In the absence of any other more appropriate criterion the design flow for subsoil systems shall be based on a standard of 1 mm/h (2.78 L/s/ha).

Refer to manufacturer's literature for information on pipe materials, filter fabrics, bedding, and filter design.

4.3.9.10 Bulkheads for pipes on steep grades

Bulkheads, or anti-scour blocks, shall be detailed on the design drawings and shall be in accordance with Appendix B drawing CM – 003. Spacing of bulkheads shall be:

Table 4.4 – Spacing of bulkheads for pipes on steep grades

Grade (%)	**Requirement**	**Spacing (S)** (m)
15 – 35	Concrete bulkhead	S = 100/Grade (%)
>35	Special design	Refer to TA
NOTE – On grades flatter than above where scour is a problem, sand bags may be used to stabilise the trench backfill.		

4.3.9.11 Trenchless technology

See 5.3.6.8 and 5.3.6.9 for guidance on the use of trenchless technology.

4.3.10 Manholes

4.3.10.1 Standard manholes

Access chambers or MHs shall be provided at all changes of direction, gradient and pipe size, at branching lines and terminations and at a distance apart not exceeding 120 m unless approved otherwise. They shall be easily accessible and located clear of any boundary. All public mains shall terminate with a MH at the upstream end.

See 5.3.8.2 and 5.3.8.3 of this Standard for further guidance on the location of MHs.

On pipelines equal to or greater than 1 m diameter, the spacing of MHs may be extended with the approval of the TA.

Appendix B drawings CM – 004, CM – 005, and CM – 006 for manholes may be adopted for stormwater systems.

4.3.10.2 Manhole materials

MHs may be manufactured in concrete, or from suitable plastics materials, including glass reinforced plastic (GRP), polyethylene, PVC or polypropylene, or from concrete/plastic lined composites.

MH materials selected shall be suitable for the level of aggressiveness of the surrounding groundwater.

4.3.10.3 Size of manholes

The standard internal diameter of circular MHs is 1050 mm and preferred nominal internal diameters are 1050 mm, 1200 mm, and 1500 mm. However, for shallow systems, DN 375/400 or 600 mm minimum diameter may be permitted (see 4.3.10.4).

When considering the appropriate MH diameter, consideration shall be given by the designer to the base layout to ensure hydraulic efficiency and adequate working space in the chamber. Where the effective working space is reduced by internal drop pipes, a larger diameter may be required. Where there are several inlets, consultation with the TA on the layout of the chamber is recommended.

The base layout of MHs shall comply with 5.3.8.4.2 of this Standard and Appendix B drawings CM – 004 and CM – 005.

4.3.10.4 Shallow manholes (or mini manholes)

For shallow systems (less than 1.2 m to invert) a DN 375/400 or 600 mm minimum diameter MH may be permitted subject to approval by the TA. Such small diameter MHs shall be classified as maintenance shafts (MSs) for the purposes of the spacing covered under this Standard. See Appendix B drawing CM – 005.

4.3.10.5 Hydraulic flow in manholes

In addition to the normal pipeline gradient all MHs on pipelines less than 1000 mm diameter shall have a minimum drop of 30 mm within the MH to compensate for the energy loss due to the flow through the MH. See 5.3.8.4.4 and 5.3.8.4.5 for further guidance.

4.3.10.6 Manhole connections

Open cascade is permitted into MHs over 2.0 m in depth and for pipes up to and including 300 mm diameter providing the steps are clear of any cascade. Other situations may be considered and require TA approval.

The bases of all MHs shall be benched and haunched to a smooth finish to accommodate the inlet and outlet pipe.

New inlet pipes shall be cut back to the inside face of the MH and provided with a smooth finish. All chambers are to be made watertight with mortar around all openings.

Minor pipelines connecting to a MH at or below design water level in the MH shall do so at an angle of not greater than 90^{o} to the main pipeline direction of inflow.

Minor pipelines connecting at above design water level may do so at any angle.

4.3.10.7 Flotation

In areas of high water table, all MHs shall be designed to provide a factor of safety against flotation of 1.25.

4.3.11 Connection to the public system

Where the connection of individual lots and developments are to the public system they shall meet the following requirements:

(a) Connection shall be by gravity flow via laterals to public mains or waterways, or to a roadside kerb, or swale, or rainwater tanks;

(b) All new urban lots shall be provided with individual service laterals, unless on-site disposal is approved by the TA;

(c) Each connection shall be capable of serving the whole of the lot. Where, for physical reasons, this is not practicable a partial service to the building area only may be acceptable (subject to approval of the TA);

(d) The minimum internal diameter of connections shall be:

(v) 100 mm for residential lots

(vi) 150 mm for commercial and industrial lots and connections serving two dwellings or residential lots

(vii) 200 mm for connections serving three or more dwellings or residential lots (unless otherwise approved by the TA);

(e) The connection shall be of a type capable of taking the spigot end of an approved pipe;

(f) Where the stormwater pipeline is outside the lot to be served, a connection pipeline shall be extended to the boundary of the lot and be marked by a 50 mm x 50 mm timber stake extending to 600 mm above ground level and painted blue;

(g) Connection to stormwater systems such as vegetated swales, soakpits, or soakage basins is acceptable provided the system is approved by the TA;

(h) All connections to pipelines or MHs shall be sealed by removable caps until such time as they are required;

(i) Connections shall be indicated accurately on as-built plans. Location relative to boundaries, depth to invert and ground level shall be given as a minimum.

4.3.12 Connection of lateral pipelines to public mains

Factory made fittings shall be used for all connections to public mains up to 300 mm diameter. Connections to larger mains up to 750 mm diameter shall use properly manufactured saddles. Concrete bondage to the exterior of the main pipe is required.

A hole may be made in a 900 mm diameter and larger main to effect a connection. The connection shall be properly dressed and plastered from inside the main to ensure that no protrusions exist.

When the lateral being connected is larger than 300 mm in diameter it shall be connected at a MH.

4.4 Approval of proposed infrastructure

The approval process for land development and subdivision design and construction and documents and supporting information on stormwater drainage infrastructure to be provided at each stage of the process shall be in accordance with section 1 of this Standard.

4.4.1 Approval process

Stormwater infrastructure requires approval from the TA and unless the TA holds a comprehensive, or network consent for the catchment, consents from the regional council to discharge, divert, or dam water may also be required.

In these circumstances it is good practice:

(a) To consult with LAs prior to consent application;

(b) To lodge applications with LAs at the same time so that land use and water-related resource consents can, if required, be dealt with at a joint hearing under s. 102 of the RMA.

4.4.2 Information to be provided

Specific information to be provided on any concept plans or scheme plans for development or subdivision incorporating stormwater infrastructure shall include:

(a) The location of any natural waterways or wetlands within the site or in close proximity to a boundary. The location in plan and level of the water's edge and shoulder of the banks shall be indicated;

(b) Typical pre-existing and post development cross sections through any natural waterways or wetlands;

(c) The proposed proximity of buildings to the water's edge or the shoulder of the banks, or both;

(d) Clear identification of the extent of any river, stream, or coastal floodplains on, or in close proximity to the site and overland flow paths within the site; and

(e) The level datum.

TAs may require some of the information following, particularly (h) and (i), in order to assess possible effects of a proposed development.

Applications for design approval shall include the information outlined in 1.8 of this Standard. In addition the following information shall be provided:

(f) A plan showing the proposed location of existing and proposed stormwater infrastructure and flow paths;

(g) Detailed long sections showing the levels and grades of proposed stormwater infrastructure in terms of datum;

(h) Details and calculations prepared which demonstrate that agreed levels of service will be maintained. All applications to develop within a flood plain shall be supported by detailed calculations and plans to determine the floodplain boundaries and building floor levels to meet the freeboard requirements in 4.3.5.2;

(i) Details and calculations prepared which clearly indicate any impact on adjacent area or catchment that the proposed infrastructure may have; and

(j) Operations and maintenance guidelines for any water quantity and or quality control structures shall be submitted to the TA for design approval along with other documents. The guidelines should describe the design objectives of the structure, describe all major features, explain operations such as recommended means of sediment removal and disposal, identify key design criteria, and identify on-going management and maintenance requirements such as plant establishment, vegetation control, and nuisance control.

4.5 Construction

4.5.1 Pipeline construction

The construction of pipelines shall be carried out in accordance with the requirements of AS/NZS 2032 (PVC), AS/NZS 2033 (PE), AS/NZS 2566 Parts 1 and 2 (all buried flexible pipelines), or AS/NZS 3725 (concrete pipes).

4.5.2 Trenching

Guidance is provided in Appendix B drawings CM – 001 and CM – 002.

Where a pipeline is to be constructed through areas with unsuitable foundations such material shall be removed and replaced with other approved material or alternatively, other methods of construction shall be carried out to the approval of the TA to provide an adequate foundation, and side support if required, for the pipeline.

4.5.3 Reinstatement

Areas where construction has taken place shall be reinstated to the condition required by the TA.

4.5.4 Inspection and acceptance

Pipe systems of 1200 mm diameter or less shall be inspected using closed circuit television (CCTV) prior to acceptance by the TA.

CCTV inspections and deliverables shall be in accordance with New Zealand pipe inspection manual and the requirements of the TA.

The TA may, at its discretion, also require a water test to be carried out. Testing shall be carried out as specified in Appendix C.

5 WASTEWATER

5.1 Scope

This section sets out requirements for the design and construction of wastewater systems for land development and subdivision. Section 5 primarily addresses reticulated systems, but reference is also made to on-site wastewater systems where applicable.

If the scope of the development is sufficiently large to include its own pumping station, then reference should be made to WSA 04.

5.2 General

5.2.1 Objectives

The objectives of the design are to ensure that the wastewater system is functional and complies with the requirements of the TA's wastewater systems.

In principle the wastewater system shall provide:

(a) A single gravity connection for each property;

(b) A level of service to the TA's customers in accordance with the authority's policies;

(c) Minimal adverse environmental and community impact;

(d) Compliance with environmental requirements;

(e) Compliance with statutory OSH requirements;

(f) Adequate hydraulic capacity to service the full catchment;

(g) Long service life with minimal maintenance and least life-cycle cost;

(h) Zero level of pipeline infiltration on commissioning of pipes;

(i) Low level of pipeline infiltration/exfiltration over the life of the system;

(j) Resistance to entry of tree roots;

(k) Resistance to internal and external corrosion and chemical degradation;

(l) Structural strength to resist applied loads; and

(m) 'Whole of life' costs that are acceptable to the TA.

5.2.2 Referenced documents and relevant guidelines

Wastewater designs shall incorporate all the special requirements of the TA and shall be in accordance with the most appropriate Standards, codes, and guidelines including those set out in Referenced Documents. Related Documents lists additional material that may be useful.

5.3 Design

5.3.1 Design life

All wastewater systems shall be designed and constructed for an asset life of at least 100 years. Some components such as pumps, valves, and control equipment may require earlier renovation or replacement. Refer to WSA 02 for the classification of life expectancy for various components in conventional gravity systems.

5.3.2 Structure plan

The TA may provide a structure plan setting out certain information to be used in design, such as flows, sizing, upstream controls, recommended pipe layout, or particular requirements of the TA. Where a structure plan is not provided, the designer shall determine this information by investigation using this Standard and engineering principles.

5.3.3 Future development

Where further subdivision, upstream of the one under consideration, is provided for in the district or regional plan, the TA may require wastewater infrastructure to be constructed to the upper limits of the subdivision to provide for the needs of this development.

Additionally, the TA may require additional capacity to be provided in the wastewater system to cater for existing or future development upstream. Peak flows and cleansing velocities should be taken into account when designing for additional latent capacity.

All infrastructure proposed to service future development will require the approval of the TA.

5.3.4 System design

5.3.4.1 Catchment design

Pipes within any project area shall be designed to be consistent with the optimum design for the entire catchment area and any future extension of the system shall be accommodated. This may affect the pipe location, diameter, depth, and maintenance structure location and layout. Designers shall adopt best practice to ensure a system with lowest life-cycle cost.

Pipes shall be designed with sufficient depth and capacity to cater for all existing and possible development of the catchment. Where future extension of the pipe is possible, it may be necessary to carry out preliminary designs for large areas of subdivided and unsubdivided land. This design shall use safety factors defined by the TA for hypothetical subdivision and service for layouts to determine the necessary depth and diameter for an extension.

5.3.4.2 Extent of infrastructure

Where pipes are to be extended in the future, the ends of pipes shall extend past the far boundary of the development by a distance equivalent to the depth to invert and be capped off, unless otherwise agreed to by the TA. This ensures that a future extension of the pipe does not require unnecessary excavation within lots or streetscapes already developed.

5.3.4.3 Topographical considerations

In steep terrain the location of pipes is governed by topography. Gravity pipelines operating against natural fall create a need for deep installations which may require trenchless installation. The pipe layout shall conform to natural fall as far as possible.

5.3.4.4 Geotechnical investigations

The designer shall take into account any geotechnical requirements determined under section 2 of this Standard.

5.3.5 Design criteria

5.3.5.1 Design flow

The design flow comprises domestic wastewater, industrial wastewater, infiltration, and direct ingress of stormwater.

The design flow shall be calculated by the method nominated by the TA. In the absence of information from the TA the following design parameters are recommended:

(a) Residential flows

(i) Average dry weather flow of 180 to 250 litres per day per person

(ii) Dry weather diurnal PF of 2.5

(iii) Dilution/infiltration factor of 2 for wet weather

(iv) Number of people per dwelling 2.5 to 3.5;

C5.3.5.1(a)

For small contributing catchments, PFs can be significantly higher but, due to the requirement for a minimum pipe size of DN 150, such flows will not govern the design.

(b) Commercial and industrial flows

Where flows from a particular industry or commercial development are known they should be used as the basis of design. Where there is no specific flow information available and the TA has no design guide, table 5.1 is recommended as a design basis. These flows include both sanitary wastewater and trade wastes and include peaking factors.

5.3.5.2 Hydraulic design of pipelines

The hydraulic design of wastewater pipes should be based on either the Colebrook-White formula or the Manning formula. The coefficients to be applied to the various materials are shown in table 5.2.

5.3.5.3 Minimum pipe sizes

Irrespective of other requirements, the minimum sizes of property connection and reticulation pipes shall be not less than those shown in table 5.3.

C5.3.5.3

For infill situations, particularly where upgrading of existing DN 100 connections in sound condition and at reasonable grades would be impractical, it is common practice for up to six dwelling units to use the existing connection. However, such connections would not normally be taken over as public pipes by the TA.

Table 5.1 – Commercial and industrial flows

Industry type (Water usage)	**Design flow** (Litre/second/hectare)
Light	0.4
Medium	0.7
Heavy	1.3

Table 5.2 – Guide to roughness coefficients for gravity sewer lines

Material	**Colebrook-White coefficient k** (mm)	**Manning roughness coefficient** (n)
VC	1.0	0.012
PVC	0.6	0.011
PE	0.6	0.009 – 0.011
GRP	0.6	0.011
Concrete machine made to AS/NZS 4058	1.5	0.012
PE or epoxy lining	0.6	0.011
PP	0.6	0.009 – 0.011

NOTE –

(1) These values take into account possible effects of rubber ring joints, slime, and debris.

(2) The n and k values apply for pipes up to DN 300.

(3) For further guidance refer to WSA 02:1999 table 2.4; AS 2200 table 2; *Plastics pipes for water supply and sewage disposal* (Janson), Metrication: *Hydraulic data and formulae* (Lamont), or the *Handbook of PVC pipe* (Uni-Bell).

Table 5.3 – Minimum pipe sizes for wastewater reticulation and property connections

Pipe	**Minimum size DN** (mm)
Connection servicing 1 dwelling unit	100
Connection servicing more than 1 dwelling unit	150
Connection servicing commercial and industrial lots	150
Reticulation servicing residential lots	150

NOTE – In practical terms, in a catchment not exceeding 250 dwelling units, and where no pumping station is involved, DN 150 pipes laid within the limits of table 5.4 and table 5.5 will be adequate without specific hydraulic design.

5.3.5.4 Limitation on pipe size reduction

In no circumstances shall the pipe size be reduced on any downstream section.

5.3.5.5 Minimum grades for self-cleaning

Self-cleaning of grit and debris shall be achieved by providing minimum grades specified in tables 5.4 and 5.5.

Table 5.4 – Minimum grades for wastewater pipes

Pipe size DN	Absolute minimum grade (%)
150	0.55
200	0.33
300	0.25

Table 5.5 – Minimum grades for property connections and permanent ends

Situation	Minimum grade (%)
DN 100 property connections	1.65
DN 150 property connections	1.20
Permanent upstream ends of DN 150, 200, and 300 pipes in residential areas with population ≤20 persons	1.00

5.3.5.6 Maximum velocity

The preferred maximum velocity for peak wet weather flow is 3.0 m/s. Where a steep grade that will cause a velocity greater than 3.0 m/s is unavoidable refer to WSA 02 for precautions and design procedures.

5.3.5.7 Gravity wastewater applications

See Appendix A for appropriate gravity pipe Standards for wastewater.

The pipe shall be designed to:

(a) Have adequate capacity, grades, and diameters;

(b) Have adequate grade for self-cleaning;

(c) Be deep enough to provide gravity service to all lots;

(d) Comply with minimum depth requirements to ensure mechanical protection and safety from excavation;

(e) Avoid all underground services, while maintaining all the necessary clearances; and

(f) Allow for various drops and losses through MHs.

5.3.5.8 Pressure and vacuum wastewater applications

The introduction of pressure or vacuum systems into a network requires approval from the TA. See Appendix A for appropriate pressure pipe and fittings Standards for wastewater. See also 5.3.12.