

3.4.11.6 Typical sign installation and location

All signs must be located in accordance with the NZTA's 'Traffic Control Devices Manual' *and* 'Manual of Traffic Signs and Markings (MOTSAM) Part 1: Traffic Signs'. Additional specifications in the table below must also apply.

Table 36: Additional signage specifications

SIGN TYPE	POLE TYPE	POLE LENGTH	HEIGHT	LOCATION
Regulatory	NB 65		• 2.5m BOS[48] (above a footpath) • 2.0m BOS (in traffic island)	• Longitudinal offset: – 5m (±1m)[49] from tangent to intersecting road kerb line (behind kerb line) – 3m from island nose (in traffic island). • Lateral offset: – poles must not be closer than 500mm from kerb line. – sign must not be closer than 500mm from kerb face – in centre of traffic island with a maximum offset of 1m from island kerb face.
Warning	NB 56	3.7m	• 2.0 BOS • 2.5 BOS when above a footpath	• In centre of traffic island • 500mm lateral offset between sign and kerb line.
Information	NB 56	3.7m	• 2.0 BOS • 2.5 BOS when above a footpath	
Free turn	NB 56		• 250mm BOS	• 1.5m from traffic island nose • in centre of traffic island • 500mm lateral offset between sign and kerb line.
Street name	NB 56	3.7m	• 3.0m TOS[50] (measured to upper blade)	• Lateral offset: – minimum 500mm, maximum 1500mm between closest part of name signs and kerb or seal edge – part of the sign's blade should be located within 1500mm of the kerb face but provide at

[48] Dimension is the clearance between the bottom of the sign and the top of the adjacent footpath/berm/traffic island.
[49] Tolerance to accommodate possible site constraints.
[50] Dimension is the clearance between the top of the sign and the top of the adjacent footpath/berm/traffic island.

SIGN TYPE	POLE TYPE	POLE LENGTH	HEIGHT	LOCATION
				least 500mm clearance to the kerb face or edge of seal where this is not possible, the signs may be reserve mounted as long as the footpath is not obstructed. • Refer to drawings: – Transportation drawing: Street name sings arterial/collector intersection. – Transportation drawing: Street name signs - arterial or collector intersection with local road. – Transportation drawing: Street name signs - local/local intersection – Transportation drawing: Attachment of street name sign blades to poles. – Transportation drawing: Street name plate
Tourist sign	NB 56	3.7m	• 2.0 BOS • 2.5m BOS when above a footpath	
Route marker	NB 56	3.7m	• 3.0 TOS	
Truck bylaw	NB 56	3.7m	• 2.0 BOS • 2.5m BOS when above a footpath	• Refer to Transportation drawing: Through truck route marker.
No stopping	NB 56	3.25m	• 2.7m TOS • 2.4m BOS is sign is for Orbiter route	• 1m from end of park
Bus stop supplement sign			• Aligned to the top of the associated Bus Stop sign	• Refer to Transportation Drawing: Bus stop/taxi supplement oriented at 90 degrees to adjacent kerb face or edge of seal such that it can be seen by approaching motorist.
Taxi stand	NB 56	3.25m	• 2.7m TOS	• 1m from end of park.
Taxi stand supplement sign			• Aligned to the top of the associated Taxi Stand sign	• Refer to Transportation Drawing: Bus stop/taxi supplement oriented at 90 degrees to adjacent kerb face or edge of seal such that it can be seen by approaching motorist.
Loading zone	NB 56	3.25m	• 2.7m TOS	• 1m from end of park.
Parking	NB 56	3.25m	• 2.7m TOS	• 1m from end of park.
Mobility parking	NB 56	3.25m	• 2.7m TOS	• 1m back from end of park.

SIGN TYPE	POLE TYPE	POLE LENGTH	HEIGHT	LOCATION
Keep left	Knock down socket	750mm	• 250mm BOS	• 1.5m from traffic island nose • Refer to Transportation drawing: Sign location and visibility at intersections
Diverge sign	Knock down socket	750mm	• 250mm BOS	• 1.5m from traffic island nose • in centre of traffic island • 500mm lateral offset between sign and kerb line
Chevron board	NB 56	1.1m	• 750mm TOS[51]	• Refer to Transportation drawing: Installation of chevron or route and low level road name sign
Chevron in roundabout			• 750mm TOS[52]	• 1m from kerb face and perpendicular to sight line of approaching vehicles approximately 50m from intersection • Refer to Transportation drawing: Installation of chevron or route and low level road name sign
Route sign (in place of chevron in roundabout)			• 750mm TOS • 100mm BOS if the area is not planted	• Lateral offset – 500mm from kerb face to sign – if no kerb, ≥1.5m from the edge of seal.
Median island low level street name	NB 56	1.1m	• 750mm TOS	• Refer to Transportation drawing: Installation of chevron or route and low level road name sign
Route shield	NB 56	1.1m	• 750mm TOS	
ADS sign (on 2 poles)				• Specific design required.
All signs installed adjacent to cycleways or shared paths must have a minimum clearance to the bottom of the sign of 2.3m.				

3.4.11.7 Parking signs

Parking signs must be as detailed in the 'Traffic Control Devices Manual'.

3.4.11.8 Signs on cycleways or shared walkways/cycleways

Refer to Transportation drawing: Cycle signage for off road cycle paths for signage of shared cycle path start and end points.

3.4.11.9 Street name signs

a) Design

Street name signs must be designed in accordance with the 'Traffic Control Devices Manual – Part 2: Direction, service and general guide signs' and *Table 36: Additional signage specifications* on page 151. On no-exit roads, a 75mm tall separate supplement plate must be attached to the bottom edge of the street name sign. All signs are to be double sided, except those on medians or at the head of 'T' intersections. Repeater plates of the primary road must be erected at every intersection.

[51] Consideration should be given to road vertical alignment when determining sign height.
[52] Consideration should be given to road vertical alignment when determining sign height.

b) Legend

The standard abbreviations listed in ‘Traffic Control Devices Manual – Part 2, Direction, service and general guide signs’ must be used with the addition of the term ‘Rise’ (no abbreviation necessary). These abbreviations must have a letter height of 50mm and 75mm for secondary and primary streets respectively.

c) Location of street name signs

Street name signs are to be located in accordance with *Table33: Guidelines for typical lighting schemes* on page 127. If there is a utility pole in the proposed location then the signs must be attached to it (see Note 4 of Transportation drawing: Attachment of street name sign blades to poles.

Street name signs at signalised intersections must be installed in accordance with Transportation drawing: Street name signs at signalised intersections

Poles must either be NB 56 or NB 65 steel poles as appropriate to the type of sign required.

3.4.11.10 General interest signs (formerly referred to as Amenity Signs)

Refer to the relevant section in the ‘Traffic Control Devices Manual – Part 2’.

a) Design

General interest signs are to be in accordance with the following specification:

Table 37: General interest sign specification

ITEM	DETAILS
Letter height	125mm
Letter styles	As for street name signs
Letter spacing	As for street name signs
Background depth	175mm
Blade profile	90 degree cuts at both ends
Colours	Blue reflectorised lettering on a white reflectorised background and all reflectorisation is to be to the engineering grade.
Arrows	Blue reflectorised triangular arrow at the end of sign plates. Refer to: • Transportation drawing: Street name signs - arterial/collector intersections • Transportation drawing: Street name signs - arterial collector intersection with local road • Transportation drawing: Street name signs local/local intersection

b) Location

General interest signs are to be located in accordance with the following specification:

Table 38: General interest sign locations

ITEM	DETAILS
Height of sign blade	As for street name signs
Lateral offset	As for street name signs
Number of signs	Maximum of 2 general interest signs per facility

Note: In addition to standard mounting requirements Transportation drawing: Attachment of street name sign blades to poles and Transportation drawing: Street name signs at signalised intersections General interest signs are to be attached below existing name signs.

3.4.11.11 Route, guide, service and tourist signs

The location and requirements for destinations, routes and facilities to be used on route, guide, service and tourist signage will be advised by Council's transportation team. Refer also to the 'Traffic Control Devices Manual – Part 2'.

3.4.11.12 School patrol signs

Signs must be manufactured and installed in accordance with Transportation drawing: School patrol signs.

3.4.11.13 Kea crossing flag and pole

KEA crossing design is to be in accordance with NZTA Traffic Note 29 – Revision 2. Kea crossing flags and poles are to be constructed and installed in accordance with Transportation drawing: Kea crossing flag and Transportation drawing: Kea crossing flag pole.

3.4.11.14 Overhead gantries

Overhead gantries must be individually designed in accordance with and must comply with the requirements of NZTA's 'Highway Structures Design Guide 2016' and NZTA Bridge Manual 'SP/M/022'.

The design must include structural and environmental requirements, the provision of safe maintenance access to the structure, and must meet the following additional requirements:

a) The gantry design will depend on the proposed size of sign and hence loading and ground clearance.

b) Sign mounting uprights must be spaced at no greater than 900mm centres.

c) Overhead gantries may be constructed from either a single piece welded or a bolted outreach arm.

d) Gantries must be hot-dipped galvanised after fabrication. All mount bolts must be galvanised.

e) If the sign support(s) is not considered frangible then it must either be protected by a compliant M/23 barrier system or mounted on frangible posts.

The layout drawings for the site locations of all structures and associated maintenance access and traffic barriers must be submitted to a nominated safety auditor for a Stage 3: Design Safety Audit. The contractor must amend the site layout design to comply with the safety audit recommendations or must submit to the engineer a proposal that has been prepared by a qualified traffic consultant that modifies the safety audits recommendations but does not compromise the intention of the recommendation.

No work must be undertaken on the gantry until the design is accepted in writing by the engineer.

3.4.11.15 Edge marker posts for rural roads

All edge marker posts (EMP) must be constructed in accordance with the NZTA's 'Specification M/14: Edge Marker Posts'. EMPs must be located on rural roads only and in accordance with the 'MOTSAM – Part 2: Markings'.

3.4.11.16 Semi-rigid barriers (w-section)

All barriers complete with reflective inserts are to be constructed in accordance with the NZTA's specifications and standard:

a) M/17P: Specification for W-Section Bridge Guardrail.

b) P/15P: Fabrication and Assembly of Standard Guardrails and Handrails for Highway Bridges and Bridge Approaches.

c) M23: Road Safety Barrier Systems.

d) AS/NZS 3845.

3.4.11.17 Wire rope barriers

The specification and guidelines for road safety hardware and devices NZTA M23:2022 must be followed. Specific acceptance by council must be obtained.

3.4.11.18 Timber sight rails

All painting of timber sight rails must be completed with at least 2 finish coats of water-based commercial grade white paint. All dirt, grime and loose, flaky paint must be removed from the surface prior to painting. It may be necessary to undercoat in some areas. All painting is to be carried out in accordance with the manufacturer's specifications.

Timber sight rails are a feature to assist with road / footpath alignment readability and are not a substitute for a roadside safety barrier.

3.4.11.19 Themed street furniture (bins, seats, specialised lighting etc.)

Council may have towns or suburbs with a particular street furniture theme. For details of these themes, refer to council.

3.4.11.20 Wheel stops

All wheel stops must be standard pre-cast rubber units with the top of the wheel stop being no more than 100mm above the adjacent surface. **The type to use must be agreed with Council prior to installation.**

3.4.11.21 Wayfinding signage

Wayfinding signage is subject to additional specifications and requirements. See NZTA's 'Cycling network Guidance' and HCC's 'Biking and Micromobility Code of Practice'. .

3.4.12 Pedestrian barrier rails and handrails

Pedestrian barrier rails and handrails must be constructed and installed in accordance with the following:

a) Transportation drawing: CBD pedestrian barrier

b) Transportation drawing: Pedestrian balustrade barrier

c) Transportation drawing: Pedestrian barrier details

d) Transportation drawing: Pedestrian accessway fence detail

3.4.13 Walkway barriers and cycle racks

All walkway barriers and cycle racks must be constructed and installed in accordance with the following:

a) Transportation drawing: Bike rack - ribbon style

b) Transportation drawing: Bike rack - hoop style

c) Transportation drawing: Pedestrian handrail or walkway barrier

3.4.14 Bus stops

This section covers the supply and installation of all components necessary for a bus stop including signage, seats, raised accessible kerb lines and bus shelters.

3.4.14.1 Standards

All bus stops must be constructed in accordance with the NZTA's 'Guidelines for Public Transport and Infrastructure and Facilities', unless Council has requirements which vary from the above standard.

3.4.14.2 Signage

All signage must be installed in accordance with the requirements set out in *Clause 3.4.11 Road signs* on page 150. However, some locations may require supplementary bus stop signs. See Transportation drawing: Bus stop/taxi supplement.

3.4.14.3 Seats

Where seats are required, but there is no shelter, they must be in accordance with Transportation drawing: Bus stop seat - no shelter. Materials and colour to be confirmed by Council.

3.4.14.4 Accessible kerb lines and tactile paving

Where specified, accessible kerb lines and tactile paving must be installed in accordance with the 'Auckland Transport Design Manual' and Transportation drawing: Tactile paving for vision impaired and Transportation drawing: Accessible bus stop

3.4.14.5 Shelters

Bus shelters must be installed as instructed by Council and in accordance with Transportation drawing: Standard 3.5m bus shelter foundation detail and Transportation drawing: Bus shelter and mini bus shelter. The large size bus shelter must be used in all locations except where an installed shelter would narrow the adjacent footpath to less than 1.2m. The mini shelter must be installed instead. Where the shelter is to be located on a shared path, the location of the shelter must be carefully considered to prevent conflict between passengers alighting buses and other shared path users such as cyclists and scooter users. The preferred location is on the roadside of the shared path so that bus service users are not required to cross the shared path. Early engagement with Council is required. Bus shelters must be painted/power-coated in black semi-gloss.

3.5. LINE MARKING

This section covers all aspects of line marking, including the supply and fixing of reflective and/or non-reflective road studs and delineators, and the removal of line marking.

3.5.1 Setting out and timing

The proposed line marking is to be set out in accordance with the accepted drawings, and any location marking out provided by Council, with modifications as necessary to make the 'lines' pleasing to the eye. Where there are inconsistencies between the line marking layout plans and the NZTA specifications, the line marking layout plans must prevail.

Council's acceptance of the set out is required prior to marking. In order to achieve this with the least delay, at least 48 hours' notice prior to acceptance being required must be given to Council.

Incorrect line marking that has been applied without acceptance of the set out must be removed at no cost to Council.

On new surfaces, marking of centreline, limit lines and other intersection markings such as 'give ways' must be completed before the road is opened to the public. For roads that are not open to traffic, such as new subdivisions, markings must be completed before the road is opened to the public. Other markings on new surfaces must be completed within 7 days of surfacing. For other works such as line removals or maintenance, timing will be specified by Council.

3.5.2 Paint types

At a minimum all paint must at least conform to NZTA's specifications 'M/7: 'Class A' type' *and* 'P/12'. All new line markings must generally be waterborne/acrylic. Chlorinated rubber or alkyd is to be used for arterial and collector roads on their final surfacing. Thermoplastics are to be used in CBD areas. Alkyd paint must be used on the sites that are to be re-marked with thermoplastic paint at a later date.

3.5.2.1 Waterborne/acrylic paint

Waterborne paint must be applied in accordance with NZTA specifications '*P/12'* and '*M/7'* with the following amendments:

a) NZTA P/12 - Clause 13.1(a) replace with: 'The finished dry film thickness must be 300 microns or greater as defined by the equation in NZTA P/12'.

All waterborne/acrylic markings are to be reflectorised in accordance with NZTA *P/22*.

3.5.2.2 Alkyd paint

Alkyd paint must be applied in accordance with NZTA specifications 'P/12' *and* 'M/7' with the following amendments:

a) NZTA P/12 - Clause 13.1(a) replace with: 'The finished dry film thickness must be 180 microns or greater as defined by the equation in NZTA P/12'.

3.5.2.3 Chlorinated rubber

Chlorinated rubber or similar paint must be applied in accordance with NZTA specifications 'P/12' and 'M/7' with the following amendments:

a) NZTA P/12 - Clause 13.1(a) replace with: 'The finished dry film thickness must be 220 microns or greater as defined by the equation in NZTA P/12'.

All chlorinated rubber markings are to be reflectorised in accordance with NZTA *P/22*.

3.5.2.4 Thermoplastic

Where long life or thermoplastic materials are specified, they must be supplied and applied in accordance with NZTA M/20 specification. The type of long-life material proposed to be used and details how it meets the NZTA M/20 specification must be submitted with any tender or proposal.

3.5.2.5 Re-markings

A re-mark will be required within 3-6 months (or prior to completion of defects period if shorter) depending on wear and deterioration of the markings. This re-mark will be with the final paint type specified in *Clause 3.5.2 Paint types* on page 158. Acceptance must be obtained from Council prior to completing this re-mark to determine the paint type and final layout of the line marking.

3.5.3 Equipment certificates and staff competence

All line marking equipment used for applying paint and glass beads must have a current NZTA T/8 certification and be in a certifiable condition. All line marking equipment used for applying long life or thermoplastic materials must have a current NZTA T/12 certification and be in a certifiable state.

The senior operator of each road marking crew must have at least a minimum qualification accepted by the Industry Training Organisation (ITO). At least 1 person in each road marking crew must be a qualified traffic controller (TC) in accordance with NZTA CopTTM, which is soon to be replaced by the Worksafe Guidelines. Note that the qualification requirements are likely to be changed.

3.5.4 Raised pavement markers (RPM)

All reflectorised pavement markers are to be glass faced (long life) or equivalent with *NZTA Specification M/12* type acceptance. All pavement markers are to comply with NZTA M/12. Installation of raised pavement markers must comply with NZTA M/12, and MOTSAM. Further to this Council may require specific RPM layouts in certain locations.

Where 'active' RPMs are specified, these must incorporate solar panels and LED lights so that they do not rely solely on reflected light.

3.5.5 Removal of line marking

When redundant line markings require erasure, Council will specify the method to be used, noting that black paint is not recommended.

3.5.5.1 Removal

When ‘removal’ is specified, the line marking material (paint or thermoplastic) must be removed from the road surface. Typical methods include grinding, sandblasting (wet or dry) and ultra-high-pressure water cutting, but other methods may be considered acceptable by Council. Care must be taken so that damage is not caused to the underlying road surface and that ‘ghosting’ of the marking does not occur.

Once complete, the surrounding area must be swept clean of all sand, paint chips or other debris. This material must be suitably disposed of with care being taken to ensure that no solid matter enters any waterway or stormwater system as a result of the removal operation. This may require the placement of filters or similar on catchpits and other drainage features.

Details of methodology, including materials to be used, equipment, staff skills and qualifications and quality assurance must be supplied with tenders or proposals.

3.5.5.2 Cold applied plastic blackout

Permanent erasure of markings may be specified to be carried out with cold applied plastic (CAP) material.

Existing long-life markings or multi-layered line markings should be ground off before applying CAP Blackout. The base coat must be a two-component cold plastic, designed and formulated for use as a road marking material and complying with NZTA Specification ‘M/20’. The CAP must be pigmented to a grey or charcoal colour that is close to the colour of the existing road surface. The product must be mixed and applied in accordance with manufacturer’s instructions.

Where the area to be blacked out abuts markings that are to remain, the edge of the blackout must be masked off, otherwise an irregular edge to the blackout is desirable to minimise any ghosting effect. While the plastic material is still wet, crushed stone or grit must be evenly broadcast onto the base.

The aggregate must have a maximum of 2% weak materials when tested using the Australian Weak Particles Test (AS 1141.32).

3.5.6 High friction or coloured aggregate surfacing

High friction or coloured aggregate surfacing is to be applied at locations specified by Council. Both surfacing types generally use a specialised aggregate bonded to the road surface in an epoxy or polyurethane resin so are included in the same specification. Proprietary surfacing systems must be applied in accordance with the manufacturer’s specification and by the manufacturer’s accepted applicators.

Documents that relate to this section are the NZTA Specification ‘M/6: Sealing Chip’. All technical documentation regarding the proprietary product or system to be used must be submitted.

3.5.6.1 Surface preparation

The surface must be clean of any dust, detritus, or loose matter. Any oil visible on the surface must be removed by washing with a detergent solution followed by flushing with clean water or other suitable system. Care must be taken to ensure that no solid matter enters any waterway or stormwater system as a result of the removal operation. This may require the placement of filters or similar on catch pits and other drainage features. The surface is to be completely dry before application of the binder.

All existing line marking, pavement markers, catch pits and kerbing must be suitably masked so that only the road surfacing is coated. The suitability of application to the pavement at the sites specified must be discussed with Council using the manufacturer’s guidelines.

3.5.6.2 Binder

The binder must be a suitable epoxy, polyurethane or other accepted proprietary product compound. When used in conjunction with coloured aggregates the binder must be pigmented to the same colour as the aggregate. Thermoplastic binders must not be used. The cured binder must be flexible so that it does not crack or delaminate under traffic loadings on non-rigid pavements. The binder must be capable of holding the aggregates so they do not become embedded or dislodged under heavy braking.

3.5.6.3 High friction aggregate

The aggregate must be a calcined bauxite or equivalent which has a PSV greater than 70 when tested in accordance with 'BS 812 – Part 114:1989 *Testing Aggregates, Method for determination of the polished-stone value*'. The grading of the aggregate must be as follows:

a) Less than 5% retained on 4.75mm BS sieve.

b) Less than 5% passing 1.18mm BS sieve.

The aggregate and binder system must be designed to achieve a high level of colour retention and resistance to both traffic abrasion and weather such that colour is intact and effective for at least 5 years from the initial installation. The aggregate must have a minimum PSV value of 50 when tested in accordance with 'BS 812 – Part 114'. The surfacing must be capable of being cleaned by high pressure water jet to remove dirt, grime and debris in order to restore the colour.

3.5.6.4 Mixing, batching and application

The manufacturer's guidelines for the mixing, batching and application rates of product must be followed, unless otherwise directed by Council.

3.5.6.5 Curing and aftercare

All masking must be removed together with the binder adhering to it. During the curing period, no disturbances or trafficking of the treated surface is permitted. The cure time must be to the manufacturer's recommendation required under the particular site conditions. Before trafficking, excess chip must be removed. Along with any subsequent chip which may have eroded off the treatment for a period of 1 month following opening of surface to traffic.

3.5.6.6 Performance

The minimum performance requirements are:

a) SCRIM value must be at least 0.7 ESC and the results made available to council. Aggregate retention – a visual assessment of the surfacing must be performed to assess the level of coverage and retention. Aggregate retention must be assessed by determining coverage on any 300mm x 300mm area. The surface must be rejected if any three locations have less than 95% chip coverage.

b) Texture depth – the surfacing must be rejected if any three locations have a mean profile depth of 1.0mm or less (105mm sand circle if determined in accordance with NZTA Specification *'T/3'*).

c) Cracking/delamination/sliding – the surfacing must be rejected if there are any of the above conditions present at the end of the 12-month defect liability period.

3.5.6.7 Cleaning

When cleaning of existing high friction or coloured surfacing is required, a high-pressure water jet or other suitable means must be used to remove all dirt, grime, debris and the like from the surface. Care must be taken to avoid damage to the surfacing. Care must be taken to ensure that no solid matter enters any waterway or stormwater system as a result of the removal operation. This may require the placement of filters or similar on catch pits and other drainage features.

3.5.7 Coloured markings

When specified, some markings may be required in colours other than white or yellow.

Typical applications are:

a) Green for cycleway markings or bus only lanes.

b) Blue for disabled car park spaces.

c) Red for specific pedestrian crossings.

Actual colours will be specified at the time of engineering acceptance or in the contract. Such markings must use the applicable paint type specified in *Clause 3.5.2 Paint types* on page 158, coloured to the specified colour. Paint application must be in accordance with the relevant clauses of this RITS.

3.5.8 Temporary markings

When specified, temporary markings may be required that can easily be removed when no longer needed. Such markings must be capable of withstanding normal road traffic and weather conditions for a period of at least three months, or longer if specified. When no longer required the markings must be removed without causing damage to the underlying road surface.

Full details of materials proposed for temporary markings, their method of application and removal, and typical properties must be supplied with any proposal for use. All materials must be handled and applied in strict accordance with the manufacturer's specifications and datasheets. In particular all environmental precautions must be adhered to.

Typical methods of temporary marking include 'removable paint' and self-adhesive road marking tape.

3.5.9 Non-standard markings

3.5.9.1 Cycle symbols

The cycle symbol must be set out in accordance with the NZTA 'Traffic Control Devices Manual', but may be scaled to be 1200mm or 800mm high as directed by Council.

3.5.9.2 Cycleway 'end'

The word 'End' must be painted at the end of cycle lanes along with a cycleway symbol, where directed by Council. 'End' must be 600mm high x 900mm long.

3.5.9.3 Cycleway hold lines

Cycleway hold lines are used at signalised intersections with advance cycle 'stop-boxes'. The cycleway hold lines must be 100mm wide and must be set back a minimum of 200mm from any crosswalk line. Refer to Transportation drawing: Typical cycle advance stop lines layout for more details.

3.5.9.4 Cycleway hook turns

Cycleway hook turns are to be provided at signalised intersections where turning right is likely to be considered a difficult manoeuvre for cyclists. Final cyclist provisions are to be confirmed by Council.

3.5.9.5 Speed cushions, speed humps and raised safety platforms (RSP)

The approach faces of speed cushions, speed humps and raised safety platforms must be painted with reflectorised white triangles to facilitate visibility. The width of the triangles must be such that there are at least 3 triangles on each speed cushion lane and the depth must cover the full depth of the tapered approach face of the speed cushion.

Refer to drawings Transportation drawing: Asphaltic Concrete Full Width Raised Pedestrian Ramp

Full Width Raised Pedestrian Threshold Imprint Patterns And Coloured Surfacing

Transportation drawing: Full Width Raised Pedestrial Threshold Imprint Patterns & Coloured SurfacingAsphaltic Concrete Tapered Raised Pedestrian Ramp

https://www.colabsolutions.govt.nz/wp-content/uploads/2022/10/D3.10.5-TRAFFIC-CONTROL-FACILITIES.pdf

3.6. STREET LIGHTING CONSTRUCTION

3.6.1 Installation

Each street light position is an 'installation' as defined in AS/NZS3000. All construction work to be undertaken by competent/accepted contractors and in accordance with the Electricity Regulations 2010, AS/NZS3000 and the applicable Electrical Codes of Practice. The most recent amendments must be used and accepted by the network company. All installations are subject to test and provision of ESC or CoC.

3.6.2 Connection to network

All proposed street lighting connections must be accepted by the relevant network company prior to commencement of the project. The steps to follow in pre-installation and installation stages are outlined below:

a) Submit proposed design/lighting plan to the network company for verification of supply points.

b) Submit an application for new connections detailing additional load required for new streetlights.

In order to liven new lighting installations, the network company will require the following documentation:

c) Accepted application for new connection.

d) CoC or ESC signed by authorised person.

e) As-builts in format accepted by the network company.

f) Confirmation of practical completion or 224c sign off.

3.6.3 Installation

All columns are to be installed in accordance with the manufacturer's specifications, electrical codes and health and safety acts. The column position in developed areas must be pegged in advance of the work and adjacent property owners notified in writing of the works so that any issues over column location can be resolved before installation begins.

Contractor to submit a 'corridor access request' (CAR) and confirm underground services location prior to groundworks commencing in developed areas. If the contractor finds underground bedrock (e.g. rhyolite) or finds underground services not allowed for that precludes installing a column in the desired location, they are to contact Council for guidance rather than simply moving the column.

Any groundwork carried out for installation is to be re-instated to Council's standard. Access doors must be accessible. Any damage caused prior to the hand-over to Council must be repaired as new with all warranties remaining intact.

Internal wiring, earthing and circuit protection devices to comply with the network company's design and construction standard.

Luminaires must be installed on columns in accordance with the manufacturer's specifications. The horizontal axis must be level and with the specified tilt angle. Where existing brackets or outreaches have a different tilt angle to that specified for new lights, a new luminaire with internal tilt mechanism may be used or suitable tilt wedges must be installed so that the existing luminaires have the same tilt angle as any new fittings.

3.6.4 Cables

Underground cable installations must be provided to all street lighting columns except for lights specified to be installed on existing power poles. Cable route and conductor sizes must be designed and installed in accordance with network company's requirements. Warranty period for new cables is 12 months. All new installations must be designed to be controlled through the network operator's control system. All column installations must be provided with accepted internal termination junction boxes for terminating lighting circuits. These are to be located at the gear openings of each column. Cables installed vertically on power poles must be fitted and enclosed in accordance with requirements of the network company.

3.6.5 Trenching

Underground cables to be installed to the network company's requirements. In order to prevent damage to road pavement and minimise disruption to the public, thrusting must be used under existing carriageways, vehicle entrances and footpaths. Location of the cables in green fields should be as detailed in Transportation drawing: Location of services in transport corridor

3.6.6 Lighting upgrades

Where lighting columns or circuits are being relocated, extended or upgraded, the existing supply, protective devices and switching control may be reused if it is in compliance with this specification. In the event that an existing circuit is extended, the network company will confirm if the supply relays and fuses are suitably rated for the additional electrical load of the new lights. The contractor will be responsible for any costs associated with uprating the supply point, fusing, changing relays or fitting contractor sets associated with the additional lighting load. All additional fittings and materials used must be new and consistent throughout the installation.

If in-fill lighting or continuation of an existing system the new fittings and materials must match the existing, if practicable.

3.6.7 Existing luminaires, columns and control gear made redundant

Council's street lighting maintenance contractor must be given an opportunity to acquire any surplus luminaires, columns and associated spare parts made redundant for the purpose of utilising them as maintenance spares. The contractor will be responsible for disposing of any redundant 'not-wanted' materials including capacitors containing PCBs. All non-usable parts are to be disposed of correctly and certificates provided to Council to this effect.

3.6.8 Inspections and testing

Prior to commissioning all inspections and testing required by the network company must be carried out. Written confirmation is required from the network company that it accepts all underground cabling and circuitry and will assume responsibility for future maintenance and renewal. A lux survey may be requested by Council at the contractor's cost.

3.7. TRAFFIC SIGNALS

3.7.1 Scope

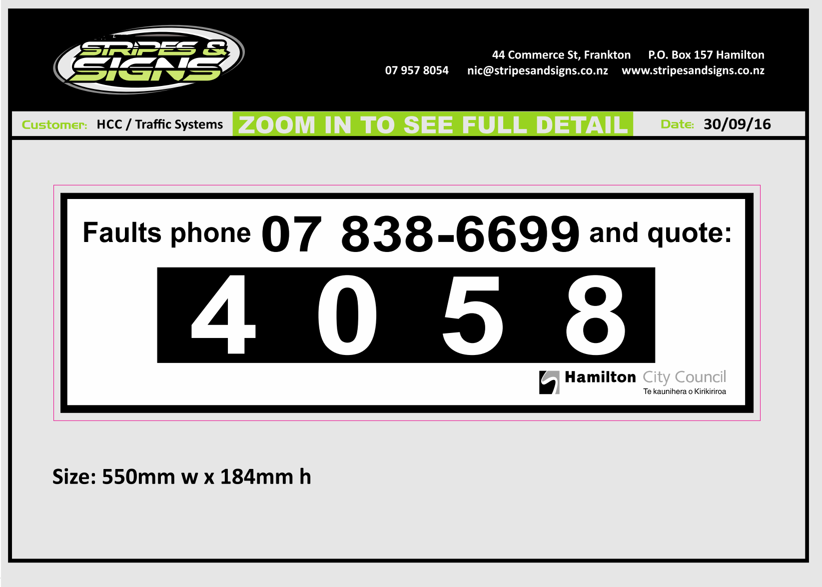
This section covers the procedure and requirements for all new or upgraded traffic signals that are to be managed by Hamilton City Council's city transportation unit (CTU) or Tauranga CC (for Rotorua Lakes Council projects). This includes the design, supply, installation and commissioning of new and existing traffic signal equipment.

3.7.2 Specifications

All traffic signals are to be installed in accordance with the specifications and standards listed in *Clause 3.2.2 Reference documents* on page 94. The key specifications are:

- NZTA P43 Specification for Traffic Signals (2020)
- Hamilton City Council Regional Special Conditions to P43 (2021)

Both the Regional Special Conditions and the following clauses supersede NZTA P43 requirements. Where reference is made in any specification to 'RCA' or 'Client', this must be read as 'Council'.



3

3.7.3 Design requirements

Design Plans and Acceptance

Council's preferred layout for traffic signal plans is to have two plans for each site, as follows:

Traffic Signal plan

- The target audience is the contractor building the traffic signals
- This plan should include poles, displays, ducting, chambers, detectors, and any other hardware required (such as CCTV, JUSP, etc).
- Key dimensions should be included for pole set out (showing distance from limit line and pedestrian crossing widths)
- It should also contain a cabling diagram, along with construction notes

Phasing and signal group plan

- This plan is primarily used for the Controller Information Sheet and SCATS operators
- This plan should show the signal groups, detectors, and external inputs (but should not show poles, displays, nor any other hardware except the controller location)
- It should also contain a phasing diagram, along with any operational or special logic notes

All signal designs must be audited and accepted by Hamilton City Council's Transportation Unit (CTU) or Tauranga CC (for Rotorua Lakes Council projects). At a minimum, acceptance is required at two stages:

- Concept design (including design report and modelling results)
- Detailed design (including updated report and modelling, if required)

The designer should provide sufficient time in their programme to update drawings following feedback, including resubmitting updated drawings to CTU or Tauranga CC (for Rotorua Lakes Council projects) for re-checking and accceptance.

The designer is encouraged to initiate discussions with CTU or Tauranga CC (for Rotorua Lakes Council projects) as early as possible in the process, to minimise the amount of rework that may be required.

3.7.3.1 Filter turn warrant

A right turn may be permitted to filter unless any of the following criteria are met:

a) The right turn movement has experienced more than five “right turn against” type injury accidents in the last five years. This requires further consideration – see below.

b) Visibility is less than the safe stopping distance at the design speed, either by horizontal or vertical alignment, or where the opposite right turn hides approaching through traffic.

c) There are three (or more) opposing through lanes to cross.

d) The right turn movement has two (or more) right turn lanes.

e) There are two (or more) opposing left turn lanes.

f) There is a need to provide protection of the pedestrian crossing at all times.

g) The 85th percentile operating speed of opposing traffic is greater than 70 km/h.

Where an existing filtered movement has more than five “right turn against” type injury accidents, two further aspects should be reviewed:

h) The accidents should be investigated to determine if there are any common factors such as time of day. If the accidents predominantly occur during similar periods, consideration should be given to providing a time-based filter.

i) Consideration should be given to undertaking a benefit cost analysis for the filter turn, where an intersection relies on a filter movement to operate effectively during peak periods. If travel time savings gained from the filter turn sufficiently outweigh the associated accident cost, the filter turn could be retained.

The decision to allow or prohibit a movement to filter is a complex engineering decision. While the above criteria provide guidance in assessing if a filtered right turn is appropriate, good engineering judgement must still be applied during each assessment.

3.7.3.2 Pedestrian Facilities

On-Crossing detectors

At locations with long pedestrian crossings (e.g. above 25m) which do not run during the main phase, on-crossing pedestrian detectors (e.g. Radar) should be used to provide dynamic pedestrian clearance. This can extend the crossing time for slower pedestrians (e.g. mobility impaired) or shorten the time to suit a fast pedestrian (e.g. a runner) to reduce non-compliance by motorists.

Slip Lanes

At signalised intersections on arterial roads it is preferable to provide a short high angle slip lane with a raised platform, with the provision of pedestrian reintroduction on main phase(s).

This is to provide the safest form of facility for pedestrians and reduce delay to pedestrians. This excludes local road and CBD environments where slip lanes are less appropriate.

Traffic signals on the slip lane are an extra option where there is specific concern for visually or mobility impaired pedestrians.

Walk Speed

For calculation of clearance times, a standard pedestrian walk speed of 1.3m/s shall be used which equates to the 15th percentile speed of adults in the NZTA Pedestrian Planning Guide.

Where the signal crossing has a high percentage of aged or school users, a walk speed of 1.0m/s shall be used which equates to the 15th percentile speed of aged and mobility impaired pedestrians.

Mid-block Crossing Operation

In speed environments of 50km/h and below, mid-block traffic signal crossings should run the pedestrian phase as soon as practical after a demand is placed, provided a suitable minimum time has passed for vehicular traffic. This is done by forcing the vehicle approaches to "gap out" after say 30s or so has passed during the vehicle phase, after which a pedestrian demand will terminate the vehicle phase immediately regardless traffic flow.
The reason for this is to give the pedestrians a level of service at least as good as a zebra crossing and ensure that SIMPED staggered pedestrian crossings sequence properly, whilst also reducing non-compliance and the need for call cancellation.

Limit line detectors should be provided for red light running statistics.

In speed zones above 50km/h advance detectors should also be provided (in addition to limit line detectors) in order to reduce the likelihood of the signals changing in a driver's dilemma zone.

For most mid-block pedestrian crossings a green walk time of 4.0s is considered sufficient, as the number of pedestrians waiting to step out does not require time more than this. Note the typical walk time at busier sites is 6.0s.

Where sites are located outside schools where children arrive or leave in groups, it may be appropriate to include time of day scheduling or use above ground footpath detection to increase/extend the walk and/or clearance times to coincide with the school start/end times. Observations should take place to confirm timings.

3.7.3.3 Pedestrian protection

Pedestrian protection must be provided at all new and upgraded traffic signals. Unless otherwise specified, pedestrians at intersections should be protected as follows:

a) Red arrow aspects installed for left turn traffic to provide partial protection (i.e. during the pedestrian walk time).

b) Red arrow aspects installed for right turn traffic to provide full protection (i.e. the red arrow remains for the walk and clearance time).

At intersections with low pedestrian and vehicle volumes, protection may be provided using a delayed start for the conflicting vehicle movements

Protection is typically provided during part or all of the walk time, determined on a site by site basis as appropriate for the number of vehicle-pedestrian conflicts. At intersections with high pedestrian volumes where there is greater concern for pedestrian vulnerability, protection should be provided for the walk time and some or all of the clearance time for conflicting vehicles.

Full pedestrian protection should be considered at sites where an unusual layout causes vehicles to interact dangerously with pedestrians, and consideration needs to be given to conflicting movements to ensure capacity is not overly compromised.

Where a priority pedestrian crossing has no conflicting vehicle movements and is adjacent to a main vehicle movement, the pedestrian phase should allow late introduction of the pedestrian phase if sufficient time is available to complete the crossing within the associated vehicle phase.

3.7.3.4 Bicycle Facilities

The standard approach to provision of Bicycle facilities at traffic signals in Hamilton is summarised below (noting that this may change following future updates to the TCD rule):

On-road lanes

Where an on-road cycle lane is provided, no bicycle displays are to be provided, and cyclists should follow the vehicle displays. This is done to minimise delay to cyclists and to avoid safety & compliance issues.

In certain situations, it may be appropriate to provide bicycle displays for a specific movement. This needs a dedicated bike phase in the sequence and require specific approval from City Transport Unit due to the associated legal and compliance implications.
Running a bicycle display green at the same time as the adjacent through traffic is not permitted.

3.7.3.5 Off-road paths

Where off-road cycle paths cross at signalised intersections or mid-block crossings, a separate cycle crossing ("Toucan" style) shall be provided. This must have dedicated 3-aspect bicycle displays. Operation shall be as follows:

a) Separate cycle push buttons shall be provided (separate pole to the pedestrian button)
b) Generally, the cycle and pedestrian push buttons will place a demand for both the cycle and pedestrian crossings, regardless of which one is pressed
c) The cycle crossing shall run green during the pedestrian green walk time, and then terminate through yellow and red as soon as the pedestrian clearance starts (to reduce the chance of a pedestrian stepping out on the cycle green without enough clearance time remaining for them to cross)
d) Where appropriate (e.g. when a slip lane is provided) the crossing shall stay in green as long as practical with the adjacent phase ("walk for green" operation)

3.7.3.6 Cyclist speed

To determine red times, a cyclist speed of 4.2m/s is considered appropriate for off-road paths. For on-road cycle lanes a slightly faster speed of 4.5m/s is acceptable.

3.7.3.7 Ethernet Cabling

All new and upgraded traffic signal work shall include the provision of spare Ethernet cables. At minimum, these shall be run to the top of each JUSP and JUMA pole, whilst additionally ensuring that each "corner" of the intersection has at least one pole with an Ethernet cable.
Cables shall be outdoor grade, shielded, and terminated with end caps to prevent water ingress; and tied near the pole top.
No Ethernet cable shall be longer than 100m. Where this is necessary, such as interchange sites which are very wide, the design shall incorporate an additional controller cabinet to contain cable terminations and power supply to restart the Ethernet run.

3.7.3.8 Advanced vehicle detectors

Advanced detectors can be costly to install and maintain but typically provide efficiency and safety benefits. The suitability, number of detectors and their location must be assessed on a site by site basis. At new intersections, advanced detectors should generally be provided on arterial roads and any road with a posted speed limit above 50 km/h.

3.7.4 Commissioning Items

3.7.4.1 Power and Communications

A separate metered power connection is required for each controller. This process typically takes 6 months and may need to be arranged prior to tendering. CTU or Tauranga CC (for Rotorua Lakes Council projects) can assist in arranging the power connection on request.

Fibre connections can also be arranged by CTU or Tauranga CC (for Rotorua Lakes Council projects) on request, and typically take 3-6 months.

3.7.4.2 Controller Information Sheet and Personality

All Controller Information Sheet (CIS) and controller personality ("SFT") is normally provided by CTU or Tauranga CC (for Rotorua Lakes Council projects), unless otherwise agreed by CTU or Tauranga CC (for Rotorua Lakes Council projects). This documentation must be requested at least 6 weeks prior to commissioning to allow sufficient time for development, reviews, and testing to take place.

3.7.4.3 Traffic Signal Upgrades (SAT)

All sites being upgraded or modified shall require completion of a 'Short Form Site Acceptance Test'. This form is provided by Hamilton City Council or Tauranga CC (for Rotorua Lakes Council projects) and can be completed either physically or via the online form.

3.7.5 Traffic signal procedure

The procedure set out in the table below applies to all traffic signals that are to be managed by CTU, including traffic signals that are installed on other RCA networks such as the local State Highway network, Waipā District Council and Waikato District Council. Rotorua Lakes Council traffic signals are managed by Tauranga CC. The table provides an overview of the entire process including the approvals and deliverables required to enable the traffic signals to be managed by CTU.

Table 39: Signal plans, software and commissioning

TASK	SUPPLY	DESCRIPTION / REQUIREMENTS	CREATED BY	APPROVED BY
Concept Design	Report, plan and traffic modelling	Concept Design plans and design report in accordance with relevant standards. Design report including existing and proposed level of service and 95%ile queue lengths for morning and evening peaks A site plan with the concept design superimposed showing: - Posts, lanterns, street lighting - Detectors - Controller	Designer	Client and HCC CTU or Tauranga CC (for Rotorua Lakes Council projects)

TASK	SUPPLY	DESCRIPTION / REQUIREMENTS	CREATED BY	APPROVED BY
		- Road marking, pedestrian signage and cycle facilities -		
Peer review of concept design	Audit Response	Peer review audit by competent traffic signal designer, of design plan and design report. Approval is required by CTU or Tauranga CC (for Rotorua Lakes Council projects) before proceeding with final design.	CTU or Tauranga CC (for Rotorua Lakes Council projects)	Client and designer
Final design	Drawings, report and schedule	Final design plans including cable diagrams and phasing Schedule of quantities Final design report Pre-construction safety audit covering traffic signals	Designer	Client and CTU or Tauranga CC (for Rotorua Lakes Council projects)
Peer review of final design		Peer review audit by competent traffic signal designer, of design plan and design report. Approval is required by CTU or Tauranga CC for RLC projects, before proceeding to tender.	Peer Reviewer	Client and Designer
Controller CIS	Controller information sheet (CIS)	Controller information sheets (CIS) based on the design drawings and report	CTU or Tauranga CC (for Rotorua Lakes Council projects)	CIS reviewer
Controller SFT	Controller software (personality)	Controller software including WinTraff Bench testing of software must be carried out by the contractor prior to commissioning and completed bench form supplied (refer P43)	CTU or Tauranga CC (for Rotorua Lakes Council projects)	SFT Reviewer
Pre-installation check	Site meeting	Pre-construction site meeting, with the signal designer, project manager, and traffic signal contractor on site, along with a traffic signal representative from CTU or Tauranga CC for RLC projects. Confirm main design elements and issues.	Signals Contractor	CTU or Tauranga CC (for Rotorua Lakes Council projects)

TASK	SUPPLY	DESCRIPTION / REQUIREMENTS	CREATED BY	APPROVED BY
Connections	Connection for communications, and power	Power and Communications: See *Clause 0* on page 166. These connections must be operational prior to switching the site on, and typically take up to 6 months	Signals contractor	CTU or Tauranga CC (for Rotorua Lakes Council projects)
SCATS	System set up and testing	SCATS graphics, related data and linking setup in accordance with HCC traffic signals operational standards document	CTU or Tauranga CC (for Rotorua Lakes Council projects)	CTU or Tauranga CC (for Rotorua Lakes Council projects)
Pre commission checks	Completed site acceptance test (SAT)	Signals contractor must complete the SAT (refer P43) in the presence of the RCA traffic signal representative (CTU or Tauranga CC for RLC projects)	Signals contractor	CTU or Tauranga CC (for Rotorua Lakes Council projects)
Commissioning	Authorisation to switch on the traffic signals	Handover of new/upgraded signals to HCC transportation to operate and manage, or Tauranga CC for RLC projects. Signed SAT and written approval to switch on the traffic signals by the RCA traffic signals representative (HCC transportation or RLC via TCC)	CTU or Tauranga CC (for Rotorua Lakes Council projects)	CTU or Tauranga CC (for Rotorua Lakes Council projects)
Asset information	As-builts and associated documentation	Contractor to supply all required asset information as stated in P43, including: - Final plans showing ducting and layout - RAMM asset data form (P43 appendix K) - C&I sheet - Keys - Test certificates - Producer statements - Cable termination chart	Signals contractor	CTU or Tauranga CC (for Rotorua Lakes Council projects)
Safety Systems Audit	Post construction safe systems audit	A post conduction safe systems audit will be required at all new sites, changes to existing roads and upgraded signals Council may request a post construction safety audit following any traffic signal upgrades or modifications at their discretion.	Qualified safety auditor	CTU or Tauranga CC (for Rotorua Lakes Council projects)

3.8. QUALITY SYSTEMS

This section is intended to describe the formal testing and acceptance requirements of construction. The design portion of this document must be read and complied with fully.

3.8.1 Inspections and acceptance

This section details the inspections and hold points where Council acceptance is required before continuing. Site visits may be carried out at any time during construction. Specific details about testing measures are detailed in *Section 3.8.2 Testing guidelines below*.

3.8.1.1 Carriageway construction inspections

After completion of the subgrade, sub-base and basecourse layers, testing in accordance with *Clause 3.8.2.2 Subgrade testing prior to design* on page 174 must be carried out.

3.8.1.2 Hold points

The following are key points for the developer to contact council.

- Kerb and channel.
- Footpath and cycleway.
- Signs and other street furniture.
- Street lighting.
- Subgrade inspection where improvements are noted as being required.
- Completion of Basecourse

The installation contractor must provide the following documentation to Council:

a) Accepted application for new connection.

b) Electrical certificate of compliance or electrical safety certificate signed by an authorised person.

c) As-built drawings in a format accepted by the electrical network provider including results of inspections and testing.

d) Street light control point form.

e) Lighting pole and luminaire data using Transportation form: RAMM streetlight data

f) Network company's acceptance sheet.

3.8.2 Testing guidelines

The following are a summary of the testing requirements. The results of each of these tests must be provided to Council at the time of the field inspection / hold point and summarised in the 224 c application or contract quality documentation.

3.8.2.1 Carriageway test spacing

Compaction and material strength tests are to be taken at the following locations and frequency:

Table 40: Test spacing locations and frequency

CARRIAGEWAY SIZE	LOCATION	SPACING[53]	REPTITION
4.0m wide and less	Along centreline	15m spacing between tests	
Between 4.0m and 8.0m	At the kerbside wheel tracks[54]	Alternating sides, 10 centreline metres between tests	20m repetition of testing rows
8.0m and wider	At the centreline and kerbside wheel tracks	Staggered across road, 10 centreline metres between tests	30m repetition of testing rows

The kerbside wheel tracks are assumed to be 1m inside the kerb and channel alignment.

3.8.2.2 Subgrade testing prior to design

Subgrade testing should begin at 100mm above the design subgrade level. Subgrade testing is to be by Scala Penetrometer for all materials that are suitable.

3.8.2.3 Subgrade testing prior to sub-base construction

If subgrade improvement measures have been carried out (such as replacement with pit sand, granular rock fill material or use of a stabilisation agent) pit sand or stabilised materials must be tested by Scala Penetrometer. . The shape of the subgrade must be measured by stringing. If a subgrade has been improved by stabilisation using a lime/cement treatment, then laboratory testing results must be provided.

3.8.2.4 Sub-base testing

The compaction of sub-base must be tested by Nuclear Densometer. The thickness and shape of the sub-base must be measured by stringing.

3.8.2.5 Basecourse testing

The compaction of basecourse must be tested by Nuclear Densometer. The thickness and shape of basecourse must be measured by stringing.

3.8.2.6 Sealed surface testing

Just prior to the surface receiving its first surfacing waterproofing coat, Benkelman Beam testing must be carried out.

3.8.2.7 Footpath testing

Scala subgrade tests are to be carried out at 15m intervals along the length of the footpath.

3.8.2.8 Private way testing

[53] On small sites there must be a minimum of 10 tests carried out.
[54] The kerbside wheel tracks are assumed to be 1m inside the kerb and channel alignment.

As part of the compliance evidence for the construction of private ways the forms are to be completed and submitted. See Transportation form: Private way – confirmation of design, supervision and construction.

3.8.2.9 Vehicle crossings/entranceways

A minimum of three (3) Scala penetrometer tests randomly spread must be taken to a depth of 300mm below the final subgrade level per crossing. One (1) test per $5m^2$ on crossings greater than $15m^2$ (kerb to boundary).

3.8.2.10 Kerb and channel

If kerb and channel is constructed on top of the same sub-base pavement as the carriageway there are no additional subgrade or sub-base tests required.

3.8.3 Testing methods

3.8.3.1 Scala penetrometer

The Scala penetrometer must only be employed where a significant part of the particles pass a 9.5mm sieve. The CBR vs penetration graph for sand silt materials is shown on Transportation drawing: Normal carriageway camber and construction tolerances. The cone is bedded into the silt with one (or more) blows. The zero point for depth and the number of blows is taken neglecting the bedding blows. There are two methods of recording the result and all test sites must comply.

Table 41: Scala penetrometer procedures

CBR	MAX MM/BLOW	MIN BLOWS/100MM
7	32	3
10 (footpath)	23	4
15 (carriageway subgrades and vehicle crossing subgrade)	17	6

As a means of compliance for an acceptable CBR in carriageways at the in-situ subgrade, the Scala readings are averaged for the top 600mm. At the imported subgrade or lower sub-base surface, the Scala readings are averaged for the full depth of the pavement layer being tested. For footpath and vehicle crossing subgrade testing, the results are the average of the top 300mm.

3.8.3.2 Lab tested soaked CBR

Subgrade samples from the site are to be tested by an IANZ accredited laboratory for their soaked CBR.

3.8.3.3 Clegg Hammer

Where the Clegg Hammer is used, it must be the standard Australian digital model with a 4.5kg compaction hammer, using a drop height of 4500. The test certificate must be less than 12 months old.

Testing is carried out on a surface that has no loose material (removed by scuffing with a stiff hand broom). The maximum Clegg Impact Value (CIV) at the end of the fourth blow must be recorded and the on-site CBR value must be taken as $0.07\ (CIV)^2$.

Table 42: Quality systems testing - Clegg hammer compliance values

COMPLIANCE VALUES	CLEGG IMPACT VALUE

Aggregate subgrade (e.g. granular rock fill material)	15
Sub-base (trench reinstatement only)	25
Basecourse (trench reinstatement only)	40

3.8.3.4 Nuclear densometer

Compaction testing must be carried out by a suitably qualified operator using a calibrated Nuclear Densometer in backscatter transmission mode. The compaction is measured as a percentage of the maximum dry density of the material. The test spacings for nuclear densometer may be double the standard carriageway test spacings shown in *Clause 3.8.2.1 Carriageway test spacing* on page 174 with a minimum of 5 tests per site.

Table 43: Quality systems testing - Nuclear densometer compliance values

COMPLIANCE VALUES	MINIMUM VALUE	AVERAGE (MEAN) VALUE
Sub-base	92% MDD	95% MDD
Basecourse	95% MDD	98% MDD

3.8.3.5 Benkleman Beam test

The surface must be tested prior to sealing with a standard Benkleman Beam test apparatus. The organisation carrying out the tests must have an IANZ accreditation.

The beam test must be undertaken in accordance with NZTA's specification 'T/1: Benkleman Beam Deflection Measurement' except that the recordings for bowl deflection must not be recorded or used in the deflection calculation. Deflections must confirm to the target figures in the table below. No more than 10% of the test results must exceed the 90th percentile and no single result must exceed the maximum.

Table 44: Maximum Benkleman Beam deflections

CARRIAGEWAY	AVERAGE (MM)	90TH PERCENTILE (MM)	MAXIMUM (MM)
On carriageways where asphalt is to be placed (with the exception of where asphalt is to be placed at cul-de-sac heads only)			
Residential cul-de-sacs and private ways ≤40 household units	1.30	1.60	2.10
All other carriageways up to 10^5 EDA	1.10	1.35	1.80
All carriageways between 10^5 and 10^6 EDA	1.00	1.20	1.60
On other carriageways surfacing situations (factored by 1.5 for block paving)			
Residential cul-de-sacs and private ways ≤40 household units	1.50	1.80	2.40
All other carriageways up to 10^5 EDA	1.25	1.50	2.60
All carriageways between 10^5 and 10^6 EDA	1.00	1.20	1.60

Table 45: Shape and relative height tolerances

AT TOP OF LAYER	CENTRELINE AND NEAR PAVEMENT EDGE	AT EDGE	CHANNEL	DEVIATION FROM 3M STRAIGHT EDGE OR CAMBER BOARD

Surface – chip sealed			12mm
Surface – asphalt (typically 25mm thick)			8mm
Basecourse	-5mm to +15mm	0mm to +10mm[55]	12mm
Sub-base	-25mm to +5mm	-25mm to +5mm	15mm
Subgrade			

Shown on Normal Carriageway Camber & Construction Tolerances

3.8.3.6 NAASRA roughness

A post sealing NAASRA roughness measure is required. This measure must be 70 maximum average value with no more than 35 readings in excess of 70 for each traffic lane. The engineer will not consider remedial measures other than remaking of the pavement surface for NAASRA roughness compliance. The survey result is required to be provided prior to the issue of a practical completion certificate or 224c.

a) **Roughness specification**

All road roughness surveys must be in accordance with the latest revision of the 'RAMM Computer User's Manual', 'RU Technical Recommendation TR12 Roughness Meter Guidelines' and 'Standard Operating Instructions for the NAASRA Roughness Meter' or the RIMS 'Specification for Road Condition Data Collection'. All results are to be reported as NAASRA counts.

The project manager and test operators must be suitably experienced and familiar with the test equipment and results required.

Measurements are to be taken on the various road types as follows:

i) **On narrow single carriageway roads**: measurements are to be taken in the normal driven wheel path. This is likely to straddle the road centre-line. The survey is to be completed in one direction only. Data processing techniques should account for instances when the vehicle deviates from the road onto the shoulder.

ii) **On single carriageway, two-lane roads:** both increasing and decreasing lanes are to be measured. These measurements are to be taken in the wheel paths. Where no obvious wheel path is visible the measurements are to be taken 50 to 70cm from the edge of the pavement.

iii) **On divided carriageway roads:** both increasing and decreasing lanes (both carriageways and service lanes). The measurements are to be taken in the wheel paths; where no obvious wheel path is visible the measurements are to be taken 50 to 70cm from the edge of the pavement.

iv) **On dual carriageway roads:** survey both increasing and decreasing lanes (both carriageways). The measurements are to be taken in the most heavily trafficked wheel paths; where no obvious wheel path is visible the measurements are to be taken 50 to 70cm from the edge of the pavement.

b) **Laser profilometer**

The consultant may use a non-contact laser profilometer to measure the paved roads' longitudinal profile. The profilometer should conform to the ASTM E950-94 standard, have a vertical resolution

[55] Chip sealed surface

of less than 0.1 mm, and achieve a roughness measurement accuracy of< 0.1 mm. The consultant must record and report the longitudinal profile data and process the profile data to provide and report NAASRA count/km. The lane roughness calculations are made from the average of the left and right wheel path profiles, and the data recorded and reported as follows:

i) Number of wheel paths: two.

ii) Longitudinal profile sampling interval: no more than 25 mm.

iii) NAASRA Counts interval 20 m and 100 m.

Any factors which may influence the survey result must be recorded during the survey and the data corrected accordingly. These factors include, for example, survey speed in congested areas, traffic congestion, sudden braking, and other events.

Some operational practices, such as sudden acceleration or braking during surveys, may also influence the result and operators should avoid these.

c) **Response type roughness meter**

The roughness data may be collected using a single/dual response-type roughness meter/s or similar, with the instrument calibrated in accordance with ASTM E 1448-92/98. The roughness data must be reported at 20m and 100m intervals in NAASRA count/km. The vehicle speed must be recorded during the survey and taken into account when calculating the roughness from the raw data.

Factors which may influence data quality must be recorded during the survey and the data corrected accordingly. These include, for example, traffic congg12estion, pavement construction activities and having to travel off the carriageway.

d) **Equipment validation**

Roughness measurement equipment with current NZTA acceptance for use on the State Highway network may be used without further validation checks. Other equipment must be validated before use as described in the RIMS High Speed Data Collection Guidelines.

3.8.4 As-built data provision

As built data requirements are detailed in *Clause 1.9 As-built plans* on page 41.

3.9. TRANSPORTATION CORRIDOR HIERARCHY TABLES

Following is a link to the transportation corridor hierarchy tables for each participating council:

Transportation: Appendix 3A Links

3.10. TRANSPORTATION ASSET DATA FORMS

3.10.1 Quality forms

These are available on the Co-Lab website using the links below.

CATEGORY	TITLE
Transportation	Basecourse shape and relative height/Clegg hammer test and NDM checklist
Transportation	Sub-base shape and relative height/Clegg hammer test Checklist
Transportation	Subgrade shape and relative height/Scala penetrometer test checklist
Transportation	As-built data checklist
Transportation	Subgrade Scala penetrometer data form
Transportation	Trench backfill compaction form

3.10.2 RAMM forms

These are available on the Co-Lab website using the links below.

CATEGORY	TITLE
Transportation	Asphalt data
Transportation	Chipseal data
Transportation	Pavement data
Transportation	Street light data
Transportation	Private way – confirmation of design, supervision and construction
Transportation	Private way construction materials

3.11. DRAWINGS REGISTER

These are available on the Co-Lab website using the links below.

CATEGORY	TITLE
Transportation	Roading Terminology
Transportation	Location of services in transport corridor
Transportation	Cross section details typical berms
Transportation	Boundary splay
Transportation	Standard residential private ways
Transportation	Cul-de-sac head
Transportation	On street parking dimensions and setout
Transportation	Normal carriageway camber and construction tolerances
Transportation	C.B.R. v penetration graphs for Hamilton sand silt materials
Transportation	Trench reinstatement
Transportation	Vehicle crossing and pedestrian cutdown set out
Transportation	Vehicle crossing profiles

CATEGORY	TITLE
Transportation	Kerb and channel profiles
Transportation	Rural entranceways - residential, light and heavy commercial
Transportation	Cross section details for footpath, vehicle crossings and depressed kerb and channel
Transportation	Cross section details associated kerb and channel reinstatement within existing pavement
Transportation	Concrete vehicle slot crossings
Transportation	Accessible bus stop
Transportation	Location of subsoil drainage
Transportation	A/C, SMA and OGPA overlay details
Transportation	A/C overlay v-ramp detail
Transportation	Timber edging details for chip seal, asphalt and block paving
Transportation	Pedestrian crossing point location at intersections
Transportation	Tactile paving for vision impaired
Transportation	Pedestrian facilities in islands
Transportation	Sign location and visibility at intersections
Transportation	Street name signs arterial/collector intersection
Transportation	Street name signs arterial or collector intersection with local roads
Transportation	Street name signs local/local intersections
Transportation	Cycle signage for off road cycle paths
Transportation	Neighbourhood watch signage
Transportation	Ground sockets for removable poles
Transportation	Installation of chevron or route and low level road name sign
Transportation	Attachment of street name sign blades to poles
Transportation	Street name plate
Transportation	Kea crossing flag
Transportation	Kea crossing flag pole
Transportation	School patrol signs
Transportation	Bus stop / taxi supplement
Transportation	Through truck route marker
Transportation	CBD cycle rack
Transportation	Bike rack - ribbon style
Transportation	Bike rack - hoop style
Transportation	Wooden bollard (see also Landscapes drawing: Timber bollard post and chain)
Transportation	Lockable removable bollards
Transportation	CBD pedestrian barrier
Transportation	Pedestrian balustrade barrier
Transportation	Pedestrian barriers

CATEGORY	TITLE
Transportation	Pedestrian accessway fence detail
Transportation	Pedestrian handrail or walkway barrier
Transportation	Concrete base details for steel litter bins
Transportation	Standard 3.5m bus shelter foundation detail
Transportation	Bus shelter and mini bus shelter
Transportation	Bus stop seat - no shelter
Transportation	Typical cycle advance stop lines layout
Transportation	On road cycle lane connection to off road shared path
Transportation	Clearway and P5 road marking
Transportation	Mobility cardholders parking
Transportation	Roundabout details
Transportation	Flush threshold (for maintenance purposes only)
Transportation	Paved raised pedestrian ramp (for maintenance purposes only)
Transportation	Concrete raised pedestrian ramp (for maintenance purposes only)
Transportation	Asphaltic concrete tapered raised pedestrian ramp
Transportation	Asphaltic concrete full width raised pedestrian ramp
Transportation	Full width raised pedestrian threshold - imprint patterns and coloured surfacing
Transportation	Pedestrian belisha and warning globe detail
Transportation	Pedestrian belisha and floodlighting
Transportation	Traffic signal ducting under-kerb access details
Transportation	Fold down traffic signal pole
Transportation	Removable traffic signal pole
Transportation	Standard dimensions for stop line detectors and advanced cycle stop
Transportation	Street name signs at signalised intersections
Transportation	Traffic controller base, signal pole and mast arm
Transportation	Overhead Directional Sign Standard
Transportation	Deco Pole With 2M Outreach
Transportation	Hcc City Heart Project Kerb Profiles
Transportation	Rural Access Ways
Transportation	Rural Road Widths
Transportation	Urban Access Ways
Transportation	Urban Access Way Turning Bay
Transportation	Urban Road Widths

STORMWATER

SECTION 4. STORMWATER

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4.1. INTRODUCTION

This section sets out requirements for the design and construction of stormwater systems for land development, subdivision, and contracts.

Stormwater systems have the potential to convey pollutants and increase the flow rate and volume of water to a receiving environment such as streams (natural and modified), rivers, lakes and groundwater. Discharges will impact on these environments and the environmental, cultural and social values which they support. The management of stormwater discharges must respond to the pollutant and hydrologic characteristics attributable to the catchment land use and provide treatment to reduce or mitigate adverse impacts.

The RITS provides high level guidance to designers with an understanding of the key design considerations to support good performance outcomes. Furthermore, specific design guidance can be sought from other existing technical resources such as the Waikato Regional Council's Waikato Stormwater Management Guideline and Waikato Stormwater Runoff Modelling Guideline.

4.1.1 Objectives

The primary objective of the stormwater system is to manage stormwater runoff to minimise flood damage and adverse effects on the environment. The stormwater system design philosophy aims to protect people, properties and ecological values by preventing or mitigating the quality and the quantity effects of stormwater on the built and natural environment.

The design of the stormwater system must ensure an acceptable stormwater service for each property and all public assets including the entire Transport Corridor by providing a treatment, control and disposal system:

a) Within each property boundary.

b) Or a service connection from each property to a stormwater management system.

c) Or a combination of the above.

The stormwater system must meet the minimum design life requirement taking into account structural strength, design loadings, soil conditions, and operational and maintenance requirements. The system must be cost efficient over its design life while accounting for environmental and community impacts through integrated three waters management and water re-use. The stormwater system must utilise low impact design solutions and water sensitive techniques to replicate the pre-development hydrological regime as far as practical. All existing open streams and channels, gullies and wetlands (perennial and ephemeral) must remain and be protected or enhanced.

4.1.2 Reference documents

Documents referenced in this section are as follows:

Table 46: Reference documents - Standards

REFERENCE	STANDARD/SPECIFIC CLAUSE
AS 3996:2006	Access covers and grates.
AS/NZS 2566	Buried flexible pipes.
AS/NZS 1252:1996	High strength steel bolts with associated nuts and washers for structural engineering.
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 applications.

REFERENCE	STANDARD/SPECIFIC CLAUSE
AS/NZS 2032:2006	Installation of PCV pipe systems.
AS3996:2019	Access Covers and Grates
AS/NZS 2033:2008	Installation of polyethylene pipe systems.
AS/NZS 2280:2014	Ductile iron pipes and fittings.
AS/NZS 2312:2014	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings.
AS/NZS 2596 Parts 1 & 2	Buried flexible pipelines – structural design and installation.
AS/NZS 3725:2007	Design for installation of buried concrete pipes.
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 4130:2009	Polyethylene (PE) pipes for pressure applications.
AS/NZS 5065:2005	Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.
BS EN 124:2015	Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control.
NZS 3103:1991	Specification for sand for mortars and plasters.
NZS 3109:1997	Concrete construction.
NZS 3114:1987	Specification for concrete surface finishes.
NZS 4404:2010	Land development and subdivision infrastructure.
NZS 7643:1979	Code of practice for the installation of un-plasticised PVC pipe system.

Table 47: Reference documents - Other

AUTHOR/ORGANISATIONS	TITLE
	Building Act 2004
MBIE, 2014	Acceptable solutions and verification methods for NZ Building Code – clause E1 'surface water'.
	Local Government Act 1974, Section 451
Bay of Plenty Regional Council	Stormwater Management Guidelines for the Bay of Plenty region, 2012/01
Bay of Plenty Regional Council	Guidelines for the design, construction, maintenance and safety of small detention dams, 2022/01
Auckland Council	Technical report TR2013/018 hydraulic energy management – inlet and outlet design for treatment devices.
Auckland Council	Technical report TR on landscape and ecological values within stormwater management, August 2010.
Auckland Council	TR 2008/020 application of low impact design to brownfield sites.
Auckland Council	Australian rainfall and runoff guide – project 11 – blockage of hydraulic structures, February 2014.
Hamilton City Council	Three waters management practice notes 2016.
IPENZ	Guideline and procedure for hydrological design of urban stormwater systems (available on 'informit.com').
Ministry for Primary Industries (MPI)	National plant pest accord (NPPA) list
NIWA	New Zealand fish passage guidelines for structures up to 4 metres, 2018
NZTA	SP/M/022:2013 bridge manual
NZTA	FS:2013 – specification for pipe subsoil drain construction.
PVC Pipe Association (Uni-Bell)	Handbook of PVC pipe design and construction
Waikato Regional Council	Building a dam.

AUTHOR/ORGANISATIONS	TITLE
Waikato Regional Council	Erosion and sedimentation guidelines.
Waikato Regional Council	Waikato Regional Plan.
Waikato Regional Council	Waikato stormwater management guideline[56]
Waikato Regional Council	Waikato stormwater runoff modelling guideline[56]
Water NZ	NZ pipe inspection manual 3rd edition

4.1.3 Level of service

The design of the system must be such that the objectives outlined above are met and a stormwater solution can be provided for each lot.

New stormwater systems must achieve the following minimum standards:

a) The stormwater system must operate by gravity. Pumped systems are not acceptable due to ongoing maintenance requirements however refer to *Clause 4.2.3.4 Primary system design requirements* on page 195 for further information.

b) The primary stormwater system must be capable of conveying the design storm event (see *Clause 4.2.4 Hydraulic design criteria* on page 198) without surcharge.

c) The secondary stormwater system must be capable of conveying the 100-year ARI storm event within a defined path and without causing undue risk or damage to persons or property. The use of a kerbed roadway as an overland flow path may be acceptable if it is in accordance with the maximum depth and velocity requirements.The stormwater system must not connect or be able to overflow to the wastewater system.

d) Development must not increase peak discharge rates for design events to the receiving waters. However an increase may be acceptable for:

i) Large events where it is demonstrated that there are no additional adverse effects, which are no more than minor, on the environment or downstream properties as a result of the increase, or

ii) Where at source mitigation is not practicable but an offset mitigation is used.

e) Development must ~~shall~~ prevent, or minimise, any increase in discharge volumes to receiving waters to the extent reasonably practicable.

f) The stormwater system must provide the required amount of treatment (see *Clause 4.2.3 System design* on page 191).

Where the existing system (private or public) is affected by the development, any system upgrades must not increase the flood hazard risk to people or property and no additional private properties must be affected (i.e. new flood risks must not extend onto previously unaffected property).

The design parameters and specific requirements for the levels of service listed above differ by land-use type, proposed solution (in the case of treatment and detention) and the catchment. Reference should be made to the following document hierarchy:

- The District Plan.
- Any relevant catchment management plan, stormwater management plan, water impact assessment, or similar Council document.
- Waikato Regional Council stormwater management guidelines.

[56] Be aware that the Guideline may differ to this RITS, but the WRC document prevails.

4.1.4 Alteration to existing infrastructure

The connection of a new development to the existing stormwater must not negatively affect the level of service in the existing network.

Alteration of the existing stormwater system to achieve the required level of service and consent compliance must generally be at no cost to Council unless it is an upgrade that benefits other properties.

4.1.5 Regional Council resource consent requirements

Resource consents from the Regional Council will be required for all works within the setback distance from any watercourse and any direct 'discharge' to a waterway unless it can be shown to a permitted activity in the Regional Plan.

Stormwater discharges to the public stormwater system are required to comply with the rules in the Regional Plan. If a proposed stormwater discharge cannot meet the permitted activity status of the Regional Plan, regardless of whether or not there is a comprehensive stormwater discharge consent in place, a resource consent will be required from the Regional Council. This consent can be subsequently transferred to Council, subject to due process, and then surrendered under the Council's comprehensive stormwater discharge consent, if one is in place at the site location.

4.1.6 Stormwater discharge consents

Individual resource consents from the Regional Council are required for all new stormwater discharges. Once all Council and Regional Council requirements have been met this consent can be surrendered and the discharge will be managed under Council's comprehensive resource consent.

Council encourages early consultation between the developer and Council staff to achieve:

- Mutual design outcomes, particularly understanding the site specific and integrated catchment management plan requirements.
- Consistency of discharge activity with requirements of Council's comprehensive resource consents.

4.1.7 Planning documents and assessments

All design must be undertaken in accordance with the District Plan, bylaws and policies. In addition, design must be consistent with national, regional and local statutory planning documents and must comply with Council's comprehensive resource consent for the discharge of stormwater to land and water.

Council will advise developers of the existence of the above documents during any consenting discussions regarding development. Design should not occur until the requirements have been confirmed.

The integrated catchment management plan and master plan may contain details of strategic infrastructure to be located within the development area. The responsibility for the design and construction of strategic infrastructure must be agreed with Council prior to commencing design.

4.1.8 Catchments and off-site effects

All stormwater systems must provide for the management of stormwater runoff for the full contributing catchment, that is, runoff from within the land being developed together with any runoff from upstream catchments. Flood levels must not be increased by any development unless the designer demonstrates that any increase will have minor impact on adjacent properties. Furthermore, development must not obstruct or divert stormwater overland flowpaths or result in changed stormwater drainage patterns on adjacent land in different ownership.

The outcome of development must be that the design of the stormwater system avoids adverse scour, erosion and sediment deposition on land, property and the beds of stormwater receiving water bodies, adverse flooding of land, property and stormwater receiving bodies and adverse effects on aquatic ecosystems.

4.1.9 Discharges

Where discharges are outside of the development site, the onsite stormwater management system must be designed so as to cause no offsite adverse effects. Prior acceptance must be obtained in writing from the landowners and any other relevant landholders that may be affected by the proposal.

4.1.9.1 Discharge into a stream or watercourse

The uncontrolled discharge of stormwater into streams and watercourses (including artificial ones) is not acceptable.

In areas where re-use and soakage are not sufficient, but a stream or watercourse is accessible from the site, the stormwater may be drained to the stream or watercourse provided that the following conditions are met:

a) Retention/detention and treatment devices must be proposed, constructed and maintained in accordance with an accepted integrated catchment management plan or water impact assessment.

b) The devices must be operated and maintained by the developer to provide best practicable stormwater treatment efficiency at all times until the asset is vested and the defects liability period has ended.

c) In the absence of an accepted integrated catchment management plan the developer must refer to *Table 52: Design level of service* on page 199 and contact both Council and the Regional Council to discuss what detention and treatment is necessary prior to discharge.

d) A suitable outlet and dissipating structure must be constructed to ensure no localised erosion of the watercourse occurs. This structure must be specifically designed to blend in with the immediate natural surroundings. The use of gabions or similar rock mattress products in streams and watercourses is not acceptable.

e) The direction of the discharge must be aligned with the natural downstream flow as much as practicable to prevent erosion of the opposite stream bank. In situations where erosion of the opposite bank is unavoidable appropriate mitigation measures are required.

f) No obstructions are to be placed in a watercourse that will impede the natural flow unless these are installed as part of an accepted stormwater management system.

g) Individual properties which border onto a stream should discharge their stormwater into the stream in a dispersed manner via an appropriate vegetated flow dispersal device to avoid causing erosion. See Stormwater drawing: Private DN100 Stormwater outlet to minor streams.

Overland flow paths must be provided in accordance with *Clause 4.2.3.5 Secondary design requirements* on page 196 to cater for events exceeding the capacity of the primary system and occasions when the primary drainage system fails.

4.1.9.2 Discharge into the public stormwater system

Council has no legal obligation to provide any property with a connection to a public stormwater system. Council currently provides a public stormwater system to most urban areas however in some areas the system may already be at capacity.

As a guideline after re-use, soakage and surface water outlets have been exhausted, small developments can connect to the public stormwater system where this is within 30m of the property boundary. Where the system is further away, a kerb outlet solution is allowable (refer to *Clause 4.1.9.4 Discharge to the Road Kerb* below. Developments requiring discharges greater than 300mm diameter will require specific assessment.

Stormwater treatment and detention will be required prior to discharge to Council's stormwater system.

Overland flow paths must be provided in accordance with *Clause 4.2.3.5 Secondary design requirements* on page 196 to cater for events exceeding the capacity of the primary system and occasions when the primary drainage system fails.

4.1.9.3 Discharge to a Council owned reserve

In situations where a property borders onto a Council owned reserve and the natural flow of stormwater is in the direction of the reserve it may be appropriate to discharge stormwater to the reserve provided suitable quantity and quality control is provided and that this does not adversely affect the amenity value or function of the reserve in any way or create any stability or flooding liability issues for Council. The method of stormwater discharge to a Council owned reserve requires specific acceptance from Council's parks staff.

4.1.9.4 Discharge to the Road Kerb

Stormwater discharge to a road kerb as a primary means of disposal is not an acceptable solution for stormwater disposal from new developments in 'greenfield' or 'brownfield' areas.

In some areas there is an existing public stormwater drainage system which serves the road network, and some properties currently discharge their stormwater onto the road and ultimately into the road drainage system. This system was generally not designed for the additional stormwater flows and there is no right to utilise the road for primary drainage purposes for any future development or transferred existing use right. As a principle, all sites must minimise discharges of stormwater onto urban roads.

4.2. DESIGN

4.2.1 Design life

All stormwater assets and networks must be designed and constructed for an ultimate asset life of at least 100 years. Some components of detention and treatment devices such as wetlands, rain gardens and other systems will require earlier renovation or replacement as part of ensuring long term function. These assets will require an accepted operations and maintenance manual which details the ongoing asset management needs.

Where any proposed device is designed with an asset life less than 100 years, this decision must be justified in design documentation and the asset renewal requirements fully document in an operations and maintenance plan which must be provided to Council for acceptance.

4.2.2 Acceptable products

Refer to *Section 8: Acceptable products* on page 365.

4.2.3 System design

Stormwater systems must 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 rainfall event appropriate for the zone, appropriate treatment of pollutants and ensure the effects from the primary system are managed.

b) A secondary system to ensure that the effects of stormwater runoff from events that exceed the capacity of the primary system are managed, including occasions when there are blockages in the primary system.

The stormwater system could include private as well as public infrastructure. While this document generally relates to the design and delivery of public infrastructure, some reference is made to private infrastructure where applicable.

4.2.3.2 Stormwater management disposal hierarchy

Disposal of stormwater from land subject to development, including new road reserve and carriageway to vest, must be carefully considered to ensure that the development does not contribute to adverse impacts downstream. These impacts can be flow related (i.e. flooding or scour) or water quality related. The proposed disposal system must there respond to downstream conditions, be they natural receiving environments or existing engineered infrastructure. When selecting stormwater management solutions, the following hierarchy must be adopted with regards to disposal:

a) Retention of rainwater/stormwater for re-use on site.

b) Soakage techniques.

c) Treatment and detention and gradual release to a watercourse.

d) Treatment and detention and gradual release to a piped stormwater system.

Stormwater must be managed as close to the point of origin as possible, in order to minimise collection and conveyance infrastructure.

Table 52: Design level of service on page 199 provides a summary of the design parameters to address specific stormwater criteria and guidance on whether these are required. These criteria and parameters should be applied for all developments unless the approve integrated catchment management plan, District Plan or Regional Plan requires different values.

Stormwater management may not be required on ‘low contaminant’ individual lots where an accepted centralised downstream device is provided and sized appropriately for the development. However, stormwater management (water efficiency measures)[57] will still be required in accordance with the District Plan but the requirement may be a reduced measure. These may include rainwater tanks for re-use, private raingardens, permeable surfaces, pervious paving or other techniques. The Hamilton City Council’s three waters management practice notes may be referred to for details of the implementation of management solutions on

[57] Only Hamilton City Council currently has these.

individual lots. The practice notes contain acceptable means of complying with Council's District Plan requirements. The practice notes are available on Hamilton City Council's website[58].

Table 48: Minimum device design summary

CRITERIA	DESIGN PARAMETER	WHEN REQUIRED
Design calculations	Rational method up to 4ha. For catchments greater than 4ha appropriate hydrological methods must be confirmed with Council who will look to the appropriate standards and guidelines.	Always.
Runoff coefficients	Pre-development runoff coefficients must be based on the existing land use. Post-development runoff coefficients must be based on the zoning. Refer to *Table 53 : Runoff* coefficients on page 199.	Always
Design rainfall	Refer to *Clause 4.2.4.3 Time of concentration* on page 204 and *Clause 4.2.4.5 Design storm detention* on page 204.	Current rainfall (i.e. not climate change adjusted) must be used for the following: • Sizing temporary works where climate change is not relevant. • Determining pre-development stormwater runoff flows and volumes for use in combination with calculated post-development flows to determine stormwater treatment (quantity and quality) requirements. Climate change adjusted rainfall must be used for the following: • Determining post-development stormwater runoff flows and volumes for stormwater infrastructure design.
Time of concentration	Calculated with a minimum of 10 minutes. Refer to relevant stormwater modelling methodology e.g. the Regional Council's Waikato Stormwater Runoff Modelling Guideline.	Always.
Flood control (100 year ARI event)	Detention required limiting the post-development 100 year ARI event flow rates to 80% of the pre-development 100 year ARI event flow rates.	Where identified downstream flooding (or risk of) exists.[59]
Flow attentuation[60] (attenuation of the 2 year and 10 year ARI events)	Match pre-development flow rates for the 2 and 10 year ARI events through controlled attenuation and multi-stage outlets or devices that reduce the runoff flow.	Catchment location dependent. Always required in the upper half of the catchment. If the development is located close to the catchment outlet and discharging to a watercourse with sufficent capacity then flow mitigation may not be required.

[58] https://storage.googleapis.com/hccproduction-web-assets/public/Uploads/Documents/Content-Documents/Property-Rates-and-Building/Compliance/Waters-practice-notes/Three-Waters-Practice-Note-HCC01-Overview.PDF
[59] Refer flood hazard areas in the District Plan, relevant accepted ICMP and any known downstream restrictions causing flooding.
[60] Retention is encouraged alongside EDV but is generally located on private property.

CRITERIA	DESIGN PARAMETER	WHEN REQUIRED
		This may also apply if the site is in the lower half of the catchment and attenuation might worsen flooding due to relative timing of peaks from the upper catchment.
Volume	Match pre-development runoff volume through reduced runoff practices and sub-catchment management. If this cannot be achieved, provide at least retention of the initial abstraction volume (refer to section 7.2 of the Waikato Stormwater Management Guideline), and mitigation within the receiving environment will be required such as channel stablisation.	When discharge is into a natural stream or modified channnel. Refer to *Table 50: Receiving environment categories (excluding flood control)* on page 197.
Water quality treatment[61]	Refer to: • *Clause 4.2.3.2 Stormwater management disposal hierarchy* on page 191 • Treatment devices hierarchy (*Clause 4.2.16 Soakage devices*) for disposal and treatment preferences. Water quality requirements include: • Total suspended solids (TSS) (75% removal of post-development loads taken as measured at the discharge point from site). • Total metals (copper, zinc) to achieve maximum practical removal possible. • Temperature (<25˚C). • Nutrients (total nitrogen, total phosphorous and ammoniacal nitrogen) to achieve maximum practical removal rates. • Hydrocarbons to achieve maximum practical removal rtes. • Gross pollutants (litter and commercial waste).	Always
Water quality storm	1/3 of 2 year 24 hour ARI rainfall depth with climate change used to calculate water quality volume (WQV)	Always. If extended detention is required to protect natural receving envrionments (refer below) , wetlands can be designed to have half of the calculated WQV included within the EDV. Hence the water quality volume provided as permanent water volume can be reduced by 50%.[62]
Extended detention volume (EDV)[62]	EDV is assessed using the water quality storm as above.	When discharge is into a natural stream or modified channel (refer to *Table 50:*

[61] Unless an alternative criteria is provided within a relevant accepted ICMP or Regional Council stormwater consent.
[62] Refer to the Regional Council's stormwater management guideline.

CRITERIA	DESIGN PARAMETER	WHEN REQUIRED
	If the receiving environment is vunerable to erosion, then EDV = 1.2 x WQV	*Receiving environment categories (excluding flood control)* on page 197 for further definition).
Primary[63] and secondary system level of service	As per level of service for the zone. Refer to *Table 52: Design level of service* on page 199. For secondary flow path design requirements for infill residential development refer to *Table 52: Design level of service* on page 199. Secondary overflow as per level of service. Refer to *Clause 4.1.3 Level of service* on page 187.	Always.
Minimum floor levels	Freeboard requirements: 100 year ARI event plus minimum freeboard heights as per NZS 4404 Clause 4.3.5.2.	Always.
Channel freeboard	The maximum of 300mm or 20% of channel depth.	

4.2.3.3 Design considerations

The following needs to be considered and where appropriate included in the design:

a) Quality and quantity requirements of any discharge.

b) How the transport networks' assets (including carriageway, footpaths, cycleways and berms etc) 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 for pipes and conveyance.

ii) Topographical and environmental aspects.

iii) Easements (existing and/or new).

iv) Clearances from underground services and structures.

v) Provision for future infrastructure and extensions to the upper limits of the subdivision including further capacity to cater for existing or future development upstream, subject to its zoning.

vi) Location of secondary flow paths in relation to public and private assets.

e) Hydraulic adequacy. Refer to *Clause 4.2.4.1 Stormwater flow estimate* on page 199.

f) Where applicable, location of service connections.

The following documents (refer to *Clause 4.1.2 Reference documents* on page 185 for details) provide guidance in the design of pipes, culverts, detention and treatment devices and open channel hydraulics:

g) The NZ Building Code (NZBC) compliance document, clause E1 surface water.

h) Regional Council stormwater management guidelines.

i) Regional Council best practice guidelines for waterway crossings.

j) AS-NZS Standards (various).

k) Queensland Urban Drainage Manual (QUDM).

[63] The primary system must be designed to ensure capacity to accommodate the peak flows, without surcharge. Refer to Table 50: Receiving environment categories (excluding flood control) on page 173.

l) Hydraulic Design of Energy Dissipators for Culverts and Channels (HEC-14)

m) Guide to Bridge Technology Part 8: Hydraulic Design of Waterway Structures (Austroads)

n) Guide to Road Design Parts 5, 5a, 5b (Drainage) (Austroads)

For catchments less than 4 hectare, surface water runoff using the rational method will be accepted. For larger catchments or where significant storage elements (such as stormwater detention and treatment devices) are incorporated, surface water runoff should be determined using an appropriate hydrological or hydraulic computerised model.

All modelling must be carried out in accordance with the Regional Council's 'Stormwater Runoff Modelling Guideline'.

A complete copy of the model must be provided to Council along with the development application supporting documents. All underlaying assumptions (such as losses, time of concentration, and catchment areas) must be clearly stated (in the supporting report) so that a full check of calculations is possible.

4.2.3.4 Primary system design requirements

The stormwater system must be capable of serving the entire contributing catchment upstream of the development and must mitigate the effect it may have on downstream waterways and adjoining areas. It must be designed within the terms of any accepted ICMP.

The means of stormwater disposal must be capable of serving the whole of the lot. Where connection to Council's stormwater system is utilised, the connection must be able to service at least the whole building and developed area available on the lot. Generally, each lot will have a single stormwater connection.

Concentrated stormwater runoff must not be permitted to discharge across footpaths, berms, and from or to adjacent properties. Sheet flow from upstream lots or sub-catchments must be intercepted by both the primary drainage system and the overland flow paths. The sheet flow must not create a nuisance to downstream lots, or present a danger to people and vehicles by way of depth and velocity.

Where further subdivision upstream of the one under consideration is provided for in the District Plan or accepted structure plan the stormwater systems are to be constructed to the upper limits of the developments under consideration.

In all developments the preferred means of stormwater disposal must be in accordance with Clause 4.2.3.2 above.

For the purposes of determining the increase in flow between pre and post development reference must be made to *Clause 4.2.4.5 Design storm detention* below.

Stormwater treatment devices such as wetlands, dry detention basins, rain gardens, and swales etc. are to be landscaped with native vegetative cover as set out in *Clause 4.2.25 Planting and aesthetic requirements* below. Landscape plans must be submitted for the acceptance of Council prior to planting. For treatment devices constructed in conjunction with subdivision or land use consents, planting must be completed and maintained as per the defects liability requirements (*Clause 4.5 As-built information* on page 262).

Treatment devices and storage solutions are to be located within Stormwater Reserves unless agreed with Council. Any treatment device/ storage solution that is to be included in road corridors, must be accommodated in addition to the features shown in the District Plans and will likely require the road corridor width to be increased to minimise utility services congestion and landscaping.

At the time of submitting a design, Council will also require a draft operations and maintenance manual in accordance with the requirements of *Clause 4.5 As-built information* on page 262. Prior to vestment this manual must be updated with monitoring results and finalised with any alterations discussed and agreed with Council. This includes any changes required by the Regional Council for consent compliance.

Under no circumstances must stormwater be conveyed to or be permitted to enter a wastewater system and vis versa.

Subdivision and development (including any land modification) must ensure that surface water runoff is appropriately managed in accordance with the drainage hierarchy in *Clause 4.2.3.2 Stormwater management disposal hierarchy* above.

a) Stormwater pumping

Council considers that pumping of stormwater as a system solution is rarely a practical option because of the need for continuity of power supply and a very conservative approach to pumping design. Applications for pumping stormwater as a smaller component (e.g. low-lying sump) of an overall on-site solution need to have exhausted the other available options and provide sufficient risk mitigation for pump malfunction and power outages.

b) Availability/capacity of Council stormwater reticulation

Where a development will result in an increase in peak stormwater flow rates. Developers must investigate the availability and capacity of existing Council channels (up to the 100 Year ARI event) or reticulation (up to the relevant LOS) to ensure the proposed additional flows to be discharged to them can be accommodated. Council may request additional capacity if the proposed system is critical for the long term planning of growth.

4.2.3.5 Secondary design requirements

Secondary systems must consist of ponding areas and overland flow paths to manage excess runoff that cater for events exceeding the capacity of the primary system and must be protected by an easement and consent notice. These must be designed to cater for the 100 year plus climate change ARI event. Public safety must be incorporated into any design e.g. street lighting to be considered if a cycleway/walkway is used.

The easement and consent notice must:

a) Cover the full extent of the secondary flow path including sufficient width for undertaking operations and maintenance functions, and must not be less than 1.5 metres wide.

b) Have the effect of preventing alteration of the ground surface and prohibit the location of structures that might impede the flow of water cross the land.

c) Be in favour of Council and/or the upstream lot(s) as appropriate.

The easement must be duly granted, reserved and shown on the survey plan.

Stormwater secondary flow paths must be delineated to assist recognition and preservation of their purpose. Stormwater drawing: Secondary flow path treatment - private property shows the minimum treatment required.

Additional edge treatments and hardening of the base surfaces must be provided where applicable due to surface flow volumes and velocities.

Secondary flow on roads must be in accordance with *Clause 3.3.14.10 Secondary flow provisions* above. The design must not result in ponding greater than 150mm deep and a velocity greater than 1m/s. Utilising roading corridors to convey secondary flow paths with contributing catchment areas of greater than 8Ha should be avoided.
These larger flowpaths must be conveyed within engineered swales.

4.2.3.6 Stormwater treatment requirements

Stormwater management can be supported by a number of different devices which remove typical urban contaminants through physical, biological and chemical processes. These devices can also provide retention and/or detention of frequent flows. Integration with flood management requirements needs to be considered to protect the treatment component of the device. The devices are summarised in *Clause 4.2.17 Stormwater treatment device selection* on page 222.

Treatment requirements are defined by the land use and receiving environment. Land use contaminant categories are given in the table below. The different categories result in different pollutant profiles (and corresponding risks to receiving environments) which will determine the treatment device(s) selected.

The receiving environment determines the level and type (i.e. water quality or quantity) of stormwater treatment required to ensure an adequate level and type of protection is provided. In particular these define whether targets for just water quality or additional water quantity are required. Receiving environment categories are given in *Table 50: Receiving environment categories (excluding flood control)* below.

Table 49: Land use categories

LAND USE CONTAMINANT CATEGORY	DEFINITION
Normal contaminant load profile	All land uses not identified as high below.
High contaminant load profile	Roads or intersections with VPD[64]>10,000, zinc or copper roofs, all industrial zones, high-density commercial zones, and uncovered car parks over 750m².

Table 50: Receiving environment categories (excluding flood control)

RECEIVING ENVIRONMENT CATEGORY	DEFINITION	REQUIRED MITIGATION[65]
Natural stream or modified channel	Downstream receiving environment includes a natural watercourse (including ephemeral) modified unlined perennial channel or surface wetland between the design point of discharge and receiving waters.	Water quality treatment, Extended detention volume (EDV), Water quantity control flow attenuation/flood control as per *Table 48: Minimum device design summary* on page 192.
River	All flows are conveyed via either piped system or concrete lined channel for entire length from legal point of discharge to receiving waters.	Water quality treatment. Water quantity requirements dependent on system capacity.

[64] VPD counts >10,000 reflect road classifications ranging from high volume arterial roads to high volume national roads as defined within the One Network Road Classification (ONRC).
[65] Refer to Table Minimum device design summary on page 168 for further details.

RECEIVING ENVIRONMENT CATEGORY	DEFINITION	REQUIRED MITIGATION[65]
Groundwater	Discharge to groundwater through infiltration or pumped injection.	Water quality treatment.
Lakes	Discharge directly to a natural or man-made lake.	Water quality treatment. Water quantity control (flow attenuation/flood control as per *Table* .

Table 51: Treatment train design requirements (excluding flood control)

LAND USE CONTAMINATION CATEGORY	RECEIVING ENVIRONMENT CATEGORY	
	NATURAL STREAM OR LAKE	RIVER OR GROUNDWATER
Normal contaminant load profile	Pre-treatment at source via selected water efficiency measure as specified in the District Plan[66] including detention tanks, raingarden, rainwater re-use system (rain tank), permeable surfaces and soakage. Centralised stormwater treatment device, including EDV, sized for contributing catchment as per *Table 47: Reference documents* on page 186 and *Table 48: Minimum device design summary* on page 192.	Pre-treatment at source via selected water efficiency measure as specified in the District Plan, including detention tank, raingarden, rainwater re-use system (rain tank), permeable surfaces and soakage. Centralised stormwater treatment device sized for contributing catchment as per *Table 47: Reference documents* on page 186 and *Table 48: Minimum device design summary* on page 192.
High contaminant load profile	Primary treatment at source via Gross Pollutant Trap (GPT) or other private stormwater treatment device(s) (which will include meeting any District Plan requirements) to manage high sediment loads and any contaminants specific to the land use. Centralised stormwater treatment device, including EDV, sized for contributing catchment as per *Table 47: Reference documents* on page 186 and *Table 48: Minimum device design summary* on page 192.	Primary treatment at source via GPT or other private stormwater treatment device (which will include meeting any District Plan requirements) to manage high sediment and any contaminants specific to the land use. Centralised stormwater treatment device sized for contributing catchment as per *Table 47: Reference documents* on page 186 and *Table 48: Minimum device design summary* on page 192.

Pretreatment devices need to achieve ≥ 50% removal of total suspended solids and trash capture. Primary treatment devices need to achieve 75% removal of total suspended solids.

Note: If there is no centralised device at source, requirements need to be specific to the land use and meet the parameters of Table 48: Minimum device design summary *on page 192 for the entire site.*

4.2.4 Hydraulic design criteria

All new stormwater systems must be designed to consider climate change adjusted design storms of at least the values set out in table below unless specific acceptance has been obtained from Council.

[66] Otherwise refer https://storage.googleapis.com/hccproduction-web-assets/public/Uploads/Documents/Content-Documents/Property-Rates-and-Building/Compliance/Waters-practice-notes/Three-Waters-Practice-Note-HCC01-Overview.PDF

Council had different levels of service and the table is for any new works.

Table 52: Design level of service

RAINFALL INTENSITY RETURN PERIOD (ARI)	
PRIMARY SYSTEMS	**YEARS**
Residential area	10
Industrial area	10
Commercial area, business, CBD	10
Community and major facilities	10
Parks, reserves and open spaces	5
Rural and future urban	5
Transport corridor	5
Residential – falling away from public land	50
SECONDARY SYSTEMS	**YEARS**
Local roads, collector, roads, off road systems	100

4.2.4.1 Stormwater flow estimate for catchments less than 8 hectares

The runoff coefficients shown in the table below are to be used for the various zones and are provided as a guide for initial calculation of system requirements. More accurate investigations into appropriate return periods and runoff coefficients will be necessary for detailed design.

Detailed design should involve calculating a weighted average runoff coefficient by averaging the value for individual parts of the catchment. This may be done for a representative sample area or the whole catchment. The formula for this calculation is shown in Clause 2.1 of the Verification Method for the NZ Building Code, Clause E1 Surface Water (BC E1). Where there are any discrepancies between runoff coefficients listed in Table 49 and in the E1 document, values in Table 53 must be used.

The entire contribution developed catchment should be accounted for. Where a future land use is anticipated the coefficient for that zone type should be used.

Table 53 : Runoff coefficients

ZONING	RUNOFF COEFFICIENT (C)
General residential (Hamilton City only)	0.80
General residential (excluding Hamilton City)	0.65
Residential intensification zone (Hamilton City)	0.85
Residential medium/high density	0.80
Industrial	0.85
Community and major facilities	0.80[67]
Parks, reserves and open spaces	0.35
Rural	0.25
Transport corridor	0.80
Hamilton City Central Precinct 1, business zones 1-6	0.95

[67] Coefficient may vary significantly dependent on specific land use and impervious coverage. Where community or major facilities comprises large pervious coverage (such as sporting facilities or large institutions) the coefficient can be lowered with specific agreement with Council.

ZONING	RUNOFF COEFFICIENT (C)
Hamilton City Central Precincts 2 and 3	0.85

In refining the estimate of runoff coefficients provided in the table above the BC E1 Table 2 must be used. The coefficients in the table below are provided as a guide.

Table 54: Runoff coefficients refined

SURFACE	RUNOFF COEFFICIENT (C)	RUNOFF COEFFICIENT (C) IF COMPACTION IS LIKELY DURING DEVELOPMENT
Roofs	0.95	NA
Asphaltic and concrete areas	0.90	NA
Uncultivated ground, lawns and playing fields	0.30	0.50
Cultivated ground and dairy farmland	0.20	0.50

4.2.4.2 Stormwater flow estimate for catchments larger than 8 hectares

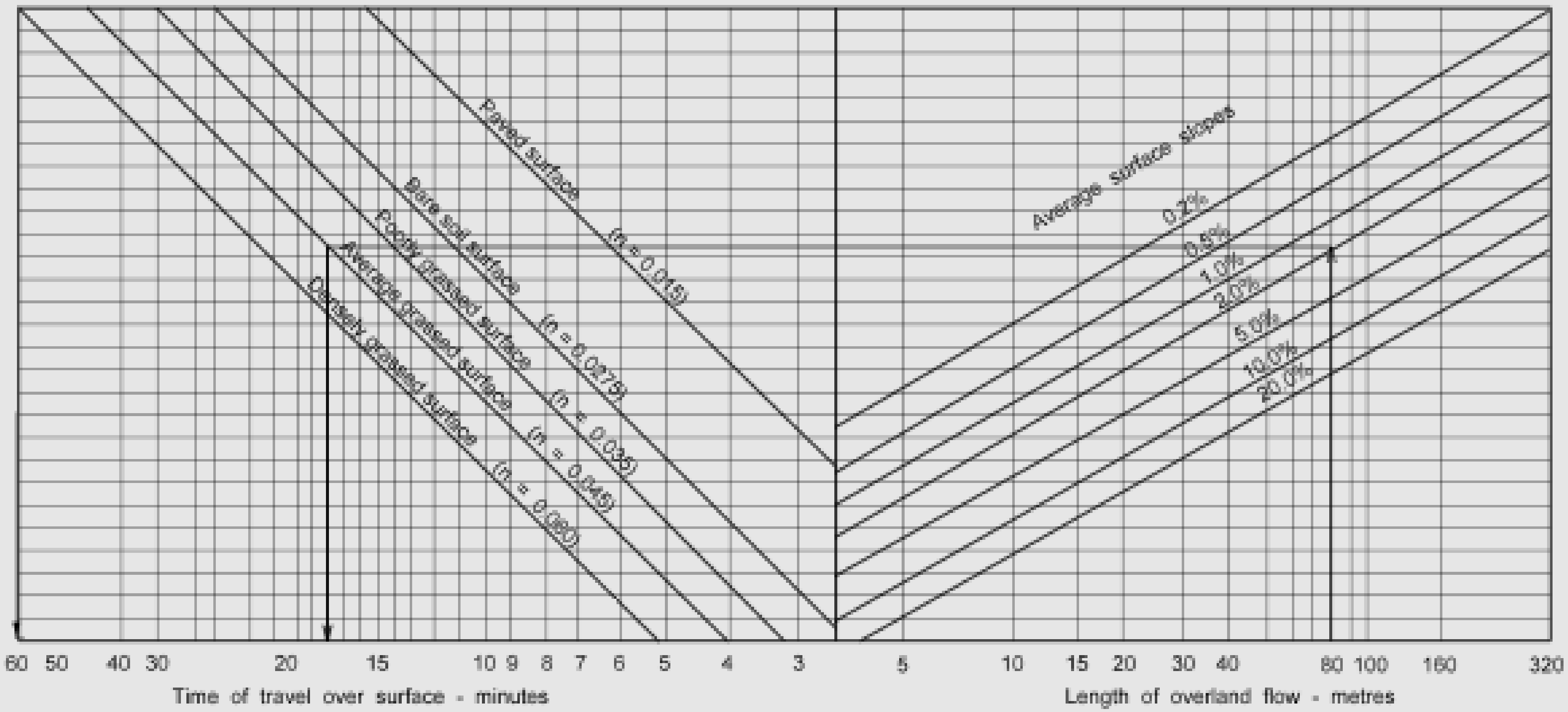
For catchments greater than 4Ha or where significant storage elements are incorporated, surface water runoff should be determined using an acceptable hydrological or hydraulic model that complies with Council's modelling methodology and software and Waikato Regional Council's Waikato Stormwater Runoff Modelling Guideline TR2018/02. Bay of Plenty Regional Council don't appear to have a similar guideline, so it is suggested that the WRC one is used.

4.2.4.3 Time of concentration

The time of concentration must be determined as the 'time of entry' plus the 'time of flow' from the furthest part of the whole catchment to the point of discharge. Time of entry to the system must be calculated from *Figure 4: Overland flow graph* on page 201 or an equivalent published graph or the formula from which it was derived. Time of flow can be calculated from the flow velocity in pipes and channels.

Note: Since time of concentration is not known initially, an iterative type of solution is necessary with time of concentration recalculated from the catchment flow calculation.

Figure 4: Overland flow graph



FORMULA $t = \dfrac{107n \sqrt[3]{\ell}}{\sqrt[5]{s}}$

Where:-
t = time of travel over surface in minutes
n = Horton's values for the surface
ℓ = length of flow in metres
s = slope of surface in %

<u>EXAMPLE</u>
Length of over land flow 80m
Average slope of surface 2%
Average grassed surface
Time of travel 18 minutes

Data attributed to U.S. Dept. of Agriculture 1942

Nomograph published in "Municipal Utilities" Sept. 1951

4.2.4.4 Design rainfall

Design rainfall intensity or depth-duration-frequency (IDF/DDF) tables for current rainfall are to be downloaded from NIWA's HIRDS Version 4[68] (or subsequent versions when they become available). Rainfall from the 'Historical Data' results tab is the rainfall for the current climate scenario. Data from a local rain gauge may be used in place of HIRDS to derive the IDF/DDF information provided the record is long, robustly reviewed for validity, and used with agreement of Council.

Note that HIRDS V4 climate adjusted rainfall depths/intensities do not include regional scaled temperature increases for the Waikato and therefore underpredicts climate change rainfall and so must not be used.

Instead, climate change design rainfall must be derived using the process set out below (unless there is a more detailed climate change assessment accepted for use by Council).

The following derivation of climate change increases references the Ministry for the Environment's 2018 [69] and 2023[70] guidance. This classifies climate scenarios into a series of Representative Concentration Pathways (RCP) which represent alternative global emissions output and control scenarios.

Recent changes have introduced Shared Socio-economic Pathways (SSP) to replace RCPs, but these have yet to be resolved for use in New Zealand and until updated advice is approved by Regional Council, RCPs must be used.

The use of specific climate change scenarios shall be confirmed with individual Councils. However, in the absence of this advice then the following shall be used:

a) Infrastructure design - RCP 6.0 with a sensitivity test to RCP 8.5

b) Flood hazard assessments - RCP 6.0 with a sensitivity test to RCP 8.5

Sensitivity testing is required in all circumstances.

Note that Hamilton City Council's preference is for RCP 8.5 to be used for the basis of design unless otherwise agreed.

The results of the sensitivity test must be discussed with Council and used to understand how the infrastructure in question performs and how uncertainty in both current information and projected climate change is managed. If the results exceed the freeboard of the design, then the design must be refined and/or adaptive management practices (based on a risk management approach) must be discussed, documented and adopted with Council. Examples of the use of the appropriate RCP are provided below.

To determine climate change design rainfall the following process must be used:

a) Obtain current climate ('Historical Data') rainfall IDF/DDF data from HIRDS V4 or an approved rain gauge.

b) Determine the future time period applicable to the design. This must be based on the design life of the infrastructure in question, as specified in project resource consents or as agreed with Council. The default is 100 years (refer Section 4.2.1).

c) Select the average temperature increase from the following table, the values being based on a combination of WRC and MfE advice. Given the 100-year design life requirement, the 2100-2120 figures must be used for the majority of cases. However, where Council accepts a reduced design life, then the climate change increase must be determined by interpolation.

[68] www.hirds.niwa.co.nz
[69] Aotearoa New Zealand Climate Change Projections Quick Reference Guide, Ministry for the Environment, 2018.
[70] Aotearoa New Zealand Climate Change Projections Quick Reference Guide, Ministry for the Environment, 2023.

TIME PERIOD	RCP	TEMPERATURE INCREASE (^{0}C)
2031 - 2050	6.0	0.8
	8.5	1.1
2081 – 2100	6.0	1.9[71]
	8.5	3.1
2100 – 2120	6.0	2.3
	8.5	3.8

d) Apply the following percent change per 1°C of predicted temperature increase. These percentages are sourced from the Ministry for the Environment's guidance[72] as being the 'most likely' increase. The one hour value must be used for storm durations less than 1 hour.

DURATION / ARI	2YR	5YR	10YR	20YR	30YR	40YR	50YR	60YR	80YR	100YR
1 hour	12.2	12.8	13.1	13.3	13.4	13.4	13.5	13.5	13.6	13.6
2 hours	11.7	12.3	12.6	12.8	12.9	12.9	13.0	13.0	13.1	13.1
6 hours	9.8	10.5	10.8	11.1	11.2	11.3	11.3	11.4	11.4	11.5
12 hours	8.5	9.2	9.5	9.7	9.8	9.9	9.9	10.0	10.0	10.1
24 hours	7.2	7.8	8.1	8.2	8.3	8.4	8.4	8.5	8.5	8.6
48 hours	6.1	6.7	7.0	7.2	7.3	7.3	7.4	7.4	7.5	7.5
72 hours	5.5	6.2	6.5	6.6	6.7	6.8	6.8	6.9	6.9	6.9
96 hours	5.1	5.7	6.0	6.2	6.3	6.3	6.4	6.4	6.4	6.5
120 hours	4.8	5.4	5.7	5.8	5.9	6.0	6.0	6.0	6.1	6.1

e) Worked examples (for an arbitrary location and return period/duration):

Intensity based for the Rational Method:

^{i}10yr, 10min = 10 year ARI, 10 minute duration current climate rainfall

= 92.3 mm/hr (from HIRDS V4 'Historical Data' tab)

Design Life = 100 years from Section 4.2.1

Climate change date horizon = 2100 - 2120

Temperature increases = RCP 6.0 = 2.3 ^{o}C and RCP 8.5 = 3.8 ^{o}C

% Change for RCP 6.0 = 2.3 x 13.1% = 30%

% Change for RCP 8.5 = 3.8 x 13.1% = 50%

[71] It is noted that the Waikato Regional Policy Statement requires a minimum of 2.1°C to 2090 which is greater than the MfE figure quoted and the WRC figure must be used where the deign life gives a 2090 date.
[72] Climate Change Projections for New Zealand, Ministry for the Environment, 2018.

^{i}10yr, 10min, RCP6, 2120 = 10 year ARI, 10 minute, 2120, RCP 6.0 rainfall

= 92.3 x 1.3 = 120 mm/hr

^{i}10yr, 10min, RCP8.5, 2120 = 10 year ARI, 10 minute duration, 2120, RCP 8.5 rainfall

= 92.3 x 1.5 = 139 mm/hr

Depth or Volume based for use in volumetric calculations or for hydrology to WRC's Waikato Runoff Modelling Guideline (WRC, 2018):

^{i}100yr, 24hr = 100 year ARI, 24 hour duration current climate rainfall

= 152 mm (from HIRDS V4 'Historical Data' tab)

Design life = 100 years from Section 4.2.1

Climate change horizon = 2100 - 2120.

Temperature increases = RCP 6.0 = 2.3 ^{O}C and RCP 8.5 = 3.8 ^{O}C

% Change for RCP 6.0 = 2.3 x 8.6% = 19.8%

% Change for RCP 8.5 = 3.8 x 8.6% = 32.7%

i100yr, 24hr, RCP6, 2120 = 100 year ARI, 24 hour duration, 2120, RCP 6.0 rainfall

= 152 x 1.198 = 182 mm

i10yr, 10min, RCP6, 2120 = 100 year ARI, 24 hour duration, 2120, RCP 8.5 rainfall

= 152 x 1.327 = 202 mm

f) Two examples of using the appropriate RCP following sensitivity testing are:

A flood attenuation pond is designed for RCP 6.0. However, under RCP 8.5 conditions, the volume of runoff results in the pond freeboard being exceeded. A consequence of the resulting overtopping would be the inundation of downstream habitable building floors. In this case, either the design should be amended to use RCP 8.5 or space be provided around the pond so that Council could increase it in the future without undue hinderance.

This allows Council to adapt the pond to an increased climate risk should that develop. If the downstream land was farmland already subject to flooding and the consequence of the pond capacity being exceeded was a minor increase in the flood depth, then the decision may be taken by Council to leave the design unchanged as the residual risks are understood.

Similarly, if a piped road drain or culvert is designed for RCP 6.0 and when tested with RCP 8.5, is found to only surcharge slightly higher than the pipe soffit, with the hydraulic grade line still well below ground level, then the consequence could be considered minor, and the pipe diameter can remain with RCP 6.0.

4.2.4.5 Design storm detention

Developments proposing detention, attenuation, storage (including in combination with soakage disposal) or other devices where the understanding runoff volumes and volume control is essential, must be based on hydraulic modelling or other methods in accordance with Table 52: Design level of service.

Sites and catchments with significant floodplain storage or that are larger than 1ha in area, also require hydraulic modelling to be undertaken to inform development proposals.

For the above situations, the design storm must be based on a 24-hour nested storm with hydrology prepared in accordance with Waikato Regional Council's Waikato Stormwater Runoff Modelling Guideline. or similar alternative methodology, accepted by Council. If the catchment has a very long response time, it may be necessary to deviate from the 24-hour storm.

4.2.4.6 Energy loss through structure

Energy loss is expressed as velocity head:

Equation 2: Stormwater energy loss

Energy loss:

$$He = kV^2/2g$$

Where K is the entrance loss coefficient and V is velocity. The entrance loss coefficient table and energy loss coefficient graph in BC E1 provides 'k' values for flow through inlets and access chambers respectively.

For bends see the table below.

Table 55: Loss coefficients for bends

BENDS		K
Manhole properly benched with radius of bend	1.5 x pipe diameter in mm	0.5 to 1.0
Bend angle	90°	0.90
	45°	0.60
	22.5°	0.25

4.2.4.7 Determination of water surface profiles

Stormwater systems must 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 must be used and the more severe relevant condition adopted for design purposes. For pipe systems at manholes and other nodes, primary (and if secondary) water levels computed at design flow must 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 (h2) for a given value of discharge and a given start water level downstream (h1).

This can be resented as:

Equation 3: Determination of water surface profile

$$h_2 + \frac{V_2^2}{2g} = \frac{V_1^2}{2g} + H_1 + H_e$$

Where:

V is velocity

H_1 is head loss due to boundary resistance within the reach (for pipes, unit head loss is read from Manning's flow charts)

H_e is head loss within the reach due to changes in cross section and alignment (refer to Table 60: Culvert design storms *on page 219 for loss coefficients).*

4.2.4.8 Minimum pipe diameters

Irrespective of other requirements, the minimum pipe size for a public stormwater pipe must be not less than DN150 and a lateral connection not less than DN100.

In no circumstances must the pipe size be reduced on any downstream section.

Table 56: Minimum pipe sizes

SITUATION	MINIMUM SIZE (MM)
Single catchpit lead	225 Smaller pipes are permitted for serving private way catchpits, subject to specific capacity design.
Double catchpit lead	300
Single dwelling	100
2-3 dwellings	150
Stormwater network pipe	150

4.2.4.9 Minimum gradients and flow velocities in pipes

Pipe gradients should be at a grade that prevents silt deposition. The minimum velocity should be at least 0.6m/s at a flow of half the 2-year ARI design flow.

For velocities greater than 3.0m/s specific design to mitigate erosion at the outlet to the waterway is required.

4.2.5 Watercourses

Refer to both the District Plan and Regional Plan to ensure all planning requirements are incorporated into any design. Also refer to Council's Stormwater Drainage Bylaw.

4.2.5.1 Natural or Modified Watercourses

Natural or modified waterways are expected to be kept and restored and protected where possible. Resource Consent is required from the Regional Council if proposing any modifications to a natural or modified watercourse. This must be done before any modifications are made.

If a natural or modified watercourse is included within a proposed development area, the watercourse must be restored and protected plus must be located within a drainage reserve of sufficient width to contain the full design storm flows from a 100-year ARI event with a minimum freeboard as per *Table 48: Minimum device design summary* on page 192. Where these waterways are being naturalised, the design must ensure that there is no increased risk of erosion and/or scour and the ecological health of the waterway is maintained or enhanced. Any stormwater discharge to a watercourse must comply with the requirements presented in *Table 50: Receiving environment categories (excluding flood control)* on page 197.

Planted riparian margins must be provided each side of the waterway and must consider maximisation of bank stability and public safety. All channel infrastructure must include protection against erosion and scour of the stream banks and stream bed using natural treatments where feasible.

To encourage the best use of the natural or modified waterway, the drainage reserve must, where possible, be linked with other reserves and open spaces to accommodate off road pedestrian and cycle access. Access points for public use and maintenance must be provided at regular intervals along the system together with footpath and pedestrian bridges, as may be defined in the resource consent or council contract

Catchment or detention factors that may lead to an increase in the temperature of the stormwater runoff (e.g., large sealed areas) must be mitigated in accordance with an accepted ICMP or Table 50: Receiving environment categories (excluding flood control) on page 197.

If the natural or modified watercourse is to be in private property, discussions will need to be held with Council to determine responsibility for maintenance. At minimum, the watercourse must be protected by an easement in compliance with Stormwater drawing: Secondary flow path treatment - private property.

4.2.5.2 Artificial watercourses

Artificial watercourses (Typically highly modified open drains) may be relocated or piped if there are valid engineering or design considerations, ecological impacts have been considered (informed by acceptable ecological assessments) and Regional Council acceptance has been obtained. This must be done before any modifications are made. The engineering plans should be noted accordingly.

Where perennial or ephemeral artificial waterways are to be incorporated in the stormwater system, they must be located within a drainage reserve of sufficient width to contain the full design storm flows from a 100-year ARI event with a minimum freeboard as per *Table 48: Minimum device design summary* on page 192. Where these waterways are being naturalised, the design must ensure that there is no increased risk of erosion and/or scour, and the ecological health of the waterway is maintained or enhanced. Any stormwater discharge to a watercourse must comply with the requirements presented in *Table 50: Receiving environment categories (excluding flood control)* on page 197.

Grass berms in reserves must have a maximum side slope of 1 in 5 for mowing and additionally include a vehicular access berm for maintenance purposes. Planted riparian margins must be provided each side of the waterway and must consider maximisation of bank stability and public safety. All channel infrastructure must include protection against erosion and scour of the stream banks and stream bed using natural treatments where feasible.

If the artificial watercourse is to be in private property, discussions will need to be held with Council to determine responsibility for maintenance. At minimum, the artificial watercourse must be protected by an easement in compliance with Stormwater drawing: Secondary flow path treatment - private property

4.2.5.3 New natural open drainage systems

Where new natural open drainage systems or formed channels are to be incorporated into the stormwater drainage system within a proposed development, they must be located within a drainage reserve of sufficient width to contain the overall system design storm flow with adequate freeboard as per *Table 48: Minimum device design summary* on page 192. Any stormwater discharge to a new natural open stream system must comply with the requirements presented in Table 48: Minimum device design summary on page 192.

When designing new natural open drainage systems, it must be demonstrated that the open drainage system:

a) Can be used where it is in keeping with the existing drainage system.

b) Is designed in accordance with natural channel design principles.

c) Where ash, clay or pumice soils are present, the maximum velocity in an unlined open drain must be 0.5m/sec. When this is unable to occur, an appropriate channel lining must be constructed.

Drainage reserves that are to be mowed must have slopes of between 1:5 and 1:50, unless they are a natural watercourse. When access for maintenance is required, access provisions must also include:

d) A 4m wide berm that is able to be driven on by an 8.2 tonne axle weight vehicle for its entire length and provision for turning (if applicable).

e) Access from a road.

To encourage the best use of the new open drainage systems the drainage reserve must, where possible, be linked with other reserves and open spaces to accommodate off road pedestrian and cycle access. Access points for public use and maintenance must be provided at regular intervals along the system together with footpath and pedestrian bridges, as may be defined in the resource consent.

The flow characteristics of natural open drainage systems must:

f) Be based on the likely long term stream condition in terms of density of vegetation.

g) Be cleared of all unsuitable plant growth and replanted to a landscape design accepted by Council.

h) Take account of the possibility of blockage under all peak flood conditions.

i) Include protection of the low flow channel against scour and erosion of the channel bed where necessary.

j) Not be changed by the discharge of stormwater resulting from development or a new discharge to the drainage system.

k) Be designed to avoid erosion of the banks of the open drainage system.

Catchment or detention factors that may lead to an increase in the temperature of the stormwater runoff (e.g., large sealed areas) must be mitigated in accordance with an accepted ICMP or Table 50: Receiving environment categories (excluding flood control) on page 197.

Where a section of the drainage system is to be piped (e.g. for crossings), reference must be made to *Clause 4.2.12 Culverts* on page 219. Resource Consent may be required from the Regional Council for the culvert, refer to the Waikato or Bay of Plenty Regional Plan.

4.2.6 Piped system layout

The preferred layout/location of pipes is as follows:

Table 57: Pipe location

AREA	LOCATION
Residential	Within the transportation corridor normally 2m out from the kerb except where the properties served are below road level. Manholes should be located wherever possible in the centre of the traffic lane.
Industrial	Within the transportation corridor normally 2m out from the kerb alternatively in the front yard area with specific Council acceptance.
Business	Within the transportation corridor normally 2m out from the kerb or alternatively in the rear service lane with specific Council acceptance.
Other areas	Within the transportation corridor except where the properties served are below road level.

Private property	If no other option is available, pipelines may be laid within private property. Where a pipeline is within a property, it is required to be parallel to and no closer than 1.5m from a boundary. No new private drains must pass between one lot and another. If crossing of private property is unavoidable, those parts of the pipeline serving more than one lot must be Council mains with service connections to the property boundaries or protected by public or private easement. The public easement width must be based on the 45° zone of influence centred on the pipe and be a minimum of 1.5m. The major reticulation and trunk lines however must be in the transportation corridor.

Where a stormwater pipeline changes location within a street, crossings of roads, railway lines, and underground services must, as far as practicable, be at an angle of 45 degrees or greater. Pipes must be located and designed to minimise maintenance and crossing restoration.

4.2.6.1 Topographical considerations

In steep terrain the location of pipes is governed by topography. The pipe layout must conform to natural fall as far as possible to remove the need for gravity pipelines operating against natural fall and thus creating the need for deep installations.

4.2.6.2 Minimum/maximum cover

All pipelines must be specifically designed to support the likely loading in relation to the minimum cover to be provided in accordance with AS/NZS 3725. The minimum cover for all types of popes must be 600mm (including during construction). Vehicle entrance culverts may be reduced to 250mm cover but the pipe class and backfill will need to be specifically designed.

For private pipelines in private property the depth of cover is dealt with under the Building Act and accepted by Council's building department.

4.2.6.3 Clearances from underground services

Clearance from underground services must be as per NZS 4404 Section 5.3.7.9.

4.2.6.4 Clearance from structures

Pipes adjacent to existing buildings and structures must be located clear of the 'zone of influence' of the building foundations. If this is not possible a specific design must be undertaken to cover the following:

a) Protection of the pipeline.

b) Long term maintenance access for the pipeline.

c) Protection of the existing structure or building.

See Stormwater drawing: Building over and adjacent to public wastewater or stormwater pipelines

The protection must be specified by the developer for evaluation and acceptance by Council. Sufficient clearance for laying and access for maintenance is also required. The table below may be used as a guide for minimum clearances for mains laid in public streets.

Table 58: Minimum clearance from structures

PIPE DIAMETER DN (MM)	CLEARANCE TO WALL OR BUILDING (MM)[73]
<100	600
100 – 150	1000
200 – 300	1500
375+	1500 + 2 x diameter

4.2.7 Manholes

Manholes are to be located:

a) On Council property or transportation corridors whenever possible and if located within the carriageway the manholes must be located clear of the likely wheel path and not in cycleways / or 2m out from the kerb.

b) Clear of all boundary lines by at least 1.5m from the outer edge of the manhole chamber plus the height of any nearby retaining walls if they exist.

c) 2m clear of new structures in private property as shown in the Drawing '*Building over and adjacent to public wastewater or stormwater pipelines*'.

d) Clear of wheel tracks to minimise noise and vehicle user discomfort.

Manholes are required at the following locations:

e) Intersection of pipes except for junctions between mains and lateral connections.

f) Changes of pipe size.

g) Changes of pipe direction, except where horizontal curves are permitted.

h) Changes of pipe grade, except where vertical curves are permitted.

i) Combined changes of pipe direction and grade, except where compound curves are permitted.

j) Changes of pipe invert level.

k) Changes of pipe material, except for repair/maintenance locations.

l) Permanent ends of a pipe.

For infill developments, manholes must not be required for a DN150 connection on a DN150 pipeline where a manhole is provided immediately inside the property being served and another manhole is within 100m as these provide adequate accessibility.

4.2.7.2 Distance between manholes

For reticulation pipes less than DN900 the maximum distance between any two manholes must be 120m.

On pipelines DN900 and greater but less than DN1800, the spacing of manholes may be extended up to 200m. On pipelines DN1800 or greater the spacing may be extended up to 300m between manholes.

Uniform curvature on pipelines DN900 and greater may be permitted providing that joint deflections are within the limits of the manufacturer's recommendations.

[73] These clearances should be increased by 400mm for mains in private property as access is often more difficult and damage risk is greater.

Branch lines should normally be connected into a manhole. However, branch lines DN300 and smaller may be saddled onto pipelines DN600 or larger providing a manhole is supplied on the branching line within 40m of the main line. Factory made 'Y" connections must be used.

4.2.7.3 Stormwater manholes on larger pipelines

Manholes on stormwater pipelines more than DN600 must have a minimum diameter equal to the largest pipe size plus 450mm. On larger pipelines, recessed steps with rungs may be required below pipe benching level. In all cases, the lowest rung must be easily reached by a person standing at invert level (see *Stormwater Drawing: DN1050-DN1350 manholes*.

4.2.7.4 Size of manholes

Manholes must be a minimum of DN1000 for depths of 1.0m or more. Manholes of DN750 are permitted to be used for depths less than 1.0m at the upstream end of public drains.

4.2.7.5 Manhole materials and parameters

Concrete manholes must be pre-cast concrete with an external flange base or accepted PE. Refer to *Section 8 Acceptable products* on page 365. Concrete manholes up to 2400mm deep must be constructed using a single riser with a pre-cast external flange base. Manholes in excess of 2400mm must be constructed using a 2400mm deep pre-cast riser with external flange base and then completed to final ground level using no more than a single riser for manholes up to 5.0m deep. Three risers are allowable for manholes in excess of 5.0m depth. In no case must a series of short risers be permitted.

The joints of all abutting units must be sealed against ingress of water by the use of Expandite BM100 'Sealastrip' or an accepted equivalent.

The cover frame must be set over the opening and adjusted to the correct height and slope using adjustment rings and mortar so as to confirm to the surrounding surface. The cover frame must be held in place with a bold fillet of concrete.

PE manholes and chambers are acceptable but only those shown in *Section 8 Acceptable products* on page 365.

Refer to the following for more information:

a) Stormwater Drawing: DN1050-DN1350 manholes

b) Stormwater Drawing: Typical dimensions for manholes greater than DN1350

c) Stormwater Drawing: Shallow manhole/chamber

4.2.7.6 Manholes requiring specific design

Consideration must be given to the design of manholes to ensure safe entry. Where manholes are more than 5.0 deep, they must be specifically design in accordance with the manufacturer's requirements for external pressures and resist floatation. Where a manhole is to be constructed in soft ground, the area under the manhole must be undercut to provide an adequate foundation and backfilled with suitable hard fill for the manhole base. Where undercutting exceeds 1.5m a special design will be required.

4.2.7.7 Flotation

In areas of high-water table all manholes must be designed to provide a factor of safety against floatation of 1.25.

4.2.7.8 Internal fall through manholes

In addition to the normal pipeline gradient all manholes must have a minimum drop of 20mm plus 5mm per 10 degrees of the angle of change of flow within the manhole.

The construction tolerance for drop through the manhole must be:

Equation 4: Construction tolerance for drop through manholes

$$Constructed\ manhole\ drop = Manhole\ drop\ (as\ calculated\ above)\ \pm 5mm$$

Grading the channel must be limited to falls through manholes of up to 150mm. To avoid excessively steep channels within manholes, steep grades must be 'graded-out' at the design phase where practicable.

4.2.7.9 Manhole covers

Manhole covers with a minimum clear opening of 600mm in diameter, complying with AS 3396 or EN124 must be used. They must be hinged, and self-locking is preferred. Refer to Section 8 Acceptable products on page 365.

Table 59: Types and locations of manhole covers

TYPE	LOCATION
'Heavy duty' covers Class F (or 400kN loading)	Must be used on all State Highway, noting NZTA have their own requirements for manholes (see NZTA P46 Stormwater Specification), and must be used in the transportation corridor, commercial and industrial properties and all public areas.
'Standard' covers Class C (100kN loading)	May only be used in residential properties without traffic loadings.

4.2.7.10 Manhole steps

All manholes must be provided with non-slip steps as set out in Section 8 Acceptable products on page 365 in order to provide safe access. These must be of the 'dropper' or 'safety' type to prevent feet sliding sideways off them.

Manhole steps must be provided at 300mm centres vertically. The top step must not be more than 450mm below the top of the top slab, and the lowest step must be not more than 375mm above the bench, or such lower level if detailed on other than standard manholes. Refer to the following drawings:

- Stormwater Drawing: DN1050-DN1350 manholes
- Stormwater Drawing: Typical dimensions for manholes greater than DN1350

4.2.7.11 Connections to manholes

Open cascade is permitted into manholes over 2.0m in depth and for pipes up to and including 300mm diameter providing the steps are clear of any cascade. Refer to Stormwater drawing: DN1050 manholes. The bases of all manholes must be benched and haunches to a smooth finish to accommodate the inlet and outlet pipes. Pipelines connecting at or below design water level in the MH must do so at an angle of not greater than 90 degrees to the main pipeline direction of inflow. Local pipelines connecting above design water level may do so at any angle. The invert of a private connection must connect to the manhole at a level no lower than the average of the soffit levels of the main inlet and outlet pipes.

4.2.8 Connections

4.2.8.1 General

The lateral connection should be designed to suit the existing situation and any future development. For all connections to an open watercourse, resource consents from the Regional Council may be required if it is not a permitted activity.

Connections are private to the point of discharge and then become public. The point of discharge can vary between councils, so developers/contractors need to check this with Council. Refer to Stormwater drawing: Connections Layout for connection layouts.

4.2.8.2 Design requirement

The following design requirements must be met:

a) Stormwater management as per hierarchy in *Clause 4.2.3.2 Stormwater management disposal hierarchy* on page 191.

b) Where no other option is available, a 'bubble-up' discharge to the kerb and channel may be acceptable. Kerb and Channel connections can be used in place of 'bubble-up' outlets in normal residential zones where, there is a suitable kerb profile and, the connection outlet can be installed at least 1m clear of any vehicle crossing. Acceptance by council is required before hand.

c) If connecting to a public pipe, the standard depth of a stormwater connection at the boundary is 1.2m (allowable range 0.9 m - 1.5 m), or to such depth that permits a gravity connection to service the whole lot.

d) To determine whether a connection can serve the whole developable area of the lot, the invert level should be calculated at grade 1:80 from the public pipeline invert to the lot boundary and then at 1:100 to the furthest point within the lot. If after allowing for the pipeline diameter, the depth of cover over the pipeline is less than 500mm, the design will need to be to the satisfaction of Council's building team.

e) Existing connections, in sound condition but not documented on Council records may be reused subject to confirmation of existing construction suitability and as-built information is provided to update Council's records.

f) Detention of stormwater prior to release to Council's system is required as per *Table 48: Minimum device design summary* on page 192. Early consultation is encouraged with Council for a suitable solution for the development.

g) Minimum size for connections is as per *Table 56: Minimum pipe sizes* on page 206.

h) All connections, which are to be made directly to the line, must be designed using a factory manufactured 'wye' or 'London Junction' and must be watertight.

The system design must allow for the above events to be contained within the development boundaries.

Secondary flows for up to the 100 ARI plus CC) must be considered against the level of service within *Clause 4.1.3 Level of service* on page 187.

4.2.8.3 Services in accessways, access lots or right of ways

The following should be considered when preparing the design where separate connections are not possible, and not inclusive of the right of way drainage itself:

a) Where drainage is to a piped system refer to Stormwater drawing: Connections Layout.

b) Council will adopt the stormwater system in the right of way where it services 2 or more properties. All private drainage reticulation that has been upgraded in accordance with this standard must be declared public at the point where it crosses a boundary once as-built information has been recorded by Council.

4.2.8.4 Multi-unit properties

For multiple occupancy situations, service of the whole property must be achieved by providing a single point of connection to the Council stormwater system where applicable. 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 be. In this instance the whole of the multiple occupancy must be regarded as a single lot. All drainage within the development boundary will be considered to be private.

a) Pipe size and material must be determined by site-specific design in accordance with Compliance Document for the *NZ Building Code* Clause E1 Surface Water or this RITS.

b) A manhole/chamber is to be provided just within the lot boundary.

4.2.8.5 Ramped risers

Unless required otherwise by Council, a ramped riser must be constructed to bring the connection to within 0.9m - 1.5m of ground level, or to such depth that will permit a gravity connection to service the whole developable area of the lot. Ramped risers must be constructed as shown in Stormwater drawing: Secondary flow path treatment - private property.

4.2.8.6 Connections to deep lines

Where an existing or proposed main is more than 5m deep, or where required by the ground conditions, a satellite manhole will need to be constructed on the shallower connection within 5 metres of the deep main laid from the manhole in accordance with *Clause 4.2.7 Manholes* on page 210.

4.2.9 Building over or adjacent to pipelines

Building close to or over pipelines is generally discouraged as this practice severely limits Council's ability to either maintain or duplicate the pipeline if required in the future. Note that Rotorua Lakes Council does not permit building over pipelines.

4.2.9.1 General

Council does not permit building over or within the specified distances of the following infrastructure (refe

Building Over and Adjacent to Public Wastewater or Stormwater Pipelines

a) Connections 2 metres.

b) Manholes 2 metres (for DN1050, and a specific design for larger ones)

The pipe must be located on site so this assessment can be made.

Alternative options such as relocating the proposed building or decommissioning of/or diverting the pipeline along property boundaries, must be thoroughly investigated by the development before building over a pipeline will be permitted.

In order of preference pipes must either be:

c) Removed (where practical) and connections relocated, dependent on usage capacity for the pipe, at a cost to the development (Refer to Section 451 of *Local Government Act 1974*).

d) Relocate to avoid the construction, and at a cost to the development (Refer to Section 451 of *Local Government Act 1974*).

e) Replaced on present alignment, extending from boundary to boundary (or manhole as appropriate) at a cost to the development (Refer to Section 451 of *Local Government Act 1974*).

The developer/applicant will be responsible for all costs associated with:

f) Investigation and design associated with seeking acceptance.

g) If acceptance is granted, then construction.

h) Repairing any damage to a stormwater main or associated stormwater infrastructure caused by construction over or near an existing pipe.

i) The creation or relocation of easements.

4.2.9.2 Inspection

Any application to build over or within 5m of an existing public stormwater must include the following:

a) A CCTV inspection of the subject stormwater, in accordance with Section 2 of the *New Zealand Pipe Inspection Manual*, undertaken by a contractor qualified and with the necessary experience to do so, or by Council at the applicant's expense. An entry permit will be required and accepted if the contractor needs to enter manholes and/or pipe.

b) The results of the CCTV inspection are to be submitted to Council with the application. The inspection may be used as a dilapidation survey.

Pre-inspections are required to confirm the location of the pipes traversing the entire development site, their condition and to ensure connections are not built over. Building or engineering plans submitted to Council need to also incorporate the confirmed locations of the main, manholes and connections identified by the CCTV inspection as these factors may impact on the development layout/design. Post inspections are required when any construction involves piling within the 45-degree influence envelope of the pipe to ensure no damage has occurred during installation of piles/foundations. No further construction work can be carried out until results are known from the post inspection.

Should the CCTV inspection identify faults, Council may require the developer to:

c) Repair the stormwater main in its existing location using construction materials as specified by Council to accepted plans or

d) Re-line the existing stormwater main by a suitably qualified contractor.

All works on gravity stormwater mains must be completed for the full extent between manholes.

4.2.9.3 Structural loads – building over

No structural loads must be placed on, or be transferred to the pipeline, or other assets. All structural loads must be absorbed (by means of piles where appropriate) outside of the 45-degree influence envelope and below the invert level of the pipe for the first row of piles (refer Stormwater drawing: Building over and adjacent to public wastewater or stormwater pipelines).

The first row of piles must be located at least 1.5m clear from the outside edge of the pipe and 2.0m clear from the outside wall of any public manhole and be founded at least 1.0m below invert level of pipe. Subsequent pile rows must be founded at least 1.0m below the 45-degree envelope of the influence line of the pipe at invert level.

4.2.9.4 Building adjacent to

Any building, structure (including retaining wall) or other development must be designed and founded so that it will not be adversely affected by public infrastructure and associated trench line, including any future excavation that may be required for the maintenance of the infrastructure. The building, structure or other development must make provision to allow for any future possible settlement of the public trench line and backfill. CCTV inspection of all pipes is required before and after construction.

4.2.9.5 Pile ramming

No pile ramming is permitted within 5m from the centreline of any public pipe, or within the 45-degree envelope of the influence line of the pipe at invert level. Pile ramming includes sheet piling. These piles must be drilled only.

4.2.9.6 Abandoned mains

Mains which have been abandoned may remain in the ground providing they are capped. Council may require certain abandoned mains to be backfilled with grout depending on size, material type and proximity to other structures. If the abandoned mains are required to be removed, then the trench must be backfilled and compacted to at least 98% standard compaction.

4.2.9.7 Excavating over pipes

Excavations over or adjacent to a stormwater main are not to reduce the cover over the main to less than the minimum limits in accordance with the AS/NZS standard relevant to the pipe material.

4.2.10 Catchpits

The design and construction of catchpits must be undertaken so that:

a) Catchpit capacity matches the design catchment.

b) The impact of a blockage or ponding is addressed.

c) Catchpits are capable of capturing and retaining the majority of gross pollutants, and floatable contaminants including oil and grease.

d) Catchpits must be accurately positioned so that the grate and kerb block fit neatly into the kerb and channel. Rectangular pits must be oriented with the longer side parallel to the kerb.

e) Catchpit leads must be of the size and material detailed on the plans or specification.

f) Catchpit leads not more than 300 mm diameter and not more than 20 m in length may be saddled on to pipes 600 mm diameter and larger, without manholes.

g) Technology regarding pre-treatment devices within catchpits is continuously evolving. Where devices are required, consultation with Council is required to ensure the proposed device meets with Council's operations and maintenance requirements and will manage existing or future tree leaf and other vegetation likely to accumulate and may wash onto the carriageway Any alternative designs of stormwater catchpits must be capable of capturing and retaining the majority of gross pollutants and floatable contaminants such as oil and grease.

h) Cycle friendly grates must be used

i) The following drawings provide details for the construction of catchpits.

   i) Stormwater drawing: Footpath berm catchpit details

ii) Stormwater drawing: Catchpit back entry details

iii) Stormwater drawing: Double sump catchpit design

iv) Stormwater drawing: Vertical entry catchpit

v) Stormwater drawing: Fish symbols for catchpits

j) Refer to Acceptable Products List 2022 for the list of acceptable precast components.

4.2.11 Outlets and inlets

Accepted structures must be constructed at the inlets and outlets of pipelines.

Where a pipeline discharges into a natural or constructed waterway, consideration must be given to energy dissipation or losses, erosion control and land instability. This is usually achieved by an appropriately designed headwall. Refer to the Regional Council.

Where outlets or inlets are located on or near natural waterways their appearance in the riparian landscape and likely effect on in-stream values must be considered. Methods could include cutting off the pipe end at an oblique angel to match 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. The use of gabions or similar rock mattress products in streams and watercourses is not acceptable.

4.2.11.1 Waikato River outfalls

Outfalls to the Waikato River need to be reviewed by both Waikato-Tainui and Mercury Energy in conjunction with seeking acceptance from Council and the Regional Council. Note that there may be equivalent requirements in the Bay of Plenty Region. Outlets should not be located in sites of recognised cultural historical significance.

Note relevant documents:

a) The Central Waikato River Stability Management Strategy.

b) Waikato -Tainui Raupatu Claims (Waikato River) Settlement Act 2010.

c) Joint Management Agreements (JMA).

4.2.11.2 Outlet design (streams and rivers)

For outlets the design must 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. (Engineering designs must clearly illustrate this).

Outlet designs must incorporate the following:

a) Alignment with an accepted ICMP, CMP or WIA.

b) Fit for purpose over the design life.

c) Receiving waters level and flows.

d) Receiving waters bank erosion protection (0.5m below minimum river level where applicable e.g. Waikato).

e) Energy dissipation and the design must ensure non-scouring velocities at the point of discharge.

f) Seasonal variations in power generation on the Waikato River.

g) Extending outlet works below the water surface.

h) Developing a consistent design criterion for outlet works taking into account public safety requirements, natural character of the surrounds, amenity and aesthetics of the river.

i) Appropriate planting of eco-sourced indigenous species where required.

j) Retaining and enhancing remnant areas of indigenous bank vegetation.

k) Consideration of fish passage requirements.

4.2.11.3 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 75% of the flow from b).

e) Determine the receiving waterway mean 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.

4.2.11.4 Inlet design

The inlet design should take into account particular circumstances at each site using the following evaluation and guidelines below:

a) Direction of upstream flow.

b) Signs of erosion both lateral and down cutting.

c) Height of headwall.

d) Need for overland flow path.

e) General aesthetics.

f) Hydraulic efficiency.

g) Fish passage.

The selection of a suitable location may influence the pipe alignment. Generally, a minimum clearance of 1m must be provided clear of the opening around any inlet structure that may allow entry for maintenance and rescue equipment. Council may determine other specific requirements subject to individual site characteristics.

Screens are required where flow from pipes (300mm and over), open drains, detention and treatment systems enters into a piped system (excluding culverts). All screens must be constructed from hot-dipped galvanised steel and the horizontal gap must not exceed 100mm. Specific design is required to meet the requirements of the site and public safety issues including the provision of access to the inlet structure for maintenance and cleaning of blockages. Screens are to be designed to minimise the build-up of material and to withstand the loads imposed by debris blocking the inlet and the resulting hydraulic head. Where the consequences of a screen blockage are likely to be severe, a backup overflow system that allows runoff to enter the pipe or a clearly defined secondary flow path must be provided. Refer to *Australian Rainfall and Runoff Guide - Project 11*.

4.2.12 Culverts

In designing culverts, the effects of inlet and outlet tailwater controls must be considered. Culverts under fill must be of suitable capacity to cope with the design storm as per Table 56 Culvert design storms
with no surcharge at the inlet, unless the fill is part of a stormwater detention device. All culverts must be provided with adequate wingwalls, headwalls, aprons, scour protection, removable debris traps or pits to prevent scouring or blocking.

When boxes/pipes or culverts are placed side-by-side to create a width of greater than 6.0m, the culvert is defined as a bridge culvert – these must be designed in accordance with the *NZTA Bridge Manual* (SP/M/022), Waikato Regional Council document '*Best Practice Guidelines for Waterway Crossings*' for fish passage and *Clause 3.3.27.1 Bridges and large culverts* on page 132. Culverts must retain stream width, natural bed material and unimpeded fish passage. The design must optimise low velocity zones, minimal turbulence, light, longitudinal bed gradient, bed level that is not raised. The design must minimise upstream flooding, blockages and scouring. If culvert design results in upstream ponding of more than 4 metres, it is considered a 'dam' Refer to *Waikato Regional Council's document 'Building a Dam'*.

Where the culvert is designed as a multi-barrel device, the inlet should be designed to favour one barrel to carry the low flow in direct line of the stream with the other barrel(s) offset. This is also favourable for fish passage. The number of barrels should be limited to ensure that the general stream profile is not unduly disturbed. To achieve this, it is expected that the overall distance to the outside collars of the barrels would not exceed the naturally available stream channel.

Regional Plan rules also stipulate design and consent requirements for the number of hectares in a catchment being drained through a culvert. It is usual for resource consents to require that culvert construction be accompanied by sediment control measures as set out in an erosion and sediment control plan. Refer to the Regional Council's *Erosion and Sedimentation Guidelines*.

4.2.12.1 Design storm

Culverts must be designed as a minimum to accommodate storms as per the table below. The design must not cause any increase in upstream water levels that will result in flooding on neighbouring properties.

Table 60: Culvert design storms

DESIGN CASE	ARI YEAR STORM TO PASS WITHOUT SURCHARGE (DESIGN FLOW)	ARI YEAR STORM NOT OVERTOPPING STRUCTURE (PEAK FLOW)
Driveway or private way	2	NA
Pedestrian or cycleway walk	5	10
Local or collector road	5	100
Arterial roads and railways	20	100

4.2.12.2 General design criteria

The following general design criteria for culverts must apply:

a) The culvert must never be more than half full at average flow.

b) Generally, culverts must accommodate the full width of the stream at average flow.

c) Where flows are typically concentrated in circular barrel culverts, the culvert diameter must be larger than the stream width at average flow. A rule of thumb is 1.2 x channel width + 0.5m.

d) Embankments and culverts must be designed so that if they do overtop, in events larger than the design flow or due to blockage, they won't cause a structural failure.

e) Culverts must be sized so that the largest bed material in the stream can pass either through or over the culvert.

f) Ponding behind the culvert embankment should not exceed 1.0m above the soffit, unless high water velocities are likely to cause scour around the culvert entrance and exit.

g) The invert of the culvert pipe must be below the waterway bed level by a factor of 20% of the culvert diameter.

h) Culverts under fills must 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. Special consideration must be given to the effects of surcharging or blocking of culverts under fill (e.g. anti-seep collars).

i) The culverts inlet and outlet will be flush with the headwall.

j) Culverts must be designed so that they are placed on a straight section of channel where the channel gradient is lowest.

k) Spillways must be provided to cater for the overtopping scenario when flows exceed the design flow and may require armouring to prevent erosion.

l) To reduce potential for excessive turbulent flow which can cause downstream erosion, the design must incorporate baffles or rocks, where the culvert does not have a natural stream bed. The design of this feature must reduce the exiting flow to that of the receiving water.

The secondary flowpath must be designed with adequate freeboard.

4.2.13 Fish passage

Fish passage through culverts must always be maintained or provided as set out in the MfE's 'National Policy Statement for Freshwater Management 2020' (January 2024) and subsequently the Regional Plan. This can be achieved by ensuring that the invert level is set below the stream bed level and the outlet is flooded at all times. The Regional Council must be consulted to determine ecological value of the waterway. In some cases, fish barriers will be desired because of their ability to prevent migration of pest fish.

The culvert design must align with New Zealand fish passage guidelines for structures up to 4 metres, NIWA 2018.

Note: it may be a requirement of the Regional Council that construction avoid spring and early summer.

If a waterway is reduced, the velocity along the banks at normal flow should be maintained at less than 0.3m/s to allow for passage of indigenous fish and trout.

Where multi-barrel circular culverts are to be used for wide channels that have low flows but occasional high flow events, the inlet should be designed to favour one barrel to carry the low flow in direct line of the stream with the other barrel(s) off set. The number of barrels should be limited to ensure that the general stream profile is not unduly disturbed. To achieve this, it is expected that the overall distance to the outside collars of the barrels would not exceed the naturally available stream channel.

Continuous fish passage to offline constructed wetlands is not required where it limits the ability to manage system hydraulics to optimise water quality treatment. However, provision must be made for fish passage either through the wetland or via a baseflow.

4.2.14 Weirs

Any weirs proposed on Council managed drains must be specifically designed for the situation considering any ICMP, CMP or WIA requirements, hydraulic design, fish pass and access for maintenance requirements. Early consultation with Council staff is encouraged.

4.2.15 Subsoil drains

Subsoil drains are installed to control groundwater levels. Perforated or slotted pipe used under all areas subject to vehicular traffic loads must comply with NZTA specification F/2 and NZTA F/2 notes. The design for subsoil drains must include regular inspection and flushing points. In the absence of any other more appropriate criterion the design flow for subsoil systems must be based on a standard of 1mm/h (2.78 L/s/ha). Subsoil drainages servicing private property will not be accepted for vesting by Council.

4.2.16 Soakage devices

Soakage devices such as soak pits and soak holes, filter strips, infiltration trenches and basins, permeable paving, and tree pits must be considered for managing stormwater from roofs, accessways, parking areas, and occasionally roads. The ability of the ground to accept stormwater can vary enormously within soakage areas, even within individual properties. Therefore, at least one percolation test will normally be required for every soakage device that is constructed and this should be done where the soakage device is likely to be placed.

Exceptions to the above expectations for testing are:

a) Extensions to car parking or paving of less than 50m^2 may use a rock filled trench along the lower edge of dimensions 0.5m wide and 0.5m deep.

b) Soakage device for an impervious area less than 40m^2 can use nominal soak holes.

Note: Larger areas may not use multiples of these nominal designs.

Soakage (with storage) is expected to be utilised where soakage results are >150mm/hr as determined using the Building Code E1 Method. Soakage is allowed in soils with lower soakage, however specific engineering design is required for soils with low permeability rates.

Specific design for residential retention applications in Hamilton is given in Hamilton City Council's 3 Waters practice notes[74]

Specific matters to be considered in soakage system design include:

c) Capacity adequate for a 10 Year ARI event, maximum potential impermeable area and located in such a way to maximise the collection of site runoff.

d) Soakage devices must be located away from overland flow paths.

e) Rate of soakage determined through a soakage test with an appropriate reduction factor (at least 0.5, as per NZS 4404) applied to accommodate loss of performance over time.

f) Secondary flows must be provided for the water which will follow during events that exceed the design capacity of the soakage device.

g) Confirmation that the soakage system will not have an adverse effect on surrounding land and properties from land stability, seepage, or overland flow issues.

[74] https://storage.googleapis.com/hccproduction-web-assets/public/Uploads/Documents/Content-Documents/Property-Rates-and-Building/Compliance/Waters-practice-notes/Three-Waters-Practice-Note-HCC01-Overview.PDF

h) Pre-treatment device to minimise silt ingress.

i) Interception of hydrocarbons.

j) Access for maintenance.

k) Soakage devices must not be located close to buildings or boundaries.

l) A clearance of 3m is generally required, but this can be reduced to 1m for porous paving or can be reduced to 1.5m where the neighbouring property is required to have a 1.5m setback to any new building. Setbacks to roadside boundaries must be 0.5m (to avoid fence footings). Further encroachment will require a site-specific design (including PS1 certification) to be carried out.

m) Soakage devices should not be located beside retaining walls

   i) For walls less than 2m high, the clearance must not be less than a horizontal distance that is equal to the retaining wall height plus 1.5m, unless a site-specific design (including PS1 certification) is carried out.

   ii) For walls higher than 2m, a site-specific design is required.

n) Soakage devices must not be located within 2m of public wastewater pipes or 1m of private wastewater pipes.

o) Soakage devices must not be positioned on unstable slopes.

p) A discharge permit may be required from the Regional Council.

4.2.16.2 Recharging of peat

Stormwater management on peat soils provides a special design challenge that needs to be addressed with care. Council defines peat soils as those with greater than 300mm of peat between 0.5m and 4.0m depth of the natural ground surface. Defining the right amount of soakage is very site specific and the release of the stormwater into the peat/soil will need to be considered on a site-by-site basis. For small developments an acceptable solution will be the provision of a single well liner to take the runoff from each 50m^2 of roof area. This will then have high level provision for overflow discharge to Council's reticulation system or an overland flow path as shown in Stormwater drawing: Groundwater recharging devices

4.2.17 Stormwater treatment device selection

There are a number of treatment and detention options available, and the preferred solution will either be identified in an accepted IMCP, CMP and WIA, in Council's standard practice notes, or via

Table 61: Vested treatment device **preferences**

LEVEL	DEVICE	PERFORMANCE			DESIGN PREREQUISITES
		TRE.	DET.	RET.	
1	Wetland	✓	✓		Suitable location downstream (offline to main channel and preferably overland flow path also, no significant topographical constraints, and can physically fit in the space available including batters). Has a contributing catchment size greater than 2 hectares. Includes impermeable base (either verified in-situ material or imported liner). Access for safe and practical maintenance can be provided.

LEVEL	DEVICE	PERFORMANCE TRE.	DET.	RET.	DESIGN PREREQUISITES
					If wetlands are undersized for their catchment due to site constraints, the developer needs to undertake inundation frequency/duration analysis to ensure that vegetation will not be drowned.
	Swale	✓	✓		Suitable location (no significant topographical constraints, sufficient length for treatment, adequate space available). Must be supported by geotechnical testing to confirm in-situ saturated hydraulic conductivity where design includes infiltration. Underdrains are required for slopes < 2%. Demonstrates required velocity and hydraulic retention time to support function. Pedestrian and vehicle crossings are provided. Access for safe and practical maintenance can be provided. Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train.
2	Raingarden (end of pipe)	✓	✓	✓	Suitable location (able to be constructed offline to avoid peak flows, can physically fit in the space available including batters). No significant topographical constraints; e.g. positive drainage towards device and able to drain outflows. Designed to ensure engagement of full filter media surface. Space for pre-treatment if catchment has a high sediment load. Includes impermeable liner when in proximity to roads/structures or as part of stormwater harvesting scheme. May include internal storage volume beneath outlet to provide water reservoir between rainfall events (support retention) Access for safe and practical maintenance can be provided.
3	Raingarden (Catchment area < 0.5ha)	✓	✓	✓	Suitable location (able to be constructed offline to avoid peak flows, no significant topographical constraints, can physically fit in the space available including batters). Space for pre-treatment if catchment has a high sediment load. Includes impermeable liner when in proximity to roads/structures or as part of stormwater harvesting scheme. May include internal storage volume beneath outlet to provide water reservoir between rainfall events (support retention)

LEVEL	DEVICE	PERFORMANCE			DESIGN PREREQUISITES
		TRE.	DET.	RET.	
					Access for maintenance can be provided.
4	Proprietary chamber filter	✓	✓		Access for cleanout and maintenance is provided without impeding traffic flow. Tie in point to system is low enough to meet operational head loss requirements. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse. Can be specified to include attenuation targets as well.

Table 62: At-source treatment measures

DEVICE	PERFORMANCE			DESIGN PREREQUISITES
	TRE.	DET.	RET.	
Raingarden (Catchment area < 0.5ha)	✓	✓	✓	Suitable location (able to be constructed offline to avoid peak flows, no significant topographical constraints, can physically fit in the space available including batters). Space for pre-treatment if catchment has a high sediment load. Includes impermeable liner when in proximity to roads/structures or as part of stormwater harvesting scheme. May include internal storage volume beneath outlet to provide water reservoir between rainfall events (support retention) Access for maintenance can be provided.
Proprietary Gross Pollutant Trap with underground storage tank.		✓	✓	Suitable location within the road corridor (free of services, exfiltration (where relevant) won't compromise structural performance of pavements.). Safe and practical access for cleanout and maintenance is provided. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse.
Porous concrete parking bays	✓		✓	Designed to reduce rainfall runoff at source. Must be supported by geotechnical testing to confirm in-situ saturated hydraulic conductivity. Not suited to high sediment load landuses. Not suited in aquifer recharge zones without pre-treatment. Must be designed to accommodate vehicle loadings. Access for safe and practical maintenance can be provided. Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train. To be used only when suitably certified installers can do the work.
Rain water tank	✓	✓	✓	Designed to reduce rainfall runoff at source and reduce potable demand. Fit for purpose reuse demand based on constant and variable uses. Design based on local rainfall runoff data.

DEVICE	PERFORMANCE			DESIGN PREREQUISITES
	TRE.	DET.	RET.	
				Sized based on roof catchment to provide acceptable reliability of supply. Storage of harvested water typically limiting factor. Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train.
Proprietary chamber filter	✓			Access for cleanout and maintenance is provided without impeding traffic flow. Tie in point to system is low enough to meet operational head loss requirements. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse.
Proprietary catch pit filter	✓			Tie in point to system is low enough to meet operational head loss requirements, access for maintenance is provided without impeding traffic flow. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse.
Swale (inside road corridor)	✓	✓		Access for safe and practical maintenance is provided. Safety and access issues have been addressed. Vehicle and pedestrian crossings are provided. Infiltration swales are not suitable within the road corridor. Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train.

on page 224. Note that multiple devices in a treatment train may be required.

The Hamilton City Council *Three Waters Management Practice Notes* provide details of the implementation of management solutions on individual lots. The practice notes contain acceptable means of complying with requirements for at source water efficiency measures. The practice notes are available on the HCC website[75]. Refer to the Overview practice note in the first instance. Design must follow the guidance provided in Waikato Regional Council's Waikato stormwater management guideline | Waikato Regional Council and the Bay of Plenty Regional Council Stormwater Management Guidelines. Care should be taken to ensure that Council's specific requirements as set out in this Section may differ.

If Council is to be ultimately responsible for maintenance it must be located on land owned by, or to be vested in Council or protected by an appropriate easement in favour of Council. Council encourages early consultation between the developer and Council staff to achieve mutually beneficial design outcomes. Council seeks design outcomes that meet functional requirements whilst avoiding poor visual results.

[75] https://storage.googleapis.com/hccproduction-web-assets/public/Uploads/Documents/Content-Documents/Property-Rates-and-Building/Compliance/Waters-practice-notes/Three-Waters-Practice-Note-HCC01-Overview.PDF

As discussed in Section 4.2.3.1, Council may require at source stormwater/rainwater treatment for all new buildings in accordance with good practice and the District Plan. These on lot stormwater management measures are sometimes referred to as 'water efficiency measures' and may typically comprise one or more of the following:

a) Soakage.

b) Rainwater reuse system (rain tank).

c) Raingarden.

d) Protecting permeable surfaces or porous paving.

Figure 5: Stormwater selection of treatment device based on development scenario below illustrates the decision tree for selecting different types of treatment devices based on the development scenario. Consideration of operations and maintenance costs is critical, as well as consideration of capital costs, overall efficiency, and best fit for managing potential adverse effects on the receiving environment.

Table 61: Vested treatment device **preferences**

LEVEL	DEVICE	PERFORMANCE			DESIGN PREREQUISITES
		TRE.	DET.	RET.	
1	Wetland	✓	✓		Suitable location downstream (offline to main channel and preferably overland flow path also, no significant topographical constraints, and can physically fit in the space available including batters). Has a contributing catchment size greater than 2 hectares. Includes impermeable base (either verified in-situ material or imported liner). Access for safe and practical maintenance can be provided. If wetlands are undersized for their catchment due to site constraints, the developer needs to undertake inundation frequency/duration analysis to ensure that vegetation will not be drowned.
	Swale	✓	✓		Suitable location (no significant topographical constraints, sufficient length for treatment, adequate space available). Must be supported by geotechnical testing to confirm in-situ saturated hydraulic conductivity where design includes infiltration. Underdrains are required for slopes < 2%. Demonstrates required velocity and hydraulic retention time to support function. Pedestrian and vehicle crossings are provided. Access for safe and practical maintenance can be provided. Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train.
2	Raingarden (end of pipe)	✓	✓	✓	Suitable location (able to be constructed offline to avoid peak flows, can physically fit in the space available including batters).

LEVEL	DEVICE	PERFORMANCE			DESIGN PREREQUISITES
		TRE.	DET.	RET.	
					No significant topographical constraints; e.g. positive drainage towards device and able to drain outflows. Designed to ensure engagement of full filter media surface. Space for pre-treatment if catchment has a high sediment load. Includes impermeable liner when in proximity to roads/structures or as part of stormwater harvesting scheme. May include internal storage volume beneath outlet to provide water reservoir between rainfall events (support retention) Access for safe and practical maintenance can be provided.
3	Raingarden (Catchment area < 0.5ha)	✓	✓	✓	Suitable location (able to be constructed offline to avoid peak flows, no significant topographical constraints, can physically fit in the space available including batters). Space for pre-treatment if catchment has a high sediment load. Includes impermeable liner when in proximity to roads/structures or as part of stormwater harvesting scheme. May include internal storage volume beneath outlet to provide water reservoir between rainfall events (support retention) Access for maintenance can be provided.
4	Proprietary chamber filter	✓	✓		Access for cleanout and maintenance is provided without impeding traffic flow. Tie in point to system is low enough to meet operational head loss requirements. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse. Can be specified to include attenuation targets as well.

Table 62: At-source treatment measures

DEVICE	PERFORMANCE			DESIGN PREREQUISITES
	TRE.	DET.	RET.	
Raingarden (Catchment area < 0.5ha)	✓	✓	✓	Suitable location (able to be constructed offline to avoid peak flows, no significant topographical constraints, can physically fit in the space available including batters). Space for pre-treatment if catchment has a high sediment load.

DEVICE	PERFORMANCE			DESIGN PREREQUISITES
	TRE.	DET.	RET.	
				Includes impermeable liner when in proximity to roads/structures or as part of stormwater harvesting scheme. May include internal storage volume beneath outlet to provide water reservoir between rainfall events (support retention) Access for maintenance can be provided.
Proprietary Gross Pollutant Trap with underground storage tank.		✓	✓	Suitable location within the road corridor (free of services, exfiltration (where relevant) won't compromise structural performance of pavements.). Safe and practical access for cleanout and maintenance is provided. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse.
Porous concrete parking bays	✓		✓	Designed to reduce rainfall runoff at source. Must be supported by geotechnical testing to confirm in-situ saturated hydraulic conductivity. Not suited to high sediment load landuses. Not suited in aquifer recharge zones without pre-treatment. Must be designed to accommodate vehicle loadings. Access for safe and practical maintenance can be provided. Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train. To be used only when suitably certified installers can do the work.
Rain water tank	✓	✓	✓	Designed to reduce rainfall runoff at source and reduce potable demand. Fit for purpose reuse demand based on constant and variable uses. Design based on local rainfall runoff data. Sized based on roof catchment to provide acceptable reliability of supply. Storage of harvested water typically limiting factor. Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train.
Proprietary chamber filter	✓			Access for cleanout and maintenance is provided without impeding traffic flow. Tie in point to system is low enough to meet operational head loss requirements. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse.
Proprietary catch pit filter	✓			Tie in point to system is low enough to meet operational head loss requirements, access for maintenance is provided without impeding traffic flow. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse.
Swale (inside road corridor)	✓	✓		Access for safe and practical maintenance is provided. Safety and access issues have been addressed. Vehicle and pedestrian crossings are provided. Infiltration swales are not suitable within the road corridor.

DEVICE	PERFORMANCE			DESIGN PREREQUISITES
	TRE.	DET.	RET.	
				Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train.

on page 224 presents the preferences for centralised vested treatment devices. At source private assets may be required to be delivered in accordance with the District Plan and good practice. At source treatment devices are summarised in Table 57. The Hamilton City Council *Three Waters Management Practice Notes* provide details of the implementation of acceptable at-source measures. The practice notes are available on the HCC website[76]. Refer to the Overview practice note in the first instance.

Level 1 represents Council's preference for centralised stormwater treatment wetlands to meet water quality and quantity outcomes. Levels 2 to 4 include stormwater treatment elements which can be designed to achieve what is required treatment through a more distributed treatment train approach.

Figure 5: Stormwater selection of treatment device based on development scenario

Stormwater Management

[76] http://www.hamilton.govt.nz/our-council/council-publications/manuals/Pages/Three-Waters-Management-Practice-Notes.aspx

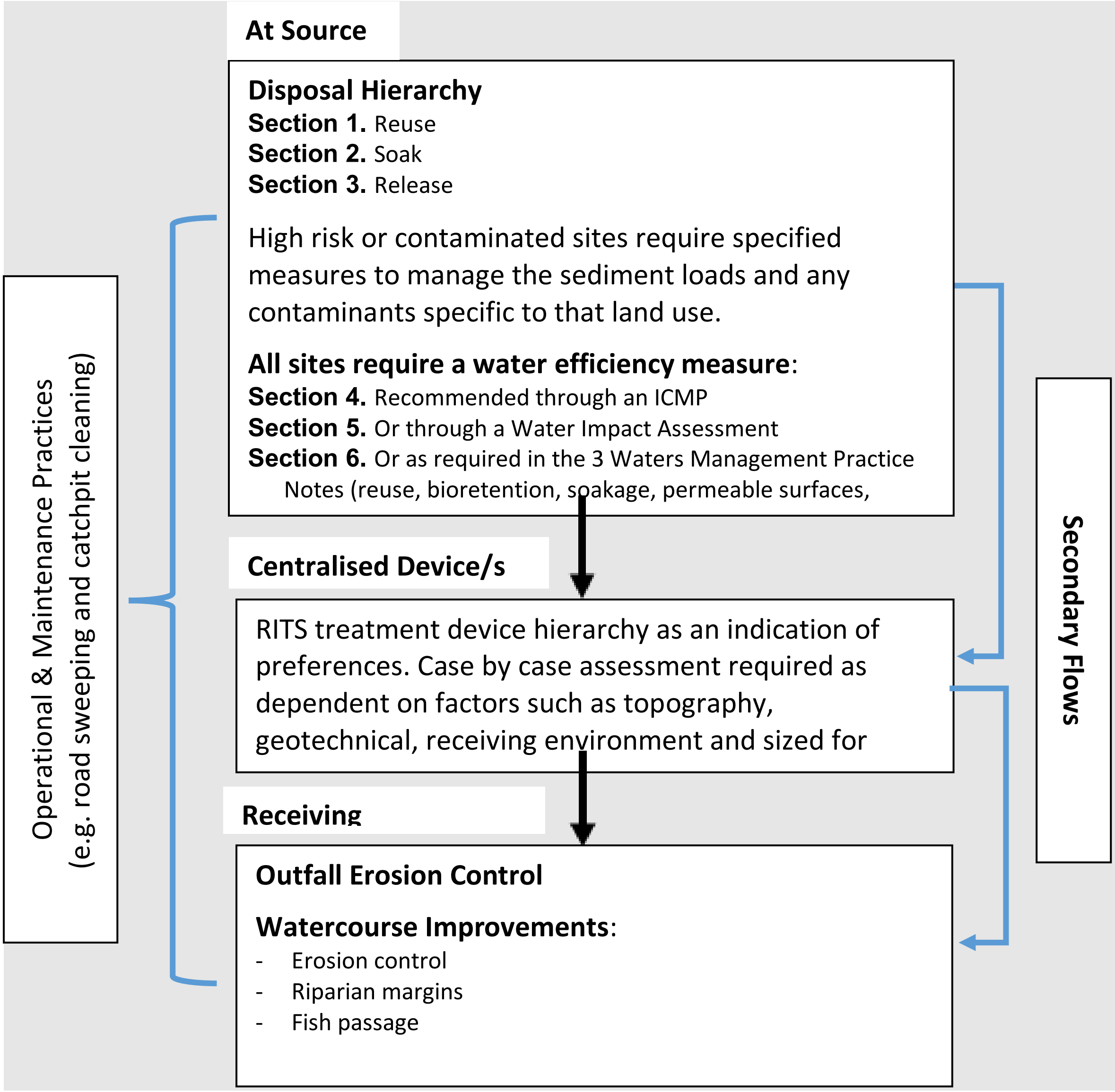


Table 61: Vested treatment device preferences

LEVEL	DEVICE	PERFORMANCE			DESIGN PREREQUISITES
		TRE.[77]	DET.[78]	RET.[79]	
1	Wetland	✓	✓		Suitable location downstream (offline to main channel and preferably overland flow path also, no significant topographical constraints, and can physically fit in the space available including batters). Has a contributing catchment size greater than 2 hectares.

[77] Tre. – Treatment: the provision of water quality treatment.
[78] Det. – Detention: the provision of flow mitigation and flood control is required.
[79] Ret. – Retention: to enable volume reduction which assists with flow mitigation and flood control.

LEVEL	DEVICE	PERFORMANCE			DESIGN PREREQUISITES
		TRE.[77]	DET.[78]	RET.[79]	
					Includes impermeable base (either verified in-situ material or imported liner). Access for safe and practical maintenance can be provided. If wetlands are undersized for their catchment due to site constraints, the developer needs to undertake inundation frequency/duration analysis to ensure that vegetation will not be drowned.
	Swale	✓	✓		Suitable location (no significant topographical constraints, sufficient length for treatment, adequate space available). Must be supported by geotechnical testing to confirm in-situ saturated hydraulic conductivity where design includes infiltration. Underdrains are required for slopes < 2%. Demonstrates required velocity and hydraulic retention time to support function. Pedestrian and vehicle crossings are provided. Access for safe and practical maintenance can be provided. Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train.
2	Raingarden (end of pipe)	✓	✓	✓	Suitable location (able to be constructed offline to avoid peak flows, can physically fit in the space available including batters). No significant topographical constraints; e.g. positive drainage towards device and able to drain outflows. Designed to ensure engagement of full filter media surface. Space for pre-treatment if catchment has a high sediment load. Includes impermeable liner when in proximity to roads/structures or as part of stormwater harvesting scheme. May include internal storage volume beneath outlet to provide water reservoir between rainfall events (support retention) Access for safe and practical maintenance can be provided.
3	Raingarden (Catchment area < 0.5ha)	✓	✓	✓	Suitable location (able to be constructed offline to avoid peak flows, no significant topographical constraints, can physically fit in the space available including batters). Space for pre-treatment if catchment has a high sediment load. Includes impermeable liner when in proximity to roads/structures or as part of stormwater harvesting scheme.

LEVEL	DEVICE	PERFORMANCE TRE.[77]	DET.[78]	RET.[79]	DESIGN PREREQUISITES
					May include internal storage volume beneath outlet to provide water reservoir between rainfall events (support retention) Access for maintenance can be provided.
4	Proprietary chamber filter	✓	✓		Access for cleanout and maintenance is provided without impeding traffic flow. Tie in point to system is low enough to meet operational head loss requirements. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse. Can be specified to include attenuation targets as well.

Table 62: At-source treatment measures

DEVICE	PERFORMANCE TRE.[80]	DET.[81]	RET.[82]	DESIGN PREREQUISITES
Raingarden (Catchment area < 0.5ha)	✓	✓	✓	Suitable location (able to be constructed offline to avoid peak flows, no significant topographical constraints, can physically fit in the space available including batters). Space for pre-treatment if catchment has a high sediment load. Includes impermeable liner when in proximity to roads/structures or as part of stormwater harvesting scheme. May include internal storage volume beneath outlet to provide water reservoir between rainfall events (support retention) Access for maintenance can be provided.
Proprietary Gross Pollutant Trap with underground storage tank.		✓	✓	Suitable location within the road corridor (free of services, exfiltration (where relevant) won't compromise structural performance of pavements.). Safe and practical access for cleanout and maintenance is provided. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse.
Porous concrete parking bays	✓		✓	Designed to reduce rainfall runoff at source. Must be supported by geotechnical testing to confirm in-situ saturated hydraulic conductivity. Not suited to high sediment load landuses. Not suited in aquifer recharge zones without pre-treatment. Must be designed to accommodate vehicle loadings. Access for safe and practical maintenance can be provided.

[80] Tre. – Treatment: the provision of water quality treatment.
[81] Det. – Detention: the provision of flow mitigation and flood control is required.
[82] Ret. – Retention: to enable volume reduction which assists with flow mitigation and flood control.

DEVICE	PERFORMANCE			DESIGN PREREQUISITES
	TRE.[80]	DET.[81]	RET.[82]	
				Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train. To be used only when suitably certified installers can do the work.
Rain water tank	✓	✓	✓	Designed to reduce rainfall runoff at source and reduce potable demand. Fit for purpose reuse demand based on constant and variable uses. Design based on local rainfall runoff data. Sized based on roof catchment to provide acceptable reliability of supply. Storage of harvested water typically limiting factor. Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train.
Proprietary chamber filter	✓			Access for cleanout and maintenance is provided without impeding traffic flow. Tie in point to system is low enough to meet operational head loss requirements. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse.
Proprietary catch pit filter	✓			Tie in point to system is low enough to meet operational head loss requirements, access for maintenance is provided without impeding traffic flow. Designed as pre-treatment in treatment train based on contaminant loadings of particular landuse.
Swale (inside road corridor)	✓	✓		Access for safe and practical maintenance is provided. Safety and access issues have been addressed. Vehicle and pedestrian crossings are provided. Infiltration swales are not suitable within the road corridor. Pollutant/hydrologic performance reflected in design of any downstream devices when used in treatment train.

When considering the above, always take into account standard effects, assessment and planning protocols e.g. will the device cause flooding, off site adverse effects, and identify and protect the secondary flow path.

4.2.17.2 Safety requirements

The treatment and detention devices must not compromise the safety of adjacent properties or the community. CPTED (Crime Prevention through Environmental Design) principles (refer to Landscape Section, Clause 7.2.2) page 355 are to be incorporated.

Embankments must be permanently planted if the slope ratio is steeper than 1 (vertical) to 4 (horizontal). Any embankment that Council determines is either too inaccessible or unsafe for regular grass mowing must be permanently planted.

A safety bench must be provided between the normally dry water level and the deep water where deep pools greater than 0.9m are proposed. The safety bench must be 2m wide at 1:8 slope extending to 250mm below NWL.

Any part of stormwater structures having either a vertical drop of over 0.9m or the ability to fall directly into standing water of depth greater than 0.9m must be fenced in 50% permeable format (e.g. pool fence) and otherwise compliant with the Building Act. Wetlands are expected to be designed as per Clause 4.2.18 below, so that there is no requirement for fencing. Council prefers such unfenced wetlands to steeper wetland that require fencing as these have a greater amenity value and are also generally less costly.

Fencing across overland flow paths must not interfere with the flow of stormwater in the design event.

4.2.18 Constructed wetlands

When designing wetlands, the following should be considered.

4.2.18.1 Location considerations

Table 63: Location considerations

ITEM	CONSIDERATION
Drainage	Ensure that the target catchment is able to drain to the wetland preferably through a single inlet with an invert, which enables the footprint to be achieved with efficient earthworks. Ensure that the proposed outlet level (i.e. invert of receiving drains and/or watercourse) will enable drawdown of the wetland to at least the normal water level (NWL).
Discharge	Ensure that the discharge is suitable for the receiving environment. This includes consideration of appropriate mitigation targets for flow attenuation and water quality, including temperature.
Maintenance access	Consider how machinery will get access to the wetland for construction and maintenance, in particular clean out of the sediment forebay.
Pre-treatment	Ensure that forebay is incorporated into the design unless accepted catchment pre-treatment is provided.
Offline	Vegetated wetlands must be placed offline to the main channel for peak flows. Allowance must be made for appropriate high flow diversion prior to the wetland.
Drawdown	Wetlands must be free draining by gravity to at least the NWL. Where possible allowance must be made for draining the wetland entirely (or as much as possible) for maintenance purposes.
Imperviousness (wetland lining)	Wetlands must be impermeable to at least the NWL with an appropriate impermeable liner to prevent water losses. Lining can be either compacted clay (in situ or imported) or synthetic products such as geo-synthetic clay liners (GCL) or HDPE in accordance with manufacturer's specifications.
Water table	Where wetlands are to be constructed below shallow water tables, attention must be given to constructability and issues such as flotation of the liner.

ITEM	CONSIDERATION
	Construction timing (when groundwater recedes) or synthetic liners may be required.
Underground services	Contact utilities (power, water, gas) and check with the council for locations of underground services in the area. If underground services are near or in the proposed wetland location, they must be relocated clear of the site or the wetlands re-sited.
Setback	Ideally wetland areas should be located at a 10m minimum from property boundaries. Wetlands should not be located within a 1V:1H plane taken from the toe of any retaining wall.
Overhead setback	If trees are included around the wetland perimeter, consideration should be given to overhead setbacks to ensure that mature trees do not interfere with utilities such as power lines. Council's utility managers must be consulted for up-to-date guidance on setbacks etc.
Contaminated land	Contaminated land may pose a financial risk due to the potentially large amount of material to be disposed of during construction of wetlands. Potential land contamination must be considered at the concept design phase and investigations undertaken.
Slope stability	To minimise the risk of slope failure, wetlands should be placed greater than 15 m away from non-engineered slopes 15% or greater and consideration must be given to the risks of slope instability from saturating the toe of slopes. Where required, impermeable lining may be required to extend above the NWL to the top of operational water levels. Geotechnical advice must be sought where appropriate.
Expansive soils	Wetlands placed within 5m of a structure should be lined entirely to the top of operational water level. Structures include buildings (residential and commercial), retaining walls (>1m height), trafficable roads/rail, utility infrastructure (i.e. cell towers, transmission pylons and masts), playgrounds, private boundary fences and swimming pools.

Wetland bathymetry must be configured to manage flow paths, water depths and velocities so that the required level of treatment is achieved while remaining resilient to the frequency and duration of inundation. The intention is to prevent high velocity flows forming and ensuring robust plant communities can develop.

4.2.18.2 Wetland design requirements

Table 64: Wetland design requirements

ITEM	DESCRIPTION
Water quality volume (WQV)	Required where the wetland is providing a water quality function.
Extended detention volume (EDV)	Required where wetland is discharging to a natural or modified watercourse and needs to mitigate potential downstream erosion, scour and ecological effects.
Extended detention depth (EDD)	Irrespective of the downstream discharge environment wetlands shall be designed with a minimum extended detention depth of 300mm.

Flood mitigation can be provided within the wetland footprint as long as the entire attenuation volume is above the live water level (including EDV). *Table 48: Minimum device design summary* on page 192 should be referred to for the requirements for the mitigation of 2, 10 and 100 year peak flows. The design of the wetland hydraulics must protect the wetland from potential scour through the use of appropriately sized flood attenuation outlet controls which support backwater inundation of the wetland and prevent the risk of high velocities through the wetland causing re-suspension of sediments and scour of biofilms. Hydraulic controls to engage the flood attenuation should be positioned within the high flow bypass channel where possible. The design of any flood control aspects must be undertaken by a suitably qualified engineer and designed in accordance with Waikato Regional Council's 'Stormwater Management Guidelines' TR202018/071 and the Bay of Plenty Regional Council Stormwater Management Guidelines

4.2.18.3 Wetland components to be considered during layout development

The functional components to consider during the wetland layout development are outlined in the table below. Treatment performance is based on the controlled passage of water through the vegetated elements of the wetland and the complex treatment processes these support. Attention to internal batters and longitudinal grade is required to ensure that flows are not concentrated into preferential flow paths which can result in short-circuiting and impaired performance. The use of gabions or similar rock mattress products within treatment wetland sites is not acceptable.

Table 65: Wetland components to be considered during layout development

ITEM	DESCRIPTION
Main body	The main wetland body is the bulk of the area of the wetland and provides water quality treatment. The body is sized to provide the WQV and the EDV in conjunction with the forebay. The footprint of the main body can also provide storage for flood mitigation above the top of any extended detention volume level (EDV).
Forebay	The wetland forebay provides coarse sediment removal prior to runoff entering the main wetland body. The forebay should be sized at 15% of the full calculated WQV. The volume of the forebay is therefore counted as part of the WQV.
High flow bypass	A high flow bypass should be included that becomes active when storm events exceed the storage provided by the extended detention zone or inflows exceed the calculated peak water quality flowrate. The high flow bypass should be located before entry to the wetland and must have capacity up to the 100-year event. In instances where flood attenuation is required, this should be primarily supported through hydraulic control within the bypass channel which causes backwatering within the channel and engagement of the wetland flood storage. Where this is not possible and flood flows discharge into the wetland, it must be demonstrated that these flows will not cause excessive scour.
Maintenance access	A 4m wide maintenance access track must be provided to the sediment forebay to allow access for equipment to dig out the forebay. Vehicle access must be provided to any other hydraulic structures which require periodic inspection.

4.2.18.4 Terms used for wetland sizing

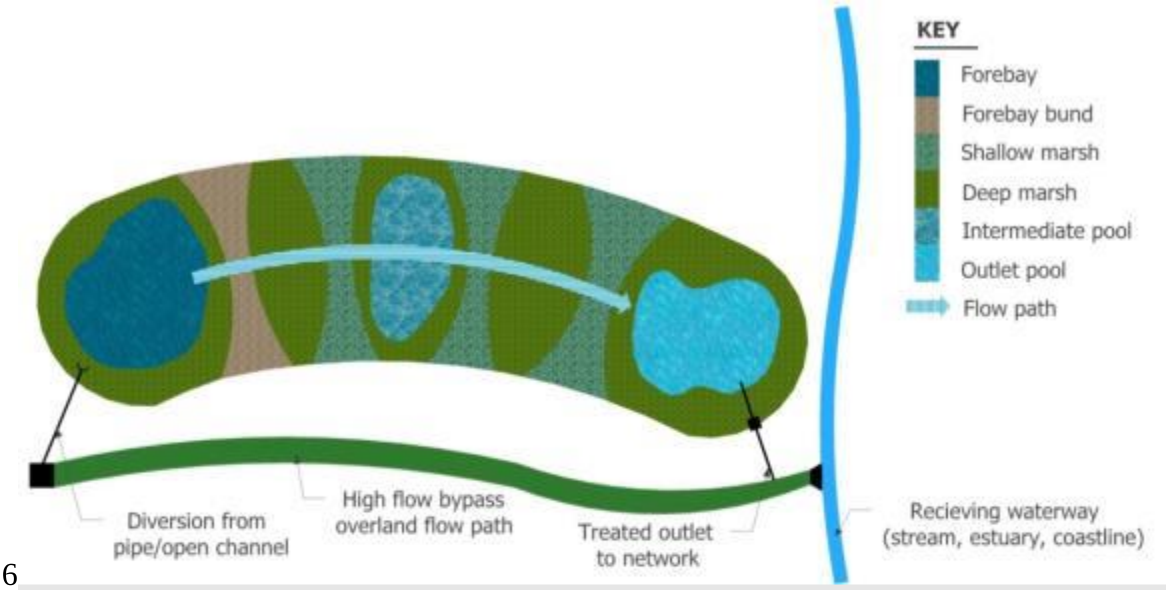
Table 66: Terms used for wetland sizing

ITEM			DESCRIPTION
Zone	Permanent storage zone	PSZ	The PSZ is the base zone of the wetland main body excluding the forebay area. The water in this zone does not drain out between events (but can evapo-transpire). The PSZ is required regardless of design requirements.

ITEM			DESCRIPTION
Zone	Live storage zone	LSZ	The LSZ is the storage zone above the permanent storage zone that provides the EDV and the live portion of the WQV (where applicable). The live storage zone cannot be counted for flood storage during large events. The LSZ is not required if the wetland is only performing a flood mitigation function, the LSZ is optional if the wetland is providing WQV (WQV can be completely provided in the PSZ) and the LSZ is required if EDV is explicitly required.
Zone	Flood storage zone	FSZ	The FSZ is the storage zone above the live storage zone that provides flood storage only. The FSZ is only required if the wetland is providing flood mitigation.
Depth	Normal water level	NWL	The NWL is the top of the permanent storage zone. This water level is relatively constant between storm events and can only be reduced by evapotranspiration or controlled drawdown.
Depth	Extended detention level	EDL	The EDL is the maximum height reached by the extended detention volume and is the top of the LSZ.
Depth	Flood water level	FWL	The FWL is the maximum height reached during 100-year event. The height is determined using routing calculations for the 100-year event. If a high flow bypass is not provided for the 10-year event, these calculations will also need to be performed for this event.

4.2.18.5 Wetland sizing

The sizing of wetlands is based on providing sufficient capacity and conditions to support water quality treatment processes. This is achieved by sizing the wetland based on the calculated water quality volume and then designing the internal bathymetry to provide a mix of shallow and deep marsh zones to sustain robust emergent vegetation. See Drawing *Stormwater Wetlands6*provides a schematic representation of an offline linear wetland configuration with key functional zones. See Drawing *Stormwater Wetlands* shows a layout more representative of a larger system which includes maintenance access to the forebay, pipes to independently draw down the sediment forebay, overflow spillway and an optimised flow path to increase the length to width ratio. The sizing and bathymetry of the wetland must be in accordance with *Table 69: Sediment forebay design* on page 235.



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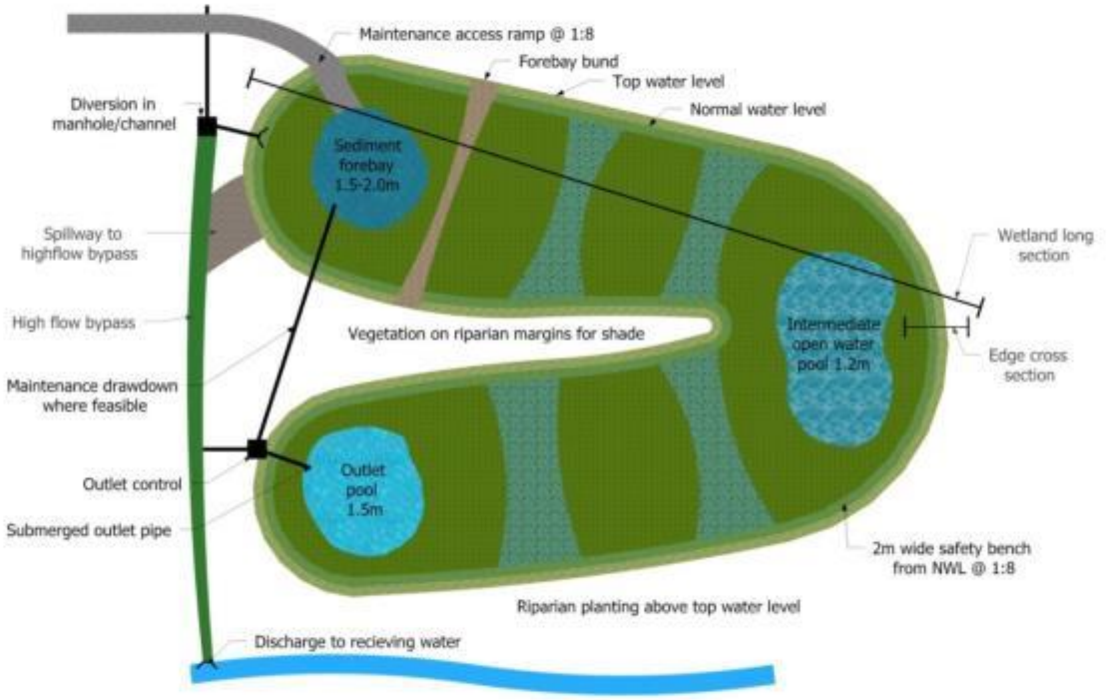

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Additional storage for flood attenuation can be provided above the extended detention volume level when required. It is recommended to use the calculation methods outlined in the Waikato Regional Council's 'Stormwater management guidelines TR2020/06' or , Bay of Plenty Regional Council's Stormwater Management Guidelines for the Bay of Plenty Region 2012/01 or other agreed methodologies, to calculate water quality volumes and peak flow rates. The following figure provides a schematic of a typical wetland bathymetry:

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4.2.18.6 Permanent storage zone design parameters

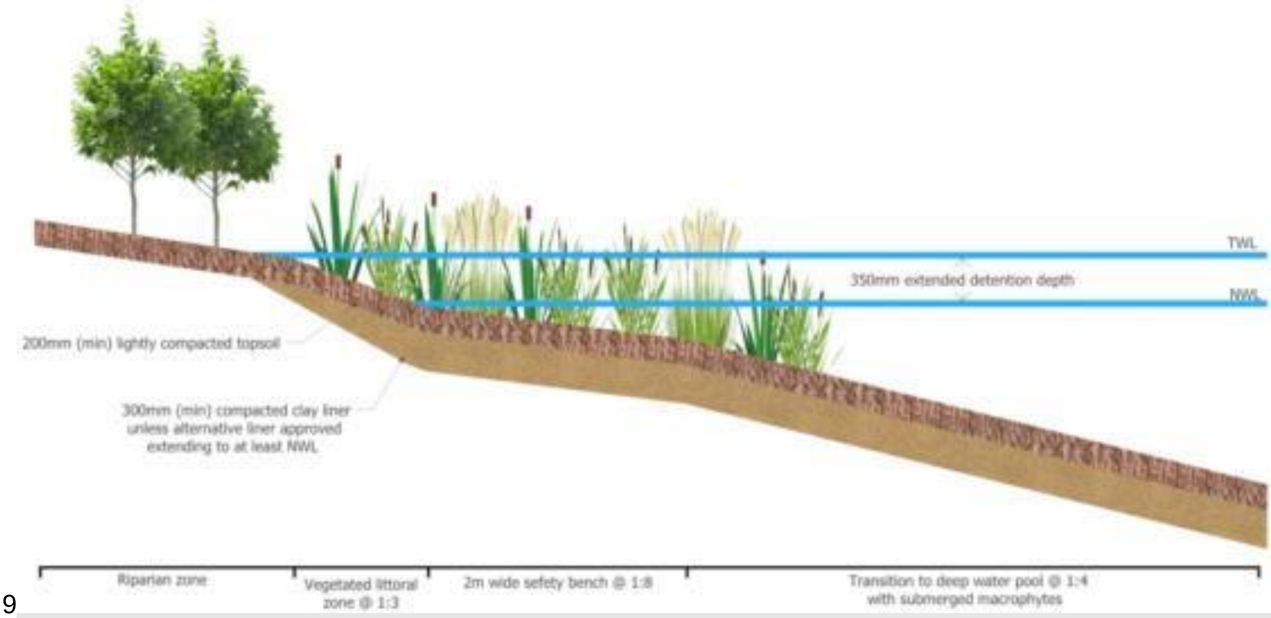
Design parameters for the permanent storage zone (with and without EDV) are given in the table below. Note that these do not include the forebay area which equates to an additional 10% of the total footprint area.

Table 67: Permanent storage zone design parameters for wetland design

EDV REQUIRED	NO EDV REQUIRED	DESCRIPTION
PSZ volume[86] x 0.75 > 50% of the WQV	PSZ volume[86] x 0.80 = WQV	More than half the WQV needs to be permanent pool to allow pollutant removal between storm events. If there is no extended detention, the permanent pool should contain the entire WQV.
40% (±5%) PSZ area between 0.00 and 0.20m deep at NWL	40% (±5%) PSZ area between 0.00 and 0.35m deep at NWL	Shallow marsh water depths to support emergent macrophyte species provided in *Table 84: Acceptable mulching* on page 261.
40% (±5%) PSZ area between 0.20 and 0.35m deep at NWL	40% (±5%) PSZ area between 0.35 and 0.50m deep at NWL	Deep marsh water depths to support emergent macrophyte species provided in *Table 84: Acceptable mulching* on page 261.
10% (±2%) PSZ area between 0.35 and 1.20m deep at NWL	10% (±2%) PSZ area between 0.50 and 1.20m deep at NWL	Intermediate deep pools within main wetland body provide habitat diversity in the wetland. These should comprise no more than 10% of the main wetland body area.
The length of the PSZ must be at least 5 times the width of the PSZ		Elongated wetlands prevent the risk of short circuiting.
Batters > 0.25m below NWL maximum 1V:3H	Batters > 0.25m below NWL maximum 1V:3H	Batters below safety bench extending to variable base
Extending from NWL a 2m wide safety bench must be provided at a maximum slope of 1V:8H		Planted Safety bench must extend around entire perimeter (including forebay) immediately below NWL.
Batters above NWL must be a maximum of 1V:3H		Planted batters above NWL to transition to existing ground.
Emergent Macrophyte vegetation to cover a minimum of 80% of main wetland area at NWL		Dense and diverse plant community critical to support treatment processes. The 80% coverage is supported by the distinct shallow and deep marsh zones

Drawing *Stormwater Wetlands Details* provides a schematic of a typical wetland edge with safety batter and planting to align with depth and inundation.

[86] PSZ volume is adjusted by 0.75 and 0.8 respectively to account for the plant mass volume in this zone.



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4.2.18.7 Live storage zone design parameters

The live storage zone provides frequent, temporary storage of runoff during and immediately after storm events when EDV is required. Design parameters for the live storage zone are given in the table below.

Table 68: Live storage zone design parameters

REQUIREMENT	DESCRIPTION
Volume of LSZ = Extended Detention Volume	The extended detention volume needs to be entirely provided in the LSZ.
Volume of LSZ > WQV – PSZ volume	Where extended detention is provided, the water quality volume can be distributed across the LSZ and PSZ.
LSZ batters are a maximum of 1V:3H	Batters above normal water level are a maximum of 1V:3H.
TWL < 0.35 m above NWL	The depth of the LSZ should be no deeper than 0.35 m to support healthy plants.
Velocity of flow with depth at: NWL + (EDL-MWL) /3	Peak flow, assuming a water level 1/3 of the way between NWL and EDL, should be less than 0.05 m s^{-1} in the WQV event, to avoid sediment resuspension and stripping of biofilms.

4.2.18.8 Sediment forebay design parameters

The sediment forebay comprises a deep, low-velocity pool to provide pre-treatment by retaining coarse to medium-sized suspended solids. This enables managed cleanout of these sediments and prevents smothering of the wetland treatment area, thereby increasing wetland longevity. A high-flow bypass is necessary to prevent re-suspension of accumulated sediment by inflows associated with storm events. Design parameters for the sediment forebay are given in the table below.

Maintenance access to the forebay is necessary to allow periodic sediment removal. A track suitable for truck access must be provided. The forebay base is to be lined with compacted crushed rock so that excavator operators can distinguish between accumulated sediment and the forebay base.

The forebay is to be separated from the wetland body with an impermeable bund of compacted earth. The bund should have a 1 m wide crest that is level, set to the elevation of the NWL, and be well vegetated.

Table 69: Sediment forebay design parameters

REQUIREMENT	DESCRIPTION
Volume of sediment forebay = 0.15 x calculated water quality volume (±10%)	The volume of the forebay(s) needs to be in proportion to the full calculated water quality volume to provide sufficient storage for coarse sediments. Multiple forebays are not preferred.
Forebay arrangement	The forebay must have a surface length to width ratio between 2:1 and 3:1.
Maximum depth of Sediment forebay = 2m	The forebay needs to be maintainable. Maximum depth is 2m as depths over 2m can result in special equipment being required for maintenance.
Maintenance bench within 10m of any part of forebay area	Unless maintenance access is provided into the base of the forebay, all parts of the forebay must be within 10m of a maintenance bench (hardstand) to ensure the forebay can be dug out without the use of special equipment. The hardstand must be designed to support the loading of a suitable excavator. Likewise with the maintenance track (see *Table 73: Maintenance access design requirements* on page 239.
Safety bench should be a minimum of 2m wide and maximum of (1V:8H slope) extending from NWL.	Safety bench to be heavily vegetated from NWL.
Batters below NWL maximum 1V:4H	-
Batters above NWL maximum 1V:3H	Batters above the NWL must have a maximum slope of 1:4 where planted and 1:5 where mowing is required. Note, all wetlands which include EDZ will require planted littoral zones above the NWL.
Forebay Bund	The forebay must be separated from the main wetland body with an impermeable bund with a crest at (or up to 100mm below) NWL to support independent drawdown of the forebay water level. The bund can be compacted (with test results to be provided) earth with a formed level crest width of 1 m.

Drawing *Stormwater Wetlands Details* shows a cross section through a typical bund separating the forebay from the main wetland body.

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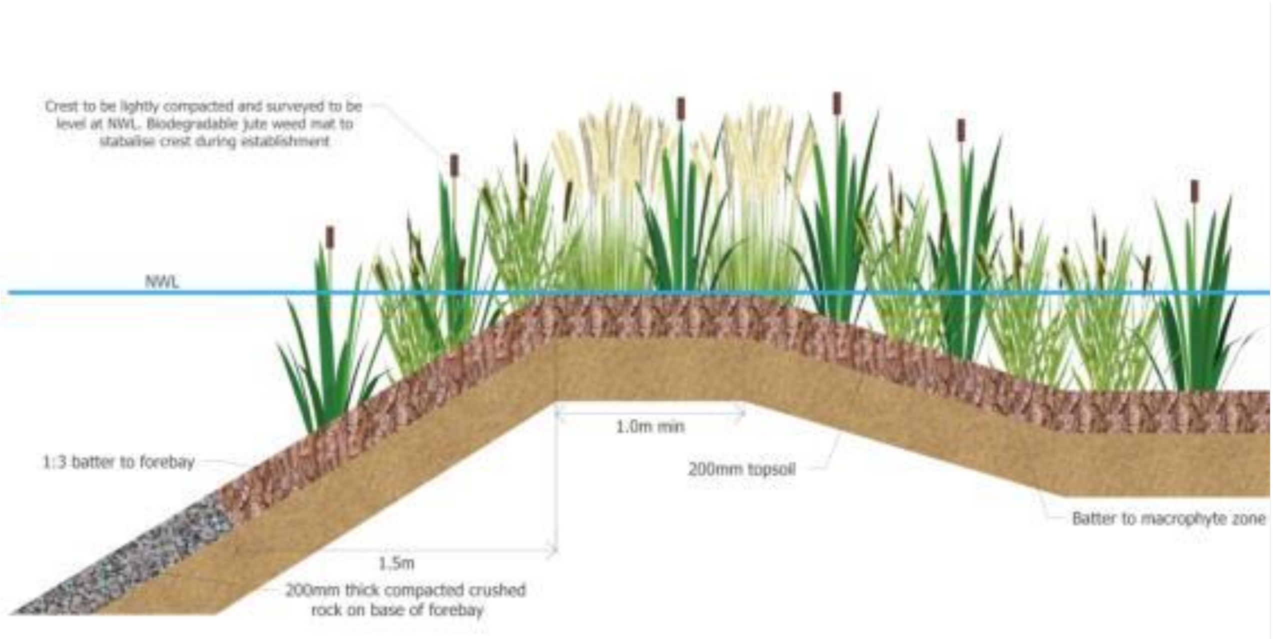

4.2.18.9 Wetland inlet design requirements

To protect the wetland from the damaging effects of uncontrolled inflows, inlet design should include energy dissipation to reduce water velocity, prevent erosion around the inlet and provide an even distribution of flow into the wetland. Inlets must discharge to the forebay to ensure pre-treatment. Inlet design requirements are given in the table below. Inlet design should follow the method described in the Auckland Council Technical Report TR2013/018.

Table 70: Wetland inlet design requirements

PARAMETER	REQUIREMENT	VERIFICATION METHOD
Inlet pipe	Pipe must meet relevant Council design standards and be appropriately sized for design flows.	Acceptance at time of construction drawings sign off. All pipe sizes to be marked clearly on as-built drawing set. Note this document does not cover design of upstream reticulated systems.
Diversion configurations	Any diversion works (including chambers, weirs, orifices and energy dissipaters) must be appropriately designed for the target inflows with consideration for operating hydraulics and head. Tolerances for critical structures must be stated in construction specifications.	As-built verification survey of all critical levels required to ensure diversion will function as intended.
Erosion protection	Design of inlets must consider potential for erosion from all design inflows. Designers must comply with TR2013/018 "Hydraulic energy management: inlet and outlet design for treatment devices".	Acceptance at time of construction drawings sign off supported by appropriate calculations.

PARAMETER	REQUIREMENT	VERIFICATION METHOD
Construction tolerances	Construction tolerance for the inlet is 5mm.	As-built survey.

4.2.18.10 Wetland outlet design requirements

The outlet structure controls the water volume and hydraulic regime within the wetland, thereby performing both water quality and quantity functions. Outlet structure design is determined by site characteristics, desired treatment functions, ecosystem connectivity, and maintenance considerations. Design requirements for outlets are given in the table below. Where practicable the design should eliminate all falls from heights in and around ponds, wetland and swales.

At wetland outlet locations, where slopes are greater than 1V:1H or vertical drops are > 900mm, barrier planting is to be used to deter access. Where barrier planting is not possible due to the nature of the site, heavy duty pool type fencing must be installed.

Safe all weather pedestrian access to all outlets into the pond or wetland and to the various levels of the inlet structure or discharge from the pond. This is to allow the operation and maintenance staff safe access during all types of weather conditions.

Hydraulic control should be provided by a removable weir plate. Weirs should be sufficiently narrow to permit a range of water levels within the wetland. A submerged pipe outlet draws off cooler deep water from the outlet pool, thereby reducing temperature-related effects on the receiving environment. Outlet structures should enable periodic drawdown of the wetland volume for management and maintenance purposes as well as control normal water level in the wetland. Depth control is especially important during plant establishment so that plants are not drowned.

Table 71: Wetland outlet design requirements

PARAMETER	REQUIREMENT	VERIFICATION METHOD
Outlet hydraulics	Control outflows to either pass design flows in wetlands without extended detention or support drawdown of extended detention over average of 24-hr period in other cases.	Stage storage and stage outflow calculations to demonstrate hydraulic function
Outlet pool	Include a deep pool (1.5m deep) at the downstream end of the wetland. Treated flows to be drawn from at least 500mm below the surface via a pipe connection to the outlet control structure.	Earthworks model based on finished surface. As-built survey to verify finished levels.
Outlet structure	Hydraulic control to be contained within a suitable manhole or open chamber with flow control to define NWL and drawdown of event flows.	Design plans and As-built survey showing all critical levels within tight (5mm) tolerance level)
Outlet location	Outlet control structures must be accessible for inspection and maintenance (i.e. within manhole on batters). Submerged connection to outlet pool is to be	Design plans and as constructed drawings showing all critical levels within tight (5mm) tolerance level)

PARAMETER	REQUIREMENT	VERIFICATION METHOD
	included to avoid blockage and draw cooler water.	
Fish passage	Where wetlands are located with fish passage required the design must include provision for passage in a range of typical operating events. Fish passage will not be achievable across the full range of operating conditions while also achieving detention requirements.	Design plans and as constructed drawings
Discharge to receiving environment	All outfalls must comply with relevant Council standards to avoid scour and instability.	Design plans and as constructed drawings
Construction tolerances	Construction tolerance for the outlet is 5mm.	As-built survey.

4.2.18.11 Wetland spillway and bypass design requirements

A high-flow bypass is necessary to divert flows away from the wetland that are greater than the design maximum flow rate. This is to ensure the biological treatment elements, such as macrophytes and biofilms, are not scoured by high-velocity flows and that accumulated sediments are not re-mobilised. The bypass must be placed upstream of the sediment forebay. Spillway design requirements are given in the table below.

Table 72: Wetland spillway and bypass design requirements

PARAMETER	REQUIREMENT	VERIFICATION METHOD
High flow bypass	Wetlands must be constructed off line to flows in exceedance of the target treatment flowrate (lesser of calculated WQ flowrate or flowrate based on velocity calculations). This should be supported with an upstream diversion where possible.	Design drawings and hydraulic calculations for all diversion structures and weirs.
Overflow outfalls	Design should include provision for overflow spillways to be engaged at top of extended detention (or maximum standing water head where extended detention not included). Spillways should be located as close to the inlet as possible and be sized to pass maximum flows without excessive head. The outfall must be designed to withstand scour forces.	Design drawings and hydraulic calculations for all diversion structures and weirs.
Flood flow protection	Where wetlands are located online to large flood flows (including those engaged as part of flood attenuation) the design must consider potential risks in	Design drawings and hydraulic calculations for all diversion structures and weirs.

PARAMETER	REQUIREMENT	VERIFICATION METHOD
	these infrequent events. The design must demonstrate that consideration has been given to all flows up to 100 ARI event and included suitable spillways or throttled outlets with attenuation storage as part of design.	
Construction tolerances	Construction tolerance for the high flow bypass weir is 5mm.	As-built survey.

4.2.18.12 Maintenance access design requirements

Vehicle access to the sediment forebay is necessary to permit periodic cleaning out of accumulated sediment. Where it is not possible to clean the forebay from the perimeter hardstand, this must include trafficable access into the base of the forebay itself. Light vehicle access to other parts of the wetland must also be available for maintenance purposes. Pedestrian access to the entire perimeter is required for weed control and maintenance of vegetated areas.

Table 73: Maintenance access design requirements

PARAMETER	REQUIREMENT	VERIFICATION METHOD
Forebay access	A 4.0m wide access driveway and platform (as applicable) with all-weather surface suitable for an 8.2 tonne axle weight vehicle, at a grade of less than 1:12 must be provided. The excavator working platform must be level and adjacent to the clean out area. The excavator working platform must be no higher than 2.0m above the base of the clean out area. If the access path is greater than 50m long then a 3-point turning area for a 10 tonne rigid truck adjacent to device (in addition to the excavator working platform); must be provided.	Sign off as part of maintenance plan prior to construction acceptance.
Wetland vehicular access	Vehicle access (e.g. for a Ute) must be provided to at least 50% of the wetland perimeter (including to all hydraulic structures) along the top of extended detention depth or minor setback for landscape planting. Design of access track must consider other site users where appropriate.	Sign off as part of maintenance plan prior to construction acceptance.
Wetland pedestrian (maintenance staff) access	Pedestrian access must be provided around the entire perimeter including any bunds, structures or hydraulic controls. Preferred access routes should be marked on maintenance plans and maintained	Sign off as part of maintenance plan prior to construction acceptance.

PARAMETER	REQUIREMENT	VERIFICATION METHOD
	free of excessive vegetation growth. All pedestrian paths must comply with the path requirements in the *Section 3 Transportation* on page 91.	

4.2.18.13 Wetland liner design requirements

Impermeable lining of all wetlands is critical to ensure that the water level is sustained during prolonged dry spells and that the emergent aquatic vegetation is supported. Direct connection with shallow groundwater (through unlined wetlands which intersect shallow groundwater) are not supported due to the inability to reliably maintain water levels through drought periods and the risk of contamination of groundwater as the primary receiving environment.

In many instances in situ soils at the proposed base level may be suitable for use as the liner with minimal work to form batters and compact the base to form consistent homogeneous liner. The use of in-situ clay material will require pre-construction verification testing and reworking of material. Where in-situ soils are not suitably impermeable, an imported impermeable liner, either natural or synthetic, must be used. Liner design requirements are given in the table below.

Table 74: Wetland liner design requirements

PARAMETER	REQUIREMENT	VERIFICATION METHOD
Permeability	Entire wetland (to top of normal water level) must demonstrate a permeability of 1×10^{-8} m/s or lower.	Geotech testing at time of construction or acceptance of synthetic liner prior to installation
In-situ Clay liner option	Minimum 300mm of well compacted clay required across entire wetland. Acceptance must be sought for use of in-situ clay material versus imported clay. Where in-situ material is accepted for use, all batters must be completely re-constructed with clay liner to ensure no heterogeneity.	In situ clay material must be tested and accepted prior to construction to demonstrate required permeability at 95% standard maximum dry density. Post construction (rolling) testing must confirm 95% standard maximum dry density to at least 300mm. Minimum testing requirements of 1 test/150 m^2 compacted clay material (based on 300mm uniform liner depth) to be tested by independent geotechnical engineers in accordance with NZ best practice.
Imported Natural Clay liner option	Minimum 300mm of well compacted clay required across entire wetland including batters. Material must be uniform in composition and constructed to achieve consistent compaction across full area.	Imported clay material must be tested and accepted prior to procurement to demonstrate required permeability at 95% standard maximum dry density. Post construction testing must confirm 95% standard maximum dry density to at least 300mm. Minimum testing requirements of 1 test/150 m^2 compacted clay material (based on 300mm uniform liner depth) to be tested by independent geotechnical engineers in accordance with NZ best practice.

PARAMETER	REQUIREMENT	VERIFICATION METHOD
Synthetic liners	Geo-synthetic Clay Liners (GCL) or HDPE (min 1.5mm) may be suitable in absence of suitable clay source. Acceptance of material to be provided prior to specification including manufacturers testing and independently verified performance data. Consideration must be given to slope stability on batters to prevent sloughing.	Material to be pre-accepted beforehand.

4.2.18.14 Planting and plant selection

Selection of suitable plants for wetlands is critical to ensure sustained performance under a range of conditions. Designers must select species adaptable to the broadest ranges of depth, frequency and duration of inundation.
The following specifications are required:

a) Tall perennial species should be planted in preference to non-perennial species. Raupo is not recommended due to die-back in winter and tendency to over dominate other species.

b) A diverse assemblage of plants is preferable. Native local species (with seed eco sourced by nurseries) should be used, to represent local vegetative communities and ensure plants are well adapted to local conditions.

c) Vegetation should be limited to plants whose root structure will not cause damage to the wetland liner or compromise the structural integrity of any bunds.

d) Plants must be supplied as individual plants (i.e. tubestock or pots) and must not be substituted for manually separated reclaimed clumps or propagation trays cut into units. Plants must be healthy and robust with vegetation extending above the planted water depth.

e) Plants should be planted with a desired density of 4 plants/m2 to form full coverage of the shallow and deep marsh areas. Water levels should not overtop planted vegetation during the developmental growth phase (water levels can be raised as the plants become well established (2-3 months when planted in spring). Appropriate plant species must be used where there is potential for drying up of the planting zone. Species should be well mixed within their growing conditions to form a natural assemblage where possible.

f) Dense, rigid and tall marsh species are best suited within deep marsh zones, whereas tall marsh species with spreading aerial cover are suited adjacent to open water areas.

g) Vegetation that provides a high level of shading (including trees, shrubs and reeds / tall sedges) should be planted around and within the wetted margin of the wetland. Tall species with spreading crowns provide aerial cover, especially if located on the northern aspect of a wetland, which assists in reducing elevated temperatures in exposed water bodies. Shade-tolerant herbaceous marsh vegetation to be selected for shaded areas. Care must be taken where synthetic liners are used in areas with permeable in-situ soils. In these instances, the use of large tree species should be avoided due to potential instability and risks of damage to synthetic liners.

Plant species types are provided in *Table 82: Acceptable plant species* on page 251. Refer to this table for guidance on plant species suitable for use in wetlands.

4.2.19 Treatment Swales

The design of swales must be undertaken by suitably qualified designers in accordance with design guidelines. The design of swales must ensure that they are able to convey the required design flows in a controlled manner, are not subject to ongoing erosion/scour and are able to be maintained in a safe and practical manner with consideration given to traffic management. The table below summarises design requirements for typical swale applications.

Table 75: Swale design parameters

PARAMETER	DESIGN REQUIREMENT
Catchment area	4ha maximum.
Longitudinal Slope	1.5–3% ideal, but up to 5% is allowed in accordance with the design guidelines. Check dams can be used if slopes between 5-10%.
Lateral slope	0%.
Hydraulic Retention Time	Average of 9 minutes or longer in accordance with Waikato Regional Council's 'Waikato stormwater management guideline' or Bay of Plenty Regional Council's 'Stormwater Management Guidelines for the Bay of Plenty region 2012/01'.
Water Quality Storm Velocity	Lesser of maximum velocity for erosion control or velocity required to meet HRT (or less than 0.8m/s).
Water Quality Storm Depth	The lesser of design vegetation height or 150mm.
Water Quality Storm Manning's Roughness	0.25.
Max Velocity in primary system design event	Maximum velocity for erosion control (or <1.5m/s for 10 year 24 hour event).
Max Depth in primary system design event	300mm deep or 150mm below top of swale, whichever is less.
Primary system event Manning's Roughness	0.03 grassed swale. 0.25 vegetated swale
Length	>30 m
Base Width	0.6 – 2m
Side Slopes	3h:1v planted or 5h:1v if mowing required
Freeboard	0.15 m above 10-yr ARI 24-hr event water level
Check Dams	Required when longitudinal slope >5% to reduce effective grade (2% recommended). Max height equal to WQS design depth (150mm max)
Level Spreaders	Good practice at all inlets, integrate with Check Dams when longitudinal slope >5% (generally required every 15m)
Under-drains	Required when dry swale slope <2 %
Planting	Base and sides of swale must be planted, refer *Figure 11: Stormwater treatment and detention device: staged landscape planting* on page 250.
Pre-treatment	Required if high contaminant loads to swale.
Vegetation	Grass to be maintained to dense and 100 – 150mm high. Grass species to be able to withstand periodic wetting including submergence. Perennial rye grass or similar. Mowing to be restricted in wet conditions.

Infiltration swale same as above, but without the underdrainage. Bioretention swale is the same as above except:

a) Max bottom width up to 7m.

b) Length to width ratio 5:1.

c) High flow bypass to protect wetland plants.

4.2.20 Raingardens

The design of raingardens (often referred to as bio-retentions) must be undertaken by suitably qualified designers in accordance with design guidelines. The design of raingardens must ensure that they can detain and treat the required water quality volume, can adequately drain between events through under-drainage, are safe for pedestrians/cyclists and are able to be maintained in a safe and practical manner with consideration given to traffic management. The table below summarises design requirements for typical road corridor raingarden applications.

The publication *Bioretention Technical Design Guidelines* from Water by Design can be referred to for design guidance for larger bioretention devices.

Table 76: Raingarden design parameters

PARAMETER	SPECIFICATION
Land use	Raingardens are suitable for: • Roofs • Residential • Local roads • Commercial (with GPT) • Industrial (within a treatment train) • Arterial roads and highways (VPD > 10,000) (with pre-treatment).
	Raingardens to be set back from intersections a minimum of 30m and must consider plant selection for sightlines and CPTED.
Performance	Raingardens can provide: • Retention storage/infiltration • Sediment removal • Hydrocarbon removal • Bacteria and nutrient removal in some situations • Small storm detention • Metals removal • Temperature mitigation • Nutrient removal (in particular Phosphorous)
Catchment area	For catchments greater than 0.4 Ha specific inlet design is required following this Waikato Regional Council's 'Stormwater management guideline' or Bay of Plenty Regional Council's 'Stormwater Management Guidelines for the Bay of Plenty region 2012/01' Minimise the amount of pervious catchment area draining to the device (in general aim to keep catchment area < 1,000m^2). Minimum raingarden area is 2m^2.

PARAMETER	SPECIFICATION
Location	Devices should be located so that stormwater can flow to the device under gravity without the need for 'bubble up' inlets. Devices may not be suitable on road reserves with steeper gradients. Incorporating horizontal structures on sloping ground can create pedestrian or vehicular safety hazards.
Safety in design	The mulch must be no more than 150mm below any adjoining public footpath/cycleway, unless it is protected by shrubs or in the worst case, a hand rail.
Inlet design	Sheet flow with pre-treatment for catchments less than 0.4ha may be acceptable. Pre-treatment is required for high contaminant load sites1 and recommended for normal contaminant load sites 2. Pre-treatment may be in the form of a grass strip, swale, proprietary device or sediment forebay. Flow must be slowed at the inlet with flow dispersal techniques such as, gravel verge or rocks. Concentrated inflow (e.g. kerb cuts) requires energy dissipation or scour protection at the inlet using rock breaching or concrete apron. Surcharge risers (bubble ups) may only be used with specific acceptance of the Council where positive drainage towards the device surface is not feasible and where blockage will not result in inundation of public/private property. Any surcharge risers must be clearly identified in the operation and maintenance plan.
Outlet Design	Where hydraulic feedback to the inlet is not possible to enable bypass of peak flows, raised overflow manhole (scruffy dome or similar) must be included above EDD. Underdrainage must be provided. Underdrains are to be sized to pass full WQV peak inflow and comprise perforated PVC pipes (un-sleeved) or similar. Note that novacoil or similar corrugated pipe must not be used. Where retention and infiltration are required, the outlet of the underdrain must be raised above base to provide inter event reservoir.
Design event	Raingardens may be designed to provide: • Treatment for the WQV (minimum 2% of impervious catchment area) • 24mm detention storage (extended detention)
Extended detention depth (EDD)	Where possible Raingardens must be designed with an extended detention depth of 200 – 300mm above the bed of the mulch layer.
Vegetation	Plants should be able to tolerate periods of inundation and longer dry periods, be perennial and have deep fibrous roots. They need to be suited to free draining soil and natives are preferred.
Planting filter	Raingarden media should meet the following specifications: Need more detail here. Need to include how hydraulic conductivity to be measured and ideally a particle size distribution • Minimum depth 500mm. • Total Nitrogen: < 1,000 mg kg-1 • Saturated Hydraulic Conductivity: 150 to 300 mm/hr. • Total phosphorus: Leachate testing required if > 100 mg kg^{-1}

PARAMETER	SPECIFICATION
	• Plant available water: 100 mm • Organic matter: 10% - 30% by volume • pH range: 6.5 – 7.5+ • Electrical Conductivity: < 2.5 dS m^{-1} • Total Copper: ≤ 80 mg kg^{-1} • Total Zinc: ≤ 200 mg kg^{-1} • Media sources: From a clean source (no waste products)
Mulch	100 – 150mm non-floating mulch layer. 75% organic mulch with 25% compost mix.
Transition layer	Clean, well graded sand with minimal fines, 100 mm thick, void ratio 0.3.
Drainage layer	5-10mm washed drainage metal (pea metal) or similar, 300mm minimum thickness.
Underdrain	Under drain should be perforated PVC or similar pipe, minimum grade 0.5%. Minimum diameter 100mm for up to $10m^2$ rain garden, 1x 150mm diameter or 2 x 100mm diameter for $10m^2$ – $20m^2$ rain garden area. Specific design is required for rain garden larger than $20m^2$. One drain per 3m width of rain garden.
Impermeable liner	Impermeable liners may be used where the raingarden is connected with stormwater harvesting scheme or site conditions require lining. Linings need to respond to site specific requirements (e.g. unstable ground or steep slopes) and must consider adjacent services, adjacent trees, slope stability, buildings (including footings) and road substrates. Geotextile is to be used across the base of the raingarden when constructed in clay/silt soils.

Note 1: Pre-treatment must remove high contaminant loads before flow enters the raingarden, refer Table 49: Land use categories on page 197.

Note 2: Pre-treatment reduces maintenance frequency and provides protection for unexpected sediment loads.

4.2.21 Hydrodynamic separator

Typical specifications for the proprietary hydrodynamic separator are provided in the table below. Refer to the acceptable products list in Section 8 Acceptable products on page 365.

Table 77: Hydrodynamic separator specifications

PARAMETER	SPECIFICATION
Landuse[1]	• Highly trafficked roads (> 10,000 VPN) • Car parking in commercial areas • New developments

PARAMETER	SPECIFICATION
	• Construction sites • Vehicle maintenance yards • Industrial and commercial facilities (i.e. Airports, mechanical workshops, truck stops, shopping malls, restaurants, supermarkets).
Catchment size	The maximum catchment size is 50 hectares
Performance	• Gross pollutant removal • Course sediment removal • Some fine sediment removal • Floatables, oil and grease removal • Must be part of a treatment train
Sizing	• Generally, treats the first flush (calculated water quality volume). • Flows exceeding the device capacity are designed to bypass the system using an upstream manhole. • Consult manufacturer's guidance for detailed sizing information.

Note 1: Although the listed land uses are suitable, locate the device outside of live traffic lanes.

4.2.22 Underground storage

Typical specifications for underground storage devices are provided in the table below. See Stormwater drawing: Underground storage with approved catchpit filter plan and section.

Table 78: Proprietary underground storage specifications

PARAMETER	SPECIFICATION
Land use	Non-trafficked areas, e.g. landscapes. Carparks (vehicles up to 2,500kg gross mass. Trafficked areas, vehicle greater than 2,500kg gross mass.
Performance	Depending on the design, the storage tank can provide: Retention (infiltration) storage and/or Detention storage. Must be part of a treatment train.
Device Type	Public owned Underground Storage Preference Order: 1 Porous manhole(s) with filter cloth 2 Open arch type soakage chamber(s) with filter cloth 3 Cell structure type(s) with filter cloth 4 Rock or accepted drainage media type with filter cloth.
Sizing	Provide extended detention for the 24 mm event and flood attenuation if required. Consult manufacturer's guidance for detailed sizing information. Depending on the device location minimum cover depths will apply.
Location	Public owned Underground Storage Preference Order: 1 Parking bays

PARAMETER	SPECIFICATION
	2 Footpath 3 Berm between kerb and footpath.

4.2.23 Catchpit filter system

The table below summarises design requirements for typical catchpit filter system (CFS) applications. As systems are manufacturer specific, general specifications have been provided. Only products on the acceptable products list at [Acceptable Products List 2022](#) *Section 8Acceptable products*on page 365 are acceptable.

Table 79: Catchpit filter specifications

PARAMETER	SPECIFICATION
Land use	• Shopping malls • Schools • Carparks • Roads
Catchment area	• Less than 1 Ha and comply with *Clause 4.2.3.5 Secondary design requirements* on page 196.
Performance	• Gross pollutant removal • Some course sediment removal • Must be part of a treatment train
Sizing	• Installed into a curb inlet or catchpit and can be customized to meet specifications. • High flows are designed to bypass. • Drainage design should account for loss of inlet capacity to system.

4.2.24 Underground chamber filter

The table below summarises design requirements for typical chamber filter applications. As systems are manufacturer specific, general specifications have been provided.

Table 80: Underground chamber filter specifications

PARAMETER	SPECIFICATION
Land use	• All land use excluding heavy industrial. For heavy industrial a treatment train may be required to meet water quality targets
Catchment area	• Recommended less than 10 Ha
Performance	• Gross pollutant removal • 75% TSS and metals removal
Sizing	• Manufacturer specified sizing designed to capture 10 mm hr^{-1} (based on flow rate to capture similar annual volume to WQV wetland) • Preferably installed in an offline configuration • Internal bypass required if installed online

4.2.25 Planting and aesthetic requirements

Aesthetic design elements must be in keeping with local character. Consider:

a) Integrating planting into the wider environment such as streetscape and/or park setting so that the planting is seamless (where this is desired).

b) Extending the footpath into wetland area as a boardwalk.

c) Making the wetland shape and edges aesthetically appealing.

d) Planting is intended to mimic natural succession by having bands or groups of different plant species growing in a sequence of conditions from open water to boggy areas and up to drier ground.

Landscaping must:

e) Comply with engineering requirements.

f) Minimise ongoing maintenance.

g) Improve stormwater water quality discharge.

h) Retain existing bush areas and tree stands where possible.

i) Become a community asset and positive visual amenity.

j) Provide, where possible, forage and habitats for native flora and fauna.

Planting plans to be submitted to Council for acceptance:

k) Plant species allocations are to be specific to soil type and conditions, site topography and exposure, post-development groundwater table levels and alignment with local indigenous native plant species. Plant species are to be indigenous to the Waikato Region, although native New Zealand grasses are permitted. Likewise, plants are to be eco-sourced where possible from the Waikato Region.

l) Of the vegetation mix in wetlands at least 10 percent and no more than 25 percent must be staked 1.5 m high grade trees.

m) Vegetatively shade inflow and outflow channels as well as those areas of the wetland with a northern and eastern exposure to reduce thermal warming.

4.2.25.2 Planting Zones

The following planting zones define the planting regimes within detention and treatment devices. They are intended for wetlands but can be applied to other devices and are based on vegetative tolerances to wet/damp roots and frequent/infrequent inundation. Refer to *Figure 11: Stormwater treatment and detention device: staged landscape planting* on page 250 and *Table 82: Acceptable plant species* on page 251 for acceptable plant species.

Due to site conditions and detention and treatment device configuration it may not be feasible for all Planting Zones to be used within a device. Consult with Council to confirm the applicable Planting Zones.

Table 81: Planting zones

Zone	Description
Submerged Zone	This area is where the pond ground surface is capable of being permanently submerged and where the plant roots may be permanently waterlogged

Zone	Description
Shallow Marsh Zone	This area is likely to be submerged or partially submerged in a 2 Year ARI return storm event
Littoral Edge Zone (between NWL and TWL)	This is the planting zone between the Shallow Marsh Zone and Riparian Zone where plants may be occasionally submerged (in storm events more severe than the 2 Year ARI return period storm). Plants are able to withstand inundation for short periods of time
Riparian (above TWL)	This planting zone is generally above the spillway level. Plants are able to sustain damp roots for periods but should not be fully inundated

4.2.25.3 Plant Sourcing and Grade

Plants are to be eco-sourced from the Waikato Region where possible, from reputable nursery stock with grades to be of good health and form that minimize potential mortality rates. It is strictly prohibited to transplant vegetation from existing wetlands and other such environments.

Plant grades are to be of a suitable size to ensure vegetation establishes rapidly with minimum mortality rates and/or replacement requirements. Refer to *Table 82: Acceptable plant species* on page 251 for the minimum plant grades. Trees are to be a minimum grade of 1.5m high.

4.2.25.4 Species Selection

Species are to be selected with regard to good conformation, healthy robust root systems and low maintenance must comply with Council's planting policies.

Planting species are to be selected according to the planting list indicated in *Table 82: Acceptable plant species* on page 251 and corresponding site topography and ecology unless there are more suitable plants according to site conditions and/or local ecology. Where trees, shrubs and groundcovers are to be planted within a transportation corridor, reference must be made to *Clause 7.2.9 General species design selection, layout and sourcing* on page 344.

Figure 11: Stormwater treatment and detention device: staged landscape planting

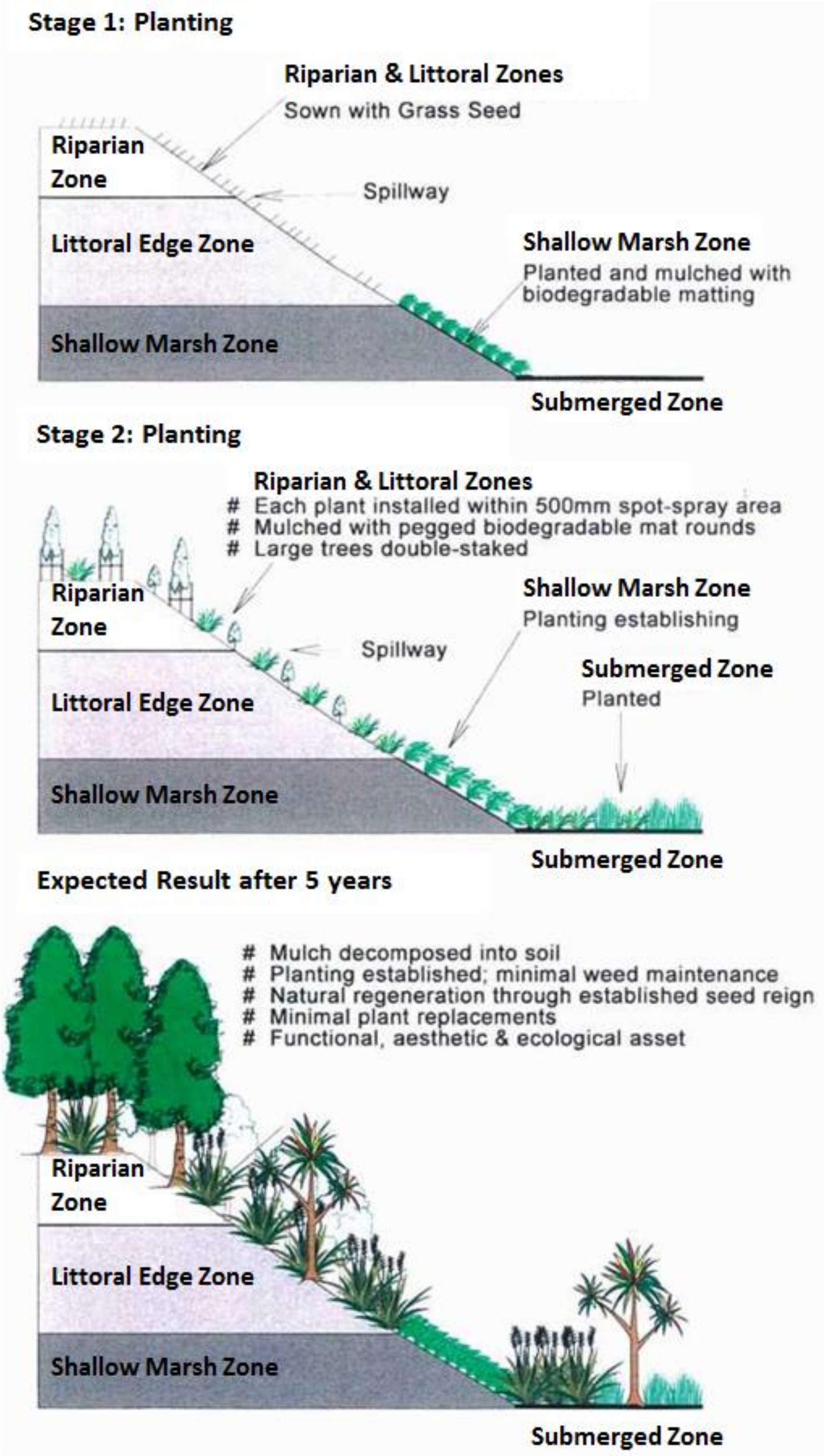

Table 82: Acceptable plant species

Botanical Name	minimum centres (m) **	Minimum Grade	Type	Applicable PSD	Pond & Wetland	Riparian Zone	Littoral Edge Zone	Shallow Marsh Zone	Submerged Zone (Depth range in bold)	Rain Garden	Vegetated Swale	Vegetated Filter	Tolerance	Peat Soil	Frost	Wet/Moist	Dry	Wind	Light Requirements	Full Sun	Part Shade	Full Shade	Characteristics	Rapid Growth	Nurse Plant	Bird Forage
Apodasmia similis	1	RT	Medium Rush				■	■	■	■		■		■	■	■	■	■		■	■					
Aristotelia serrata	2	5	Small Tree			■		x		■		■			■	■	■	■		■	■	■		■	■	■
Astelia grandis	1	3	Medium Shrub			■	■			■		■		■		■	■	■			■	■				
Austroderia fulvida	1	RT	Small Grass			■	■			■		■			■	■	■	■		■					■	■
Austroderia toe toe	1	3	Medium Grass			■	■			■		■			■	■	■	■		■					■	
Baumea articulata	1	RT	High Rush					■	0.30m			■		■	■	■		■		■						
Baumea rubiginosa	1	RT	Low Rush					■	■					■	■	■		■		■						
Baumea teritifolia	1	RT	Rush									■		■	■			■		■				■		
Blechnum minus	1	3	Fern				■	■						■	■	■				■	■					
Blechnum novae-zelandiae	1	3	Medium Fern			■				■		■		■		■	■	■		■	■	■				
Carpodetus serratus	2.5	5	Mediam tree			■									■			■		■	■					
Carex dispacea	1	RT	Sedge					>		■	■	■			■	■		■		■	■					■
Carex dissita	1	RT	Sedge			■	■	■		■	■	■		■	■	■		■		■	■					
Carex gaudichaudiana	1	RT	Sedge					■								■		■		■						
Carex geminata	1	RT	Sedge			■	■	>	0.05m	■	■	■		■	■	■	■	■		■						
Carex maorica	1	RT	Sedge				■	■		■	■	■		■	■	■		■		■	■			■		
Carex secta	1	RT	Sedge			■	■	>	0.05m	■	■	■		■	■	■	■	■		■	■			■		
Carex virgata	1	RT	Sedge			■	■	>		■	■	■		■	■	■	■	■		■	■			■		
Coprosma grandifolia	1	5	Tall Shrub			■	■	x						■		■	■			■	■					
Coprosma 'Hawera'*	0.5	3	Groundcover			■									■		■	■				■				
Coprosma kirkii 'Minogue'	1	3	Groundcover			■						■			■		■	■		■	■					
Coprosma propinqua	1	5	Tall Shrub				■	x		■				■	■	■		■		■						
Coprosma rhamnoides	1	5	Tall Shrub			■		x									■	■								
Coprosma rigida	1	5	Tall Shrub			■		x							■		■	■		■	■					
Coprosma robusta	1	3	Tall Shrub			■		x		■		■		■	■	■				■	■	■		■	■	■
Coprosma tenuicaulis	1	5	Tall Shrub				■	x		■		■		■	■	■				■	■					■
Cordyline australis	1	3	Small Tree			■	■	x	0.10m	■		■		■	■	■	■	■		■	■	■		■		
Cyathea dealbata	1	8	Tree Fern			■	■	x		■		■		■	■	■				■	■	■				
Cyperus ustulatus	1	3	Medium sedge			■	■			■		■		■	■	■		■		■	■			■		
Dacrycarpus dacrydioides	2.5	1.5m High	Tall Tree			■		x				■		■	■	■		■		■	■					■
Dianella nigra	1	5	Small Shrub			■	■					■			■			■		■	■					■
Dicksonia fibrosa	1	8	Tree Fern			■	■	x		■		■		■	■	■				■	■					
Dicksonia squarrosa	1	8	Tree Fern			■	■	x		■		■		■	■	■				■	■	■				
Dodonea viscosa	2	5	Small Tree			■	■	x				■					■	■		■						
Eleocharis acuta	1	RT	Low Rush					■	0.20m					■	■	■				■						
Eleocharis sphacelata	1	RT	Low Sedge					■	0.40m					■	■	■				■				■		
Fuschia excorticata	2.5	1.5m High	Medium Tree			■		x						■	■	■					■	■				■
Griselinia littoralis	2.5	1.5m High	Medium Tree			■		x				■			■		■	■		■				■		
Hebe diosmifolia	1	3	Medium Shrub			■						■		■	■		■			■						
Hebe parviflora*	1	3	Medium Shrub			■						■			■		■			■						
Hebe stricta	1	3	Medium Shrub			■						■		■	■		■	■		■	■			■		
Hebe 'Wiri Cloud'*	0.5	3	Small Shrub			■						■		■	■		■			■						
Hebe Wiri Mist*	0.5	3	Small Shrub			■						■		■	■		■			■						
Hoheria sextylosa	2	5	Small Tree			■		x				■			■		■			■	■			■		
Isolepis reticularis	1	RT	Sedge				■	■						■		■		■		■						
Juncus edgariae	1	RT	Rush				■	■						■	■	■		■		■						
Kunzea ericoides	2.5	3	Tall Tree			■	■	x		■		■		■	■		■	■		■				■	■	
Leptospermum 'Crimson Glory'	1	3	Small Shrub			■	■			■		■		■	■	■	■	■		■	■			■		
Leptospermum scoparium	2	3	Small Tree			■	■	x		■		■		■	■	■	■	■		■				■	■	
Libertia ixioides	0.5	3	Small Shrub			■						■		■	■		■	■		■	■					
Machaerina arthrophylla	1	3	Sedge			■	■					■		■	■	■	■	■		■	■					
Melicytus ramiflorus	2	3	Medium Tree			■	■	x				■		■	■	■				■	■	■		■	■	■
Myrsine australis	2	3	Medium Tree			■	■	x				■		■	■	■					■	■		■		
Paesia scaberula	0.5	RT	Fern			■									■		■	■		■	■			■		
Phormium cookianum	1	3	Medium Flax			■								■	■	■		■		■	■	■		■		■
Phormium 'Green Dwarf'*	1	3	Low Flax			■	■			■		■		■	■	■	■	■		■	■			■		■
Phormium tenax	1	3	Medium Flax			■	■	■	0.15m	■		■		■	■	■	■	■		■	■			■		■
Pittosporum crassifolium*	2	3	Small Tree			■		x				■					■	■		■	■					
Pittosporum eugenoides	2	3	Small Tree			■		x				■						■		■				■		
Pittosporum tenuifolium*	2	3	Small Tree			■		x				■						■		■	■					■
Pittosporum tenuifolium 'Mountain Green'*	2	3	Small Tree			■		x				■						■		■	■					■
Plagianthus regius	2.5	1.5m High	Medium Tree			■		x												■	■					
Podocarpus totara	2.5	1.5m High	Tall Tree			■		x						■	■		■			■	■	■				
Potamogeton cheesemanii	1	RT	Herb							■						■	■			■	■					
Pseudopanax ferox	2	5	Small Tree			■	■	x							■		■	■		■	■					■
Schefflera digitata	2	5	Small Tree			■	■	x				■				■					■	■		■		
Schoenoplectus validus	1	RT	Rush				■	■				■				■				■	■			■		
Sophora 'Dragons Gold'*	2	5	Small Shrub			■						■			■		■			■	■			■		■
Sophora microphylla	2	1.5m High	Small Tree			■		x				■			■		■			■	■					■
Streblus heterophyllus	2	3	Small Tree			■	■	x												■	■					
Syzgium maire	2.5	1.5m High	Tall Tree					x				■				■				■	■					■
Typha orientalis	1	RT	Rush			■	■	■	■					■		■				■	■			■		
Grassing			Groundcover				■					■			■	■	■	■		■				■		
Roll-on Turfing			Groundcover				■				■	■			■	■	■	■		■				■		

KEY:

■	These species may be planted according to PSD requirements and species tolerances. Only those nominated cultivars are acceptable unless approved otherwise by Council.
x	Plant must not be planted in the Shallow Marsh Zone as they may damage the slope toe should they fall over and/or require future removal.
>	Indicates that the vegetation mix for this planting zone should have a high percentage of this plant.
#	Swales: Plant only on slopes. Forms trunks that impede water flow.
*	Plant species is not indigenous to the Waikato region, but is an approved PSD plant.
**	Minimum staggered centres unless otherwise specified. Tree centres indicated are the minimum distances from other tree species and are to be underplanted with 4 equidistant same species groundcovers at 0.75m centres from tree trunk/stem.

NOTES:

Plants should be 100% native.

Planting plans need to be accepted by Council, and site specific plants can be put forward for consideration.

The above list is a guide only and targets the early years of a planted device, for example, light and frost tender species could be introduced after the device is mature.

Site specific constraints should always be taken into account, for example, the use of the land adjoining the riparian zone may limit the hieght of trees in this zone.

4.2.25.5

Swale Planting

Swales may be turfed or grassed to ensure rapid establishment and mitigate channel surface scouring. Generally, grass needs to be maintained at heights between 50mm and 150mm, depending on engineering design parameters.

Where engineering requirements permit, specific grass species may be planted in the Submerged and Shallow Marsh Zones. No other groundcover, shrub or tree species are permitted in these Zones. These need to be planted with mulch rounds.

Table 83: Swale planting - velocity/grade matrix

Type	Grade	Velocity
Swale – Roll on Turfing	Less than 2%	Less than 1.5m/s at 10 Year ARI flow
Swale – Vegetated	2-5%	Less than 2.5m/s at 10 Year ARI flow
Swale – Rocks	Greater than 5%	2.5m/s or greater at 10 Year ARI flow

Both during and post-establishment, the height of the turf must be consistently maintained at least fortnightly to designed stormwater engineering requirements. Turf must be of a drought-resistant hard-wearing rye-grass based variety with no weeds species.

4.2.25.6 Filter Planting

Filters can be planted with a mix of Council accepted groundcovers, shrubs and trees according to the Planting Zone criteria, as site conditions and engineering requirements permit.

4.3. PIPELINE CONSTRUCTION

4.3.1 Pipeline construction

This section covers the installation requirements for all piped stormwater systems. The installation of pipelines must be carried out in accordance with the AS/NZS standard relevant to the material type.

4.3.2 Materials

Refer to*Section 8Acceptable products*on page 365 Acceptable Products List 2022

4.4. TOLERANCES

Pipes must be accurately laid to the lines, levels and gradients shown on the engineering design drawings using pipe-laying laser equipment.

Where the variation exceeds the tolerance Council may order the removal and relaying of any affected pipes.

4.4.1 Invert levels

The permissible deviation from the designated level of the invert at each manhole or structure must be ± 50mm, provided that the fall between successive manholes or structures must be at least 90% of that specified.

4.4.2 Horizontal alignment

The permissible deviation of the horizontal alignment between manholes or structures must be ± 100mm.

4.4.3 Gradient

For straight gradients, the permissible deviation from the specified gradient must be ± 50mm from a straight line drawn between the inverts of successive manholes, provided that no point in the pipeline is lower than any downstream point.

4.4.4 Trenchless construction

4.4.4.1 General

Trenchless technology may be preferable or required 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.

Trenchless construction must only be used for applications in which the specified tolerance can be achieved.

Pipes used for trenchless installation must have suitable mechanically restrained joints, specifically designed for trenchless application, which may include integral restraint, seal systems, or heat fusion welded joints.

Any trenchless technology and installation methodology must be chosen to be compatible with achieving the required gravity pipe gradient — refer to manufacturer's and installer's recommendations.

4.4.4.2 Installation methods

Trenchless installation methods for new pipes include:

a) Horizontal directional drilling (HDD) (PVC with restraint joint/fusion welded PE).

b) Uncased auger boring/pilot bore micro-tunnelling/guided boring (PVC with restraint joint/fusion welded PE).

c) Pipe jacking (GRP/ reinforced concrete).

4.4.5 Joints

4.4.5.1 General

Specification of joints must be as follows:

a) All pipes must have flexible joints of an accepted type, such as RRJ.

b) Steel pipes must be flexibly jointed (gibault 'Denso' wrapped and sealed with accepted outer wrapping or accepted rubber ring).

c) Joints must be provided adjacent to manholes to the requirements of AS/NZS 2566 with the exception of PVC or PE, where proprietary connections may be used.

4.4.5.2 Rubber ring joints

Rubber ring joints must be installed strictly in accordance with the manufacturer's instruction. Care should be taken to ensure that the rubber rings are located evenly around the joint with no twists in them. The pipe must be pushed up firm and tight to the joints.

4.4.5.3 Site mortar jointing of pipes into manholes

All mortar used for the 'on-site' jointing of drainage components must be Expocrete 'UA' or an accepted equivalent such as provided by the pipe manufacturer. See Acceptable Products List 2022 The surface priming, mixing of components, application and cure period are to be in accordance with the manufacturer's directions.

4.4.6 Manholes

4.4.6.1 Channels and Benching

A semi-circular channel must be formed in the concrete floor of the manhole. The benching must rise vertically from the horizontal diameter of the pipe to the height of the soffit and then be sloped back at a gradient specified in:

a) Stormwater drawing: Stormwater DN1050 manholes

b) Stormwater drawing: Stormwater typical dimensions for manholes greater than DN1350.

c) Stormwater drawing: Stormwater shallow manhole/chamber

The flow channel must be formed so that it presents an evenly curved flow path through the manhole. The cross section of the flow channel must be uniform with the main channel benched.

Benching must be floated to a dense, smooth hard surface using 3:1 sand cement mortar and a steel float. Side branches must be similarly formed with a smooth bend into the main channel.

The benching must have step recesses as shown on Stormwater drawing: Stormwater typical dimensions for manholes greater than DN1350. A U3 standard of finish as specified in NZS 3114 must be achieved.

4.4.6.2 Flexible Joints

All pipelines must have a flexible joint adjacent to the manhole on all incoming and outgoing pipes. The base of the manhole must extend up to these flexible joints. The upper part of the pipe inside the manhole must be cut back to the wall, the reinforcement cut out and the ends plastered with epoxy to prevent rusting.

4.4.6.3 Manhole Steps

a) Manhole steps

The steps must be attached to the manhole wall using steps in accordance with *Section 8 Acceptable products* on page 365.

Bolts through the manhole wall are not acceptable.

4.4.6.4 Concrete

All concrete must have a minimum crushing strength of 20.0 MPa at 28 days, unless otherwise specified or detailed by Council.

4.4.7 Connections

All connections must be sealed by removable caps painted blue until such time as they are required.

All connections and disconnections to or from Council pipes and all works outside the property boundary must be undertaken by Council or an accepted contractor along with rodding points which are to be installed inside the property boundary.

Connections must be constructed as per Stormwater drawing: Lateral connection.

4.4.8 Catchpits

The connection of the lead into the catchpit must be constructed as detailed in:

a) Stormwater drawing: Footpath berm catchpit details

b) Stormwater drawing: Catchpit back entry details

c) Stormwater drawing: Double sump catchpit design

d) Stormwater drawing: Vertical entry catchpit

e) Stormwater drawing: Fish symbols for catchpits

4.4.9 Backfilling and reinstatement

Backfilling must keep pace with the excavation and laying of pipes so that not more than 15m of pipes must be left exposed in open trench to prevent flotation.

4.4.10 Embedment

The designed trench width must be the minimum width to allow pipes to be safely laid and all embedment material properly and sufficiently compacted.

The foundation must be able to support all design loads placed on it for the duration of the lifecycle of the pipeline it supports. Where the bottom of the trench will not provide adequate support for the pipe the designer must be contacted to provide a suitable means to stabilise trench foundation. Acceptable methods include:

a) Groundwater drainage.

b) Use of geotextile fabric.

c) Cement stabilisation.

d) Removal of unsuitable material and replacement with compacted selected material.

Embedment material must not be placed, or pipes laid before the trench foundation has been inspected and accepted by a suitably qualified drainlayer or engineer.

Where pipelines have protrusions such as sockets, flanges or couplings, a suitable recess must be provided in the supporting material to ensure the pipeline is fully supported along the pipe barrel.

Any PVC pipes must be laid with product labelling uppermost in the trench.

4.4.11 Fill

4.4.11.1 General

The trench or embankment fill material, must be as specified. Where reuse of previously excavated material is proposed its use must be accepted by the engineer. The density of the fill material must not be less than that of the original material prior to excavation. When compacting in layers the depth of each layer must be as specified by the engineer and designer.

The depth of fill must comply with the relevant pipe AS/NZS standard.

Mechanical compaction of the fill material directly above the pipe must not be used until the depth of cover above the top of the pipe is adequate to prevent damage. Non-mechanical compaction equipment may be required.

4.4.11.2 Fill outside a transportation corridor and other trafficked areas

Trench or embankment fill must be compacted in layers to the specified finished level. The designer must specify a testing regime to verify the compaction effort meets the density specified.

4.4.11.3 Fill in a transportation corridor and other trafficked areas

Trench or embankment reinstatement must conform to the requirements shown on Transportation drawing: Trench reinstatement. Trench or embankment fill must be compacted in layers to the specified finished level. The designer must specify a testing regime to verify the compaction effort meets the density specified to support the designed traffic loading.

4.4.11.4 Outside of transportation corridor

Bulk backfill must be placed in layers and mechanically compacted. The degree of compaction must be such as to produce an in-situ density which must not be less than that of the original material prior to excavation. To establish the criteria for compliance, Scala Penetrometer tests must be carried out along the line of the trench prior to excavation.

There must be no less than one test per 50m of trench length. Compaction tests (or substituted Scala Penetrometer tests) must be carried out for the full depth of the trench to within 300mm of the pipeline (subsequently referred to as the ‘test area’). There must be at least one test area per 50m of trench length, or, at least one test area per 50m3 of trench backfill, whichever method returns the greater number of test areas.

Compaction test results (or substituted Scala Penetrometer tests) must be submitted to Council for acceptance.

The area must be reinstated to the same condition or better.

All drains, fences and other structures must be replaced or reconstructed to their pre-construction, or better, standard and in their original place.

4.4.11.5 In transportation corridor

Pipe trenches must be backfilled using an accepted hardfill placed immediately above the pipe embedment and reinstated as specified by Transportation drawing: Trench reinstatement. The depth of the basecourse and type of finishing seal coat must conform to the standard of the existing road construction.

Compaction test results (or substituted Scala Penetrometer tests) must be submitted to Council for acceptance.

4.4.12 Stormwater treatment and detention devices

4.4.12.1 Planting

Stormwater treatment and detention devices are to be planted up as soon as possible after civil construction is completed according to the Planting Zones indicated in *Table 81: Planting zones* on page 248. All stormwater features with an inner batter slope ratio of 1 (vertical) to 4 (horizontal) or steeper must be landscaped (planted) to minimise risk with ongoing maintenance. See *Clause 4.2.16 Soakage devices* on page 221 and *Clause 4.2.18 Constructed wetlands* on page 228.

Where site conditions such as unstable soil structures require a more rapid groundcover than shrubs and trees provide, exposed surfaces above the Riparian and Littoral Edge Planting Zones must be stabilised with grassing prior to landscape planting.

Planting within the Shallow Marsh Zone must be installed at the same time that the upper slopes receive grassing to minimise slope toe erosion. The Submerged Zone must be planted up once the normal standing water level has been achieved and it must then be maintained.

Where feasible, consider placing rough logs, dead trees (snags), large rocks/boulders in select locations to encourage wildlife habitats. Ensure that the slope stability, slope toe, inlet, outlet, water flow and forebay are not compromised by the placement of these items and that maintenance can be carried out. Ensure no soil compaction occurs during the installation in surrounding area. The developer must consult with an ecologist and Council prior to material selection and placement.

Minimum planting provision requirements are:

a) Quick establishment of plant cover is required throughout the site, as engineering requirements permit.

b) No material storage or heavy equipment is to be stored within the site or buffer area after site clearing except to excavate and/or grade site.

c) All construction and other debris are to be removed prior to topsoil placement.

d) Soil testing and making adjustments is required (refer to *Section 7 Landscapes* on page 337).

e) Unless existing soil is unstable, sloped soils must be ripped 150mm deep either in a criss-cross pattern or horizontal to base (following contours) prior to topsoil application. Heavy clay will need deeper ripping. Topsoil must be spread to a minimum 300mm depth, ensuring heavy equipment does not compact the slopes.

f) Where bark mulch is used, it is to be contained within the plant area that it is providing cover for. Other mulch applications are to be utilised on slopes greater than 1:3.

4.4.12.2 Staged planting

The staged planting must be as follows.

a) Stage 1: Grassing

Banks must be prepared and sown with grass seed to establish rapid ground stabilisation, according to *Clause 7.3.6 Grassing, sowing and turfing* on page 351.

Where plants are to be established in nitrogen-deficient soils, the seed mixture must be:

i) Annual Rye Grass 150 kg/ha.

ii) Sweet Clover 100 kg/ha.

All seed must be certified and less than 12 months old at the time of sowing. The Ryegrass component is to be certified as having greater than 80% live endophyte content. Council may prohibit the use of seed that has deteriorated because of wetting, fertiliser burning, etc. Otherwise the standard landscaping grass seed specifications must apply as per *Clause 7.3.6 Grassing, sowing and turfing* on page 351.

The site must be grassed for at least three months and meet establishment requirements for sown areas prior to landscaping. Shallow Marsh Zone planting and mulching must be established at Stage 1.

b) Stage 2: Landscape Planting

Stage 2 planting must occur within the Council planting season (May to August inclusive) once Stage 1 sown grass has established. Ensure that no weed species exist throughout the site. Where weed species need to be eradicated either carefully spot spray and/or hand-pull in such a manner that erosion is minimised, and surrounding groundcover remains undamaged. The sown grass groundcover must be spot sprayed to 0.5m diameter for each location where individual plants are to be planted four weeks prior to planting, ensuring that the established grass between spot sprays remains undamaged. Maintain sprayed areas so that no new weed growth exists at time of planting. Install and establish planting and mulching as per *Section 7 Landscapes* on page 337.

4.4.12.3 Plant spacing

Plants are to be planted according to the following spacing allocations.

a) Within the Shallow Marsh Zone, Carex must be evenly staggered at 1.0m intervals.

b) Where plantings are to include accepted partially submerged species, these are to be irregularly clumped in groups of 3 to 7 plants along the circumference of the stormwater wetland/pond.

c) For permanent stormwater ponds, plant 0.4m below the designed normal standing waterline, accepted sedges and rushes.

d) Amenity plantings of tussocks are to be clumped in groups of 3 to 10 plants.

e) Trees must be spaced at minimum 2.5m centres from other trees and underplanted with 4 equidistant same-species groundcovers, installed 0.75m from the tree stem. The groundcover species must provide a weed suppression canopy while the tree is establishing, and as such will have no more than 1.0m mature height and minimum 0.75m spread. Ensure that the groundcover species does not compete with the tree establishment requirements. Depending on the Zone planting location, possible plants could be *Phormium* 'Green Dwarf', various *Carex* such as *Carex virgata*, and *Coprosma* groundcovers such as *Coprosma kirkii* 'Minogue'.

f) In respect to the maintenance access track:

i) No shrub or groundcover centres are to be located within 1.0m of the track.

ii) No trees centres are to be located within 2.5m of the track.

iii) Plantings within 2.0m either side of the access track are to have species that are able to recover quickly should they become damaged during pond maintenance.

iv) In subdivision and shopping complexes, planting design either side of the access track should also ensure that the track may be used for pedestrian amenity purposes.

4.4.12.4 Staking and protection

a) Trees 1.5m high or greater

Newly planted trees must be staked with two 50mm x 50mm x 1.8m rough sawn Pine H5 treated stakes with at least one third of their length (600mm) in the ground and at least 1.0m exposed minimum, or as specified on the plan with the acceptance of Council. All stakes must be inserted to avoid hitting the root ball. Stakes must be at least 400mm away from the tree trunk and no more than 500mm away.

Two flexible ties per stake must be attached. Ties must be tensioned to avoid chafing of the tree against the stakes but with enough play for the tree to move in the wind. All ties must be fixed to the stakes. Ties must be of a type accepted by Council prior to tying. Ties are to be fixed to the outer stake face with a minimum of four staples in a square pattern.

b) Smaller grade staking

All tree species planted at 2 litres to 12 litre grades. All shrub species planted at greater than 5 litre grades.

Small grade trees and shrubs should not be staked to ensure strong growth and resilient plants.

The tie must be adjusted periodically so that the stem/trunk does not become damaged, or the stem/trunk grows over the tie.

The tie must be removed at a time designated during the design phase of the landscape planting.

Some nursery-supplied plants are provided with a stake attached, usually directly against the main stem. This stake is to be removed and replaced according to this specification.

4.4.12.5 Site preparation

In regard to adjacent water bodies and/or courses, ensure that no debris or chemical spray enters or impedes the functionality of the water body, whether it is natural or manmade.

4.4.12.6 Mulching

All areas must be mulched except for areas that are grassed or turfed. All mulch is to be accepted by the Council prior to spreading.

The types of mulching specified are to ensure rapid planting establishment while maintaining good ground infiltration without souring the soil or causing negative amenity values and allowing some scope for landscape design variations. Mulching must be as detailed in *Table 84: Acceptable mulching* on page 261.

Only biodegradable weed mats is to be used except to meet device engineering requirements, for example: at inlets, outlets and high velocity channels. No geotextile weed matting or weed matting with synthetic geonet content is to be utilised in the installation of the landscaping portion of landscaping engineered stormwater devices.

a) Be a single layer of biodegradable mulching fabric or material without synthetic geonet or geotextile content with at least 1000 g/m^2 density composed of approximately 100-125mm long coir fibres, and preferably a 100% rubber-based binder.

b) Have a minimum of 24 months life expectancy and be fully biodegradable into soil within six years.

c) Prevent weed growth within the mulched area.

d) Help stabilise the soil while plants are establishing.

e) Not easily lift from the ground if submerged for periods of time.

f) Appear tidy from a visual amenity perspective.

A simple test to ascertain whether the mulching fabric is viable is to hold a sample to the sky. It should be mostly opaque. This density inhibits weed seeds trapped under the mulching fabric from sprouting, provides good moisture retention and assists with batter erosion control.

At Council's discretion, mat rounds may be used instead of matting. These must be a minimum 500mm diameter and have the same characteristics as the mulch fabric. Each round must be secured to the ground with eight pins: four pins equidistant near the outer edge and four pins around the plant stem. Pins must be a minimum 300mm long to prevent Pukeko removing them.

Section 7 Landscapes technical specifications apply where bark mulch is used. Ensure it is contained within the plant area that it is providing cover for. Likewise bark mulch is not permitted:

g) Within 3.0m of any watercourse or water body.

h) Where water ponding or flooding may occur.

i) On slope gradients of greater than a 1:3 ratio.

Biodegradable coir netting and staked coir logs may be used in high erosion sites as per *Section 7 Landscapes*.

4.4.12.7 Amenity areas mulching

Landscape planting between the drainage reserve boundaries to the Riparian Zone must only be mulched with bark or aged woodchip mulch where there is no possibility of surface ponding, flooding or mulch travel. Where surface ponding, flooding and mulch travel is possible within this area, biodegradable weed matting must be used for all landscape planting.

Table 84: Acceptable mulching

Device	Planting Zone	Mulch Type
Rain garden	All	
Wetland	Amenity Planting – Site Entrance and Drainage Reserve Boundary Line to Riparian Zone where no ponding, flooding or mulch travel is possible	Council accepted bark and/or aged woodchip but it must not be placed in the Littoral zone or below

Device	Planting Zone	Mulch Type
	Amenity Planting – Site Entrance and Drainage Reserve Boundary Line to Riparian Zone where ponding or flooding is possible	Council accepted biodegradable weed matting
	Riparian and Littoral Edge Zones	
	Shallow Marsh Zone	
	Submerged Zone	
Swale – River Rocks	All	Loose, graded river rocks, sized for the design velocity and laid on biodegradable weed mat. Check dams may be used to slow the flow and allow for filtration.
Swale – Roll-on Turfing	All	No mulch
Swale – Vegetated (Carex grasses)	All	Council accepted biodegradable weed mat or secure biodegradable mat rounds
Grass Filters Strips	All	No mulch

4.4.12.8 Riparian and littoral edge zone mulching

All plants must be mulched with Council accepted 0.5m diameter biodegradable weed mat rounds that must be secured around plants, allowing adequate room around the stem for future growth. Firmly secure fabric mulch with wooden or other biodegradable pegs as per the manufacturer's instructions so that the fabric mulch does not detach from the soil, during inundation and high winds.

4.4.12.9 Submerged zone mulching

No mulching is required within the Submerged Zone.

4.4.12.10 Stormwater information board

A stormwater information board is to be installed adjacent to the stormwater devices. Developers are to confirm wording for the information board specific to their device with Council. An example information board is to be added at a later date as shown on Stormwater drawing: Wetlands Information sign board.

4.5. AS-BUILT INFORMATION

Upon completion of construction work, copies of As-built plans and data attributes of the completed works, as described in Clause 1.9 of Section 1: General, must be provided to the Council. Separate plans are required for wastewater, stormwater, and water supply.

Responsibility for providing the plans and associated data must lie with:

a) The developer, in the case of land development (urban and industrial sub-division).

b) The contractor, in the case of works constructed for Council under contract to Council.

4.6. DEFECTS LIABILITY

4.6.1 Defects liability periods

The following defects liability periods apply to all planted treatment and detention devices, after obtaining Council's acceptance as per the table below.

Table 85: Defects and liability periods

Type	Defects Liability Period
Dry detention basins	Where dry detention basins are to be permanently grassed, the Defects Liability Period for the grassing is a minimum of six months if sown between May and August. If sown between September and April the period is extended for a further six months.
Wetlands, Rain Gardens, Swales and Filters (including staged planting)	Stage 1: Temporary Grassing (if applicable) The Stage 1 Grassing Defects Liability Period will extend for a minimum of six months or until such time as Stage 2 Planting is investigated
	Stage 2: Landscape Planting The Stormwater Stage 2 Defects Liability Period must be a minimum of 24 months except when planting is carried out between September and May the Defects Liability Period must be extended for an additional six months.

4.6.2 Defects maintenance requirements

The developer/contractor must be responsible for the routine maintenance of the landscape planting works including weeding, mulching, replacement of plants and watering during the defect's liability period.

The minimum standards required during the defect's liability period must be as per the table below.

At the end of the required defects liability period, the developer/contractor must advise the Council at least 7 working days prior to vesting the asset, or practical completion has been achieved.

Table 86: Defects period maintenance schedule

Maintenance Type	Sub-Type Regime	Frequency (months)
Mulching bark	Check and ensure that mulch has not deteriorated nor travelled below the Riparian Zone.	12
	Replace where quality and depth has diminished below specification requirements. Bark should only be topped up during winter or spring	
Biodegradable matting	Check, repair or replace any matting that has rips and non-plant stem holes. Matting should remain intact for minimum 24 months post-planting installation	6

Maintenance Type	Sub-Type Regime	Frequency (months)
Biodegradable rounds	Check and ensure rounds are intact and remain properly pegged around plant stems for minimum 24 months post-planting installation. Remove any weeds that have uplifted rounds	3
Permanent grass	Check and ensure that permanent grass is establishing and maintained to a minimum 100mm height and maximum 200mm height in accordance with the Landscaping Section	3
Planting establishment	Check and ensure all installed plants are healthy and free of pests, disease, spray and weed-trimmer damage, and are growing generally consistent with the species type shape and form Where plants are not establishing, either remediate or replace plants	3
Installed trees	Check and ensure that trees remain staked as per specifications Check and ensure that all trees are growing upright	3
Self-seeded trees	Remove all self-seeded trees from the Submerged Zone and Shallow Marsh Zone without damaging embankment toe and installed plants. Use systemic pre-mix picloram gel where this is not feasible	3
Replacements	Keep a record of all replacement plants installed, including the plant species botanical name, plant grade, quantity and date(s) planted Replacement installations should only occur between 1 April to 1 October each year in the Shallow Marsh, Littoral Edge and Riparian Zones. Planting in the Submerged Zone may occur in any season as long as the soil is moist to a depth of 300mm at the location of planting	As required
Rubbish	Check and remove any domestic rubbish or building material within the site	3
Soil moisture	Check and ensure that all areas with installed planting have soil that is moist to a 200mm depth. Irrigation may be required during summer if planting installation was late spring-early summer	3
Stormwater inlets and outlets plant cover	Ensure that no plants are evident within 1.0m of the stormwater inlet and outlet pipes	3
Swale maintenance channel	Check and remove weeds, dead plants, debris dams and pest damage Remediate any channel surface scouring that has occurred	6

Maintenance Type	Sub-Type Regime	Frequency (months)
	Ensure that Submerged Zone plants are no higher than 0.5m high Remove any non-installed plants from the swale channel	
Vegetative waste	Ensure that all vegetative waste is safely removed and disposed of offsite Check and remove any vegetative debris that is blocking the access track	3
Weeds noxious plants	Check, remove and dispose of safely all noxious plants, including root systems	3
Notifiable plants	Notify Waikato Regional Council should any notifiable weeds be identified	3
Weed cover	Check and ensure that there is no more than one 300mm high weed per $1.0m^2$	
Weed control	Check and ensure that all plants are fully weed-released Weeds may be controlled by weed-trimming, chemical or steam spraying, hand or other manual releasing unless otherwise specified	3
Chemical spraying	Ensure that no chemical spraying occurs in the Submerged Zone and Shallow Marsh Zone. All weeds growing in these Zones must be removed by other means	As required

4.6.2.1 Spraying and Weed Control

Chemical weed control must be carried out in accordance with *Clause 7.3.10 Weed and litter control* on page 355 ensuring that no spray enters any water body or watercourse.

In respect to wetland, where weed species exist both on and within 2.5m adjacent to the normal standard waterline, weeds must be controlled by either hand-pulling or weed-eating in such a manner that no debris enters any water body or watercourse.

Unwanted woody vegetation, such as Salix caprea (Pussy Willow), must not to be removed with hand-pulling or weed-eating. Use a systemic pre-mixed gel containing picloram according to manufacturer's instructions.

4.6.3 Final defects inspection criteria

To achieve final defects liability acceptance, the stormwater treatment and detention device must meet the following 'planting' criteria as outlined in the following tables where applicable.

Percentages indicated are based on the total quantity of plants specified on the accepted Planting Plan Plant Schedule.

Note: Any defects liability period extensions must apply to the whole of the site.

Table 87: Planting establishment

Zone	Planting establishment requirements
Submerged zone	75% planting established 25% establishing.
Shallow marsh zone	100% plants established
Littoral edge zone	Groundcovers: • 75% established • 25% establishing Shrubs: • 50% established • 50% establishing All trees establishing
Riparian zone	Groundcovers: • 75% established • 25% establishing Shrubs: • 50% established • 50% establishing All trees establishing
Plant canopy	Littoral Edge and Riparian Zone groundcover canopy is providing 50% minimum cover over ground surface
Planting density	Installed plantings are at the accepted consent planting plan centres

Table 88: Minimum inspection requirements

Inspection	Minimum requirements
Loose mulch (for example, bark)	• 75 mm minimum depth between plants and 25 mm maximum depth around plant stems • No loose mulch is below the bottom edge of the Riparian Zone
Permanent grass	• Permanent grass has established and is maintained in accordance with the Landscape Section
Planted areas soil	• All planted areas must be moist to at least 200mm

Inspection	Minimum requirements
Replacements	• All replacement plants that have been installed due to plant failure have been successfully establishing on site for at least three months. Council may request replacement records to verify installation dates • No more than 25% replacements have been installed three months prior to the final defect's inspection • More than 25% replacements must incur a 12-month minimum defects extension • Should the final defects inspection find that areas of the device require replacement planting: – Less than 25% replacements must incur an additional three months defects period after replacement planting has been completed to Council's acceptance, if the replacement planting occurs between May and August, otherwise the extended defects must be six months minimum. – More than 25% replacements must incur an additional 12 months defects period after replacement planting has been completed to Council's acceptance.
Rubbish	• No rubbish, including domestic and building material is evident within the Drainage Reserve, or where the device is located elsewhere, within 5m of the device
Spraying	• There is no evidence of installed plants killed or severely damaged by weed spraying.
Stormwater inlets and outlets	• No plants are evident within 1.0m of the inlet and outlet pipes.
Trees	• Where trees were installed with stakes, the trees are staked and tied as per this specification. • Trees are upright, healthy, free of disease and pests, without spray or weed-trimmer damage, and of good conformation • No self-seeded trees are growing within the Submerged or Shallow Marsh Zones
Weed cover	• The device has no noxious or Regional Council notifiable plants evident • There is no more than one 300mm maximum height weed per 1 m2 within the device • All plants are fully weed released • There is no evidence of vegetative waste within the Drainage Reserve, or where the device is located elsewhere, within 10m of the device.
Weed matting	• Within 24 months of planting installation, biodegradable matting remains intact, has no non-plant stem holes or rips, and has not become brittle enough for a hole to be created if stood on by an adult wearing safety boots • Where matting rounds have been used: – These are intact – Are properly pegged to the ground around plants as per manufacturer's instructions; and – Have no weeds uplifting them from underneath the round.

4.7. ACCEPTANCE OF PROPOSED WORKS

4.7.1 Stormwater treatment and detention devices

The acceptance process for stormwater pipe system, treatment and detention devices is as follows.

	STORMWATER FACILITIES TRANSFER (FLOW CHART FOR DEVELOPER)
	↓
PLAN	Consent issued requiring stormwater facility. Submit engineering plans for acceptance including a planting plan and proposed operations and maintenance plan
	↓
	Apply for WRC resource consents and building consents if stormwater activity is not permitted and retaining structure required
	↓
CONSTRUCT	Construct facility once plans are accepted and necessary consents obtained. Comply with Council and WRC consent conditions
	↓
	Carry out mulching and landscaping to the accepted planting plan
	↓
MAINTAIN	Apply for first 'defects liability' inspection (notify Council seven days in advance). Complete checklist. Once all works satisfactory, Council will notify Developer to initiate defects liability period
	↓
	During defects liability period carry out maintenance requirements of facility and rectify problems as they occur (e.g. weed and plant mortality). Comply with consents. Council will undertake audits during this time
	↓
	At the end of the defect's liability period, apply for a final 'defects liability' inspection. Council must be notified seven days in advance. Carry out further works as required.
	↓
TRANSFER	Apply for works clearance acceptance once: • Physical works completed to in accordance with the accepted plan (including all weather maintenance access) • As-built plans and datasheets have been submitted • Planting has been completed in accordance with the accepted plan • Operations and maintenance plan has been received and accepted • Site complies with Checklist, including acceptance of defects liability inspections
	↓
	Land is vested to Council via 224 c process (at earliest stage). Device is maintained by Council after defects liability, which may be at a different time.

Request WRC transfer Discharge Consent to Council ownership (WRC Consent must be in full compliance and all defects remedied)

NOTE: To obtain 224 c the device has ideally been completed to standard and the defects liability period is complete. If the defects liability has not yet lapsed, consult with Council about options for obtaining 224 c. This will include requirements such as a programme of works detailing who will undertake the maintenance during the defect's liability period and the proposed process for transferring maintenance ownership of the device to Council at a later date.

4.8. FORMS AND CHECKLISTS REGISTER

These are available on the Co-Lab website using the links below.

CATEGORY	TITLE
Stormwater	Design confirmation
Stormwater	Pipe laying checklist
Stormwater	Manhole checklist
Stormwater	Trench backfill compaction test summary
Stormwater	Catchpit checklist
Stormwater	Pipe network final inspection checklist
Stormwater	Wetland construction inspection checklist
Stormwater	Wetland and ponds inspection / signoff checklist

4.9. DRAWINGS REGISTER

These are available on the Co-Lab website using the links below.

CATEGORY	TITLE
Stormwater	Bubble up pit
Stormwater	Kerb connection
Stormwater	100mm diameter stormwater outlet
Stormwater	Secondary flow path treatment - private property
Stormwater	Groundwater recharging devices
Stormwater	Footpath berm catchpit details
Stormwater	Catchpit back entry details
Stormwater	Double sump catchpit design

CATEGORY	TITLE
Stormwater	Vertical entry catchpit
Stormwater	Fish symbols for catchpits
Stormwater	Swale plan and section
Stormwater	Swale driveway crossing detail
Stormwater	Rain garden plan and underdrain long section
Stormwater	Rain garden detention/soakage cross sections and kerb detail
Stormwater	Underground storage with accepted catchpit filter plan and cross section
Stormwater	Underground storage with accepted catchpit filter long section
Stormwater	Underground storage with gross pollutant trap long section
Stormwater	Stormwater connection layouts
Stormwater	DN1050-DN1350 manholes
Stormwater	Typical dimensions for manholes greater than DN1350
Stormwater	Shallow manhole/chamber
Stormwater	Lateral connection
Stormwater	Anti-scour blocks for steep drainage pipes
Stormwater	Building over and adjacent to public wastewater or stormwater pipelines
Stormwater	Stormwater device information sign board

WASTEWATER

SECTION 5. WASTEWATER

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5.1. INTRODUCTION

This section sets out requirements for the design and construction of wastewater systems for development and subdivision. The section is generally limited to the standards required for conventional reticulation systems. Alternative systems such as:

a) effluent drainage systems (EDS)

b) modified conventional sewerage systems (MCS)

c) low pressure sewer (LPS) and

d) vacuum systems

are subject to specific acceptance by Council and agreement on design standards.

5.1.2 Objectives

To provide an environmentally sustainable wastewater system, which produces no objectionable odour, does not overflow or adversely affect receiving waters and is affordable while meeting the Regional Council discharge rules and consents as well as meets Council's levels of service.

The design of the wastewater system must ensure an acceptable wastewater service for each property by providing:

a) A wastewater main laid generally within the road reserve and at a level that will allow a gravity connection by a private line laid in accordance with the Building Act.

b) Service connection from the main to each property.

Designers must consider the hydraulic adequacy of the network including the specified levels of service, the ultimate service area of the system and impact on the existing network. The wastewater system must meet the minimum design life requirement considering structural strength, design loadings, soil conditions and wastewater conditions (internal and external corrosion). The system must be designed to minimise the potential for water ingress and egress using good design practice and technologies. The wastewater network must be cost efficient over its design life while accounting for environmental and community impacts through integrated three waters management and water reuse.

5.1.3 Reference documents

Details of documents referenced in this Section are as follows:

Table 89: Reference documents

SOURCE	TITLE
AS 2200 : 2006	Design charts for water supply and sewerage.
AS 3996 : 2019	Access covers and grates.
AS 1579 : 2001	Arc-welded steel pipes and fittings for water and wastewater.
AS 1741 : 1991	Vitrified clay pipes and fittings with flexible joints – sewer quality.
AS/NZS 1260 : 2009	PVC-U pipes and fittings for drain, waste and vent applications.
AS/NZA 1546 : 2008	On-site domestic wastewater treatment units (Part 1: 2008 septic tanks).
AS/NZS 2032 : 2006	Installation of PCV pipe systems.
AS/NZS 2280 : 2014	Ductile iron pipes and fittings.

SOURCE	TITLE
AS/NZS 2566 Parts 1 & 2	Buried flexible pipeline – structure design and installation.
AS/NZS 2980 : 2007	Qualification of welders for fusion welding of steels.
AS/NZS 3725 : 2007	Design for installation of buried concrete pipes.
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 : 2009	Polyethylene (PE) pipes for pressure applications.
AS/NZS 4671 : 2001	Steel reinforcing materials.
AS/NZS 5065 : 2005	Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.
Bay of Plenty Regional Council	Bay of Plenty Regional Council: On-site Effluent Treatment Regional Plan see https://www.boprc.govt.nz/environment/resource-consents/holding-a-resource-consent/consent-and-compliance/wastewater/on-site-effluent-treatment-systems
EN124 : 2015	Gully tops and manhole tops for vehicular and pedestrian areas
NZS 3114 : 1987	Specification for concrete surface finishes.
NZS 4404 : 2010	Land development and subdivision infrastructure.
NZS 4402 : 1988	Welded steel pipes and fittings for water, sewage and medium pressure gas.
NZS 7643 : 1979	Code of practice for the installation on un-plasticised PVC pipe systems.
	Building Act 2004.
ISO 13953 : 2001	Polyethylene pipes and fittings – determination of the tensile strength and failure mode of test pieces from a butt-fused joint.
Lamont	Metrication: Hydraulic data and formulae (available from Iplex Pipelines).
Lars-Eric Janson	Plastic pipes for water supply and sewage disposal (2003).
	Local Government Act 1974: Section 451
NZTA	SP/M/022 bridge manual
PVC Pipe Association (Uni-Bell)	Handbook of PVC pipe design and construction
	Council's Trade Waste Bylaw
Waikato Regional Council	Waikato Regional Plan: Section 3.5.7 – Implementation methods – On-site sewerage discharges
	Best practice guidelines for waterway crossings
Water New Zealand	NZ pipe inspection manual 3rd edition
Water Services Association of Australia	WSA 02 : 1999 (table 2.4)
	WSA 02 : 2002 WSSA sewerage code of Australia
	WSA 02 : 2014 Gravity code of Australia version 3.1

5.1.4 Level of service

The design of the system must be such that a wastewater connection can be provided for each lot. New wastewater systems must achieve the following minimum standards:

a) Pipelines must not surcharge at the peak design wet weather flow.

b) The system must not be designed to overflow under normal conditions.

c) Pumping station emergency storage must not be used for flow buffering purposes.

d) The system must be designed with self-cleaning velocities.

Where the existing network is affected by the development, system upgrades must meet the following minimum design standards (which may need to be assessed in Council's wastewater model), Council may consider storage as a solution to manage capacity constraints.

5.1.5 Areas not serviced by public wastewater systems

Areas not serviced by a Council-owned and operated public wastewater system must comply with the Regional Plan's section on on-site sewerage discharges.

5.1.6 Alteration to existing infrastructure

Alteration of the existing wastewater network to achieve the required level of service may be subject to a development agreement regarding cost sharing.

Existing private pipework will only be considered for vesting to Council if it can be shown that both the materials and construction methodologies meet the requirements of this specification. A CCTV internal inspection and report in accordance with the 4th Edition NZ Pipe Inspection Manual will be required. For networks serving more than two properties a 'net present value' calculation and cash contribution may be required prior to vesting.

5.1.7 Planning documents and assessments

All design must be undertaken in accordance with the District Plan, bylaws, polices and this RITS. Where relevant documents exist, such as an ICMP, a WIA, a wastewater network master plan, an infrastructure plan or an AMP, the planning and design of the wastewater network must be in accordance with the principles and requirements contained within the document(s).

Council will advise developers of the existence of any relevant documents during initial discussions regarding development. Design must not occur until the requirements have been confirmed. The relevant documents may contain details of strategic infrastructure to be located with the development area. The responsibility for the design and construction of strategic infrastructure must be agreed with Council prior to commencing design.

5.2. DESIGN

5.2.1 Design life

Wastewater systems must be designed and constructed for an asset life of at least 100 years. Specific components such as pumps, valves and control equipment may require earlier renovation or replacement but must meet the life expectancies as set out in Council's AMP.

5.2.2 Acceptable products

Refer to Section 8 Acceptable products on page 365.

Materials and grades for gravity pipelines greater than DN375 must be determined by specific design and in consultation with Council. Rising mains must be specifically designed based on the characteristics of the pumped system being serviced.

Where a trade waste discharge is known, material selection must be specific to the nature of the discharge.

5.2.3 Catchment design

The system must be designed to serve the whole of the natural (gravity) catchment area. The design flow must be calculated from all the upstream catchment falling within the Council's zoning boundary. The calculation must assume complete urbanisation (excluding reserves). Refer to *Table 90: Peaking factors* on page 277.

Council strategic planning may require an adjacent catchment to be serviced via another. Where this is required it will be stipulated in an ICMP or master plan where one exists, or it will otherwise be identified by Council.

Pipes must be designed to service the entire catchment area and any future extension of the system. This may affect the pipe location, diameter, depth, and classifications such as trunk mains. Designers must adopt best practice to ensure a system with lowest whole of life cost is achieved.

5.2.3.1 Extent of infrastructure

Where pipes are to be extended in the future, the ends of pipes must extend past the boundary of the development by a distance equivalent to the depth to invert and be capped off. This ensures that future extension of the pipe does not require unnecessary excavation within lots or streetscapes which are already developed. Easements may be required over the pipe in the adjacent property.

5.2.4 Design criteria

5.2.4.1 General

Wastewater flows are a function of water consumption, infiltration, and direct ingress of stormwater. All wastewater pipelines must be designed such that they have sufficient capacity to cater for the design wet weather flow from the area they serve without surcharge and that on at least one occasion every day a minimum velocity for solids re-suspension (self-cleaning) is achieved.

5.2.4.2 Calculation of flows

The wastewater flows must be calculated from the following design parameters:

a) Water consumption is 200 litres per person per day.

b) Infiltration allowance is 2,250 litres per hectare per day.

c) Surface water ingress is 16,500 litres per hectare per day.

d) Peaking factors as per *Table 90: Peaking factors* on page 277.

e) Population equivalent as per *Table 91: Population equivalent* on page 279.

f) Gross contributing land area upstream (see *Clause 5.2.3 Catchment design* above) of the wastewater pipe is defined as the total catchment area, excluding reserve land but including land within legal road boundaries.

Contact Council for advice regarding the extent (both present and future) of any upstream catchment boundaries if an IMCP does not exist.

5.2.4.3 Average daily flow (ADF)

The ADF is calculated as the sum of the infiltration allowance and the daily wastewater flow.

Equation 5: Average daily flow (ADF)

$$
\begin{aligned}
&ADF\ (m^3/day) \\
&= \big((\text{inf}\,i\,ltration\ allowance\ x\ catchment\ area) \\
&+ (water\ consumption\ x\ population\ equivalent)\big)/1000\ (L/m^3)
\end{aligned}
$$

5.2.4.4 Peak daily flow

The system must achieve a daily self-cleaning velocity.

Equation 6: Peak daily flow (PDF)

$$
\begin{aligned}
PDF\ (L/sec) = &\big((\text{inf}\,i\,ltration\ allowance\ x\ catchment\ area) \\
&+ (peaking\ factore\ x\ water\ consumption\ x\ population\ eqivalent)\big) \\
&\div 86400(sec/day)
\end{aligned}
$$

5.2.4.5 Peak wet weather flow (PWWF)

The system must accommodate the design PWWF without surcharge.

Equation 7: Peak wet weather flow (PWWF)

$$
\begin{aligned}
&PWWF\ (L/\sec) \\
&\quad = \big((\text{inf}\,i\,ltration\ allowance\ x\ catchment\ area) \\
&\quad + (surface\ water\ ingress\ x\ catchment\ area) \\
&\quad + (peaking\ factor\ x\ water\ consumption\ x\ popluation\ equivalent)\big) \\
&\quad \div 86400(sec/day)
\end{aligned}
$$

5.2.4.6 Wastewater peaking factors

Table 90: Peaking factors

POPULATION EQUIVALENT FOR CATCHMENT OF SUB-CATCHMENT AREA	WASTEWATER PEAKING FACTORS RESIDENTIAL	COMMERCIAL
10	14	13
15	12	11
20	10	9.5
25	9.1	8.5
30	8.5	8.0
35	8.0	7.5
40	7.5	7.2
45	7.0	6.9
50	6.8	6.3
55	6.7	6.0
60	6.3	5.7
65	6.2	5.5
70	6.0	5.4
75	5.9	5.3
80	5.8	5.1
90	5.5	5.0
100	5.3	4.8
125	5.0	4.2
150	4.8	4.0
175	4.4	3.8
200	4.1	3.7
250	4.0	3.5
300	3.8	3.3
350	3.7	3.1
400	3.5	3.0
450	3.4	2.9
500	3.3	2.8
600	3.2	2.7
700	3.2	2.6
800	3.1	2.55
900	3.0	2.5
1000	3.0	2.4
1500	2.9	2.2
2000	2.8	2.1
2500	2.8	2.0
3000	2.7	1.9
3500	2.6	1.85

5.2.4.7 Population equivalent

The following equivalent population densities per hectare must be adopted in the absence of specific supportable design data.

Table 91: Population equivalent

ZONES	POPULATION EQUIVALENT
General Residential Special Purpose Zones including Special Character & Historic Heritage and any other Precincts	70 persons per hectare, or not less than 2.8 persons per dwelling
Medium Density Residential	120 persons per hectare
High Density Residential	150 persons per hectare
Central City Zone	>300 persons per hectare
Large Lot Residential All business zones Community facilities zone All industrial zones Major facilities zone	45 persons per hectare
Future urban zones	70 persons per hectare

OTHER ESTABLISHMENTS SHOULD BE TREATED AS FOLLOWS:	
Primary schools	45 persons per hectare
Secondary schools	150 persons per hectare
Hospitals	3.5 persons/bed
Motels	0.6 persons/bed

Assessment criteria to determine flows from any development, or re-development, not covered in this section must be determined in conjunction with Council.

5.2.4.8 Commercial and industrial flows

Where the industrial domestic waste and trade waste flows from a particular industry are known, these must be used as the basis of the wastewater design. Where this information is not available, flows must be calculated using the relevant peaking and population densities defined in the table above. Where not known, provision for 'wet' industries must be considered and provided for by the design.

Notwithstanding the above, provision for trade waste must be made by arrangement with Council and must be subject to the provisions of the Trade Waste Bylaw.

5.2.4.9 Hydraulic design

The hydraulic design of pipelines should be based on the Colebrook-White formula. The coefficients to be applied area as per the table below. Minimum grades and maximum velocities are provided in Clause 5.2.4.10 Minimum grades for self-cleaning on page 280 and Clause 5.2.4.12 Maximum and minimum velocity on page 280 respectively.

Table 92: Guide to roughness coefficients for gravity wastewater lines

MATERIAL	COLEBROOK-WHITE COEFFICIENT K[87] (MM)
PVC	0.6
PE	0.6
GRP	0.6
Cement lining	1.5

[87] The k values apply for pipes up to DN300.

PE or epoxy lining	0.6

Note: These values take into account possible effects of rubber ring joints, slime and debris.

For further guidance refer to:

a) WSA 02-2014 Version3.2 table 2.4

b) AS 2200 table 2: Plastic pipes for water supply and sewage disposal (Janson).

c) Metrication: Hydraulic data and formulae (Lamont).

d) Handbook of PVC pipe (Uni-Bell).

5.2.4.10 Minimum grades for self-cleaning

Self-cleaning of grit and debris must be achieved by providing minimum grades, as specified in the tables below.

Table 93: Minimum gradients for self-cleaning

TYPE	PIPE SIZE DN (MM)	MINIMUM GRADE (%)
Reticulation	150	0.55
	225	0.33
Lateral connections	100	1.65
	150	1.2
Permanent upstream ends	100	1.0
	150	1.0

Table 94: Minimum gradients for self-cleaning - small developments

HOUSES	POPULATION	GENERAL	MINIMUM GRADE	PEAT SOIL GRADES
3-4[88]	7-10	1:100	1.0%	Specific design
5-8	12-20	1:120	0.83%	
9-18	22-45	1:150	0.67%	
>18	45 and above	1:180	0.55%	

5.2.4.11 Steep grades

Where the pipeline gradients are greater than 1 in 5, anchor and/or anti-scour blocks must be constructed of a type comparable to that illustrated in Stormwater drawing: Anti-scour blocks for steep drainage pits.

Note: On gradients flatter than above where scour is a problem, sandbags or similar are to be used to stabilize the trench backfill.

5.2.4.12 Maximum and minimum velocity

The preferred maximum velocity for peak wet weather flow is 3.0m/s. Where a steep grade that will cause a velocity greater than 3.0m/s is unavoidable refer to the Water Services Association of Australia: Sewerage Code of Australia: WSA 02-2014 for precautions and design procedures.

[88] See also the guidelines for service connections in Clause 5.2.8 Connections on page 191.

The minimum velocity for self-cleaning at peak daily flow will be deemed to be 0.6m/s for gravity pipelines. Refer to Section 5.2.10.7 Rising Mains for minimum velocities for rising mains.

5.2.4.13 Piped reticulation system minimum requirements

Irrespective of other requirements, the minimum pipe size for a public gravity wastewater pipe must be not less than DN150 and a lateral connection not less than DN100. In no circumstances must the pipe size be reduced on any downstream section.

5.2.4.14 Structure design for installation of buried pipes

AS/NZS Standards provide methods and data for calculating the working loads on buried pipes due to:

- The materials covering the pipes.
- Superimposed loads.

5.2.4.15 PE and PVC pipes

AS/NZS 2566 Part 1 (including the commentary) and Part 2 provides the method to assess the pipe selection and embedment method of buried flexible pipelines. This standard is also applicable to other materials listed in Clause 5.1.3 Reference documents on page 273. Also refer to the definitions of 'embedment' and 'fill' commencing on page 17.

5.2.5 System layout

The preferred layout/location of pipes is as follows:

Table 95: Pipe locations

AREA	LOCATION
Residential	Within the transportation corridor normally 2m out from the kerb except where the properties served are below road level. Manholes should be located wherever possible in the centre of the moving lane (outside the wheel tracks).
Industrial	Within the transportation corridor normally 2m out from the kerb; Alternatively in the front yard area with acceptance by Council.
Business	Within the transportation corridor normally 2m out from the kerb or alternatively in the rear service lane with acceptance by Council. The major reticulation and trunk lines however must be in the transportation corridor (as for residential zones).
Other areas	Within the transportation corridor except where the properties served are below road level.
Private property	If no other option if available, pipelines may be laid within private property. Where a pipeline is within a property, it is required to be parallel to, and no closer than 1.5m from, a boundary. No new private drains must pass between one lot and another. If crossing of private property is unavoidable, those parts of the pipeline serving more than one lot must be Council mains with service connections to the property boundaries or protected by public or private easement. The public easement width must be based on the 45 degrees zone of influence centred on the pipe and be a minimum of 1.5m. The major reticulation and trunk lines however must be in the Transportation Corridor.

Where a wastewater pipeline changes location within a street, crossings of roads, railway lines, and underground services must, as far as practicable, cross at an angle of 45 degrees or greater. Pipes must be located and designed to minimise maintenance and crossing restoration.

5.2.5.1 Topographical considerations

In steep terrain the location of pipes is governed by topography. The pipe layout must conform to natural fall as far as possible to remove the need for gravity pipelines operating against natural fall and thus creating the need for deep pipes.

5.2.5.2 Aerial pipes and pipe bridges

Aerial pipes, inverted syphons, and pipe bridges are not preferred. Before adopting the use of aerial pipework and pipe bridges alternative routes and solutions must be investigated. Benefit cost analysis must be completed for all proposals and whole of life costs including future maintenance must be provided. Benefit cost analysis must be completed for all alternative designs for comparison purposes.

5.2.5.3 Minimum/maximum cover

All pipelines, other than those in private property, must be specifically designed to support the likely loading if minimum cover is provided and be in accordance with AS/NZS 3725. The minimum cover for all types of pipes under all conditions must be 600mm. The depth of cover for private pipelines in private property is dealt with under the Building Act 2004 and requires acceptance by Council's building team.

5.2.5.4 Clearances from underground services

Clearance from underground services must be as per NZS 4404 Section 5.3.7.9.

5.2.5.5 Clearance from structures

Pipes adjacent to existing buildings and structures must be located clear of the 'zone of influence' of the building foundations. Refer Wastewater drawing: Building over and adjacent to public wastewater or stormwater pipelines. If this is not possible, a specific design must be undertaken to cover the following:

a) Protection of the pipeline.

b) Long term maintenance access for the pipeline.

c) Protection of the existing structure or building.

The protection must be specified by the Developer for evaluation and acceptance by Council. Sufficient clearance for laying and access for maintenance is also required. The table below may be used as a guide for minimum clearances for mains laid in public streets. See Wastewater drawing: Building over and adjacent to public wastewater or stormwater pipelines.

Table 96: Minimum clearance from structures

PIPE DIAMETER DN (MM)	CLEARANCE TO WALL OR BUILDING (MM)
<100	600
100 – 150	1,000
200 – 300	1,500
375 +	1,500 + 2 x diameter

Note: These clearances should be increased by 500mm for mains in private property as access is often more difficult and damage risk is greater.

5.2.6 Venting and odour control

Situations where venting may be required include:

a) At pumping stations.

b) At manholes where pumping stations discharge to a gravity pipe. Refer Wastewater drawing: Standard pumping station for Flygt 3085, 3102 and 3127 pumps.

A specific engineering design must be submitted to Council for acceptance where pressure wastewater lines are likely to discharge odours because of changes in hydraulic conditions and/or for aged sewage.

5.2.7 Manholes

Manholes are to be located:

a) On Council property or transportation corridors whenever possible and if within the carriageway, they must be 2m out from the kerb but clear of wheel tracks (to minimise noise and vehicle user discomfort).

b) Out of hollows, dips or any area that may be subjected to inundation or identified as a secondary flow path.

c) Clear of all boundary lines by at least 1.5m from the outer edge of the manhole chamber plus the height of any nearby retaining walls if applicable.

d) 2m clear of vehicle crossings and new structures in private property as shown in Wastewater drawing: Building over and adjacent to public wastewater or stormwater pipelines.

Manholes are required at the following locations.

e) Intersection of pipes except for junctions between mains and lateral connections.

f) Changes of pipe size.

g) Changes of pipe direction, except where horizontal curves are permitted.

h) Changes of pipe grade, except where vertical curves are permitted.

i) Combined changes of pipe direction and grade, except where compound curves are permitted.

j) Changes of pipe invert level.

k) Changes of pipe material, except for repair/maintenance locations.

l) Permanent ends of the public pipe where a maintenance shaft (MS) is not possible.

m) Discharge of a pressure main (public or private pump) into a gravity pipe.

For infill developments, manholes are not required for a 150mm connection on a 150mm pipeline where a manhole is provided immediately inside the property being served and another manhole exists within 100m on the existing pipe as these provide adequate accessibility without needing another manhole.

5.2.7.2 Distance between manholes

For reticulation pipes, the maximum distance between any two manholes must be 400m, but rodding eyes or maintenance chambers are required every 120m.

5.2.7.3 Size of manholes

Manholes must be a minimum of 1050mm Internal diameter for depths of 1.0m or more. If the manhole has internal drops, it must be a minimum of 1350 mm internal diameter to provide more space to help with safe entry. Manholes of 750mm diameter are permitted to be used for depths less than 1.0m at the upstream end of public wastewater systems.

5.2.7.4 Manhole materials and parameters

All concrete manholes must be pre-cast concrete with a fixed external flange base. Manholes up to 2400mm deep (excluding the top and manhole lid) must be constructed using a single riser with a pre-cast external flange base. Manholes more than 2400mm deep must be constructed using a 2400mm deep pre-cast riser with external flange base and then completed to final ground level using no more than a single riser for manholes up to 5.0m deep. Three risers are allowable for manholes in excess of 5.0m depth. In no case must a series of short risers be permitted.

The joints of all abutting units must be sealed against ingress of water by the use of BM100 (Hume's Sealing Strip or Hynd's Grey Butyl manhole sealant or an accepted equivalent. The cover frame must be set over the opening and adjusted to the correct height and slope using adjustment rings and mortar so as to conform to the surrounding surface (refer to Wastewater drawing: DN1050 - DN1350 manholes, Wastewater drawing: Typical dimensions for manholes greater than DN1350 and Wastewater drawing: Shallow manhole/chamber). The cover frame must be held in place with a bold fillet of concrete.

PE manholes are acceptable but only those in. Acceptable Products List 2022

5.2.7.5 Manholes requiring specific design

Where manholes are more than 5.0m deep they must be specifically designed in accordance with the manufacture's requirements for external pressures and resist floatation. Where a manhole is to be constructed in soft ground, the area under the manhole must be undercut to provide an adequate foundation and backfilled with suitable hard fill for the manhole base. Where undercutting exceeds 1.5m, a special design will be required.

5.2.7.6 Flotation

In areas of high-water table, all manholes must be designed to provide a factor of safety against flotation of 1.25.

5.2.7.7 Allowable horizontal deflection through manholes

A maximum allowable deflection through a 1050mm diameter manhole for pipe sizes 150 to 225DN is up to 90 degrees. The maximum allowable deflection for pipe sizes greater than DN225 is 110 degrees.

5.2.7.8 Connections (services and other gravity mains) to manholes

The invert of a connection must connect to the channel in the manhole at a level no lower than the average of the soffit levels of the main inlet and outlet pipes. Maximum angle of deflection of lateral connection into the manhole main channel must be 90 degrees. Drop connections of mains and laterals at manholes must be designed in a manner similar to the illustrations in Wastewater drawing: DN1050 - DN1350 manholes, and Wastewater drawing: Shallow manhole/chamber). A maximum of two internal drops will only be accepted where the existing manhole diameter is 1200mm or greater.

5.2.7.9 Internal fall through manholes

In addition to the normal pipeline gradient, all manholes must have a minimum drop of 20mm plus 5mm per 10 degrees of the angle of change of flow within the manhole. The construction tolerance for drop through the manhole must be:

Equation 8: Wastewater construction tolerance for manhole drop

$$Constructed\ Manhole\ Drop\ =\ Manhole\ Drop\ (as\ calculated\ above)\ +/-\ 5\ mm$$

Grading the channel must be limited to falls through manholes of up to 150mm. To avoid excessively steep channels within manholes, steep grades must be 'graded-out' at the design phase where practicable.

Channel half pipe liners must be used and match the diameter of the downstream pipe with a tolerance of + 5mm, - 0mm.

5.2.7.10 Manhole covers

Watertight manhole covers with a minimum clear opening of 600mm in diameter, complying with AS 3996 or EN124, must be used. Refer to Acceptable Products List 2022

Only Class E or D400 covers can be used in the transportation corridor, carriageway, commercial and industrial properties and all public areas.

Class B or greater covers may only be used within residential properties.

5.2.7.11 Manhole steps

All manholes must be provided with steps in order to provide access. These must be of the 'dropper' or 'safety' type to prevent feet sliding sideways off them. Manhole steps must be provided at 300mm centres vertically (refer Wastewater drawing: DN1050 - DN1350 manholes and Wastewater drawing: Typical dimensions for manholes greater than DN1350.

Only steps in *Section 8 Acceptable products* on page 365 can be used. They must not bolt through the manhole wall.

The top step must not be more than 450mm below the top of the top slab, and the lowest step must be not more than 375mm above the bench, or such lower level if detailed on other than standard manholes. The manhole steps must be located over the downstream pipe.

5.2.8 Connections

5.2.8.1 General

Before dwellings are connected to the public wastewater system, the Council connection process and the following forms must be completed by the applicant and accepted by Council:

a) Wastewater form: Design confirmation.

b) Wastewater form: Pipe laying checklist

c) Wastewater form: Manhole checklist

d) Wastewater form: Trench backfill compaction test

e) Wastewater form: Final inspection

This applies to:

f) All new connections and disconnections from private property.

g) All new connections of new wastewater mains to be 'teed' into the existing public wastewater system.

h) All connections where trade waste will be discharged, require compliance with the Trade Waste Bylaw.

The lateral connection should be designed to suit the existing situation and any future development. The lateral will be positioned so that the private section of the connection with each lot can be constructed in accordance with the *Building Act*. This is generally at the lowest location in the lot.

Refer to Wastewater drawing: Connections layout.

Where Council's Wastewater Bylaw differs from this specification, the Bylaw must take precedence over the point of discharge as shown in the drawing.

5.2.8.2 Requirement of design

The following design requirements must be met.

a) Irrespective of other requirements, the minimum sizes of lateral connection and reticulation pipes must be not less than those shown in *Table 97: Minimum pipe sizes for lateral connections* below.

b) Each connection must be capable of serving the building platform by gravity. This requirement must allow adequately graded drains within the lot, together with the depth required for gully traps. Private wastewater pumps will not be accepted where gravity discharge is feasible.

c) The standard depth of a new connection at the boundary is 1.2m (range 0.9 - 1.5m). Refer to. Wastewater drawing: Lateral connection.

d) Where practicable and where the connection to be installed is to be within 5.0m of a manhole the connection must be to the manhole.

e) All connections, which are to be made directly to the line, must be designed using a factory manufactured 'wye' or 'London Junction' and must be watertight.

f) Service connections must generally enter each lot from the road frontage. Where a property has no road frontage, pipes must be located within that property's legal access (private way or access strip).

g) Private pipes must not cross property boundaries but where this is not feasible, the developer must provide an appropriate drainage easement.

Table 97: Minimum pipe sizes for lateral connections

PIPE	MINIMUM SIZE DN (MM)
Connection servicing up to four dwelling units	100
Connection servicing more than four dwelling units	150
Connection servicing commercial and industrial lots	150

Sections which slope away from the drainage direction may require a service connection which is deeper than 1.5m at the boundary in order to comply with the requirement to drain the whole of the lot. In such cases the service pipe must be extended into the property on grade and to the extent that it's end cap is no deeper than 1.5m.

5.2.8.3 Services in private ways (access ways, access lots or right of ways)

The following should be considered when preparing design.

a) Where a private way is to be provided, wastewater services for all newly created lots should drain to the private way where possible.

b) Where the existing lot does not have direct access to the public wastewater after subdivision, the connection which runs through the newly created lot must be designed and constructed as per this specification and vested in Council to allow for normal operations, maintenance, renewals and prevent building over. See Wastewater drawing: Connections layout.

5.2.8.4 Multi-unit properties

For multiple occupancies (unit title, cross lease or company lease), service of the whole development must be achieved by providing a single point of connection to the wastewater 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. Private drainage is to be accepted and constructed as per the *Building Act* and *Building Code*.

5.2.8.5 Ramped risers

Unless required otherwise by Council, a ramped riser must be constructed to bring the connection to within 0.9m - 1.5m of ground level, or to such depth that will permit a gravity connection to service the whole lot. Ramped risers must be constructed as shown in Wastewater drawing: Lateral connection.

5.2.8.6 Connection to trunk and interceptor pipelines

Connections to wastewater trunk pipelines must be at manholes, or alternatively, and only with specific acceptance by Council, utilising factory fabricated 'wye' junctions in pipelines of PVC or vitrified clay materials and only products as per https://www.colabsolutions.govt.nz/wp-content/uploads/2023/06/Acceptable-products-list-2022-update.pdf *Section 8Acceptable products*on page 365. A reticulated pipe connection to a wastewater interceptor must only be specifically designed and accepted by Council.

Note: No individual lot connections are permitted into an interceptor.

5.2.8.7 Connections to deep pipelines

Where an existing or proposed wastewater pipe is more than 5.0m deep (to the top of the pipe), or where required by the ground conditions, a manhole will need to be constructed on the shallow line. This should be 5m from the deep line and ramped down to it.

5.2.9 Building over or adjacent to pipelines

5.2.9.1 General

Building close to or over pipelines is generally discouraged as this practice severely limits Council's ability to either maintain/replace or duplicate the pipeline if required in the future. Council does not permit building over or within the specified distances of the following infrastructure (refer to Wastewater drawing: Building over and adjacent to pipelines):

Table 98: Infrastructure building exclusion distances

INFRASTRUCTURE TYPE	SPECIFIED EXCLUSION DISTANCE
Wastewater rising mains and interceptors	5 metres
Pump stations and associated infrastructure	5 metres
Connections	2 metres

INFRASTRUCTURE TYPE	SPECIFIED EXCLUSION DISTANCE
Manholes	2 metres (for 1050mm diameter, with specific design for larger ones)

The pipe must be located on site so this assessment can be made. Alternative options such as relocating the proposed building or decommissioning of/or diverting the pipeline along property boundaries, must be thoroughly investigated by the developer before building over a pipeline will be permitted.

In order of preference pipes must either be:

a) Removed (where practical) and connections relocated, dependent on usage capacity for the pipe, at the cost of the development.

b) Relocated to avoid the construction, and at the cost of the development.

c) Replaced on present alignment, extending from boundary to boundary (or manhole as appropriate) at the cost of the development.

Note: Refer to Section 451 of the LGA 1974.

The developer/applicant will be responsible for all costs associated with:

d) Investigation and design associated with seeking acceptance.

e) Construction, if acceptance is given.

f) Repairing any damage identified to the wastewater main or associated wastewater infrastructure caused by construction over or near it.

g) The creation or relocation of easements.

5.2.9.2 Inspection

Any application to build over or within 5m of an existing public sewer must include the following:

a) A CCTV inspection of the subject sewer, in accordance with Section 2 of the *New Zealand Pipe Inspection Manual*, undertaken by a contractor qualified and with the necessary experience to do so, or by Council, at the applicant's expense.

b) Where the CCTV inspection is undertaken by the developer, prior acceptance from Council must be obtained.

c) The results of the CCTV inspection are to be submitted to Council with the application. The inspection may be used as a dilapidation survey.

Pre-inspections are required to confirm the location of the pipes traversing the entire development site, their condition and ensure connections are not built over. Building or engineering plans submitted to Council must also incorporate the confirmed locations of the main, manholes and connections identified by the CCTV inspection as these factors may dictate the development layout/design.

Post inspections are required when any construction involves piling within the 45-degree influence envelope of the wastewater pipe to ensure no damage has occurred during installation of piles/foundations. No further construction work can be carried out until results are known from the post inspection.

Should the CCTV inspection identify faults, then Council may require the developer to:

d) Reconstruct the sewer main in its existing location using construction materials as specified by Council to accepted plans; or

e) Reline the existing sewer main by a suitably qualified contractor.

All works on gravity sewer mains must be completed for the full extent between manholes.

5.2.9.3 Structural loads – building over

No structural loads must be placed on, or be transferred to the pipeline, or other assets. All structural loads must be absorbed (by means of piles where appropriate) outside of the 45 degree influence envelope and below the invert level of the wastewater pipe for the first row of piles (refer to Wastewater drawing: Building over and adjacent to pipelines).

The first row of piles must be located at least 1.5m clear from the outside edge of the wastewater pipe and 2.0m clear from the outside wall of any public manhole and be founded at least 1.0m below invert level of pipe. Subsequent pile rows must be founded at least 1.0m below the 45-degree envelope of the influence line of the wastewater pipe at invert level.

5.2.9.4 Building adjacent to

Any building, structure (including retaining wall) or other development must be designed and founded so that it will not be adversely affected by public infrastructure and associated trench line, including any future excavation that may be required for the maintenance of the infrastructure. The building, structure or other development must make provision to allow for any future possible settlement of the public trench line and backfill and consequent reduction in lateral support. This is to ensure the public infrastructure will not be adversely affected. CCTV inspection of all wastewater and stormwater pipes is required before and after construction.

5.2.9.5 Pile ramming

No pile ramming is permitted within 5m from the centreline of any public wastewater, or within the 45-degree envelope of the influence line of the wastewater pipe at invert level. Pile ramming must include sheet piling. These piles must be drilled only.

5.2.9.6 Abandoned mains

Pressure or gravity mains which have been abandoned may remain in the ground providing they are capped. Council may require certain abandoned mains to be backfilled with grout depending on size, material type and proximity to other structures which may be put at risk in the event of the main collapsing. If the abandoned mains are required to be removed, then the trench must be backfilled and compacted to at least 98% standard compaction.

5.2.9.7 Excavating over existing pipes

Excavations over or adjacent to an existing wastewater main are not to reduce the cover over the main to less than the minimum limits in accordance with the relevant AS/NZS standard. Where the cover is changed due to, for example new carriageways or fill, the existing pipe must be protected, or the pipe upgraded to take the additional load.

5.2.10 Pump stations

Pump stations will only be accepted if they are incorporated into an accepted IMCP. In an area where there is no accepted ICMP, specific acceptance to install a pump station is required from Council. Where topography does not permit gravity connection to the wastewater system, pump stations must not be proposed for less than 25 lots unless accepted by Council. Individual pump stations with individual connections (i.e. low pressure wastewater systems) are preferred in these circumstances. These are subject to specific design.

Where a combined rising main is the best option then the extent of public /private ownership is to be agreed with Council.

5.2.10.1 Minimum requirements

The pump station design must ensure that the following minimum requirements are met.

a) Area around the pump station must be graded away to prevent surface water flowing onto or over the pump station cover slabs.

b) Free of secondary flow paths for 1% AEP flood level, and the pump station lid levels must be provided with a minimum freeboard of 300mm above the estimated flood level.

c) Pumping systems must:

  i) Have a pumping capacity of N+1 with a minimum of two identical pedestal mounted submersible sewage pumps.

  ii) Each pump must be capable of discharging the design peak wet weather flow rate from the catchment.

  iii) Include sufficient well volume to operate under normal conditions without surcharge into the incoming wastewater network.

d) The station must be located to ensure that the entire design catchment can be serviced.

e) All stations must be contained within a separate local purpose reserve - drainage title set out to provide safe and easy operation and maintenance of the site without impacting on public activities surrounding the site, designated in accordance with the District Plan or vested as part of a subdivision

f) The station must be designed to service the entire catchment area of land beyond the reach of the existing gravity system. Refer to *Clause 5.1.7 Planning documents and assessments* on page 275.

g) In staged construction, guidance from Council is required to ensure the correct sizing of the pump station and associated rising mains and storage facilities meet the short- and long-term requirements of the catchment.

h) A minimum emergency storage capacity of nine hours average dry weather flow, measured between the high-level alarm & the point of overflow.

i) It is recommended that prior to submission of the detailed design, consultation is undertaken with Council to ensure that the design is fit for purpose.

5.2.10.2 Pump station sizing

A pump station design will document the effluent volumes and associated pump requirements for the fully developed catchment and at commencement of operation. The calculation of flow will follow the design specifications in *Clause 5.2.4.2 Calculation of flows* on page 276.

These projections will be described as

a) Average daily flow (ADF).

b) Peak wet weather flow (PWWF).

c) Peak daily flow (PDF).

If the station catchment is to be fed by other pumping stations, then these flows are to be calculated both for the direct gravity catchment as well as direct plus contributing catchment. These projections will be used as the basis for sizing the various components within the design:

Equation 9: Wastewater pump station sizing

$$Wet\ well\ diameter = Peak\ Wet\ Weather\ Flow\ at\ 50\ year\ projection$$

$$\emptyset = 2 \times \sqrt{\frac{\left(\frac{900 \times Q}{N}\right)/d}{\pi}}$$

$$Where:$$
$$Q = Pumping\ Rate\ L/s$$
$$\bullet\ N = 15\ (maximum\ number\ of\ starts\ per\ hour)$$
$$\bullet\ d = minimum\ operational\ depth\ @\ 400mm$$

Ø = Well diameter in mm

The pump selection and physical clearance may necessitate the development of a wider wet well

Storage = Peak Wet Weather Flow at 50-year projection for direct gravity catchment

Pump Size = Peak Wet Weather Flow at 20 years projection with contributing catchment.

Rising Main Diameter – must be selected to achieve flow velocities of 1-3m/s. Rising mains must ideally operate in the efficient range of 1.0 to 1.5m/s but may exceed this for the purposes of staging and future flows.

Where connection to an existing rising main is required, a full analysis of all combinations of pumps must be carried out.

All calculations need to be submitted to Council for acceptance with all assumptions, design variables etc. clearly documented.

5.2.10.3 General layout

The site must be laid out such as to comply with Wastewater drawing: Pumping station site plan layout. The alignment of the pump station must be set out with reference to permanent land transfer pegs or temporary boundary marks, placed by the licensed cadastral surveyor responsible for the final land transfer pegging. The site design will include a paved all weather access road, no narrower than 3.5m with the centre line of the parking space being no greater than 4.0m in plan from the pump chamber and no greater than a 0.5m difference in elevation between the parking area and lid elevation. Where the accessway has to be of a length greater than 30m, a turning point for a light truck is to be provided at the well. The gradient of the access way must not exceed 1 in 6 and all turning radii comply with light truck tracking curves.

The control cabinet must be located with the switch gear facing the wet well and placed no closer than 2.5m to any well or valve chamber lids and no greater than 5.0m. This is to provide safe working room between an open lid and the cabinet. The above ground structures, including but not limited to control cabinet, odour control and RPZ, must be positioned such that any 'out of control' vehicles leaving surrounding public roadways are unlikely to damage these structures. Protection such as guardrail or posts and rails may be required. An area of 5.0m x 5.0m must be available to accommodate an odour biofilter, either at the time of construction or in the future.

5.2.10.4 Collection manhole

Immediately upstream of the pump station and within the local purpose reserve a single manhole is to be provided with the purpose of the collection of all wastewaters flows from the catchment. The collection manhole must be sited to allow ease of access for cleaning purposes. The collection manhole is to be constructed with a sump to trap gravel, rocks and other solid objects and prevent them entering the pump station wet well. The manhole must be a minimum of 1200mm diameter and have a minimum sump depth of 500mm as measured from the invert of the outlet pipe. The minimum volume of the collection manhole must be five times the litre per second rate for peak wet weather flow.

5.2.10.5 Pump station inlet pipe

Only one gravity pipe may discharge into the wet well and must include an isolation valve. Where multiple inflows occur, they must discharge to the collection manhole, then into the wet well. The inlet must be positioned so that it does not cause pump cavitation. A baffle may be required to avoid this.

5.2.10.6 Wet well

a) Diameter

The minimum diameter of the pump chamber will meet both the minimum separation distances of the pump supplier and provide sufficient operational capacity to meet the maximum number of starts per hour (refer Section 5.2.10.10) but be no less than 1.8m.

b) Depth

Sufficient depth must be provided in the pump chamber such that

i) The invert level of the gravity inlet pipe and emergency storage well must be a minimum of 100mm above the standby pump start level to prevent surcharge of the system during normal operation.

ii) That the minimum distance between duty pump start and stops levels is 400mm.

iii) The design stop level is 50mm above the pump manufacturer's minimum continuous operating levels.

c) Structural stability

The pump station wet well must be designed to have negative or zero buoyancy when the well is empty. Accordingly, the chamber may require mass concrete in the bottom to counter buoyancy forces. The depth and extent of mass concrete must be as specified on the engineering plans.

The ground water level must be assumed to be at ground level unless an actual level is established by geotechnical investigation and accepted as suitable for this purpose by the Council.

The mass of the wet well structure included in the stability analysis must not include the associated mechanical and electrical components of the pump station nor can the soil friction forces of backfill around the wet well chamber be taken into account. Any additional weight needed must be added in the form of mass concrete in the bottom of the chamber as indicated in Wastewater drawing: Pumping station cross section. The proposed pump station drawings must provide dimensions of the extent of mass concrete needed to counter buoyancy of the chamber.

d) Valve chamber

The valve chamber must be attached to the pumping chamber. Where the delivery point is within close proximity to the pumping station the valve chamber may be dispensed with and a separate rising main from each pump laid to the delivery point. Where this occurs provision in land allocation must still occur to cater for any future operational changes.

The layout of the pumping chamber, valve chamber and pipe work must be similar to that shown on Wastewater drawing: Standard pumping station Flygt 3085, 3102 and 3127 pumps. Note that some councils use other pumps but the same design must be used.

e) Lids

The lids must be of a standard design as shown in Wastewater drawing: Wet well secondary lids.

For any well or chamber where the depth is greater than 2m secondary lids are required for health and safety purposes.

f) Emergency storage

Pump stations must provide for wastewater storage in the event of pump failure which is usually an electricity outage.

g) Sizing

A minimum 9 hours emergency storage based on Average Daily Flow (ADF) must be provided prior to emergency overflow occurring. The storage volume should be measured between the high level alarm and the point of overflow.

The required storage volume must be provided by:

i) The volume of the wet well, plus
ii) Any additional ancillary storage chambers, plus
iii) The volume of pipelines (500 mm below overflow level) draining to the facility at time of commissioning.

The lowest point in the catchment must be 300mm above the overflow level.

h) Layout

A typical storage layout is provided in Wastewater drawing: Pump station storage plan. Also see Wastewater drawing: Pump station storage section for emergency storage chamber details. Specific site design is required.

Preferably the storage volume must be provided in the pumping wet well structure and upstream pipelines. Where this is impractical, additional storage can be provided by additional manholes or horizontal chamber(s) made up from large pipes diameters. For all sole purpose storage facilities, the benching must be at a minimum gradient of 1 in 3 to allow self-draining. A central channel within the storage well must be at a minimum of 1% gradient. If the storage chamber is designed as a horizontal pipe, the chamber must be provided with an automated wash down facility. The minimum gradient of the horizontal pipe must be 2%. Where storage is developed within the upstream pipework and normally carries wastewater flow these structures must have the benching constructed to cater for the normal operation, with a seamless progression to the benching required for the free drainage post emergency.

i) Structural stability

The buoyancy of the storage chambers must be determined as per the methods used for the wet well.

5.2.10.7 Rising main

a) Sizing

The rising main will be a minimum size of DN80 and designed such that the minimum velocity, with one pump operating, is at least one metre per second and the maximum velocity, with all pumps operating, is less than or equal to three metres per second. Where a configuration does not allow for at least one start per hour, the agreement to the proposed configuration will need to be obtained from Council.

Design should ensure that one pump run occurs per hour under dry weather flow. The pump run duration should be designed to ideally replace the rising main volume during a single run.

Additional isolating valves will be required on rising mains longer than 100 metres.

Where the length of the rising main is such that the volume of sewage exceeds the storage capacity of the wet chamber then additional isolating valve(s) is required.

b) Connection to downstream wastewater system

Rising mains must discharge into a receiving manhole in accordance with the detail on Wastewater drawing: Standard pumping station for Flygt 3085, 3102 and 3127 pumps.

The point at which the pumping station is connected to the existing public wastewater system will be governed by the capacity of the network downstream from that point. The capacity of the gravity pipeline system to which the station discharges, must be calculated to ensure the system will accommodate the discharge when all pumps are operating in combination with the peak wet weather flow from the adjoining gravity network.

c) Rising main layout

Wherever possible, the rising main must be designed on a positive gradient avoiding high and low points and therefore minimise the need for air release and scour valves. To accommodate all out of balance forces on the main its installation and design must be similar to that of a watermain incorporating suitable anchorage at all changes of direction.

d) Material selection

Refer *Section 8*. Acceptable Products List 2022

e) Isolation

Downstream from the rising main flow meter, no closer than two rising main pipe diameters, to a flow monitoring device, an isolation valve will be installed to allow work to occur on the pump set without need to drain the entire rising main volume or for high service stations to isolate the rising main in case of emergency bypass.

f) Bypass outlet

For stations that have a design service level of greater than 20 L/s PWWF or the depth of the well is greater than 4.0m a rising main bypass outlet as shown in Wastewater drawing: Standard pumping station for Flygt 3085, 3102 and 3127 pumps and must be provided and located after the rising main isolation valve. This outlet is to be utilised in the event of a need to bypass the pump station.

g) Air valve

Air relief valves must be fitted as necessary and/or as required by Council for the purpose of automatic relief of gas build up within the rising main.

h) Valves solely for the purpose of wastewater applications.

Each air relief valve is to be housed within a separate manhole structure no less than 1050mm in diameter and located ideally out of the carriageway.

i) Scour valve

Scour valves must be fitted as necessary and/or as required by Council for the purpose of removing accumulated sediment built up within low lying areas of the rising main that potentially lead to a reduction in flow capacity. Scour valves must discharge to a receiving chamber and each scour point must have vehicle access for tanker truck for the collection of scoured material. Suitable structures for containment of potential spillage are to be provided in the design.

j) Gross solids protection

The inlet to the overflow pipe must be baffled to restrict the entry of solid floatable material.

5.2.10.8 External services

The successful operation of the wastewater pumping station relies on the provision of external services and as such these services must be sized correctly for the operation loads experienced at commissioning of the station and where staged development of the station occurs, as a result of final catchment utilisation, that capacity is installed prior to commission, or a detailed succession plan is provided including any acceptances from service providers for these increases.

These services include, but are not limited to:

a) Wash water.

b) Power.

c) Stormwater.

d) Wastewater (receiving catchments).

e) Telemetry wireless pathways.

f) Wash water

All pump stations must be provided with a water supply of DN50 PE80 as used for water supply ridermains. Wastewater pump stations are a ‘High Hazard’ risk requiring reduced pressure zone type backflow prevention devices installed above ground level. The backflow prevention device is to be positioned adjacent to the electrical control cabinet as shown on Wastewater drawing: Pumping station site plan layout. The backflow prevention device must be installed within a separate housing as shown in Wastewater drawing: Pump station backflow prevention.

The size of the water connection may need to be larger for the washdown flow requirements of the emergency storage chambers. A second water supply connection (including 24VDC solenoid valve) must be installed on the RPZ outlet to facilitate supply should a wash-down sprayer be installed (refer to Wastewater drawing: Pump station storage section). The solenoid valve is to open when the pump well low-level float switches the pump off, and remain open for 10 minutes, after an event where the storage is used.

g) Power

Council will only provide the minimum specification for sizing and selecting electrical equipment. It is the responsibility of the designer to determine the suitability and requirement of electrical equipment and connections with the network utility supply operator. The power account will be opened by Council at the request of the developer/contractor and after installation of the cabinet.

h) Stormwater/overland flow

The stations are to be designed with a layout such as to afford free draining of stormwater away from cabinets and well openings.

5.2.10.9 Electrical and telemetry

Councils have different electrical and telemetry specifications and will provide them on request. The alarm and operational data control system is to be installed by the developer/contractor. However, some councils have specialist contractors that they may require to be used, but at the developer/contractor's cost.

a) Control levels

Control/Alarm settings must generally be as follows:

Table 99: Control/alarm settings

Control Type	Level
Low level alarm	Set to activate if the water level drops below cut out level for more than 1 minute.
Pump stop level	50mm above minimum submergence level of pumps
Duty pump start level	150mm below incoming wastewater invert level
Standby pump start level	100mm above duty cut-in level
High level alarm	100mm above standby cut-in level
Critical (overflow) alarm	Set at overflow level
For stations with dedicated storage volumes	
Emergency storage in use	Set to activate at inlet level to emergency storage.
Storage at 50% level	Set to activate when emergency storage capacity is at 50%.
Storage full level	Set to activate when emergency storage capacity is full.

b) Critical (overflow) float switch

One float switch must be installed to provide an alert at the point of loss from the wastewater network typically at or near the pump station. The float switch must be wired to the telemetry to provide a 'critical level alarm' and to override relay to operate the pumps in the event of the level control system failing. The float is to be positioned at or upstream of the point of overflow from the network. Where the point of installation is separate from the wet well, the float is to be connected by a 50mm duct to the cabinet plinth.

5.2.10.10 Pump design

a) Pump selection

The pump system must be an N + 1 system where, one duty pump is required for duty and an identical standby pump is required as a standby backup. The pumps must be operated from a three-phase electrical power supply system. Pumps must be of Flygt small to medium head range submersibles, NP version, or similar as per *Section 8 Acceptable products* on page 365.

The pumping range must be selected to give greater than 1 and not more than 15 starts per hour. The pumps are to be connected by way of a 'duck foot' discharge pedestal to enable the removal and manipulation of the pump from the top of the wet well. In selecting the appropriate pumps, the operating conditions must correspond as closely as possible to the point of maximum pump efficiency. However, final pump selection must be accepted by Council in order to facilitate some standardisation of pump model and impellor sizes to ease ongoing maintenance and minimise spares.

Table 100: Criterion for pump selection

RANK	CRITERIA	
1	Level of service	Peak wet weather flow
2	Operations and maintenance	Energy consumption (kW/m^3)
		Fleet compatibility
3	Cost of investment	Pump
		Rising main diameter
4	Downstream restrictions	Network capacity impact

In calculating the system head losses, the effects of all bends and fittings beyond the pump discharge bend must be allowed for, together with the rising main friction losses. The system static head must be based on the difference in level between the centreline of the inlet face for the pump discharge bend and the highest point on the rising main system. The rising main system curve is to be modelled using Colebrook White formula. Calculations of friction loss should be carried out based on roughness 'k' values of 1.5m and 0.5mm to ensure that the selected pump is capable of operating over this range of duty points.

b) Risers and valve sizing

The pumpset riser is defined as all pipework between the discharge bend to the inlet of the rising main isolation valve. Internal pipework for each pumpset will be at a minimum of that determined by the pump discharge bend. Where there is a difference in the size between the discharge bend and subsequent steel work the reducer is to be immediately post discharge bend and/or prior to isolation valve if needed. The valve installed along the pump set riser will be of a similar dimension to the pipework. Isolation valves for each pump set will be of a quarter turn eccentric plug type with ability to lock in either open or close position using a (standard padlock).

c) Non-return valves

The installation of a non-return valve on each pump set is required to ensure the pumps are protected from reverse flow and that flow from a pump is not returned to the well through the standby pump reducing operational capacity. Where the dynamic head for a pump is less than 15m, as measured at the location of the non-return valve, a ball type valve can be used. For those stations that experience levels greater than 15m a resilient seated rubber flap check valve is to be used. Flap check valves are to be installed with an external indicator arm. For those stations where the total head is above 30m a detailed engineering design solution is to be provided showing the limitations on the system for water hammer following the controlled shutdown of pumps (excluding power failure).

d) Flow meter sizing

The flow meter model must be as set out in *Section 8 Acceptable products* on page 365 and sized for the rising main. The pump station design must ensure the flow meter is fully charged at all times. The transmitter must be located in the cabinet with analogue and digital information connected to Council's telemetry system. The meter is to be housed in a 1050mm diameter manhole with 400mm clearance from the invert and must be connected to the cabinet by ducting. The ends of the ducts are to be sealed to prevent ingress of soil, moisture and odour.

5.3. CONSTRUCTION

5.3.1 Pipeline construction

This section covers the installation requirements for all piped wastewater networks. The installation of pipelines must be carried out in accordance with the relevant AS/NZS standard (see *Clause 5.1.3 Reference documents* on page 273.

5.3.1.1 Materials

Refer [Acceptable Products List 2022]

5.3.1.2 Embedment

The designed trench width must be the minimum width to allow pipes to be safely laid and all embedment material properly and sufficiently compacted. Embedment and fill must keep pace with the excavation and laying of pipes so that not more than 15m of pipes must be left exposed in open trench where this could represent a danger to road users. The foundation must be able to support all design loads placed on it for the duration of the lifecycle of the pipeline it supports. Where the bottom of the trench will not provide adequate support for the pipe during construction, the developer (or their agent) must be contacted to provide a suitable means to stabilise trench foundation. Acceptable methods include:

a) Groundwater drainage.

b) Use of geotextile fabric.

c) Cement stabilisation.

d) Or removal of unsuitable material and replacement with compacted selected material.

No embedment material must be placed, or pipes laid before the trench foundation has been inspected and accepted by a suitably qualified drainlayer or engineer. The various zones comprising the embedment depth must be laid in ascending order. Each zone must be laid in accordance with the accepted design. Each zone must contain the specified selected material and compacted to the required density. Where pipelines have protruding projections such as sockets, flanges or couplings, a suitable recess must be provided, in the supporting material, to ensure the pipeline is fully supported along the pipe barrels. Pipes must be laid with product labelling uppermost in the trench.

5.3.1.3 Fill

a) General

The trench or embankment fill material, must be as specified. Where reuse of previously excavated material is proposed its use must be accepted by the designer. Under no circumstance must the density of the fill material be less than that of the material prior to excavation. When compacting in layers the depth of each layer must be as specified by the designer. The depth of fill must comply with the relevant AS/NZS standard for the pipe material (see *Clause 5.1.3 Reference documents* on page 273). Mechanical compaction of the fill material directly above the pipe must not be commenced until the depth of cover above the top of the pipe is adequate to prevent damage. Compaction equipment which can produce horizontal or vertical earth pressure on the pipeline, which can cause damage or excessive distortion of the pipeline, must not be used.

b) Fill outside a transportation corridor and other trafficked areas

Trench or embankment fill must be compacted in layers to the specified finished level. The designer must specify a testing regime to verify the compaction effort meets the density specified.

c) Fill in a transportation corridor and other trafficked areas

Trench or embankment reinstatement must conform to the requirements shown on Transportation drawing: Trench reinstatement. Trench or embankment fill must be compacted in layers to the specified finished level. The designer must specify a testing regime to verify the compaction effort meets the density specified to support the designed traffic loading.

5.3.1.4 Tolerances

Pipes must be accurately laid to the lines, levels and gradients shown on the accepted construction drawings using pipe-laying laser equipment. The permissible deviation of the alignment and gradient of pipelines must be as per AS/NZS 2032. There can't be any steps at the junctions between successive pipes and no point in the pipeline must be lower than any downstream point. Where the variation exceeds the tolerance Council may order the removal and relaying of any affected pipes.

a) Invert levels

The permissible deviation from the designated level of the invert at each manhole or structure must be ± 50mm, provided that the fall between successive manholes or structures must be at least 90% of that specified.

b) Horizontal alignment

The permissible deviation of the horizontal alignment between manholes or structures must be ± 100mm.

5.3.2 Trenchless construction

5.3.2.1 General

Trenchless technology is required 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.

However, trenchless construction must only be used for applications in which the specified tolerance can be achieved. Pipes used for trenchless installation must have suitable mechanically restrained joints, be specifically designed for trenchless application which may include integral restraint, seal systems, or heat fusion welded joints. Any trenchless technology and installation methodology must be chosen to be compatible with achieving the required gravity pipe gradient — refer to manufacturers and designer's recommendations.

5.3.2.2 Installation Methods

Trenchless installation methods for new pipes are:

a) Horizontal directional drilling (HDD) (PVC with restraint joint or fusion welded PE80 or PE100).

b) Uncased auger boring/pilot bore micro-tunnelling/guided boring (PVC with restraint joint or fusion welded PE80 or PE100).

c) Pipe jacking (GRP/reinforced concrete).

5.3.2.3 Pipe detection tracer wire

When a pipe is installed by a directional drilling technique or bored through the ground, the pipe must have a 'Tracer Wire' attached. This wire must take the form of a continuous 2.5mm^2 multi strand (polythene sleeved) cable, strapped to the pipe wall by means of a minimum of two complete wraps of heavy-duty adhesive tape, at a maximum of 3.0m intervals. The tracer wire must be tested for electrical continuity at the completion of the drilling section.

5.3.3 Gravity pipe joints

5.3.3.1 General

Specification of joints must be as follows.

a) All pipes must have flexible joints of an accepted type, such as RRJ.

b) Concrete lined steel pipes must be flexibly jointed (gibault with 'Denso' system or similar accepted product wrapped and sealed with outer wrapping).

c) Joints must be provided adjacent to manholes to the requirements of AS/NZS 2566 except for PVC where proprietary connections may be used.

5.3.3.2 Rubber ring joints

Rubber ring joints must be installed strictly in accordance with the manufacturer's specifications. Care should be taken to ensure that the rubber rings are located evenly around the joint with no twists in them. The pipe must be pushed to the witness mark.

5.3.3.3 Site mortar jointing of pipes into manholes

All mortar used for the 'on-site' jointing of drainage components must be Expocrete 'UA' or an accepted equivalent. The surface priming, mixing of components, application and cure period are to be in accordance with the manufacturer's instructions. Before backfilling the mortar must be pushed firmly into the manhole/pipe cut out until the space is completely filled and the mortar exudes to the outside of the manhole riser.

5.3.3.4 Butt and electrofusion welded jointing

Electrofusion welded jointing must only be carried out by experienced certified PE welders. The certifying organisation must be acceptable to the Council. In addition, welders may be required to carry out satisfactory test welds for each joint type and to stamp the welder's number on each joint. Butt welds must be, at least, 90% of the tensile strength of the parent pipe material, when tested in accordance with ISO 13953. All internal weld beads must be removed in an accepted manner, to be smooth and flush with the pipe inner surface, without compromising the strength of the pipe joint.

5.3.3.5 Jointing by electrofusion welding

Couplers must be of the same rating as the pipe or superior and installed to the manufacturer's specifications.

5.3.4 Manholes

5.3.4.1 Channels and benching

A semi-circular earthenware channel must be formed in the concrete floor of the manhole. The benching must rise vertically from the horizontal diameter of the pipe to the height of the soffit and then be sloped back at a gradient specified in:

a) Wastewater drawing: DN1050 - DN1350 manholes.

b) Wastewater drawing: Typical dimensions for manholes greater than DN1350.

c) Wastewater drawing: Mustow manhole/chamber.

For changes in direction the flow channel must be formed so that it presents an evenly curved flow path through the manhole. The cross section of the flow channel must be uniform. In wastewater pipelines the main channel must be lined with preformed channels, as per accepted products in *Section 8 Acceptable products* on page 365. If concrete, benching must be floated to a dense, smooth hard surface using 3:1 sand cement mortar and a steel float. Side branches must be similarly formed with a smooth bend into the main channel.

For larger manholes and pipelines greater than 600mm in diameter the benching must have step recesses as shown on Wastewater drawing: Typical dimensions for manholes greater than DN1350. A U3 standard of finish as specified in NZS 3114 must be achieved.

5.3.4.2 Flexible joints

All pipelines must have a flexible joint adjacent to the manhole on all incoming and outgoing pipes not more than 600mm away from the manhole wall. The upper part of the pipe inside the manhole must be cut back to the wall, the reinforcement cut out and the ends plastered with a cement mortar to a neat finish. Where the pipe is cut using a power saw the ends of the steel reinforcement must be protected from corrosion by the application of epoxy.

5.3.4.3 Sealing of manholes

Where precast concrete manhole units are used, the joints of abutting units must be sealed against ingress of water with Humes' Sealing Strip, Hynds' Grey Butyl Manhole sealant or similar accepted product and with epoxy mortar on the inside and outside of the joints.

PE manholes are acceptable but only those included in *Section 8 Acceptable products* on page 365.

5.3.4.4 Manhole steps

Manhole steps must be of the type that meets the standard, accepted and included in *Section 8 Acceptable products* on page 365. Steps must not be through the manhole wall.

5.3.4.5 Concrete

All concrete must have a minimum crushing strength of 20.0 MPa at 28 days, unless otherwise specified or detailed by Council.

5.3.5 Connections

All connections must be sealed by watertight removable caps until such time as they are required. All connections and disconnections to or from Council pipes and all works outside the property boundary must be undertaken by Council or an accepted contractor. Connections must be constructed as per Wastewater drawing: Lateral connection.

5.3.6 Backfilling and reinstatement

Backfilling must keep pace with the excavation and laying of pipes so that not more than 15m of pipes must be left exposed in open trench.

5.3.6.1 Outside of transportation corridor

Bulk backfill must be placed in layers and mechanically compacted. The degree of compaction must be such as to produce an in-situ density which must not be less than that of the material prior to excavation, Refer to Transportation drawing: Trench reinstatement. To establish the criteria for compliance, Scala Penetrometer tests must be carried out along the line of the trench prior to excavation.

There must be not less than one test per 50m of trench length. Compaction tests (or substituted Scala Penetrometer tests) must be carried out for the full depth of the trench to within 300mm of the pipeline (subsequently referred to as the 'test area'). There must be at least one test area per 50m of trench length, or, at least one test area per 50m3 of trench backfill, whichever method returns the greater number of test areas.

Compaction test results (or substituted Scala Penetrometer tests) must be submitted to Council for acceptance. Refer to *Section 3 Transportation* on page 91.

The area must be reinstated as near as possible to the original condition. All drains, fences and other structures must be replaced or reconstructed to their pre-construction standard and in their original place.

5.3.6.2 Inside transportation corridor

Pipe trenches must be backfilled using an accepted hard fill placed immediately above the pipe embedment and reinstated as specified by Transportation drawing: Trench reinstatement. The depth of the basecourse and type of finishing seal coat must conform to the standard of the existing road construction. Compaction test results (or substituted Scala Penetrometer tests) must be submitted to Council for acceptance. Refer to *Section 3 Transportation* on page 91.

5.3.7 Pump stations

5.3.7.1 Wet well and valve chamber

The pumping station chamber must be constructed from a manhole base and section risers but without steps, as shown on Wastewater drawing: Pumping station cross section. Care must be exercised to ensure that the pump chamber is vertical and set to the correct levels before the station floor is poured. A precast base may be used, provided flotation of the chamber is prevented. Manhole joints must be sealed and made watertight using 'Expocrete UA' or an acceptable equivalent.

5.3.7.2 Foundations

Once excavated to a firm foundation free of any organic soil, the wet well pump station foundation must be prepared with a layer of compacted GAP40 no less than 250mm thick followed by a capping of site concrete no less than 100mm thick.

5.3.7.3 Painting and lining

Any block work mortar joints must be pointed inside and outside, and all cores filled with grout. The outside of the block work must be painted with two coats of 'Mulseal' or acceptable equivalent in accordance with the manufacturer's specifications. The internal walls of the well and valve chamber are to be painted using Sika Guard 62 or acceptable equivalent in accordance with the manufacturer's specifications and applied by a licensed Contractor.

5.3.7.4 Top slab

The top slab must be cast as shown on Wastewater drawing: Pump station upper section reinforcing. The placement of reinforcement must be carefully controlled to ensure adequate cover. The lids and frames must be carefully set into the concrete upstands so that they fit flush with the finished upstand level. All concrete must be ordinary grade 21 MPa crushing strength.

The lid and frame specified on the drawings must be constructed as shown on Wastewater drawing: Pump station upper section reinforcing. All reinforcing steel bars must be grade 300 deformed bars complying with AS/NZS 4671. All nuts, bolts and washers must be grade 316 stainless steel with an appropriate releasing agent applied prior to setting any nut. Where concrete is to be poured around high-density polyethylene pipe, the pipe must be first wrapped with 1.5mm thick butynol sheeting.

5.3.7.5 Well and chamber lids

The primary covering lids are to be constructed as shown in Wastewater drawing: Pump station lid frame 1 & 2 and Wastewater drawing: Pump station lid frame 4 & 5 as appropriate for the pump size selected at full development.

a) All stainless welds are to be AS/NZS 2980, pickled to prevent corrosion.

b) All metal-to-metal fasteners are to be coated with an appropriate releasing agent before installation.

c) All fasteners are to be 316 stainless steel.

d) All edges are to be made clean of burs or sharp edges.

e) Secondary Safety Lids required where depth is greater than 2.0m.

5.3.7.6 Cable Bracket

The float and motor cables must be secured by a grade 316 stainless steel bracket with ceramic insulators. The bracket must be mounted in such a position as to be easily accessible from the lid opening as shown in Wastewater drawing: Minimum clearance from structures.

5.3.7.7 Pump discharge bends or pedestal

The pump discharge holding down bolts must be grouted in place and accurately positioned so that the 50mm dia. pipe guide rails stand vertically between the guide rail brackets and the discharge connection. Care is to be exercised in grouting in the bolts to ensure that they will not vibrate loose with use.

5.3.7.8 Guide rails

Guide rails are to be fixed to the edge of the well, using stainless fittings with the guide rails installed vertically using the Flygt guide rail bracket. The guide rails are to be 316 schedule 40 stainless steel tube and each guide rail is to be of a single continuous pipe run with no joins, unless pre-accepted by Council.

5.3.7.9 Riser

Each pump installed must be fitted with an individual riser manufactured from 316 schedule 40 stainless steel tube, all welds are to be to AS/NZS2980, pickled to prevent corrosion. All flanges are to be Table E. Where a flange is installed on a horizontal pipework, the two bolts are to be placed so they are level at the top, on vertical sections the two bolts are to be perpendicular to the discharge bend inlet coupling base. The riser for each pump consists of three major components, these being:

a) The pump lift.

b) Valve wall penetration.

c) Non-return valve connector.

5.3.7.10 Pump lift

The pump lift component consists of a vertical section of pipe from the bellows located on the discharge bend to the valve set elevation. The section is to contain a single 90-degree flanged bend. If the design requires that the pump lift component is to be connected to a discharge bend of a smaller diameter, this is to occur by way of a reducer fabricated into the base of the vertical riser and the bellows sized to meet the discharge bend.

Where the pump lift component riser is greater than 3.0m, additional support brackets are to be installed, as shown in Wastewater drawing: Pumping station cross section at 2.0m intervals, measured down from the centre line of the valve wall penetration.

5.3.7.11 Valve wall penetration

A flange is to be installed prior to entering into the valve chamber wall, no closer than 200mm to the wet well wall facing. The penetration through the valve chamber wall must be horizontal and centred vertically over the pipe discharge bend. No partial bends for realignment must be used without specific authorisation from Council.

Where the pipe penetrates the valve wall, a square stainless-steel flange must be welded to the pipe and bolted to the wall with dimensions at least 2.5 times the external pipe diameter and fixed with M16 stainless steel Chemset studs. The penetration hole for the riser to pass through must be approximately 20mm larger than the external diameter of the pipe and extend a sufficient length to the cut off to fully allow the gibault connection to slide fully onto this length of pipe work to release all downstream pipework.

A non-return valve connector is to be fitted with a length no less than 100mm plus 60% the overall length of the gibault. It must be fitted with a Table E flange and welded as per the required specifications and a 15mm BSP threaded socket welded to the centre line of the pipe with a stainless steel plug no closer than 50mm to valve flange.

5.3.7.12 Non return valve and riser isolation valves

The non-return and isolation valves must be installed as per the manufacture's specifications and past the isolation valve.

5.3.7.13 Collection manifold

The individual riser is to be joined together by a collection manifold which continues through the exterior valve wall including puddle flange over each pipe. On leaving the valve chamber, the individual risers are to be joined together using 45-degree connections. On collection of all individual risers the manifold is to proceed with a minimum straight length, free of fittings, of no less than 5 diameters prior to termination in a flange, for connection to the flow meter. The downstream section of the flow meter is to continue in stainless steel without fittings for at least 2 diameters, until either a rising main bypass tee fitted or the isolation valve. All fastening bolts are to have a releasing compound applied prior to installation.

5.3.7.14 Storage

The emergency storage chamber must be constructed from skid ring jointed minimum Class 2 reinforced concrete pipes installed as shown on Wastewater drawing: Pump station storage section and Wastewater drawing: Pump station storage end elevation and details or an acceptable alternative as per *Section 8 Acceptable products* on page 365. The entire storage tank must be painted inside as per the requirements of the wet well. Any washing fixtures are to be constructed using 316 Stainless Steel pipe and fixtures.

5.3.7.15 Miscellaneous

Reference must be made to *Section 3 Transportation* on page 91 for design and construction requirements for kerbing and vehicle crossings and *Section 7 Landscapes* on page 337 for fencing requirements.

5.3.7.16 Odour control

Council does not generally require odour control on new pump stations. However provision of space free of services must be provided as shown in Wastewater drawing: Pump station site layout plan.

5.3.7.17 Reinstatement

Refer *Clause 5.3.6 Backfilling and reinstatement* on page 302.

5.3.7.18 Electrical cabinet plinths

The electrical cabinet plinth is to be constructed as per Wastewater drawing: Control cabinet plinth and SPS flow meter.

5.3.7.19 Direct buried cable

Where specified cables are laid directly in the ground, they must be located not less than 0.6m below ground on a 50mm thick bed of clean sand. The trench must be backfilled with a 75mm thick layer, measured from the top of the cable, of clean sand. Lengths of 'Mag- Slab' cable cover must then be laid end to end to provide cable protection. The trench must then be further backfilled with clean sand or soil, free from rock, stones, or other debris to a level 200mm below the surface. Orange PVC signal tape must then be laid, backfilling completed, and then surfaced as per the accepted construction drawings.

5.3.7.20 Cable ducting

The following cable ducts are required

a) One pump cable duct and one control cable duct of 100mm dia. must be installed from the base of the electrical control cabinet concrete plinth to the pump station chamber.

b) One 100mm duct will be installed in the plinth for the mains cable.

c) A 50mm duct will be installed from the electrical control cabinet concrete plinth to the flow meter.

d) A further 50mm duct will be installed for each of the emergency storage spray wash control solenoid and/or a distal float overflow if fitted.

Each cable duct is to be fitted with a pull cord for future cable repair works and is to be sealed, to restrict corrosive fumes entering the electrical cubicle, by way of expanding foam encased in a plastic liner to allow ease of future removal.

5.3.7.21 Electrical cabinet supply

Councils have different cabinet componentry requirements and will provide details on request. A six week lead in time is required to supply the standard two pump cabinet. The cabinet must be supplied by an electrical contractor acceptable to council and with a Certificate of Compliance. The developer/contractor is responsible for providing the connection to the electrical network, installation of power meter and connection of the external fittings, including but not limited to:

a) Pumps control and protection.

b) Floats.

c) Level sensor.

d) Any wash solenoids or odour controls as required by the site design.

5.3.8 Testing and inspections for pipelines

All wastewater mains and branch pipelines, including extended connections, must be inspected during construction. On completion of all other engineering work within the subdivision, there must be a final test conducted and recorded via a data logger. Council requires a Council observer present during the test. A minimum of 24 hours' notice is required to be given to Council before the test is carried out, so that arrangements for an observer can be made. The developer/contractor must provide all fittings and materials to carry out the test.

5.3.8.1 Inspections

The developer/contractor needs to ensure that inspection and subsequent acceptance is granted before continuing with the installation, as failure to follow this process may mean that the developer/contractor is required to remove items or excavate work to allow inspection of standards of installation. These hold points are:

a) Set out.

b) Excavation and bedding.

c) Backfill.

d) Pre-pour form and reinforcing.

e) Pre-cover installation.

f) Water tightness.

g) Rising main pressure test.

h) Electrical inspection.

5.3.8.2 Non-Pressure Pipeline – Field Leakage Tests

The materials and workmanship used must be carried out by at least one of the following methods:

a) Low pressure air testing.

b) Hydrostatic testing.

Refer to Appendix C2 of NZS 4404 for testing methodology.

5.3.8.3 Manhole Leakage Tests

The materials and workmanship used must pass one of the following tests.

a) A low pressure test as described in *Clause 5.3.8.2 Non-Pressure Pipeline – Field Leakage Tests* above, for manholes up to 3.5m depth only.

b) Or a vacuum test

5.3.8.4 Vacuum Test

The vacuum test creates differential pressure between the inside and outside of the manhole. This test must be completed with the manhole completely backfilled and the lid in place.

a) Procedure

i) Clean manhole thoroughly.

ii) Seal openings using properly sized or inflatable plugs.

iii) Connect seal plate to manhole opening.

iv) Draw vacuum of -254mmHg (or -338.6mbar) and isolate valves.

v) Hold test time according to the manhole sizes as listed in the table below:

Table 101: Manhole leakage test - hold test time

DEPTH (M)	MANHOLE DIAMETER (MM)							
	750	1050	1200	1350	1500	1800	2400	3000
	TIME (S)							
<2	11	17	20	23	26	33	39	45
3	14	21	25	29	33	41	49	57
3.5	17	25	30	35	39	49	59	69

4.3	20	30	35	41	46	57	69	81
5	22	34	40	46	52	67	81	95
5.5	25	38	45	52	59	73	87	101
6	28	42	50	53	65	81	97	113
6.7	31	46	55	64	72	89	107	125
7.3	33	51	59	68	78	97	115	133
8	36	55	64	75	85	105	125	145
8.5	39	59	69	81	91	113	135	157
9	42	63	74	87	98	121	145	169
9.5	46	69	81	94	105	129	153	177
10	49	74	87	98	113	139	165	191

vi) Release the vacuum and remove the test gear and plugs.

b) Acceptance

i) For the duration of the test the vacuum did not drop below -228mmHg (or –304mbar).

ii) There are no visible wet patches or “sweating” at any of the pipe penetrations, seals or riser joints.

5.3.9 CCTV inspections

CCTV inspection must be carried out on 100% of all new systems and must be completed once the road surface is to a finished level and prior to any road surfacing. CCTV inspections and deliverables must be in accordance with 4th Edition The New Zealand Pipe Inspection Manual with the expectation that new pipes will score a ‘1’. Any defects are to be fixed to the satisfaction of Council. Where faults are found and repaired the section of pipe must be re-filmed to ensure that there are no further problems.

5.3.9.1 Particular specification

Slope corrections must be carried out where the pipe alignment is out of tolerance. The pipe must not be in service during the CCTV inspection. The pipe must however be jetted/cleaned to ensure all debris and other material are removed prior to CCTV so that no ‘Service Grading’ defects are present. In addition, the CCTV camera must travel upstream with a small flow of water travelling down the pipe towards the camera. Still images of all severity ‘L’ and ‘M’ defects must be provided.

5.3.9.2 Deliverables

The following deliverables are required.

a) Computer generated log sheets.

b) CCTV inspection record digital video format.

c) Electronic data in suitable format for Council to download to its asset management system.

d) CCTV footage needs to be referenced to ensure manhole names and DDTS ID's link footage to as-builts.

e) Still images in electronic format and hard copy.

f) CCTV summary sheets in electronic format and hard copy.

5.3.9.3 Header information required

The developer must provide the following header information with each inspection record:

a) Name of main contractor.

b) Name of CCTV contractor.

c) Name of operator.

d) Date and time of inspection.

e) Location (e.g. street name).

f) Upstream manhole number notated with Council's manhole asset ID.

g) Downstream manhole number notated with Council's manhole asset ID.

h) Material type and diameter.

i) Pipe function.

5.3.10 Pump Station Commissioning

All pumping stations must undergo a series of inspections and tests during construction including:

Table 102: Pump station test schedule

INSPECTION	TEST
Pre installation	Electrical cabinet inspection and testing
On-site	Civil inspections
	Telemetry
	Pump station tests
	Post cabinet installation
	Station set up
	Final sign off
Post-installation	Commissioning tests
	Rising main test

5.3.10.1 Onsite Inspections

a) Civil inspections/audits

Civil inspections/audits by the developer's representative and Council will occur throughout the civil construction of the pump station. This will cover areas such as the wet well, valve chamber and storage construction, the station inlets, the rising main, discharge manhole, any other associated pipework with the station and the odour bed if this is to be installed.

b) Telemetry

Notification of the upcoming commissioning must be made to Council 14 days in advance, to ensure that SCADA is set up. The SCADA must be pre-commissioned in consultation with Council to ensure that all alarms are being received by Council's telemetry system.

c) Pump station tests

Once installed, the equipment is to be adjusted where necessary and placed into operation as near as possible in the manner, and under the conditions it will operate in practice. Tests are made to ensure all protective devices, and controls are fully operational. Performance tests will also be made to verify the designed performance under operational conditions. The pump station will not be commissioned/deemed operational until all the following documentation (electronic format) has been provided.

i) Plant data sheets.

ii) As-built drawings for civil, mechanical and electrical (SPS and RM).

iii) SCADA programme.

iv) Job safety analysis for all routine maintenance tasks to be performed at the pump station.

v) Operational and maintenance manuals inclusive of pump system curves.

vi) Copy of concrete compressive strength and slump test results.

vii) Copies of rising main pressure tests.

viii) Contingency plan for bypass pumping.

ix) Factory pump test results.

x) Switchboard factory and site acceptance test certificates completed and signed.

Additional requirements:

xi) Council representatives must attend the station commissioning.

xii) The pre-commissioning record sheets must be completed and lodged with Council five working days prior to the planned commissioning date.

xiii) Pumps should not be accepted if the maximum flow delivery rate is substantially above the specified limits. Such excess flows can have adverse hydraulic effects at the wastewater treatment plant or at other downstream elements in the system.

xiv) Prior to the start of the pump station tests, the site is to be inspected for suitability of running of the pumps and is to include, but not be limited to the following.

- Lifting chains are attached and secured to the holding brackets.
- The electrical cable is free of the pump and any excess cabling is coiled and secured at the top of the well and free of the pump path along the guide rail.
- All tests and checks required for provision of certificate of electrical compliance by a registered electrician.
- Receipt of factory test certificate for the pumps and present for sighting at site by Council representatives.
- Ensuring all pumps are clear of all debris and tools.
- Checking signals from all level control equipment to ensure safe operation and to ensure the pumps will not run dry.

Following the clearance of the site for pump operation, each piece of equipment can singly and in their possible combinations be operated to confirm system and component performance. This will involve but not be limited to the following:

Table 103: Pump tests

PUMP TEST	SPECIFIC REQUIREMENTS
Impellor clearance	Ensure the impellor clearance is set correctly for optimal performance and that manual operation of the impellor identifies no resistance to free movement.
Pump rotation	This is to be confirmed by running the pump out of the well using a standard bump test. Check the pump travel up/down the guide rails is free with no adverse sticking.
Testing of duty equipment and performance	• Measurement of duty pump performance is to be made immediately prior to the duty stop level. • Measurement of each pump individually. • Measurement of: – Current draw, CT. – Current draw, as read by analogue display. – Flow. • Pump seating correctly with no flow pass from discharge coupling. • Pumps open NRV valves. • NRV close on completion of pumping and do not allow draining of the rising main to the well.
Testing of duty and standby equipment and performance	• Measurement of duty pump performance is to be made immediately prior to the combined stop level. • Measurement of: – Current draw, CT. – Current draw, as read by analogue display. – Flow.
Critical alarm float activation of pumps without the aid of the PLC controls and shutoff at low level float return	Both pumps start when the critical alarm float is tipped.
Vibration checks	No adverse vibration is detected on the pump system, pipe work or movement is detected on the pipe work at cessation of the pump operation.

Where any of the above fail to satisfy the requirements of the specification or Council, the Developer/Contractor must correct the defect and retest.

On the successful completion of the pump test the station is to be left in automatic float level operational mode.

d) Post cabinet installation

The commissioning of the electrical components will be on the mains supply to the cabinet and the external downstream electrical connections.

Table 104: Telemetry connection and electrical cabinet commission test schedule

TEST REQUIRED	SPECIFIC REQUIREMENTS
Mains supply	
Generation connection	**Phase rotation** As no standard rotation direction can be specified for the connection to the supply mains, should there be a difference between the mains supply and the generator rotation, differences are to be rectified at the generator supply connection.
Alarm and controls	• Phase fail relay. • Spill inhibit. • Final US calibration. • Digital controls: – Critical level. – Standby start. – Duty start. – Common stop. – Wash solenoid(s) (if installed). • Analogue controls: – Analogue high. – Duty start. – Standby start. – Stop. – Storage in use. – Storage @ 50%. – Storage full. – Pump 1 amps. – Pump 2 amps. – Flow.
Pump operation on manual	
Pump operation on automatic	
Pump duty change over	
Mini-CAS	
Overload settings	
Soft-start settings (if fitted)	

At the successful completion of the above electrical tests, the developer's electrical representative is to complete the site's Electrical Certificate of Compliance. Provision of this document to Council will mark the successful completion of electrical and control commissioning.

5.3.10.2 Station set up

On completion of the developer's installation of the electrical cabinet at site, the final radio connection to the Council telemetry network will be carried out by Council or their nominated agent. On completion of the network connection the station will be available for final electrical commissioning which will be carried out by Council's current service supplier in conjunction with Council as well as the developer for the mechanical and electrical installation. Two weeks advance notice must be given of the programmed commissioning date.

5.3.10.3 Final sign off

This is to cover mechanical, electrical and telemetry aspects. On completion and acceptance of performance the Developer can apply for the station to undergo a Commissioning test. Council representatives must be present at the test and a minimum of 5 working days' notice must be given to Council prior to commissioning taking place. Any defect, found or non-conformance to agreed standards, must be rectified prior to acceptance of the pump station by Council.

5.3.10.4 Commissioning

As a follow on from electrical testing, the developer must allow for a full commissioning of the switchboard, associated pumps, soft starters, control, alarms, and measurement instrumentation and telemetry system and commissioning of the filter and extractor fan if installed. Included with this requirement is the commissioning by standby generator of the switchboard and interconnections. Full operational checks and pump running must be carried out on the standby power generator supply.

A fully scheduled pre-commissioning and commissioning program must be derived and submitted to Council. This must include (but not necessarily be limited to) defining all activities to be undertaken after the testing is completed. Such pre-commissioning checks and commissioning must allow co-ordinating with the Council's operational staff and allow for their input.

Commissioning in the regard to the confirming of operational safety and reliability only after all non-livened tests have been completed. Full written records of all operational set points, readings of all dials, instrument digital displays for the whole range of operational equipment, alarm indications etc., must be taken at the time, on site, and presented in a tabulated and written/typed form to Council.

a) Site installation of electrical cabinet.

b) Plinth.

c) External wiring to auxiliary units.

d) 3 phase supply.

e) Pumps.

f) Floats.

g) Ultra-sonic.

h) Wash solenoids.

i) Flow meter.

5.3.10.5 Rising Main Test

Refer to NZS 4404 Appendix C3.

5.3.11 As-built information

Upon completion of construction work, copies of As-built plans and data attributes of the completed works, as described in *Clause 1.9 As-built plans* on page 41, must be provided to Council. Separate plans are required for wastewater, stormwater, and water supply.

Responsibility for providing the plans and associated data must lie with:

a) The developer, in the case of land development (urban and industrial subdivision).

b) The contractor, in the case of works constructed for Council under contract to Council.

5.4. FORMS AND CHECKLISTS REGISTER

These are available on the Co-Lab website using the links below.

CATEGORY	TITLE
Wastewater	Design-confirmation
Wastewater	Pipe-laying-checklist
Wastewater	Manhole checklist Manhole checklist
Wastewater	Trench backfill compaction test Trench backfill compaction test
Wastewater	Final inspection
Wastewater	Pump station

5.5. DRAWING REGISTER

These are available on the Co-Lab website using the links below.

CATEGORY	TITLE
Wastewater	DN1050 - DN1350 manholes
Wastewater	Typical dimensions for manholes greater than DN1350
Wastewater	Shallow manhole/chamber
Wastewater	Lateral connection
Wastewater	Anti-scour blocks for steep drainage pipes
Wastewater	Building over and adjacent to public wastewater or stormwater pipelines
Wastewater	Pump station site plan layout
Wastewater	Pump station cross section
Wastewater	Standard pump station for FLYGT 3085, 3102 and 3127 pumps
Wastewater	Pump station upper section reinforcing
Wastewater	Pump station lid frame

CATEGORY	TITLE
Wastewater	Pump station lid frame detail 1 & 2
Wastewater	Pump station lid frame detail 4 & 5
Wastewater	Pump station lid details
Wastewater	Pump station wet well secondary lids
Wastewater	Pump station storage plan
Wastewater	Pump station storage section
Wastewater	Pump station storage end elevation and details
Wastewater	Pump station control cabinet plinth & SPS flow meter
Wastewater	Pump station backflow prevention
Wastewater	Pump station backflow prevention cage
Wastewater	Connections layout

Water Supply

SECTION 6. WATER SUPPLY

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6.1. INTRODUCTION

This section sets out requirements for the design and construction of water networks for land development and subdivision. It covers the design of water pipes for the purpose of supplying water for drinking, including restricted flow supply, and firefighting purposes up to and including 250mm diameter. All trunk mains and reservoirs will require specific design and are excluded from this specification.

6.1.1 Objectives

To supply the required quality and quantity of water to all customers as required by legislation and to Council's minimum level of service. The design of the water network must ensure an acceptable water supply for each property, including fire flows, and system head losses, by providing a service connection from the watermain to each property. Designers must consider the hydraulic adequacy of the network including the specified levels of service, water quality and impact on the existing network.

The water network must meet the minimum design life requirements of 100 years taking into account structural strength, design loadings, soil conditions and water conditions (internal and external corrosion). The water network must be cost efficient over its design life while accounting for environmental and community impacts through integrated three waters management and water conservation.

6.1.2 Reference documents

Details of documents referenced in this section are as follows:

Table 105: Reference documents

REFERENCE	STANDARD / DOCUMENT
AS 1579:2001	Arc-welded steel pipes and fittings for water and wastewater
AS 1628:1999	Water supply: Metallic gate, globe and non-return valve
AS 1646.1:2007	Elastomeric seals for waterworks purposes
AS 3996:2006	Access covers and grates
AS/NZS 23032:2006	Installation of PCV pipe systems
AS/NZS 2033:2008	Installation of polyethylene pipe systems
AS/NZS 280:2014	Ductile iron pipes and fittings
AS/NZS 2566.1:1998	Buried flexible pipes – structural design
AS/NZS 2638.2:2011	Gate valves for waterworks purposes: Part 2 Resilient seated
AS/NZS 2845.1:2010	Water supply – backflow prevention devices: Materials, design and performance requirements
AS/NZS 3725:2007	Design for installation of buried concrete pipes
AS/NZS 404:2005	Testing of products for use in contact with drinking water
AS/NZS 4058:2007	Design for installation of buried concrete pipes
AS/NZS 4040:2005	Testing of products for use in contact with drinking water
AS/NZS 4058:2007	Precast concrete pipes (pressure and non-pressure)
AS/NZS 4087:2011	Metallic flanges for waterworks purposes
AS/NZS 4129:2008	Fittings for polyethylene (PE) pipes for pressure applications
AS/NZS 4130:2009	Polyethylene (PE) pipes for pressure applications
AS/NZS 4158:2003	Thermal bonded polymeric coatings on valves and fittings for water industry purposes

REFERENCE	STANDARD / DOCUMENT
BS 5154:1991	Specification for copper alloy globe, globe stop and check, check and gate valves
BS 5163:2004	Valves for waterworks purposes. Predominantly key operated cast iron gate valves
NZS 4404:2010	Land development and subdivision infrastructure
NZS 4442:1988	Welded steel pipes and fittings for water, sewage and medium pressure gas
NZS 4541:2003	Automatic fire sprinkler systems
NZS 7643:1979	Code of practice for the installation of un-plasticised PVE pipe systems
SNZ PAS 4509:2008	NZ Fire Service firefighting water supplies code of practice
ISO 13953:2001	Polyethylene pipes and fittings: Determination of the tensile strength and failure mode of test pieces from a butt-fused joint
NZ Utilities Advisory Group (NZUAG)	National code of practice for utility operators' access to transport corridors (2010)
MBIE Building Code	Compliance document G12: Water supplies
Building Act 2004	
Health Act 1956	
Water Services Act 2021	
Water NZ COP 2019	Boundary Backflow Prevention for Drinking Water Supplies Code of Practice

6.1.3 Level of service

6.1.3.1 On demand water supply area

The design of the network must conform to the '*Code of Practice for Fire Fighting Water Supplies (SNZ PAS 4509)*' and must be such that a water supply connection can be provided for each lot. The water supply network must achieve the following standards:

a) The residual pressure and flow at point of supply to residential lots must be a minimum of 200 kPa (20m) and 25 L/min. Check with Council as some specific areas may require a higher level of service.

b) The minimum fire supply service level must be FW2 for general residential areas only, and FW3 for all other areas, including medium and high density residential. The requirements of FW2 and FW3 are described in the '*Code of Practice for Fire Fighting Water Supplies (SNZ PAS 4509).*' Some specific areas may require a higher level of service.

c) To protect the level of service of new subdivisions, no more than 150 residential lots may be serviced, at any point from a single ended DN150 watermain. Connectivity of the water network is to be confirmed prior to any further lots being developed.

For the purpose of pipeline design, the maximum static pressure at ground level for each lot must be considered to be 1,000 kPa. Therefore, the design pressure range for specific pipeline design is 200 kPa to 1,000 kPa (20-100m).

6.1.3.2 Restricted flow water supply area

The design of the network must provide for a water supply to the 'restricted flow areas' and to the conditions as set out in Council's water supply bylaw. The water supply network must achieve the following standards:

a) The flow to the lots within the water supply 'restricted flow areas' must be no less than 1.8m³/per day, however some specific areas may require a higher level of service.

b) The flow is to be a steady rate through the meter.

c) Properties reliant on the water supply in the ‘restricted flow areas must consider the separate provision of fire-fighting capacity as this is not provided by this restriction. *Note: Refer to Council regarding compliance with Fire Service provisions.*

6.1.4 Alteration to existing infrastructure

The connection of new developments may require upgrading or extending the existing water network and must maintain the minimum level of service for the existing infrastructure. Alteration to the existing water network to achieve the required level of service must be at no cost to Council.

6.1.5 Strategic documents and assessments

All designs must be undertaken in accordance with the District Plan, Bylaws, Polices and this RITS. Where the following documents exist, planning and design of a water network extension must be in accordance with the principles and requirements contained within an accepted ICMP, WIA, AMP, and WDP.

Council will advise developers of the existence of the relevant documents during initial discussions regarding development. The design should not occur until the requirements have been confirmed. The documents may contain details of strategic infrastructure to be located within the development area. The responsibility for the design and construction of strategic infrastructure should be agreed with Council prior to commencing design.

6.2. DESIGN

6.2.1 Design life

Water supply infrastructure must be designed and constructed for an asset life of at least 100 years with timely maintenance as defined in the AMP. Some components such as pumps, electrical and electronic components and control equipment may require earlier renovation or replacement.

6.2.2 Acceptable products

Refer to *Section 8 Acceptable products* on page 365.

Materials and pressure rating for pipelines greater than DN250 must be determined by specific design and in consultation with Council.

6.2.3 System design

Watermains must be designed with sufficient capacity to cater for all existing and predicted development within the area to be serviced. Watermains must not be located on private property unless specific acceptance from Council has been provided. The water demand calculations in the subdivision design must provide for:

a) A domestic demand of 260 litre/person/day with a peak flow rate of five times this amount for on demand supply.

b) For restricted flow areas, use 1.2m³/lot/day.

c) Population targets.

d) The area to be serviced.

e) Property size and layout.

f) Proposed land use (zoning).

g) Design pressures including the requirements of SNZ PAS 4509.

h) For population densities, refer to Table 91 , Section 5.2.4.7

6.2.3.2 Pipe details

By convention, PVC pressure pipes in New Zealand are usually referred to by their nominal internal diameter (i.e. DN 50, 100, 150 etc.) whereas the equivalent size ISO dimension PE pipes are usually referred to and specified by their nominal outside diameter (i.e. 63, 125, 180 OD). In any instance where an external diameter is shown on a drawing or specified it will be deemed to be PE. Dimensions in absence of either 'ID' or 'OD' will be assumed by Council to refer to an internal diameter and be PVC.

For general application, Council has standard sizes for all watermains as shown in the table below. Pipe sizes other than those listed below must not be used on the water supply network. All trunk mains will require specific design.

Table 106: Standard pipe details

PIPE TYPE	SIZE AND MATERIAL
Connections	Various sizes, DN20, DN25, PE80, PN12.5
Ridermains	63 OD, PE80, PN12.5
Principal mains	DN150 PVC or 180 OD PE80, all PN12.5.
Trunk mains	DN250, series 2 PVC-O or DN315, PE100 (see note 2 below).

Notes:

1 >DN250 requires specific design in consultation with Council.

2 For acceptable pipe materials and suppliers see Section 8 Acceptable products *on page 365.*

Table 107: Standard pipe configuration

AREA	CONFIGURATION
General Residential (outside of Tier 1)	Principal main on one side of the road and a ridermain on the other.
Tier 1 General Residential, Industrial, commercial, medium and high density residential, arterial or dual carriageway streets	Principal main on both sides of the road.
All other areas	Principal main on both sides of the road.

6.2.3.3 Ridermains

Table 108: Water supply ridermains

PRESSURE	MAXIMUM NUMBER OF DWELLING UNITS	
	One ended supply	Two ended supply
Medium pressure	15	30

PRESSURE	MAXIMUM NUMBER OF DWELLING UNITS	
	One ended supply	Two ended supply
(400-600 kPa)		
Low pressure (<400 kPa)	7	15

Where the number of dwelling units exceeds the maximum number for a ridermain an additional connection/road crossing must be installed, or a principal main must be installed on both sides of the road.

6.2.3.4 Potable water

.

6.2.3.5 General design notes

To support future growth Council may require mains to be upsized. Refer to *Clause 6.1.4 Alteration to existing infrastructure* on page 321. All undersized mains associated with a development must be upsized to minimum requirements at no cost to Council and detailed in a development agreement or resource consent conditions.

The design of the reticulation must be such that a water supply connection can be readily provided to the 'front' of each allotment but avoiding the potential driveway location. Connections must not pass under a roadway. Dead end watermain design should be avoided by the provision of linked or looped mains. Staged developments must terminate with a temporary fire hydrant for mains or a flushing valve for ridermains.

Drinking water supply systems must be designed and equipped to prevent backflow. The location and operation of hydrants, air valves and scours must ensure no external water enters the system through negative pressures from normal operation.

The standard position of watermains in the transportation corridor must be in the roadway berm, parallel to and 2.0m from the (average) property boundary (1.5m behind face of kerb) in accordance with the '*National Code of Practice for Utilities' Access to Transport Corridors (NAUAG)*' and Transportation drawing: Roading terminology. Where watermains cannot be laid in the standard alignment, an alternative alignment showing the relative locations of all services must be designed and proposed with the engineering plans.

Watermain crossings in roads, railway lines and underground services must as far as practicable be at right angles. Mains should be located to facilitate maintenance. At road intersections 90-degree tees or 90-degree bends are required. Refer to Water Supply drawing: Typical urban water supply network layout.

Root boxes will need to be provided for new developments to protect mains from tree root damage. Refer to *Section 0* on page 336.

Minimum cover requirements are shown in the table below. The sections of the main adjacent to a carriageway crossing must be gradually deepened to allow the required cover under the carriageway without the provision of vertical bends. Similar provision must be made to ensure the necessary cover over valve and hydrant spindles.

Table 109: Minimum cover requirements

SITUATION	MINIMUM COVER (MM)
Principal mains and ridermains in berms	750
Principal mains and ridermains under carriageways	900
Service connection pipes	350

SITUATION	MINIMUM COVER (MM)
Trunk mains	900

6.2.3.6 Rural area design notes

Restricted flow water supply schemes do not provide firefighting capacity. Individual rainwater tanks, individual privately owned bores, wells or restricted supply, may adequately serve isolated small subdivisions in rural settings. Where rainwater tanks are provided for the purpose of rainwater harvesting and reuse within the building, the design for domestic demand can be reduced to 225 litres/person/day except in rural trickle supply areas.

6.2.3.7 Fire Fighting Supply

Council's standard design meets the FW2 firefighting requirements at the street boundary for General residential areas and provides for FW3 for other zones. Some specific areas or developments may require a higher level of service. Where additional firefighting coverage is required, private fire suppression and storage must be designed to comply with the requirements SNZ PAS 4509. The minimum requirements are based on SNZ PAS 4509; however, this may need to be increased to ensure security of supply for operational purposes within the premise. It should not be assumed that current pressure and flow will be available in the future when designing private fire services as these are likely to reduce in the future due to demand growth and pressure management.

6.2.3.8 Structural design

The pipeline installation must be specifically designed to resist structural failure (static and dynamic loads). The design must be in accordance with AS/NZS 2566.1 including Supplement 1 and the manufacturer's specification. Details of the final design requirements must be shown on the drawings. Where the watermain is being laid in an area of fill, advice should be sought from a geotechnical engineer and provided to Council.

6.2.3.9 Above-ground watermains

Above-ground watermains should be avoided. If necessary, specific engineering design will be required and accepted by Council. The specific engineering design of above-ground watermains must include but is not limited to the following:

a) The design of pipeline supports for static and dynamic forces.

b) Maintenance and access requirements.

c) Pipe thermal movements.

d) Provide corrosion protection, UV protection and insulation to prevent the freezing of watermains.

6.2.3.10 Non-Council supply

In order to meet the requirements of the Building Act and Health Act in all developments outside of a water supply area, details of the source, capacity and quality of the existing and proposed water supply must be provided to Council in accordance with the LGA and the NES for Sources of Human Drinking Water.

The Developer should check with Taumata Arowai to see if the supply needs to be registered or not.

Where any property is connected to Council's water supply network and uses an alternative supply of water for any purpose, reference must be made to the requirements set out in Council's Water Supply Bylaw and these must be met. Cross connections between any other water supply is prohibited.

6.2.3.11 Water pipes laid in HAIL sites

For water pipes that will be laid in areas identified as being HAIL sites, a specific design must be undertaken.

6.2.4 Clearance from underground structures

Clearance from underground services must be as per NZS 4404 Section 6.3.9.1 and Transportation drawing: Location of services in the transport corridor. Watermains laid parallel to power mains must maintain a minimum horizontal clearance of 400mm at all times, including between meter boxes and power plinths.

6.2.5 Working around structures

Watermains that are located close to structures, such as foundations for walls and buildings, must be clear of the "zone of influence" of the structure's foundations. Refer to the table below for guidance on minimum clearances from structures.

Table 110: Minimum clearance from structures

PIPE DIAMETER DN (MM)	CLEARANCE TO WALL OR BUILDING (MM)
100 – 150	1,500
≥ 200	2,500

These clearances may need to be increased for mains in private property (even with easements) as access could be more difficult and the damage risk is greater.

6.2.6 Shared trenches

Where shared trenching is accepted by Council and all affected utility owners, a detailed design must be submitted for acceptance by those parties and must include:

a) Relative location of services (horizontal and vertical) in the trench.

b) Clearances in millimetres, between services.

c) Pipe support and trench fill material specifications.

d) Trench marking – blue metallic tracker tape.

e) Services' location from property boundaries.

f) Any limitations on future maintenance.

g) Special anchoring requirements, such as for bends and tees.

See Water Supply drawing: Shared trench standard detail for right of way/shared accessway.

6.2.7 Pipeline restraint

Anchorage must be provided at bends, tees, reducers, valves, and dead ends where unbalanced thrust occurs.

6.2.7.1 Anchor blocks

The design of anchor blocks must be based on the maximum test pressure and the allowable bearing capacity of the site soil conditions, except that the maximum value used must be 75 kPa. The inner face of the block must not be of a lesser thickness than the diameter of the fittings and must be constructed so as not to impair access to the bolts on the fittings. Concrete must have a minimum compressive strength of 17.5 MPa at 28 days. Anchor blocks are to consist of sufficient mass concrete to prevent pipe movement, refer NZS 4404 Appendix B drawing WS – 004 and 005.

6.2.7.2 Restrained joint watermains

Commercially available, mechanically restrained, jointing systems may be used to avoid the need for thrust and anchor blocks subject to the specific written acceptance of Council.

6.2.8 Hydrants

Hydrants are installed in reticulation systems for firefighting and/or operational purposes. Operational purposes may include mains flushing, chlorination, and to allow the escape of air during charging and the release of water during the dewatering of the main.

6.2.8.1 Hydrant design

Hydrants are to be located in the road berm and not in the carriageway. However, NZS 4509 requires hydrants not to be located within 6.0m of any existing or proposed building. Where this is not possible, advice should be sort from Council.

Hydrants must not be fitted to any main less than DN 100. Hydrant risers must be used, or the watermain laid deeper, where necessary to ensure the top of the spindle is between 50mm and 200mm below the fire hydrant lid. Hydrants must be spaced at intervals not exceeding the following:

a) Residential areas 135m

b) Commercial and Industrial areas 90m (on each side of the road)

In a cul-de-sac or in temporary road ends the last hydrant must be not more than 65m from the end of the road measured along the road boundary. Where houses or residential units are situated on private ways, there must be a hydrant within 135m of any house or unit measured along the vehicle path (this is where fire hoses would be laid out).

Hydrants should be located clear of vehicle crossings (in the grassed roadway berm). In new developments, where formation of vehicle crossings are deferred until construction of the buildings, hydrants should be located in the centre of the street frontage to avoid the most likely location of the vehicle crossings alongside boundaries.

In addition to hydrant spacing for firefighting, hydrants must be positioned at high points to facilitate flushing air from the mains and at low points to facilitate flushing sediment from the mains. Hydrants must be placed within hydrant boxes designed in accordance with Water Supply drawing: Fire hydrant details. The location of the hydrants must be marked in accordance with the requirements set out in SNZ PAS 4509. Flushing points (hydrant or valve) must be installed at the end of DN 100 and larger (Water Supply drawing: Typical urban water supply network layout) / 63 OD ridermains (Water Supply drawing: Flush out valve assembly).

6.2.9 Valves

Valves must be installed to permit isolation of sections of the pipe network for maintenance and operational purposes. The spacing and location of valves must be such as to limit the number of dwellings affected by a shutdown to no more than 50. Valves must be provided as follows.

a) Each side of arterial roads and railway crossings.

b) Adjacent to street intersections, having regard to the safety requirements for operational access by workers.

c) On at least two legs leading from each tee intersection.

d) A maximum spacing of 250m.

Subject to these considerations, valve numbers must be minimised. Attention should also be given to the location of the valve in particular:

e) Ensure that the valve can be operated safely, i.e. traffic management requirements.

f) Avoid clustering of surface fittings in the footpath at intersections.

g) The design must ensure valve positioning places them outside of the sealed carriageway, behind the kerb and in the grass berm.

Valves must be installed next to other fittings such as tees or bends where possible. Refer Water Supply drawing: Sluice valve details.

6.2.9.2 Valve types

Table 111: Valve description

TYPE	DESCRIPTION
Sluice valves	Sluice valves must be used on principal mains. The valves must be resilient seated, anticlockwise closing with a non-rising spindle to NZS/AS 2638.2 (pressure rated PN16). All valves must be thermal-bonded polymeric coated to AS/NZS 4158.
Gate valves (also known as peet valves)	Gate valves DN 50 or less must be clockwise closing with cast iron T bar handles. Valves to be manufactured to BS 5154 or AS 1628.
Air/vacuum valves and scour valves	Use only with the specific acceptance of Council. Air valves and scour valves must be specifically designed to suit the installed location.
Butterfly valves	Butterfly valves may only be used with the specific acceptance of Council.

6.2.10 Connections

6.2.10.1 General

Before connection to the water network, Council connection process and forms must be completed by the applicant and acceptance provided. This applies to the following situations:

a) All new connections and disconnections for private property.

b) Connections of new watermains to the existing public watermains.

c) All temporary connections.

For all connections where volumes greater than 15m³/day are required, compliance with Council's water take resource consent, or bylaw, is required where specified. The connection should be designed to suit the existing situation and any future development and be supported with an accepted plan as described in *Clause 6.1.4 Alteration to existing infrastructure* on page 321. Council advises all commercial and industrial premises, and others reliant on continuous water supply, to have operational storage to suit their needs (e.g. at least 24 hours).

Refer to Water Supply drawing: Water connections layout.

6.2.10.2 Requirements of design

The point of supply to the consumer is shown on:

a) Water Supply drawing: DN20 metered and unmetered service connections on demand

b) Water Supply drawing: 20mm metered and un-metered multi-service connections

The following design requirements must be met:

c) All residential connections must be DN20 unless the pressure from the reticulation is less than 10m or served by an access way longer than 45m. In these cases a DN25 connection is required.

d) Other customers' connection sizing will be determined by specific design and agreed with Council. However, no connection must be sized at the same size as the Council main it is drawing flow from.

e) No connections will be allowed from bulk mains.

f) Connections from trunk mains greater than 250mm will require specific acceptance from Council.

g) For front properties, service connections must be located at the centre of the road frontage or adjacent to vehicle entrances. For a rear lot serviced by an access strip, the service connection must be located adjacent to the access vehicle entrance.

h) The service connection must have a meter (if required by Council), a manifold incorporating a toby valve and backflow preventer under a meter box located in the road reserve, 300mm from the boundary and the supply connection must be extended a minimum of 300mm inside the boundary

Refer to:

i) Water Supply drawing: 20mm metered and un-metered multi-service connections
ii) Water Supply drawing: 50mm meter connection
iii) Water Supply drawing: 100mm and 150mm meter connections
iv) Water Supply drawing: Water connections layout.

6.2.10.3 Services in accessways, access lots, or right of ways

The following must apply.

a) Where there are between two and four lots on a right of way an appropriately sized manifold box and lid is to be used to house up to two service connections per box. The manifold box must be located in the right of way clear of vehicle traffic movements and adjacent to the vehicle entrance.

b) Where five or more service connections will be required in an access lot or right of way, a single pipe must be used, subject to the following design criteria:

i) A ridermain of 63OD PE80 must be used, unless firefighting requirements control the design.
ii) Service pipes crossing the access lot must be DN25 PE80and must be placed in a DN50 duct.
iii) The service pipe connections to the ridermain must be in the grass berm.
iv) Service connections, metres (where applicable), manifold boxes and gate valves must be constructed to Water Supply drawing: 20mm metered and un-metered multi-service connections
v) and Water Supply drawing: 20mm metered and un-metered service connections

vi) The ridermain must have a 50mm flushing valve at the furthest point from the reticulation. Refer to Water Supply drawing: Flush out valve assembly

vii) Metallic detector tape, laid directly above the ridermain at a maximum depth of 200mm is required where; the alignment of the pipe is not clearly defined as a straight line between valve box lids and, in other circumstances as required by Council.

viii) An "Easement in Gross" over the right of way must be granted in favour of Council for water supply purposes to allow access for maintenance of the ridermain connections and meters.

ix) Ownership of the ridermain must transfer to Council. Council's responsibility for maintenance of the service pipes ceases at the boundary to each individual lot.

6.2.10.4 Multi-unit properties

Council does not own or operate pipelines on private property (except as per *Clause 6.2.10.3 Services in accessways, access lots, or right of ways* on page 328. Unit Title developments must conform to service connection layouts described in *Clause 6.2.10.3* above in order to facilitate for subsequent sub-division should this be required as a future development of the site.

Isolation valves for individual units (required under Clause 5.4.1 of the Building Act Compliance Document G12 Water Supplies) must be located outside of the building platform but within the property.

6.2.10.5 Connections in rural restricted flow areas

Connections in rural restricted flow area are to be constructed as per those in *Clause 6.2.10.3 Services in accessways, access lots, or right of ways* above. All connections in rural restricted supply areas are to be metered.

6.2.10.6 Water metres

a) Residential connections

Manifold boxes, manifolds and metres (where required by Council) are to be installed on all connections as per Water Supply drawing: 20mm metered and un-metered multi-service connections and *Section 8 Acceptable products* on page 365. Heavy-duty manifold boxes for use in trafficked areas must be used. Where four manifold boxes are to be installed side by side, the use of two Jumbo manifold boxes can be used as per Water Supply drawing: 20mm metered and un-metered multi-service connections.

b) Restricted, Commercial and Industrial Connections

Water metres are required to be installed in all flow restricted supply, commercial and industrial connections as per Water Supply drawing: 20mm metered and un-metered multi-service connections. Refer to Water Supply drawing: 50mm meter connection and Water Supply drawing: 100mm and 150mm meter connections where water metres DN50 or larger are required.

6.2.10.7 Fire connections

Some 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 at the time of building consent application, the developer must design the water reticulation system to meet the required demands, where these are known in advance. Where a site owner requires a specific flow and pressure for internal fire systems, it will be the responsibility of the owner to provide any storage, back up facilities or equipment necessary for that level of service from within their own system.

The requirements for internal firefighting, with reference to automatic fire sprinkler systems, must be designed in accordance with *NZS 4541*. Reference should be made to the Building Code and Council's water supply bylaw. The design for any fire connection must take into account on site usage requirements, and any components required (e.g. backflow protection, strainers, meters etc). Council only permits one fire connection to a single lot, and that the connection size must be no greater than the public main it connects to. The system will require backflow prevention to be incorporated into the design.

6.3. CONSTRUCTION

6.3.1 Pipe laying

All watermain pipe laying and associated fitting installation must only be carried out, or supervised on site, by a water service person holding the qualification of '*National Certificate in Water Reticulation*' or its replacement the '*New Zealand Certificate in Pipe Installations*'.

Pipes must be handled, stored and laid in accordance with the accepted pipe manufacturers specifications and relevant standards. Pipes and fittings must be free of defects (internally and externally) and cleaned of dirt on the inside prior to lowering them into the excavation. Pipes must be set true to line and level and care taken to ensure that joints are kept free from dirt. Pipe bedding and backfill must be to the manufacturer's specification. Pipes must be laid with the product labelling uppermost in the trench. At any time when the pipeline is not being worked upon, open pipe ends must be blanked off in a manner which prevents the ingress of animals and dirt.

6.3.2 Setting out of watermains in road reserve

All watermains must be laid in a straight line or the street layout. The deviation from accepted design alignment permitted either in plan or elevation must be:

a) Open Cut ± 50mm on straight and 100mm in curves.

b) Drilling ± 150mm.

6.3.3 Jointing

Electrofusion and butt-welded jointing must only be carried out by experienced and certified PE welders. The certifying organisation must be acceptable to Council. In addition, welders may be required to carry out satisfactory test welds for each joint type and to stamp the welder's number on each joint. Butt welds must be, at least, 90% of the tensile strength of the parent pipe material, when tested in accordance with ISO 13953.

6.3.4 Pipe fittings

Pipe fittings such as tees, hydrant tees, crosses, tapers, hydrant risers, blank caps, plugs, bends of various degrees, and surface boxes (where applicable) must be ductile iron, or other metallic material and manufacture as listed in *Section 8 Acceptable products* on page 365.

Ductile iron fittings must be cast from high quality grey iron coated with a proven corrosion preventative compound after adequate preparation. Flanges must be to Table E of NZS 8. Fittings laid contiguous with other fittings must have flanged joints, or flexible joints where accepted by Council. All bolts and nuts must be hot dip galvanised or 316 stainless. Gaskets for flanged joints must be to BS 5292.

6.3.5 Anchor or thrust blocks

Cast in situ concrete anchor blocks must be provided at all points where an unbalanced thrust occurs on mains exceeding 50mm diameter. The design of anchor blocks must be based on the test pressure and bearing value of the site soil conditions, except that the maximum value used must be 75 kPa. The inner face of the block must not be of a lesser thickness than the diameter of the fittings and must be so constructed as not to impair access to the bolts on the fittings. Concrete must have a minimum compressive strength of 17.5 MPa at 28 days. A protective Denso system or black protective coating membrane to protect abrasive damage to the watermain should be provided between the pipe (irrespective of the pipe material) and the concrete anchor and thrust blocks.

6.3.6 Valves

Where the valve is fitted to the branch of a tee it must be flanged unless this results in the valve being in the carriageway. In these cases, spigot ended valves connected to adjoining pipes with gibaults are the acceptable alternative. Spigot ended valves must be secured to anchor blocks designed to NZS 4404.

6.3.7 Valve and hydrant boxes

6.3.7.1 Berm areas (includes installations in the road berm)

Valve and hydrant boxes located in berm areas must be in accordance with Water Supply drawing: Sluice valve and Water Supply drawing: Fire hydrant. Wood or similar packers are not acceptable. Backfill and reinstatement must be in accordance with *Section 3 Transportation* on page 91.

6.3.7.2 Carriageway Areas

Valve and hydrant boxes located all streets must be in accordance Water Supply drawing: Sluice valve and Water Supply drawing: Fire hydrant and with the following:

a) The base must be well compacted and properly levelled prior to installation of the concrete surrounds.

b) The edge of the excavation must be saw cut to provide a neat and clean edge for reinstatement.

c) The valve or hydrant box is to be installed parallel to the main.

d) The box and surrounds must be installed so that no traffic load on the surface box can be reflected onto the pipe or fittings.

Specific requirements regarding valve boxes include:

e) The direction of the pipe must be indicated by the longer side of the lid.

f) Valve surface boxes in grassed or planted areas must be firmly and securely surrounded with a cast in-situ or accepted precast flush concrete edging.

g) A single section of 200mm diameter of pressure PVC pipe may be used as a riser with a circular surface box. Precast risers are to be used for rectangular boxes.

6.3.7.3 Tolerances

The top surface of the ductile iron valve or fire hydrant box must be neither raised nor depressed from the surrounding ground, concrete or seal, and the following tolerances must be adhered to.

Table 112: Valve and hydrant tolerances

ROAD TYPE	GRASS BERM	PAVEMENT	FOOTPATH
Local, collector and arterial roads	+ 5mm, – 5mm	+ 0mm, -5mm	+5mm, -0mm

The tolerances must be measured from a 1.0m diameter of the surrounding surface across the box and those not meeting this requirement may be rejected.

6.3.7.4 Valve and Hydrant Markers

Marker posts must be installed near all valves in accordance with Water Supply drawing: Typical network layout and Water Supply drawing: Valve indicator and post details. All fire hydrants and valves must be marked according to SNZ PAS 4509:2008 which includes the following requirements.

a) The lid of the fire hydrant box painted yellow with NZTA M/7-Y.

b) A yellow painted triangle on or near the centre line of the road.

c) A yellow painted circle encircling the hydrant if its location can be obscured by parked vehicles.

d) Fire hydrants must be indicated with blue raised reflective pavement markers in addition to the markings indicated above. (Refer to SNZ PAS 4509).

6.3.8 Connections

Refer to the following drawings:

a) Water Supply drawing: 20mm metered and un-metered service connections

b) Water Supply drawing: 20mm metered and un-metered multi-service connections

c) Water Supply drawing: 50mm meter connection

d) Water Supply drawing: 100mm and 150mm meter connections

All connections must be sealed by removable caps until such time as they are required. Electrical tape is not allowed as a cap. All connections and disconnections to or from Council live pipes and all works outside the property boundary must be undertaken by Council, or Council accepted contractors.

The physical connection to the existing water reticulation can only be carried out once the pressure and bacteriological test results have been submitted to and accepted by Council. Connections must be made under pressure wherever possible. Care must be taken during installation of the connection to ensure that no foreign matter enters the pipes or meter. All metres must be checked after installation to ensure that the meter is recording the flow passing through it. The location, lot number, water meter and backflow preventer serial numbers, must be recorded. Confirmation of the installation of a flow restrictor is required when fitted.

6.3.8.2 Tapping Bands, Ferrules and Service Pipes

Service connections to principal mains must be by means of a tapping band and a ferrule. Service connections to ridermains must be by means of a tee joint or Tapping Saddle. Ferrules are to be left fully opened and gate valves fully closed. All service pipes must be laid at right angles to the street in accordance with the following drawings:

a) Water Supply drawing: 20mm metered and un-metered service connections

b) Water Supply drawing: 20mm metered and un-metered multi-service connections

c) Water Supply drawing: 50mm meter connection

Tapping bands and ferrules on the watermain must be fitted when the mains are first laid.

6.3.9 Embedment, backfilling and reinstatement

Pipes and fittings must be surrounded with a suitable bedding material and backfilled using an accepted hard fill placed immediately above the pipe embedment and compacted in layers not exceeding 200mm in loose depth in accordance with the pipe manufacturer's specifications, Transportation drawing: Trench reinstatement and AS/NZS 2566. The depth of basecourse and type of the finishing seal coat must conform to the standard of the existing road construction. Compaction test results (or substituted Scala penetrometer tests) must be submitted to Council as part of the acceptance process.

6.3.9.1 Detector tape

For open trenching, detector tape must be placed approximately 200mm below final ground level. The metallic 'detector' tape is to be coloured blue, stipulating 'Danger – Watermain Below' (or similar).

6.3.9.2 Tracer wire

Directional drilling or micro tunnelling - tracer wire, in the form of a continuous 4mm^2 multi strand (minimum four) polythene sleeved copper cable, must be installed with all non-metallic pipes to allow detection. The wire must be strapped to the pipe wall by means of a minimum of two complete wraps of heavy-duty adhesive tape, at a maximum of 3m intervals. The wire must have some slack to allow for bends in laying and for future installation of tapping saddles.

The tracer wire must run continuously between valves and hydrants. At each valve or hydrant, the wire must be ducted to surface level through a length of polyethylene pipe ending immediately below the lid. The tracer wire must be long enough to extend 600mm minimum above ground level when uncoiled. The excess length must be neatly coiled in the valve or hydrant box. The tracer wire must be tested for continuity between surface boxes using an electronically generated tone and detector probe or alternative accepted method.

6.3.10 Pressure testing

6.3.10.1 General

At least one working days advance notice must be given to council for pressure testing of pipelines. All pipelines must be pressure tested and backfilled after anchor blocks, specials and fittings are completed, but with joints and connections visible. The final tests are to be witnessed by Council prior to the pipe being connected to the 'live' network. No further connections will be permitted after this stage.

6.3.10.2 Steel, ductile iron and PVC pipes

Refer to NZS 4404 Appendix C3 for the requirements or if this is not available, the pipe manufacturer's procedure.

6.3.10.3 PE80 and PE100 pipes

Refer to NZS 4404 Appendix C3 for the requirements or if this is not available, the pipe manufacturer's procedure.

6.3.11 Disinfection and flushing

Refer to the Water NZ Hygiene Practice to Prevent Water Supply Contamination 2019

6.3.11.1 Removing the disinfectant

Sometime after the minimum contact period for disinfection, the sterilising solution is to be flushed from the pipeline. Flushing should continue for at least 10 minutes beyond the initial removal of the sterilising solution. Projects involving pipelines of 250 NB and larger should be flushed until such time as the residual chlorine level matches that of the normal water supply in the area (i.e. upstream of the new pipe).

Individual customer connections must be flushed by opening each connection valve installed on the pipeline. In the case of a pipeline repair where it is not practical to flush water at the connection, an outside hose tap should be used as the flushing point.

6.3.11.2 Bacteriological test

Refer to the Water NZ Hygiene Practice to Prevent Water Supply Contamination 2019

6.3.12 As-built information

Upon completion of construction work, copies of as-built plans and data attributes of the completed works, as described in *Clause 1.9 As-built plans* on page 41, must be provided to Council. Separate plans are required for wastewater, stormwater, and water supply. Responsibility for providing the plans and associated data lies with:

a) The developer, in the case of land development (urban and industrial sub-division).

b) The contractor, in the case of works constructed for Council under contract to Council.

6.3.13 Watermains to be kept charged

After any watermain has been laid, tested and disinfected, it must be kept continually charged with water, and under pressure. If the permanent connection to the existing reticulation is delayed by more than 5 days, a temporary small diameter connection must be made from the existing reticulation. The pressure must be maintained while other underground services are being laid in the vicinity of the new main.

6.3.14 Abandoned watermains

In the event that a watermain is decommissioned, all removable values, hydrants (including marker posts and road markings), fittings and surface boxes must be recovered. The items must be recycled, either by delivery to Council for reuse or by delivery to a scrap metal merchant. Council must be provided with an opportunity to inspect the removed items and direct which recycling option is to be taken.

6.4. FORMS AND CHECKLISTS REGISTER

The following drawings can be found on the Co-Lab website:

CATEGORY	TITLE
Water Supply	Quality assurance design certificate
Water Supply	Pipe laying checklist
Water Supply	Final inspection checklist

6.5. DRAWINGS REGISTER

The following drawings can be found on the Co-Lab website:

CATEGORY	TITLE
Water Supply	Typical network layout
Water Supply	Sluice valve
Water Supply	Fire hydrant
Water Supply	Valve indicator and post details
Water Supply	Ridermain in a cul-de-sac
Water Supply	20mm metered and un-metered service connections
Water Supply	20mm metered and un-metered multi-service connections
Water Supply	50mm meter connection
Water Supply	100mm and 150mm meter connection
Water Supply	Water connection layouts
Water Supply	Flush out value assembly
Water Supply	Location of services in transport corridor
Water Supply	Shared trench standard detail for right of way / shared accessway

Landscapes

SECTION 7. LANDSCAPES

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7.1. INTRODUCTION

The landscape section sets out requirements for the design and construction of landscaping and planting for land development and subdivision. For landscape areas requiring planting and vegetation in wetlands, dry detention basins, swales, filter strips and rain gardens - refer to *Section 3 Transportation* on page 91 and *Section 4 Stormwater* on page 183.

7.1.1 Objectives

Landscape design has application throughout the subdivision and development process. As such, it 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.

The objective of any landscape design must:

a) Maximise long term benefit.

b) Minimise risk to staff and the public.

c) Minimise on-going maintenance works.

d) Protect, maintain and restore existing natural ecosystems, vegetation, and landscape features.

e) Respond to the surrounding landscape character and context including cultural and heritage (including waahi tapu), ecological and geological elements.

f) Contribute to ecological and habitat biodiversity.

g) Provide amenity open space, “buffer areas”, open space connections and access to watercourses.

h) Enhance and strengthen existing character and intended future character.

i) Promote integrated neighbourhoods.

j) Use species that will quickly establish and form a weed suppressing canopy.

k) Provide a coherent design.

l) Protect and enhance existing vegetation.

m) Minimise risk to the public.

7.1.2 Reserves and land protection covenants

Layout plans, location of recreational reserves, streams, parks and public walkways, and land protection covenants should be discussed with Council prior to the lodgement of finalised plans.

7.1.3 Reference documents

Details of standards, specifications and other documents referenced in this Section are as follows:

Table 113: Reference documents

REFERENCE	STANDARD / DOCUMENT
NZS 5828:2015	Playground equipment and surfacing
NZS 8409:2004	Management of agrichemicals

REFERENCE	STANDARD / DOCUMENT
Austroads	Guide to road design – Part 4A unsignalised and signalised intersections, clause 3
	Guide to road design – Part 4B roundabouts, figure 3.1
Ministry of Justice	National guidelines for crime prevention through environmental design principles in New Zealand (2005)
Ministry for Primary Industries (MP)	National plan pest accord (NPPA) list
Waikato Regional Council	Regional pest management strategy
NZ Arboricultural Association	A guideline for tree protection fencing on development sites (2011)
	A guideline for tree protection on development sites (2011)
Fencing Act 1978	An Act relating to the erection and repair of dividing fences
NZS HB 8630:2004	Tracks and outdoor visitor structures

7.2. DESIGN

7.2.1 Design principles and requirements

Landscaping and planting should be designed to respond to the overall environmental context of an area 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, restoration planting, and other amenity garden features.

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 and vice versa. Consideration should also be given to vegetation growth and impact on sight lines. 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.

7.2.2 Crime prevention through Environmental Design (CPTED)

All landscape design, irrespective of location, except ecological areas, must ensure that CPTED principles are applied. The basic principles are:

Table 114: CPTED principles

PRINCIPLE	MEANING
Territoriality	The physical design is used to promote a sense of ownership, respect, responsibility, and community well-being.
Natural surveillance	All areas throughout the site that are publicly accessible can be seen from other parts of the site so that people can see and be seen. Likewise, ensuring there are no visually closed entrapment areas.
Access control	The site has well-defined routes, spaces and entrances that provide for convenient movement without compromising security.
Space management	The site has an appropriate use of space, is well cared for, attractive and has vandal resistant facilities and buildings.

Activity support	The site promotes positive human activity that is appropriate to the location.

7.2.3 Landscape plans

Refer to the District Plan for specific site plan and landscape plan requirements. In conjunction with these requirements, accompanying information to be included for acceptance by Council includes:

a) A statement of design intent and design objectives.

b) A plant schedule, detailing proposed plant species (botanical and common names), the centres/spacing's, and plant grades and quantities.

c) A plan including dimensions of the area to be planted and the locations for the planting

d) A plan showing existing trees and vegetation (refer *Clause 7.3.1 Protecting existing vegetation and trees* on page 348).

e) Technical specifications for landscape implementation if they deviate from this RITS. If specifications are not provided, Council assumes the developer will abide by this RITS and will assess them accordingly.

f) Local purpose reserves will require a complete plan, not just landscaping.

g) A landscape maintenance schedule that will be applied during the defects and liability period.

7.2.4 Access

Connecting existing reserves, accessways and open spaces provides routes and return loops for recreational use. They also encourage sustainable transport choices by allowing for continuous off-road journeys. These can provide more direct routes to destinations than vehicular routes and encourage a healthier access alternative. Connections can also create larger open space areas and add recreational amenity value (walkers and runners prefer a loop to a dead end).

Consideration should be given to how the development will link to the surrounding landscape including existing areas of open space, and to other public areas, such as schools, town centres, community facilities or public transport routes. Neighbourhood Parks should be accessible to all surrounding neighbourhoods and communities. Refer to SNZ HB 8630:2004 for guidance.

7.2.4.1 Pedestrian/cycle access

Generally, paths in reserves and on accessways to reserves are required to be three metres wide to allow for shared use by pedestrians and cyclists and should be straight and direct according to pedestrian desire lines, in order to provide long lines of sight and reduce the potential for entrapment. Refer to Section 3 Transportation clause 3.3.16

Ensure there is a clear space buffer on either side of paths of at least one metre between the height of 500mm to 2.4m to ensure adequate visibility for pedestrians and cyclists. Furniture should be set back at least 1m from paths, whilst still providing for connectivity and access for people with disabilities (such as wheelchair and mobility scooter users), and any plant species should be selected so that future growth will not encroach into the clear space buffer. Groundcovers may be planted within the clear space buffer, at a minimum of 400mm setback from the path edge, as long as the mature height is no more than 500mm and the plant(s) do not encroach over the path edge.

Pedestrian/cycle accessways should have an accessible gradient (maximum 1:12 where practicable) and avoid steps where possible to allow for cycle and mobility vehicle use. Where steps are required then a half-round open concrete channel should be formed adjacent the steps to assist cycle movement.

Consider the location of the path and plantings on reserve accessways to ensure the path receives maximum sunlight hours in winter and that any planting avoids the ability to create damp and cold pathway conditions, which could in turn lead to frosting and ice.

Path and track construction standards must be considered in conjunction with the standards set within *Section 3 Transportation* on page 91 to enable vehicle access for maintenance purposes.

For further information in relation to pedestrian and cycle access, please refer to the District Plan and *Section 3 Transportation* on page 91.

7.2.4.2 Vehicle access

Generally, vehicle access will be installed by the applicant prior to the vesting of the reserve. Vehicle access points are required for vehicles to undertake mowing, rubbish collection, maintenance and for emergency vehicles. Vehicle access points must be wide enough to allow for heavy machinery (minimum 4m). Vehicle crossings must comply with *Section 3 Transportation* on page 91.

Access roadways and off-street parking may be required for reserves such as sports parks, amenity parks, horticultural parks, the starting point of walking tracks and neighbourhood parks receiving high-use or serving a regional function. Consult with Council to see if parking areas and access roadways are required. The design and construction of roadways, parking areas and vehicle crossings must comply with *Section 3 Transportation* on page 91.

7.2.4.3 Vehicle barriers (to prevent vehicular access)

Where required, measures to prevent unauthorised vehicle entry will be installed by the applicant prior to vesting of the reserve. Where possible planting and landscaping should be used. Where vehicle barriers are required to control unauthorised vehicles, this may be in the form of a standard non-mountable kerb, a physical vehicle barrier or bollards.

Vehicle barriers should meet the following objectives:

a) Prevent vehicles from accessing reserve land.

b) Continue to allow pedestrian and cycle access.

c) Be of a design that ensures consistency with other reserve structures and furniture.

d) Does not adversely affect the visual amenity of the area.

e) Does not greatly increase maintenance requirements.

f) Able to withstand or discourage vandalism pressure.

g) Where bollards are required the standard wooden bollard (see Landscapes drawing: Timber bollard post and chain) must be used on road frontages to reserves (other than entrances). They should be spaced 1.5m apart, or 3m apart if using a connecting chain.

h) Bollards should be placed to allow for easy mowing and maintenance and incorporate a mowing strip, as shown on the drawing.

7.2.5 Fencing

All reserves should contain adequate covenants or fencing agreements, to ensure Council is not responsible for any fencing costs on reserve boundaries. Refer to the Fencing Act 1978 or the District Plan and fencing policy (if applicable) for any clarification.

7.2.5.1 Standard types of fences

Fencing will need to comply with CPTED requirements and the District Plan and fencing policy (if applicable). Over height fences will also require a building consent from Council.

Table 115: Fencing types

TYPE	DETAILS
Standard paling fence	A paling fence at least 1.0m high, posts 100 x 75mm and placed not more than 2.75m apart. There should be two rails (three if the fence is higher than 1.0m), with sawn timber palings placed upright and well nailed to both rails, with a gap of no more than 40mm between palings[89]. All rails and palings should be tanalised to H3.1 or H3.2 and the posts to H4.
Close boarded fence	The same sizes and wood treatment as the paling fence but with the boards butted closely.[89]
Seven wire fence	A seven-wire fence, properly strained, the wire to be 12.5 H.T. galvanised or similar. The posts are to be concrete or H4 treated timber placed no more than 4m apart, and the battens or droppers should be of treated timber, metal or plastic, evenly spaced, and at least three between posts. The top wire is to be at least 1000mm from ground level, and no barbed wire is to be used
Mesh fence	As for the seven-wire fence, but without battens and all wires except the top, middle and bottom ones replaced by 75mm galvanised chain link mesh fixed to the wires at every second mesh row.
Livestock fence	Refer to Clause 7.3.12.2 Livestock fencing on page 357.
Pool fence	The fence must be of a style and height such as the steel and tube hurricane 'pool fence' and complies with the Schedule in the Fencing of Swimming Pools Act.

If the fence is to be painted, the colour must be as specified by the District Plan.

7.2.6 Lighting

Refer to the District Plan and Section 3 Transportation on page 91.

7.2.7 Signs

Signs will be installed by Council following vesting of the reserve. If street signs are required refer to *Clause 3.3.11 No-exit roads, cul-de-sacs, service lanes and private ways* on page 110 and NZTA Signs and Markings to Designate Paths for Pedestrians and Cyclists guidance note (April 2019).

[89] Refer to the District Plan for specific information.

7.2.8 Structure and furniture

Provision of any structure or furniture must be designed in accordance with the relevant Council's plans and/or policies and follow CPTED principles. Also refer to SNZ HB 86320:2004. It must also be as specified in Section 8 Acceptable products on page 365.

7.2.8.1 Play equipment

Play equipment may be required to be installed by the developer, or Council may decide to install the equipment following the vesting of the reserve. Council's objective is to provide interesting playgrounds that meet the needs of the local community. Any equipment and surfacing installed must comply with NZS 5828. In addition, all the equipment and surfacing must meet the requirements of required building or resource consents. All play space design must be accepted by Council prior to installation.

7.2.8.2 Landscape structures

Landscaping structures include (but are not limited to) sculptures, walls, fences, screens, bollards, tree cages and grates, entranceways, and posts. The materials should be robust to suit their purpose and ideally reflect the local character. Whole of life costs (durability and maintenance) must be considered and addressed.

Entranceway wall structures must be located fully on private land or recreation reserves. Any other immovable landscape structure (for example boulders) must be located to prevent obstructing access to underground services. Structures must be designed to safely withstand appropriate loadings. Structures not exempt under the Building Act can only be constructed on receipt of a building consent. Code compliance certificates will be required for all structures that require a building consent. All retaining walls, including those not requiring a building consent, should be constructed to resist lateral earth pressures, including those from any surcharge loading that may be present. They should be located wholly within private land, or recreation reserves.

7.2.9 General species design selection, layout and sourcing

7.2.9.1 General species selection

In selecting species for planting, the overall composition, level of maintenance, longevity, and the need to comply with Council's planting policies are to be considered. Council maintains a register of suitable species for local conditions. Native planting should be used where possible but also allow for exotic plants to give year-round interest and seasonal variances.

The following matters must be considered:

a) Suitability of eco-sourced and diverse native plants for re-vegetation 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.

e) Potential to become invasive – refer the Regional Pest Management Plan.

f) Non-suckering habit.

g) Final height, form, longevity, and potential impact upon neighbouring properties, structures, and infrastructure.

h) Maintenance requirements.

i) Safety such as toxicity of leaves, flowers, seeds, and bark in areas likely to be used by young children, along with impairments to pedestrians.

j) Plants considered to be short lived, frost tender or high maintenance should be avoided in areas other than re-vegetation ecological areas.

7.2.9.2 Plant numbers

Refer to *Clause 7.5 Plant number calculator* on page 361 to calculate plant numbers for level sites and slopes.

7.2.10 Streetscape

Landscaping within a road reserve is otherwise known as streetscaping. This applies to all proposed road reserve landscape design or works in any part of the transportation corridor (in respect to both existing and proposed roads, including any subdivision or where required as a condition of subdivision consent). For design purposes refer to Council's streetscape strategy or policy.

For transportation corridors where speeds are greater than 50km/hr, landscape design is to consider potential for errant vehicles to strike objects and landscape which increases the likelihood of crash severity. Frangibility and setbacks of proposed trees and features is to be considered. Other considerations are the safety for staff undertaking maintenance work, the associated costs of traffic management but also the added benefit of trees stopping or slowing down out of control traffic crossing into the opposing lane.

7.2.10.1 Visibility splay requirements

Driver sight distances need to relate to traffic function and vehicle speeds, and as such tree and streetscape planting should not be placed in the visibility splay. The achievement of relevant Austroads criteria is required. In front of low intersection sign boards, planting must be designed to be not more than 300mm high at maturity or these areas are to be paved to ensure compliance with visibility splay requirements.

7.2.10.2 Traffic calming and shared space environments

All traffic calming and shared space initiatives must be accepted by Council.

a) Traffic calming

From a traffic-calming perspective, landscaping helps to reduce vehicular speed by reducing the perceived openness of streets, signals where an area is not intended to be traversed or moved through and indicate where traffic-calming initiatives have been implemented.

When landscape planting is used in this context, vegetation is intended to visually block, reduce, or impair motorist's line of sight, either along the carriageway berms or within the carriageway. The mature height of the vegetation will therefore be according to the traffic engineering specifications instead of normal carriageway landscape specifications.

Other considerations include.

- Ensuring there will be sufficient drainage (and water reticulation) for new landscaped traffic calming devices to be installed in existing carriageways.
- Ensuring that existing infrastructure (such as underground piping, cabling, aqua cells etc) will not be compromised by the plant roots.
- Maintenance requirements (including the establishment of traffic management plans).
- Landscape replacement costs should a traffic calming device be traversed by a motorist.

- Proximity to other services such as lighting columns and utilities.
- Signage, bus stop and pedestrian crossing (formal and informal) visibility.
- CPTED principles, especially passive surveillance.
- Using the appropriate plant species for the traffic engineering, ecological, sense of place and amenity requirements.

b) Shared space environments

Landscaping in shared space environments is intended to reduce speed, through measures such as reducing forward visibility and introducing a horizontal deflection to create a meandering route through the space. This is especially useful in long straight streets; however, pedestrian and motorist visibility should not be reduced to impair safety for either.

7.2.10.3 Minimum design requirements

A service-free corridor for landscaping purposes, of a minimum 1500mm wide must be located within the berm on both sides of the road. See Transportation drawing: Location of services in Transport Corridor

Unless otherwise stated by the District Plan, street trees are to be planted at an equivalent rate of at least one tree per residential property although groups of trees may be accepted where the kerb line and location of services allow for local features. Alternative tree planting areas must be provided where streets are narrow, or such a corridor cannot be provided. Alternative areas are equivalent to 1.0m2 per metre of street length with any one area having a minimum site area of 12.0m2. Areas protecting existing trees may be accepted as contributing to dedicated tree planting areas.

Typically, tree planting locations should conform to those shown on Landscapes drawing: Street tree planting clearances noting that a greater housing density should have more trees.

Design of streets may include kerb extensions for intersections and speed controls which allow non-standard tree planting where utilities are not a problem and visibility requirements are designed to incorporate planting as a means of slowing traffic.

a) Traffic Islands and Berms

Design of planting in traffic islands, splitters and median strips must be in accordance with the following table.

Table 116: Infill areas

PER INFILL AREA	SURFACE APPLICATION
Infill area less than $6m^2$	Hard surface – concrete or decorative hardstand.
Infill area more than $6m^2$	Accepted landscaping.
Internal kerb to kerb width less than 1,500mm	Hard surface – concrete or decorative hardstand.
Internal kerb to kerb width more than 1,500mm	Accepted landscaping.

b) Roundabouts

Design of planting on roundabouts must be in accordance with the following table:

Table 117: Design criteria for roundabouts

TYPE	DESIGN CRITERIA
Visibility splay Austroads criterion 2 areas[90]	Groundcovers and bedding should not exceed 300mm in height although these may vary depending on road grades and levels
Visibility splay Austroads criterion 2 areas[90]	Groundcovers and bedding should not exceed 400mm in height although these may vary depending on road grades and levels
Roundabouts more than 12m diameter	These roundabouts are to have at least 65% of the internal area planted with accepted intersection plant species while ensuring that visibility splays, frangibility requirements and utility services remain uncompromised. Centralised trees can be included, subject to specific acceptance by Council. In alignment with the Road Reserve Planting Strategy tree framework, the centre must be planted with taller accepted shrub and tree species to aid in slowing traffic and act as a visual nodal reference
Roundabouts between 6-12m diameter	These roundabouts may be planted with up to 50% of the internal area in-filled with low groundcovers or shrubs, otherwise they are to have a Council-accepted hardscape application such as paving, concrete, concrete embedded with rocks Centralised trees can be installed subject to acceptance.
Roundabouts less than 6m diameter	These roundabouts are to have a Council-accepted hardscape application such as paving, concrete, concrete embedded with rocks

7.2.10.4 Street tree layout

Unless otherwise stated all street trees are to be centrally located within road berms. All trees are to be planted a minimum of:

a) 3m from any driveway.

b) 8m from any light stand.

c) 10m from any intersection. If the intent is to plant closer, then specific design is required. One of the considerations will be visibility and another will be the speed environment.

d) 5m from any bus stop or school speed sign.

e) 1.5m from underground services (ideally).

f) Or any other location that causes a safety concern.

For street tree clearances, refer Landscapes drawing: Street tree planting clearances

All service locations shown on the planting plans are to be used as an indicative guide only. All services must be located on site and any damage repaired or mitigated.

7.2.10.5 Tree pits

The minimum berm width is 1500mm for trees. For tree pits that are installed within existing carriageways refer to the following drawings:

a) Landscapes drawing: Street tree root barrier

b) Landscapes drawing: Tree pits within carriageway pavements

c) Landscapes drawing: Kerbside tree pit

[90] Refer to References.

Carriageway tree pits require additional design consideration such as frangibility, tree root intrusion into base material, the possibility of the tree drowning in a confined root space – or obtaining insufficient water. Optimum species would be those with a ball root system or those which have a deep rooting habit with minimum surface roots. Species will be site specific according to conditions and soil type.

7.2.11 Problematic plant species

Council may maintain a list of plant species that are not to be planted in parks, reserves or road reserves. Check with Council.

7.3. CONSTRUCTION

Following construction standards and recommended procedures will 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/contractor's responsibility to ensure that the landscaping meets these required standards at the termination of the maintenance period. The developer/contractor is responsible for the routine maintenance and replacement of the planting, including dead wooding, weed control, mulching, replacing dead trees, shrubs, and plants, watering, and rubbish removal for the period from planting to the issue of a section 224 completion certificate under the Resource Management Act or contract maintenance period.

7.3.1 Protecting existing vegetation and trees

7.3.1.1 Root protection zone

The minimum area required to ensure that a tree's health and stability is safeguarded, can be calculated using the following formula for :
Street trees use 12x DBH as the root protection zone radius in metres, and open grown park trees use 15 x DBH with a maximum radius of 15 metres.
DBH is Diameter at Breast Height, and this is considered to be 1.4m.

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7.3.1.2 Below ground works

If installation is required under existing trees and vegetation, then trenchless technology should be considered. If this is not practicable, advice from a qualified arborist is required to minimise damage to the vegetation. No works are to commence within 30m of historic/protected or notable trees without written acceptance from Council's parks staff. Council may require that a qualified arborist provide a work plan on the installation works to avoid adverse impacts on the tree, and then monitor the works.

7.3.1.3 Assessment prior to works

Prior to undertaking any work within the dripline of retained vegetation an on-site assessment of the work proposed must be undertaken by the arborist and those areas where supervision by the arborist is necessary.

Where heavy machinery would be operated, driven or sited within the dripline of any retained tree, temporary protective fences must be erected between the tree and the work area so as to protect the tree and roots from damage. The position and composition of the protective fences must be established prior to works commencing, and once erected, accepted by the arborist prior to the commencement of any site construction works.

The temporary protective fences must be strong enough and appropriate to the degree of construction works taking place on the site. The protective fences must be a solid barrier which cannot easily be picked up and moved and be at least 1.5m high.

No works, storage of materials, cement/concrete washings and leaching of chemicals, trenching or alteration of soil grade must occur within those areas demarcated by the temporary protective fence. The temporary protective fences must remain in place throughout the duration of the construction works. The position of the protective fence must not be altered without the prior written agreement of the arborist.

7.3.1.4 During works

Within the root zone of retained trees:

a) The removal of any existing footpath, kerb and channels, within the root zone of retained trees, must be carefully undertaken so as to cause no more than minor damage to the retained trees.

b) All roots of greater than 35mm in diameter must be carefully worked around and protected. No such roots are to be removed, except:

i) Where no practicable alternative to removing the root exists and;

ii) Where this would have a no more than minor detrimental effect on the tree and this is the supported professional opinion of the qualified arborist.

Any root severance must have been accepted by Council beforehand and be undertaken by a qualified arborist.

c) Exposed roots greater than 35mm diameter must be covered with at least 50mm of sand and rootzone areas must be immediately covered with a suitable permeable geotextile fabric immediately after removal of the existing concrete.

d) Prior to the laying of basecourse the underlying roots must be protected by laying a suitable permeable geotextile fabric over the soil surface.

e) There must be no positioning (sitting or driving through) of heavy machinery unless this is on an existing hard surface (concrete or paved) or temporary hard surface - see (f) below.

f) The temporary hard surface methodology must be accepted in writing by a qualified arborist or the council's engineer. It must be constructed by laying Geotech matting on the surface, 100mm weed free mulch or similar soft material on a hard surface placed on the soft material, i.e. sheets of plyboard or swamp mats.

All roots that are severed must be pruned cleanly back to the surface of the excavation face nearest to the tree, using a sharp handsaw, loppers or secateurs. All exposed or severed roots must be kept damp (using hessian cloth or similar) until the excavated area is backfilled.

No damage to the trunk and above ground parts of any tree that is to be retained are to occur. If damage does occur, the Council arborist is to be advised immediately

Any pruning required to facilitate the works to retained trees must be undertaken by the arborist.

7.3.2 Reserves specimen tree location

All reserve plantings must be marked out on site, and accepted by Council, prior to planting works commencing.

7.3.3 Site preparation

All irrigation and drainage work, utilities installation, signs or landscape structures must be completely installed prior to planting.

7.3.3.1 Excavation and Bedding of Planting Areas

Excavation must be carried out where necessary to achieve either of the following required soil profiles where depths indicated are post consolidation.

a) Landscape planting

Refer to Landscapes drawing: Landscape planting areas

b) Annual bedding planting

Refer to Landscapes drawing: Landscape planting areas. All waste material must be removed from site. The exposed subgrade must be trimmed and levelled so that no part of the subgrade must be above the required depth of cut.

7.3.4 Soil

Topsoil, both imported and existing on site, must be:

a) A loam soil of good quality rich in organic content at >10%.

b) Free draining.

c) Free of weeds and contaminates.

d) Free of building materials and debris.

e) Screened.

f) Healthy.

g) Contain no pans.

All new planting areas on existing topsoil must be deep ripped to a minimum of 300mm prior to planting.

7.3.5 Tree pits

Saw-cutting of existing seal where required must be undertaken between 250mm to 300mm from the back of the kerb. The design and measurements must be accepted by Council prior to works commencing. The cut line must be parallel to the kerb lines wherever possible. All cut-outs are to be square and to be a minimum 1.5m x 1.5m dimension.

Refer to Landscapes drawing: Tree pits within carriageway pavements and Landscapes drawing: Kerbside tree pit for tree pit details. Planting holes must be excavated, according to the following specification:

Table 118: Tree pit design criteria

TREE TYPE	TREE GRADE	PIT SHAPE	PIT DEPTH

Street trees	45 litre	1.5m x 1.5m square	1,000mm
Park/reserve tree	45 litre	2.0m diameter	1,000mm
Park/reserve tree	90 litre	2.5m diameter	1,000mm

The base of the planting hole must be forked to a minimum depth of 200mm and any stones over 50mm diameter or poor-quality subsoil must be removed from the hole. It is important that trees are not planted too deeply. The sides of the planting hole must also be loosened by forking to 150mm minimum, and the surrounding ground to two times the root ball diameter must be 'forked' over to reduce compaction. Where topsoil is unsuitable for backfilling, imported or modified topsoil for backfilling must be used. The imported topsoil must be a free draining loam accepted by Council prior to placement.

Modified backfill soil must consist of a homogenous mixture of the following.

a) Parts by volume of good quality, friable topsoil from the site or imported.

b) Three parts by volume of council accepted compost.

c) Two parts by volume of coarse river sand.

7.3.6 Grassing, sowing and turfing

This section covers the preparation and sowing of any new grassed areas or those requiring reinstatement or turfing of such areas. It includes berms, lawns, and embankments.

7.3.6.1 Preparation for sowing or turfing

The following conditions apply:

a) Grassing and fertilising must be carried out over all existing grassed areas disturbed by contract activity and other specified areas which may require reinstatement.

b) Excessive compaction of subsoil in existing grassed areas must be relieved to achieve satisfactory long-term growing conditions.

c) All topsoil removed to permit contract works to be carried out must be stockpiled for reuse where it is acceptable.

d) All new grass areas must be built on soil prepared to industry best practice standards.

e) Sloped areas must be neatly contoured into adjoining grassed areas.

f) Perennial weeds must be controlled with industry best practice methods.

g) Area must be free from ponding, construction waste, rocks/stones or noticeable divots for ease of mowing

7.3.6.2 Grass sowing

The following requirements apply:

a) The seed mixture must be an industry standard quality.

b) On large areas the seed must be "check" sown in at least two directions and surface rolled with suitable flat roller.

c) On small areas the grass seed must be evenly applied and raked into the soil.

d) Grass must have even coverage and with an even density. Patches of uneven germination must be resown.

7.3.6.3 Establishment of sown areas

The following requirements apply:

a) Newly established grass must be protected from damage by pedestrian and vehicular traffic until grass has reached a self-sustaining state.

b) Grassed areas must be watered as required to achieve an efficient germination of the seed.

c) Newly grassed areas must be maintained with regular mowing (90mm-300mm) ensuring that all clippings are removed from adjacent hard surfaces.

All grassed areas adjacent hardscape - such as paths, kerbs, hardstand areas – to ensure base of grass is flush with adjacent path. If base of grass level is 30mm lower or more than adjacent hardstand, grass will need to be removed min 1m back from path, soil put back in, levelled and re-consolidated to spec and grass resown to correct level. If less than 30mm top dressing at 10mm each time, over time will be acceptable until the correct level is achieved.

7.3.6.4 Turf/instant turf

The following requirements apply:

a) The turf must be of good quality in line with industry standards.

b) Turf must be installed and maintained in accordance with supplier's requirements.

c) Areas of turf where there has been a poor establishment must be re-laid.

7.3.6.5 Slope areas

In all sites, except natural gully systems, where the slope gradient is steeper than 1:3 (one metre high by three metres long), it is preferable that the embankment is either scarified or grooved on an angle to a depth of 200mm, from the top of the bank to the base. This assists topsoil adhesion and prevents separation of the top 150mm topsoil from the base material due to gravity and/or glazed/planning of base material.

7.3.7 Street tree planting

7.3.7.1 Timing

All tree planting must be undertaken between May and August and all trees must be planted on the day of delivery to the site. Council must be provided with not less than five days' notice of the planting date.

7.3.7.2 Layout

Trees must be planted in the locations shown on the planting plans and in accordance with these specifications. Unless otherwise indicated on the planting plans all plants must be planted centrally within the road berm. Refer to Transportation drawing: Location of services in Transport Corridor.

7.3.7.3 Tree root barriers

Root barriers must be installed prior to tree planting. The location of root barriers must be as specified and centred around the plant stem (refer to Landscape drawing: Street tree root barrier).

7.3.7.4 Street tree mulching

All street trees must have a minimum 1.0m diameter mulching circle from the tree trunk and it must be well rotted organic tree mulch. Mulch must be free of foreign debris such as rocks and plastic.

Mulch must be applied to a depth of no more than 150mm after planting with the final settled depth no more than 120mm, and no less than 100mm. The mulch is to be welled up to ground level around the tree trunk.

7.3.8 Irrigation and fertilising

7.3.8.1 Irrigation

During installation and establishment, the soil in all planting areas moisture must be retained to ensure active plant growth throughout the growing season (September – May). To achieve a high level of site presentation or in areas of annual bedding display planting, irrigation systems may be required to achieve this.

Where an irrigation system is required to be installed, 'Toro' brand or a similar accepted brand must be used. The system must be capable of providing a minimum soil moisture level of 50% to 200mm depth, throughout the planted areas or within the dripline of trees specified. It must be capable of fully re-wetting the root zone to 200mm depth when the irrigation is applied; and must be fully automated to operate between 1:00am and 6:00am when moisture levels drop below 50%.

7.3.8.2 Passive street tree irrigation

When surrounded by hard surfaces or as specified, a street tree must have a 1900mm long section of perforated Novaflow, or similar, perforated pipe inserted into the tree pit. The Novaflow is to run down one side of the tree pit, under the intended root ball and up the opposite side of the tree pit to be level with the ground surface. The other end is to extend above the intended mulch layer by 20mm. Both ends of the pipe should be capped. Underground irrigation systems can be used instead of manually watering.

7.3.8.3 Fertilising

Generally, some form of fertiliser must be applied to planting depending on the soil type. For shrubs and trees, all fertilisers must be well mixed with the backfilled soil. For bedding or groundcover all fertilisers must be well mixed with the site topsoil prior to planting. Fertilisers must be either an accepted pelletised natural or organic fertiliser or an accepted synthetic fertiliser.

An exception to these accepted pelletised natural and organic fertilisers or accepted synthetic fertilisers is for the Proteaceous species and ferns which should not be fertilised with Phosphate (P) containing fertilisers.

7.3.8.4 Street trees

All specimen tree plantings must have two-year slow release fertiliser tablets installed at the time of planting.

7.3.8.5 Grass sowing and turf

All fertilisers must be delivered to the site immediately before they are required for spreading and must be thoroughly mixed on the site. Council may prohibit the use of any fertilisers which have deteriorated because of interaction, wetting, etc. Fertilisers must be lightly harrowed into the topsoil, 2-3 days prior to seed sowing. Seed sow at 200kg/ha.

Table 119: Fertiliser rates for grass sowing

TYPE	RATE
30% potassic superphosphate	150kg/ha (15g/m^2)

Sulphate of ammonia	50kg/ha (5g/m²)
One month after sowing, apply	
Di-ammonium phosphate (DAP)	100kg/ha (10g/m²)

7.3.9 Quality control

7.3.9.1 Plant grades, species and quality

a) General plant grades

All plants must be supplied true to the species and grades specified on the accepted landscape plans and fill the specified planter bag. All street trees, unless specified otherwise, must be of a minimum grade of 45 litre with a minimum 35-45mm calliper.

All other stock must be of minimum 2 litre grade for groundcover and 3 litre grade for shrubs.

b) General plant species and quality

Where relevant, trees must be selected from Council's accepted tree species list. Where such a list exists, no substitution of species or grade must be made without the written acceptance of Council. Where no such list exists, refer to Hamilton City Council's Street Tree Species list.

All plant material supplied must be clearly labelled.

Council must be provided with at least five working days' notice of dates upon which plants are to be delivered on site, so that arrangements can be made for a quality inspection and confirmation of the identification of plant material against the nursery packing slip.

Trees must be well branched, symmetrical and of typical form for the species.

All plants must be nursery stock of good form, healthy and vigorous with strong fibrous root systems (i.e. not root bound) and free of all pests and diseases.

All trees must be supplied with the central leader intact - no pruning of the central leader must have taken place. All torn or damaged roots must be pruned before dispatch. All stock must be well rooted but not root bound. Open ground stock must be well-wrenched.

All root balls and containers must be free of all weeds. Plants must be well 'hardened-off' prior to supply.

All plants and their roots must be maintained in a moist environment, protected from adverse conditions such as drying winds, frost or water logging. All roots must be covered during transit and storage to prevent desiccation or damage.

c) Street tree grades, species and form

All street trees, unless specified otherwise, must be of a minimum grade of 45 litre/PB 95 and be first grade nursery specimens. No substitution of species or grade must be made without the written acceptance of Council.

Trees must be well branched, symmetrical and of typical habit for the species. All plants must be nursery stock of good form, healthy and vigorous with strong fibrous root systems and free of all pests and diseases. All trees must be supplied with the central leader intact, whereby no pruning of the central leader must have taken place. All torn or damaged roots must be pruned before dispatch. All stock must be well rooted but not root bound. All root balls and containers must be free of all weeds.

7.3.10 Weed and litter control

7.3.10.1 Litter control

The planting area must be kept clear of all rubbish, including domestic and building materials.

7.3.10.2 Chemical applications for weed and pest control

All chemical application on planted areas must be carried out by qualified, trained personnel and according to NZS 8409:2004 – Management of Agrichemicals, any local Herbicide Policy, and manufacturers' requirements. All spraying operations must be carried out in windless, dry conditions, when rain is not imminent for at least 12 hours and at times which minimise possible hazards or disruption to the public, animals, or other beneficial fauna. Care must be taken to prevent spray drifting onto non-target areas or plants and comply with notification requirements as required by the Regional Plan.

Herbicides may be used to control weeds or excess grass growth over structures, surfaces or into planting areas. Refer to *Section 8 Acceptable products* on page 365 for accepted herbicides.

All trees in grassed areas must have a weed release spot spray applied between four and six months after planting. General weed control must be carried out whenever necessary, but particularly in spring and summer (due to high invasive weed growth rates) to maintain the planting weed-free.

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Chemical weed control in planting areas must be kept within the edge of the planting beds, within a maximum of 500mm of tree trunks, within 50mm of the edge of any undefined mulch surface, and within 50mm of any posts or the base of any landscape structures.

7.3.11 Mulching

Unless otherwise accepted by Council, all new planting areas must be mulched. All care must be taken in placing the mulch to protect the plants and any irrigation system, ensuring that no plant canopy is covered by mulch post-installation. All damage to the plants or irrigation system must be rectified. The mulch must be placed so that it will not be washed onto the footpath or carriageway during rain events. It also must not be mounded up and must be clear of any tree trunks to avoid collar rot.

7.3.11.1 Site specific mulch applications

a) Flat site mulch

On sites flatter than a 1: 3 grade (1metre by 3 metres long) bark or arb mulch must be spread evenly to a final settled depth of 80-100mm over the planted area, creating an inverted cone hollow around each plant stem with a maximum 25mm depth around plant stems. The mulch must be supplied as scheduled, clean, aged, (minimum of 3 months) and free of soil, sawdust and wood preservatives, and a sample must be provided to Council for acceptance prior to spread.

i) Coarse untreated shredded pine bark should have an average diameter of 50mm and with no pieces longer than 100mm. Coarse bark is appropriate to most locations.

ii) Fine untreated shredded pine bark should have no pieces longer than 40mm and be evenly graded. Fine bark may be specified by Council in commercial areas, or for other specified locations.

iii) Aged woodchip or arb mulch may be used at Council's discretion.

b) Steep site mulch

On slopes steeper than 1: 3 mulching for weed control must consist of a Council accepted matting with the following criteria:

i) The matting consists of:

- A single layer of biodegradable mulching fabric or material without synthetic geonet or synthetic geotextile content; with
- At least 1000gsm density composed of approximately 100-125mm long coir fibres; and
- Has preferably a 100 percent rubber-based binder to hold the fibres together.

ii) It must be installed according to manufacturer's instructions prior to planting, ensuring that the matting will not uplift due to inundation or interference from wildlife.

iii) The mulching fabric must have a minimum 24-month life expectancy and be fully biodegraded into the soil within six years. It should be able to be walked on by maintenance staff, without causing damage to the fabric, for the first 12 months after installation.

iv) Pegs used with matting also need to be biodegradable.

A simple test to ascertain whether the mulching fabric is viable is to hold a sample to the sky. It should be mostly opaque. This density inhibits weed seeds trapped under the mulching fabric from sprouting, provides good moisture retention and assists with batter erosion control.

Council’s may accept mat rounds instead of matting. These must be a minimum 500mm diameter and have the same characteristics as the mulch fabric. Each round must have 8 pins: 4 pins equidistant near the outer edge and 4 pins around the plant stem.

On steep slopes (1 in 4) with erosion issues that are receiving planting, biodegradable netting with no geotextile or geonet content must be used. The netting will have an expected lifespan of at least 36 months. This may be placed on top of the mulch matting and must be installed according to manufacturer’s instructions. The netting is not intended to suppress weeds and should be used in conjunction with mulch matting or rounds.

7.3.12 Staking, fencing and protection

7.3.12.1 Specimen and street trees

Newly planted specimen trees must be staked with four 50 x 50 x 1.8m rough sawn Pine H4 treated or hardwood stakes with at least one third of their length (600mm) in the ground and at least 1.0m exposed minimum, or as specified on the plan with the acceptance of Council. Two flexible biodegradable ties per stake must be attached. Ties must be tensioned to avoid chafing of the tree against the stakes but with enough play for the tree to move in the wind. All ties must be fixed to the stakes. Ties must be positioned no more than one third of the height of the tree on the stake. All staking must be parallel with the road kerb for street trees, north and south for specimen trees. All stakes must be inserted to avoid hitting the root ball. Refer to Landscapes drawing: Street tree root barrier.

a) Non-street tree staking

Unless otherwise accepted by Council:

i) All shrub species must be planted at 1.5 litre to 5 litre grades.

ii) All tree species must be planted at 5 litre grade minimum.

iii) All non-street trees must be staked with a rough sawn pine H4 stake with a biodegradable tie or a Council-accepted alternative.

iv) The tie must be removed at a time designated during the design phase of the landscape planting.

v) Some nursery-supplied plants are provided with a stake attached, usually directly against the main stem. This stake is to be removed and replaced according to this specification.

7.3.12.2 Livestock fencing

Where required livestock fencing must be provided. At road frontages, no hot wires are to be used unless they are attached at 300mm inside a physical barrier. The stock-proof fence must be a durable fence which achieves the required purpose of preventing access of all livestock to the site under development. At road frontages the fence must meet the following minimum standards:

Table 120: Livestock fencing standards

COMPONENT	TYPE	SIZE AND PLACING
Strainers	No. 1	2.4m long with stay
Angles	No. 1	2.1m long with stays (if required) at fence line
Stays	No. 2	2.4m long
Posts	No. 2	1.8m long
Battens	50 x 40	Equidistant placing 0.8m maximum spacing
Wire	High tensile wire	8 wires

The wires must be facing the roadside with posts and battens behind. Strainers must be set to lean away from the angle of the fence and be vertical upon completion of the tensioned fence. In poor soil conditions or variable topography, longer posts, longer strainers and more substantial footings and stays must be used where necessary to achieve a stable fence.

7.3.13 Pruning

Pruning should be carried out in accordance with acceptable arboriculture and horticultural practices with oversight from Council's appointed arborist.

7.4. DEFECTS LIABILITY

Works to be carried out under the defect's liability period include routine maintenance of the landscape planting works i.e. weeding, litter removal, mulching, watering and replacement of dead or diseased plants. Refer to Landscape form: Street trees and gardens final inspection

Council may periodically check the site to ensure that maintenance requirements are being met. Should any defects be identified, the defects must be remedied or mitigated within one month.

7.4.1 As-built information

Upon completion of construction work, copies of As-built plans and data attributes of the completed works, as described in *Clause 1.9 As-built plans* on page 41, must be provided to Council on its own plan.

Responsibility for providing the plans and associated data must lie with:

a) The developer, in the case of land development (urban and industrial subdivision).

b) The contractor, in the case of works constructed for Council under contract to Council.

7.4.2 Works clearance inspection

After completing all proposed works Council must be provided notice at least seven working days prior to the proposed commencement of the defects liability period and must be available for a joint pre-defect's liability period inspection.

7.4.3 Defects liability period final inspection

The developer/contractor must request acceptance from Council of the asset and its ongoing maintenance at least 7 working days prior to the end of the defect's liability period. Refer to [Landscape form: Street trees and gardens final inspection]

Planting defects liability period

The planting defects liability period must be 2 years from works clearance or practical completion (or as defined in the resource consent) upon release of any implementation bond held for uncompleted landscaping.

During and at the end of the defect's liability period, the following minimum standards are required:

a) All topsoiled areas prior to planting and mulching must be weed-free.

b) All planted areas must be kept weed-free.

c) All planted areas including street trees must be replenished with bark or arb mulch.

d) All trees and other planting must be vigorous and healthy, free of disease and free of dead growth or dead flowers.

e) If planting is to take place during drier, summer months, provision of temporary on-site irrigation should be discussed with Council.

f) The planting has become established. Any plants failing during this period must be replaced to the specification, to ensure adequate establishment of the planting.

g) The plant growth must have been trimmed to the extent and height required for any visibility splays.

h) All tree stakes and ties must be intact and correctly installed.

Refer to *Table 121: Minimum general landscape maintenance schedule during defects liability period* on page 360 for further maintenance objectives, methodology and frequency requirements.

7.4.3.2 Replacement planting

All replacement plants must have been successfully established for at least three months prior to the final defects check. Council reserves the right to request replacement records that preferably include dated digital photographic evidence to verify installation dates.

7.4.4 Fencing and landscape structure defects liability maintenance

During and at the end of the defect's liability period the following minimum standards must be maintained:

a) All permanent or temporary landscape structures must be structurally sound, safe, functional or operational and in a presentable finished form.

b) Paint work and other finishes must be maintained in a clean and presentable finished form. Bolts and other fixtures must be maintained sound and without loose parts or rough edges.

c) All structures must be free of litter, graffiti, grime, weeds and plant growth or any other foreign matter

d) Borders, footing edges or paving must be maintained so that no more than 25mm of grass or other vegetation is allowed to encroach. Vertical elements without mowing edges must have vegetation maintained clear of the structure by no less than 25mm and no more than 75mm.

e) Refer to and use the checklists on the website; *Street trees and gardens pre-defects liability period inspection* and to Landscape form: Street trees and gardens final inspection

7.4.5 Grassing and turf defects liability period

After initial establishment, during and at the end of the defect's liability period, the following minimum standards must be maintained:

a) All kerb and channelled verges must have grass growth no more than 50mm high, non-kerb-and-channelled verges must have grass growth no more than 200mm high and banks must have grass growth not more than 250mm high.

b) The sward must be maintained in a healthy, weed-and-disease free state without bare patches.

c) Trees and other plantings must be protected from damage by maintenance or mowing operations and if damaged must be reinstated within one week of the damage occurring.

d) Maintenance and mowing operations must be carried out at times which minimise disruption to the public.

e) Maintenance and mowing operations must be carried out only in conditions with equipment that ensures maintenance of good soil structure, minimum deformation of ground surfaces and on-going establishment of the grass sward.

f) Litter must be removed prior to commencing maintenance or mowing operations. Highly visible shredded litter must be removed following maintenance and mowing.

g) Grass clippings, when not required to be collected during mowing, must be spread evenly over the sward.

Table 121: Minimum general landscape maintenance schedule during defects liability period

DEFECTS LIABILITY PERIOD MAINTENANCE	REGIME	FREQUENCY	TERM	SEASON
Compliance inspections – Council	Assess that site(s) is being maintained as per specification.	Three months maximum or as required.	Defects duration.	All.
Compliance inspections – developer/contractor	Check for problem weeds, failed plants, pest damage, pruning and replacement needs. Ensure mulch application correct depth/coverage/placement	Monthly	Defects duration.	All.
Fertiliser	Pellets: NPK at 100g/m² on shrub planted areas or 100g/tree	Pellets: once only at start of second growing season or after replacement planting.	As applicable.	Spring preferably.
	Foliar feed: On Council acceptance apply accepted liquid foliar feed	Foliar feed: once two weeks prior to end of defects liability period.		
Mulching	Bark and arb mulch: Maintained at 80-100mm depth with 25mm depth around stem with inverted hollow cone. Mulch travel not evident outside planting area.	Bark and arb mulch: Replace/top up once after planting (if required)	Bark and arb mulch: no more than two months before end of defects liability period.	Apr-Oct preferably.
	Matting and rounds: Check and ensure pins and matting installed correctly, fabric is intact.	Matting and rounds: Replace/repair fabric and pins (as required)	Matting and rounds: Periodically throughout defects liability period.	
Plant replacement	Replace according to allocated planting scheme, plant schedule species and centre(s).	As determined by compliance inspections.	Up to three months before end of defects liability period.	Winter-Spring
Rubbish	Remove to waste domestic and builders rubbish from planted areas.	Monthly.	Defects duration.	All
Staking	Damaged ties and stakes (including those leaning over) are to be replaced and reinstalled, including stakes on lean. Replant if on lean ensuring roots are not exposed.	As required. Two month inspection rotation.	Defects duration.	All
Weed control	Manual removal of weeds or ‘knock-down’ herbicide. No spraying near waterways.	Monthly.	Defects duration.	All.

7.5. PLANT NUMBER CALCULATOR

7.5.1 Level sites

To calculate plants required for level sites, determine the plant centre required:

Equation 10: Landscapes plant number calculator for level sites

Planting Area X Level Site

Example: Plants to be planted at 300mm centres in a Planting Area of 10m^2 on a Level Site
Planting Area (10m^2) X Level Site (11.11) = 111 plants required

7.5.2 Sloped sites

To calculate plants required on sloped sites, determine the plant centre required:

Equation 11: Landscapes plant number calculator for sloped sites

Formula: (Plant Area X Level Site) X Slope gradient

Example: Plants to be planted at 300mm centres in a Planting Area of 10m^2 on a Slope 1:1 (1 horizontal to 1 vertical)
(Planting Area (10m^2) X Level Site (11.11)) X Slope multiplier (1.41) = 157 plants required

Table 122: Plant number calculator on sloped sites

PLANT CENTRES (MM)	MINIMUM AREA APPLICABLE (M^2)	MULTIPLIERS				
		LEVEL SITE	SLOPE 1:1	SLOPE 1:2	SLOPE 1:3	SLOPE 1:4
250	0.10	16.00	1.41	1.12	1.05	1.025
300	0.15	11.11	1.41	1.12	1.05	1.025
400	0.25	6.25	1.41	1.12	1.05	1.025
500	0.25	4.00	1.41	1.12	1.05	1.025
600	0.50	2.75	1.41	1.12	1.05	1.025
700	0.75	2.05	1.41	1.12	1.05	1.025
750	0.75	1.78	1.41	1.12	1.05	1.025
800	1.00	1.56	1.41	1.12	1.05	1.025
900	1.00	1.23	1.41	1.12	1.05	1.025
1000	1.00	1.00	1.41	1.12	1.05	1.025
1100	1.25	0.83	1.41	1.12	1.05	1.025
1200	1.50	0.69	1.41	1.12	1.05	1.025
1300	1.75	0.59	1.41	1.12	1.05	1.025

PLANT CENTRES (MM)	MINIMUM AREA APPLICABLE (M²)	MULTIPLIERS				
		LEVEL SITE	SLOPE 1:1	SLOPE 1:2	SLOPE 1:3	SLOPE 1:4
1400	2.00	0.51	1.41	1.12	1.05	1.025
1500	2.50	0.44	1.41	1.12	1.05	1.025
1600	2.75	0.39	1.41	1.12	1.05	1.025
1700	3.00	0.35	1.41	1.12	1.05	1.025
1800	3.25	0.31	1.41	1.12	1.05	1.025
1900	3.75	0.28	1.41	1.12	1.05	1.025
2000	4.00	0.25	1.41	1.12	1.05	1.025
2100	4.50	0.23	1.41	1.12	1.05	1.025
2200	4.75	0.22	1.41	1.12	1.05	1.025
2300	5.50	0.19	1.41	1.12	1.05	1.025
2400	6.00	0.17	1.41	1.12	1.05	1.025
2500	6.25	0.16	1.41	1.12	1.05	1.025
2600	6.75	0.15	1.41	1.12	1.05	1.025
2700	7.25	0.14	1.41	1.12	1.05	1.025
2800	7.75	0.13	1.41	1.12	1.05	1.025
2900	8.35	0.12	1.41	1.12	1.05	1.025
3000	9.25	0.11	1.41	1.12	1.05	1.025

7.6. FORMS AND CHECKLISTS REGISTER

The following checklists can be found on the Co-Lab website:

CATEGORY	TITLE
Landscapes	Street trees and gardens pre-defects liability period inspection
Landscapes	Street trees and gardens final inspection

7.7. DRAWINGS REGISTER

The following drawings can be found on the Co-Lab website:

CATEGORY	TITLE
Landscapes	Landscape planting areas
Landscapes	Street tree planting clearances
Landscapes	Tree pits within carriageway

CATEGORY	TITLE
Landscapes	Street tree root barrier
Landscapes	Tree pits within carriageway pavements
Landscapes	Kerbside tree pit
Landscapes	Timber bollard post and chain

Acceptable products

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8.1. GENERAL INFORMATION

8.1.1 Purpose

Products used in the construction and maintenance of infrastructure are one of the key elements in the success or failure of the assets to reach the design life. There are many types and versions of products in the marketplace, and one of the big challenges for asset owners, consultants and contractors is knowing which ones will meet the design life requirements. Well made products will possibly cost a little more than those of lower quality, but this cost becomes irrelevant if they need to be replaced earlier than planned or expected. The cost of this should not be unfairly transferred to ratepayers. Developing a list of products that are acceptable to asset owners, provides certainty and a level playing field for consultants and contractors that ultimately saves ratepayers and shareholders money and increases resilience.

8.1.2 Scope

This specification covers the list of products and fittings acceptable for use within Council utilising the RITS. This covers products and fittings council has, or will, assume a continuing responsibility for. Products not contained in the accompanying list may be rejected with a requirement to remove the non-complying product from the construction site at no cost to Council.

For specific design requirements, such as reservoir construction, wastewater interceptor and structures, where a designer identifies a solution/product that is not currently accepted, the acceptance process outlined in *Clause 1.1.4.2 Alternative design* on page 11 applies.

8.1.3 Removal from acceptable products list

Waikato LASS reserves the right to delete any product or material from the acceptable products list as and when required. Removing a product may occur for many reasons but will most likely be for one of the following;

a) Experience shows that the product or material does not meet the application criterion as expected.

b) The source has changed.

c) The product is no longer available cost effectively in New Zealand.

d) The product has been discontinued.

e) Improved replacement product/material has become readily available.

Co-Lab will consult with the affected manufacturer outlining the reasons for the proposed removal of the material or product . The manufacturer will be given reasonable time to respond.

Deleted products will be removed from the acceptable products list as and when required.

8.2. ACCEPTABLE PRODUCTS LIST

The following are the column headings within the acceptable products list:

Table 123: Column heading descriptions

COLUMN HEADING	DESCRIPTION
Category	The type of product.
Application	What the product is used for.
Sizing	The size (in mm) of the product.
Product	The brand name and manufacturer's unique ID number of the product or material.
Standards	The applicable standards and class requirement for the product or material.
Manufacturer	The company who made the product.
Licence mark	The company's product licence mark.
Expiry date	Expiry date of the Licence.
Comments	Any notable requirements for the product.

The acceptable products lists are available on the Co-Lab website using the links below.

CATEGORY	TITLE
Acceptable products	General products
Acceptable products	Transportation products
Acceptable products	Stormwater products
Acceptable products	Wastewater products
Acceptable products	Water supply products
Acceptable products	Landscaping products

8.3. NEW PRODUCT ACCEPTANCE PROCESS

8.3.1 The application

All applications for acceptance of a product is to be included on a list must be made on the prescribed application form (available on the Co-Lab website).

The following supporting information is required, as a minimum:

a) Evidence that the product conforms to the appropriate New Zealand, Australian, British, ISO Standard or Organisation International Metrology Legal Publication[92].

b) Evidence of the licencemark number issued where appropriate.

c) The licencemark certifier must be a member of JASANZ.

d) Details of composition, dimensions, specific use and design life supplied by the manufacturer.

e) Details of acceptance by other New Zealand local authorities where appropriate.

f) Installation, operational and maintenance details.

Completed applications and supporting information should be addressed to:

[92] Where there is no standard, the manufacturer must supply copies of their quality assurance procedures and producer statements to support the composition and performance claims for the product.

Secretary
Co-Lab Solutions
PO Box 1198
Cambridge 3434

and/or emailed to rits@colabsolutions.govt.nz

It is intended that the acceptable products list will be updated twice per year in March and September. To be considered for inclusion on the acceptable products list fully completed applications must be received by the Co-Lab Secretary 6 weeks prior to any update.

8.3.2 The Decision Process

Each application will be considered against the following criteria:

a) The application form and supporting information.

b) Durability of the product during transport, storage and installation.

c) Any sample provided.

d) The track record of the manufacturer making the application.

e) Any specific installation requirements.

f) Reliability.

g) Parts availability.

h) Parts life expectancy in the physical environment it will be subjected to.

i) Maintenance requirements.

j) Manufacturer support.

k) Frequency and ease of replacement.

l) Compatibility with the existing network.

The products will initially be evaluated by the RITS Co-ordinator who will liaise directly with the product applicant. Products not on the list can be considered for immediate use but will need to be accepted in writing prior to installation and meet the above criteria.

It cannot be assumed that by meeting all technical specifications of acceptance that a product or material will be accepted. Asset management considerations e.g. operating, maintenance and replacement costs, product and material compatibility within networks and systems are important as well as the other criteria Council considers.

Where the RITS Co-ordinator considers a proposed product may be suitable for acceptance, the following process will be followed:

m) The RITS Co-ordinator will acknowledge receipt of the application with the applicant and add it to the list of products to be considered at the next 6-monthly review.

n) The RITS Co-ordinator will forward a copy of the application and supporting information to the Product Evaluation Panel (see following clause) and relevant Council asset managers for their information and preliminary feedback, e.g. whether the product could/should be trialled.

o) The RITS Co-ordinator will consider any feedback received and determine if a product trial is appropriate.

p) Where appropriate, the RITS Co-ordinator will arrange for a product trial to be initiated.

q) The Product Evaluation Panel carries out their scheduled 6-monthly review and makes a decision to accept, trial or decline the product(s).

r) Where the product is accepted, the RITS Co-ordinator will update the acceptable products list and notify the applicant accordingly.

8.3.3 Product evaluation panel

The Production Evaluation Panel is an informal panel of experienced professionals that comprises the following:

a) The RITS Co-ordinator, who will chair panel meetings.

b) Relevant Council asset managers (appropriate to the asset/s related to the product being applied for).

c) *(optional)* An independent industry expert (not connected in any way to the product, manufacturer, supplier or Council).

d) *(optional)* Any other professional the Product Evaluation Panel considers would assist in reviewing the application. (This professional may be a member of Council staff or be an external party.)

The Product Evaluation Panel will convene bi-annually in January/February and July/August, or when a decision of extreme challenge or difficulty is required. This ensures a more streamlined and less expensive management process for the Council and applicants.

8.3.4 Trial installation (where relevant)

Where trial installation is recommended by the Project Evaluation Panel then:

a) The cost of this installation will usually be met by Council. However, Council may require an extension to any warranty and the payment of a bond to the value of replacing the product and any other cost, i.e. damage that may be incurred should the product fail.

b) The product will be reviewed at intervals of 3, 6, 9 and 12 months to assess durability in a live situation.

c) At the end of the specified trial period, members of the Project Evaluation Panel will inspect the product and determine if it is suitable for acceptance. Assessment will include identifying any signs of deterioration, distortion or other failure.

d) The RITS Co-ordinator will notify the applicant of the trial outcome and advise of any further action requirements (if any).

Once a decision has been reached, the process will conclude as specified in Clause 8.3.2q) and Clause 8.3.2r) above.

Note: A product undergoing a trial installation is not deemed to be an acceptable product.

8.3.5 Declining an application

An application may be declined for one or more reasons as follows:

a) The application form is not completed in full.

b) The supporting information required is not supplied in full.

c) The criteria listed in *Clause 8.3.2 The Decision Process* on page 368, do not meet Council's needs.

d) The Product Evaluation Panel considers the product is not acceptable.

e) The product fails any trial(s) undertaken.

Whatever the reason for declining an application, the applicant will be advised of the reason(s) for decline.

Failure to have a product/material accepted does not mean it can never be used. It may be appropriate for use for a specific design reason but not appropriate for frequent use. (See *Clause 1.1.4.2 Alternative design* on page 11).

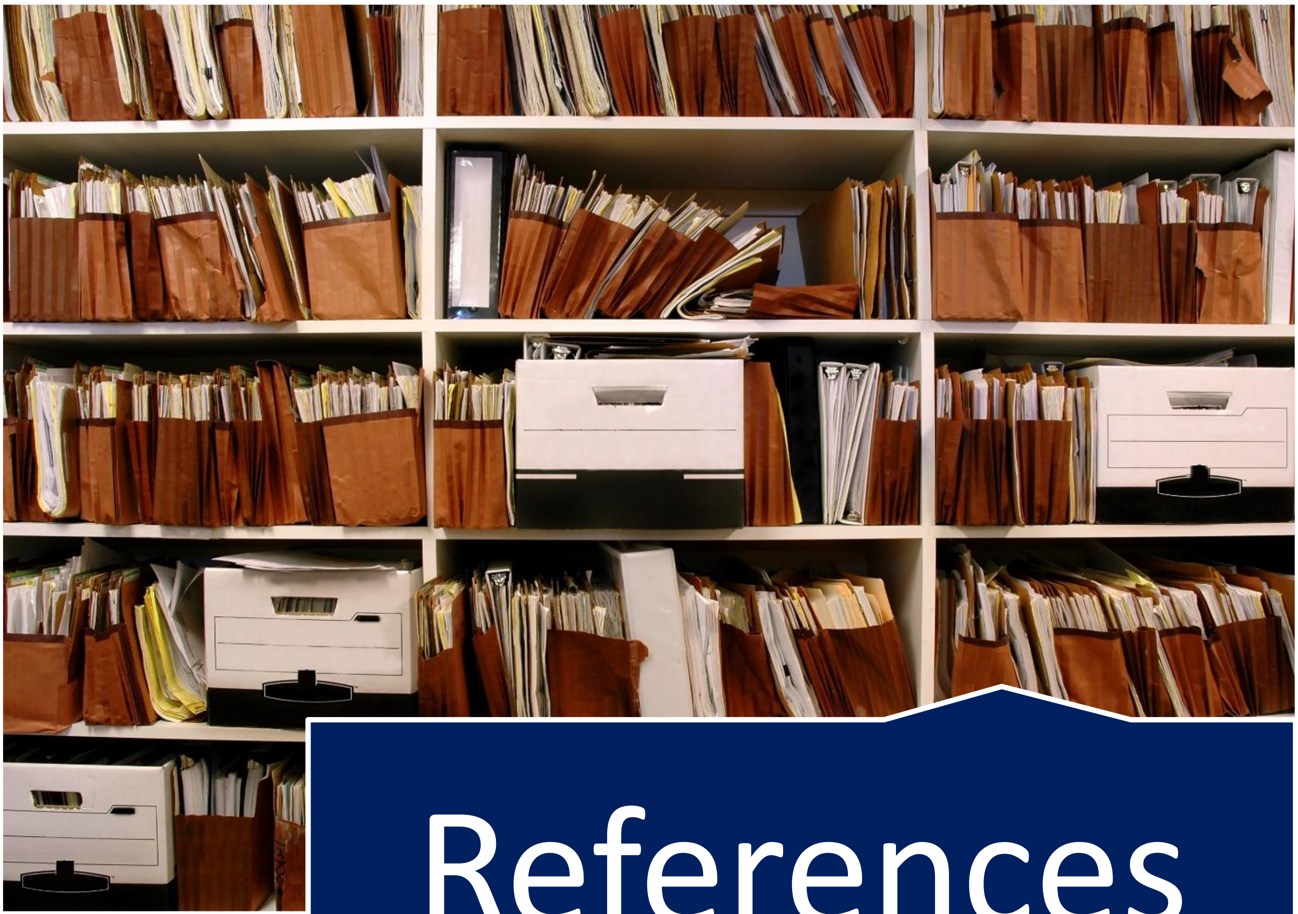
Acceptance must be obtained from the specific Council to allow use of non-acceptable products/materials.

8.3.6 Removal from the acceptable products list

Refer to *Clause 8.1.3 Removal from acceptable products list* on page 366 for details.

8.3.7 Acceptable products list

See Co-Lab website RITS page   Acceptable Products List 2022



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