WAIMAKARIRI DISTRICT COUNCIL

ENGINEERING CODE OF PRACTICE

PART FIVE

STORMWATER & LAND DRAINAGE

September 2019

Part 5: Stormwater & Land Drainage

CONTENTS

Part 5: Stormwater & Land Drainage

Part 5: Stormwater & Land Drainage

TABLES

Part 5: Stormwater & Land Drainage

5.1 INTRODUCTION

This Part of the CoP covers the design and construction requirements of stormwater and land drainage works for land development and subdivision, including capital works projects.

This Part is not intended to be a detailed design guide or to replace the need for stormwater engineering expertise in some areas of the design process. The standards included in this Part are one way of achieving the desired outcomes and performance criteria of the network components described below.

5.1.1 Philosophy

The Waimakariri District Council is taking a values-based approach to management of the natural and physical resources that make up the District's system of waterways, wetlands and drainage. This includes not only the natural waterway system but also the built network. By understanding the natural processes operating in land and water we are much more able to bring to life values that are important to the community while addressing drainage issues associated with individual developments. Values that have been specifically identified are ecology, landscape, recreation, heritage, culture and drainage.

The emphasis on each value at a particular site will be dependent on the objectives of the project. The process toward understanding these values, how they can be reflected and enhanced in new developments, and an appreciation of ongoing management requirements, is outlined in the CCC *Waterways, Wetlands and Drainage Guide* (*WWDG) Part A*.

5.1.2 Objectives

The stormwater drainage system serves four purposes:

- The conveyance of storm surface run-off with minimal flood damage;
- Control of water quality (surface and groundwater);
- Protection of bio-diversity and ecological function;
- Groundwater control and protection.

The objective of a stormwater drainage system is to balance these four aspects; to the extent that agreed levels of service are maintained and any adverse effects on the environment are minimised. To satisfy the latter, remedial or mitigation works will often need to be incorporated within the stormwater drainage system (see *WWDG Part B* section 2.2). Potential adverse effects include flood damage, surface and channel erosion and sedimentation, water pollution, loss of bio-diversity and damage to aquatic ecosystems.

Opportunities exist for the stormwater drainage design to integrate with the natural drainage system. Grassed swales, natural or artificial waterways, ponds and wetlands, for example, may in certain circumstances be not only part of the stormwater drainage system, but a required solution (depending on urban priorities) especially if a low impact on receiving waters downstream is critical.

Well designed and maintained alternative systems that replicate the pre-development hydrological regime can not only mitigate adverse environmental effects but also enhance amenity and ecological values.

Part 5: Stormwater & Land Drainage

5.2 CONSENT AND COMPLIANCE ISSUES

The consent and compliance information set out in Part 2: *General Requirements* applies to all works within the Waimakariri District, with the addition of the clauses below.

5.2.1 Legislation

The following Acts and amendments are the principal statues governing stormwater and land drainage:

- Local Government Act (2002) (LGA)
- Resource Management Act (1991) (RMA)
- Land Drainage Act (1908)

5.2.2 District Council Requirements

Requirements in the *Stormwater Bylaw* must be met (see also *WWDG Part B* chapter 17).

5.2.3 Consent Application – Information Required

In addition to the information required to support the concept drawings and/or Resource Consent plans in CoP Part 2: *General Requirements*, the following data shall also be provided:

- Catchment boundaries by defined surface levels (where the location of the catchment boundary is uncertain, the developer must define the boundary by survey);
- Identification of any natural or artificially created basins.

Part 5: Stormwater & Land Drainage

5.3 QUALITY ASSURANCE REQUIREMENTS AND RECORDS

Provide quality assurance records that comply with the requirements in CoP Part 3: *Quality Assurance* and the CCC *Construction Standard Specifications* (CSS), during design and throughout construction.

5.3.1 The Designer

The designer of all stormwater reticulation systems that are to be taken over by Waimakariri District Council and the person undertaking the catchment analysis must be suitably experienced. The qualifications and experience of the designer may be requested by the Council for approval prior to commencement of the design.

The design reviewer must have at least equivalent experience to the designer.

5.3.2 System Review

When the pipe selection and layout have been completed, perform a system review to ensure that the design complies with both the parameters specified by the Council and detailed in the CoP. The documentation of this review must include a full hydraulic system analysis. Compliance records must cover at least the following requirements:

- Pipe and fittings materials are suitable for the particular application and environment;
- Pipe and fittings materials are approved by Council;
- Pipe class is suitable for the pipeline application (including operating temperature, surge and fatigue where applicable);
- Layout and alignment meets the Council's requirements;
- Capacity is provided for future adjacent development;
- Hydraulic analysis details are provided;
- All assumptions are stated.

5.3.3 Engineering Design Approval

Provide the following information to support the engineering drawings and Design Report, as a minimum:

- Details and calculations that demonstrate that minimum standards of protection required by clause 5.5.2 will be maintained;
- Detailed calculations and drawings where applying to build within a flood plain, which determine the floodplain boundaries and levels relative to building floor levels (see *WWDG Part B* chapter 20 and the Building Act);
- Details and calculations that clearly indicate any impact on adjacent areas or catchments that the proposed works may have;
- Estimates of catchment imperviousness and the basis for its derivation;
- Summaries of hydrological and hydraulic modelling as required by the *WWDG* (see *WWDG Part B* chapters 21 and 22), including design parameters and assumptions;
- All assumptions used as a basis for calculations, including pipe friction factors;
- Draft versions of operations and maintenance manuals for any water quantity or quality control structures (refer also to clause 5.3.7);
- Landscape and planting drawings complying with QP-C811-AA *Standard Draughting Layout and Format Requirements* (attached to CoP Part 2 as Appendix A);
- System review documentation as detailed in clause 5.3.2;
- All options considered and the reason for choosing the submitted design.

Design checklists, to aid this process, are available in *WWDG Part B* sections 6.10 and 19.2.

Part 5: Stormwater & Land Drainage

Provide the following additional information for detention basins and swales:

- The design return period;
- The design rate of discharge at each discharge point;
- The design water level;
- The design volume, where there is a storage function;
- The volume of the basin or swale below surrounding ground level.

5.3.4 Construction Records

Provide the information detailed in CoP Part 3: *Quality Assurance* and the CCC *CSS*, including where applicable:

- All performance test results;
- Material specification compliance test results;
- Compaction test results;
- Subgrade test results;
- Infiltration test results.

5.3.5 Post-Construction Records

Provide the information detailed in CoP Part 3: *Quality Assurance*, Part 12: *As-Builts*, and the CCC *CSS*, including where applicable:

- Design report;
- Completion certificates;
- Producer statements – design, construction, construction review;
- Commissioning report, including all test results;
- Operations & maintenance manuals, where applicable;
- As-built plans and records.

5.3.6 Approved Materials

Where a material or product is proposed that is not approved in the district, prior to approval, the Council may require assurance that demonstrates the durability of that material. Where there is no current standard, the manufacturer will be required to supply copies of their Quality Assurance procedures and producer statements to support their performance and composition claims for the products concerned.

5.3.7 Operations and Maintenance Manual

Provide an Operations and Maintenance Manual in accordance with *WWDG* Part B clause 19.2 for any water quantity and/or quality control structures or formed features such as ponds. The manual must describe the design objectives of the structure, describe all the major features, identify all the relevant references to the *WWDG* and identify key design criteria (including any conditions attached to the relevant resource or other consents).

A separate section must explain operations such as the recommended means of sediment removal and disposal, and identify on-going management and maintenance requirements such as landscape establishment, vegetation control and nuisance control. CoP Part 10 section 10.6 – *Establishment & Maintenance* expands on these requirements.

Part 5: Stormwater & Land Drainage

5.3.8 Acceptance Criteria

All pipelines, pump stations and other integral components must be tested before acceptance, and must have been inspected and signed off by the Council. Testing shall be carried out in accordance with CCC *CSS: Part 3* clause 14.

Part 5: Stormwater & Land Drainage

5.4 GENERAL DESIGN PRINCIPLES

Stormwater drainage is the total system protecting people, land, infrastructure and improvements against flooding. It consists of a primary drainage system of pipes and waterways and detention areas and a secondary system consisting of open channels, controlled flood plains, natural ponding areas and flow paths. These are utilised in conjunction with the setting of building levels to ensure that buildings remain free of inundation up to the minimum protection standards set out in clause 5.5.2 and the Building Act.

The primary system must cater for the more frequent rainfall events and the secondary system must cater for higher intensity rainfall events and occasions when there are blockages in the primary drainage system. Table 5.1 sets out the minimum level of service requirements for the District. Where required, the developer shall provide new treatment and disposal facilities, and upgrade the existing facilities. Treatment and disposal systems in Business zoned area shall be specifically designed.

The designer shall have an appreciation of the local catchment, both upstream and downstream, and limit or mitigate any adverse effects imposed by the development, including effects on surface water and groundwater

To maintain water quality, it is desirable to avoid mixing stormwater and spring water if at all possible. The reticulation and disposal system should receive minimal influence from wastewater and groundwater.

5.4.1 Design Considerations

Consider the following aspects and include in the design, where appropriate:

- Size (or sizes) of the surface water drainage pipework throughout the proposed reticulation system;
- Selection of appropriate pipeline material type(s) and class;
- Mains layout and alignment including: route selection, topographical and environmental aspects, easements, foundation aspects, clearances and shared trenching requirements, provision for future system expansion;
- Hydraulic adequacy including acceptable flow velocities and other requirements where applicable to satisfy *WWDG Part B* chapter 22;
- Property service connection locations and sizes;
- Seismic design – all structures must be designed with adequate flexibility and special provisions to minimise risk of damage during earthquake. Provide specially designed flexible joints at all junctions between rigid structures (e.g. reservoirs, pump stations, bridges, buildings, manholes) and natural or artificially formed ground;
- Geotechnical investigations – take into account any geotechnical requirements determined under CoP Part 4: *Geotechnical Requirements*.

5.4.2 Integrated Stormwater Systems to Manage Quality and Quantity

Integrated stormwater systems are both the optimum and preferred method of stormwater treatment. When these systems are being considered, discuss their use with the Council at an early stage (Refer to *WWDG Part B* chapters 5 to 12 for more information on this topic).

Part 5: Stormwater & Land Drainage

Well-designed and well-maintained integrated systems, which replicate the pre-development hydrological regime, can not only mitigate adverse environmental effects, but also enhance local amenity, water quality and ecological values. These systems are designed in accordance with the waterway's six values of ecology, landscape, recreation, heritage, culture and drainage (refer *WWDG Part 1* Table 1.1).

- Ecology - Includes ecological processes and inter-relationships between plants, birds, fish and insects.
- Landscape - The special character of sites, aesthetic quality, and sense of place to people and communities.
- Recreation - Active and passive recreation, play and facilities associated with recreational activities.
- Heritage - Sites and activities of both human (e.g. structures) and natural (e.g. landforms) significance.
- Culture - The values of Maori and Pakeha, as well as wider community aspirations and involvement.
- Drainage - Groundwater and surface water inter-relationships, flows, flooding and stormwater.

The Council may approve existing or proposed areas of vegetation that are protected by way of an agreement, such as conservation covenant or Queen Elizabeth II Trust Covenant.

Matters that the Council will assess when considering approval shall include:

- Vegetation type, cover and location with respect to the stormwater system;
- Duration and purpose of the agreement (as defined above);
- Planned or potential earthworks or vegetation removal.

5.4.3 Catchment Management Planning

Carry out stormwater planning on a coordinated and comprehensive catchment-wide basis. Consider catchment-wide issues at the concept design stage and comply with the catchment management plan, if one exists.

The implications of future development upstream of the site, and the cumulative effects of land development on water quality and flooding downstream, are important considerations. The larger the scale of the development the more significant the catchment management planning issues are likely to be.

Discuss any catchment management planning issues with the Council at an early stage (see also *WWDG Part B* chapters 2, 5, 7 to 12 and 20).

5.4.4 Effects of Land Use on Receiving Waters

Impervious surfaces and piped stormwater drainage systems associated with urban development have a major effect on catchment hydrology. Faster run-off of polluted storm flows, reduction in stream and groundwater base flows and accelerated channel erosion and depositions alter the hydrology and adversely affect the quality of receiving waters. This in turn reduces the diversity of the aquatic biological community.

The effects of rural development on receiving waters are generally less significant where riparian margins are protected. However, any reduction in riparian vegetation which increases sediment loads and nutrient concentrations is likely to reduce aquatic biodiversity.

Consult with Environment Canterbury (ECan) and Waimakariri District Council at an early stage to identify likely adverse effects of land use on receiving waters (see also *WWDG Part B* chapter 2).

Part 5: Stormwater & Land Drainage

5.4.5 Catchments and Off-Site Effects

All stormwater systems must provide for the collection and controlled disposal of surface water from within the land being developed, together with any existing run-off from upstream catchments. In designing downstream facilities, consider the upstream catchment to be fully developed, including both the existing zoning and any catchment management plans.

For all land development works (including projects involving changes in land use or coverage), include an evaluation of stormwater run-off changes on upstream and downstream properties. This evaluation will generally be required at the resource consent stage.

Development must not increase upstream or downstream flood levels, unless any increase is negligible and can be shown to have no detrimental effects.

Investigate downstream impacts including changes in flow peaks and patterns, flood water levels, contamination levels, erosion or silting effects, and effects on the existing stormwater drainage system. Where such impacts are considered detrimental, mitigation measures (e.g. peak flow attenuation, velocity control, contamination reduction facilities) on or around the development site, or the upgrading of downstream stormwater disposal systems at the developer's expense, will be required.

5.4.6 Stormwater Pumping

Permanent stormwater pumping will only be permitted under exceptional circumstances. Refer to *WWDG Part B* section 13.6, taking into account the following additional requirements:

- Pumping systems shall be specifically designed using a multi-pump system to best balance the need for regular pump operation against the relative infrequency of major storm events. Design philosophy and technical details shall be discussed with the Council before detailed design is commenced;
- All pumps within a station shall be of the same or similar capacity. An additional installed pump shall act as standby;
- All electrical equipment shall be designed for a maximum of 15 starts per hour. Depending on the consequences of flooding during a pump station power outage, the Council may require that an on-site emergency power source or hook-up be provided;
- Valving of pumps shall be such that maintenance can be undertaken on the standby pump and check valve without interfering with the operation of the duty pump. Flanged or welded fittings shall be provided throughout, with a proprietary dismantling joint or similar in the system to facilitate dismantling;
- Stormwater pump stations shall incorporate control, monitoring, alarm and telemetry communication systems to Council standards at the time of the design. Any station on private land must have all weather access for light 5 to 7 tonne trucks.

5.4.7 Flood Risk

Flood Risk Assessment shall take account of the characteristics of the total catchment. A search shall also be undertaken to find any relevant historical information on flooding. This could include reviewing records held by relevant bodies, discussions with the local inhabitants or appropriate field investigations.

Part 5: Stormwater & Land Drainage

The assessment shall address the following:

- The proximity and nature of any river, stream or watercourse and associated flood plains;
- The capacity of culverts or watercourses downstream of the site and likelihood of upstream ponding resulting from under capacity or from blockage by debris or slips;
- The upstream culvert and watercourse conditions and the location of the secondary flow path for floodwater in the event of blockage or under capacity.

Flood design shall take into account the overall site conditions, details of the drainage system and the probable impediments to free flow (both upstream and downstream) when determining the expected runoff and design flood levels.

5.4.8 Reducing Waste

When designing the development, consider ways in which waste can be reduced.

- Plan to reduce waste during site clearance e.g. minimise earthworks, reuse excavated material elsewhere.
- Design to reduce waste during construction, e.g. prescribe waste reduction as a condition of contract.
- Select materials and products that reduce waste by selecting materials with minimal installation wastage rates.
- Use materials with a high recycled content e.g. recycled concrete subbase.

See the Resource Efficiency in the Building and Related Industries (REBRI) website for guidelines on incorporating waste reduction in your project www.rebri.org.nz/.

5.4.9 Alternative Technologies

The Council will consider alternative technologies on a case-by-case basis. Examples of such technologies are gross pollutant traps and bio-filters.

Part 5: Stormwater & Land Drainage

5.5 DESIGN PARAMETERS

5.5.1 Design Lifetime

All stormwater reticulation systems are to be designed to last for an asset life of at least 100 years with appropriate maintenance. Design the systems accordingly, to minimise lifecycle costs for the whole period. Assets designed to minimise capital cost at the expense of overall lifecycle cost will not be accepted.

5.5.2 Minimum Protection Standards for New Developments

Design all new surface water and land drainage systems to cope with design storms in accordance with Table 5.1 and *WWDG Part B* chapters 20, 21 and 22.

Table 5.1 Design Storm AEP for System or Infrastructure

System or Infrastructure	AEP
Primary reticulation system – general	20%
Primary reticulation – Rangiora and Kaiapoi CBD	10%
Secondary flowpaths	2%
Culvert (Refer also NZTA Bridge Manual Clause 2.3 for heading up and maximum levels below road surface).	10%
Bridge (Refer also NZTA Bridge Manual Appendix A3 for minimum clearance above water level).	1%

Post-development peak flows for all intensity events shall be less than pre-development flows.

The minimum floor level must be as specified in the *District Plan Chapter 27: Natural Hazards* where those plans apply, otherwise as specified in the Building Code E1/AS1 subject to the limitations of that document. Where neither document is applicable, specific flooding design shall be required to demonstrate compliance with the Building Code.

Note:

- The Building Code requires that the floor height must be above the 2% AEP (annual exceedance probability) flood level, plus a set freeboard depending on the building site. Freeboard is the provision for flood level design estimate imprecision, construction tolerances and natural phenomena (e.g. waves, debris, aggradations, channel transition and bend effects) not explicitly included in the calculations.
- Discuss commercial and industrial developments with special circumstances with the Council.
- In circumstances where ponding water on roads will exceed 100 mm a greater freeboard may be required.
- It is the responsibility of the developer to identify the 2% AEP level and ensure the accuracy of that information.

Discuss protection standards in tidal areas with ECan and the Council at an early stage. Storm surge and tsunami hazards, climate change, the *District Plan* requirements, and sea level rise must be considered, and a precautionary design approach is recommended.

5.5.3 Surface Water Run-off

Surface water hydrology shall be in accordance with *WWDG Part B* chapter 21, with the adjustments stated below. Drainage system hydraulics shall be in accordance with *WWDG Part B* chapters 20 and 22. Disposal to soakage chambers shall be in accordance with *WWDG Part B* chapter 6.

Part 5: Stormwater & Land Drainage

Estimation of the peak flow rate and volumes shall be in accordance with *WWDG Part B* chapters 21, 22.

The rainfall intensity tables for use in runoff calculations are provided in QP-C814-AA (attached as Appendix A). These have been taken from HIRDS V4 Scenario RCP 8.5 (2081-2100). For areas not covered by the tables, interpolate between the nearest points given. If required, more precise data may be obtained by using HIRDS V4 Scenario RCP 8.5 (2081-2100) or by requesting the data from WDC.

To be conservative, the rainfall estimates should be increased further for hill catchments.

The runoff coefficient (C value) used shall be taken from either Table 5.2 or Table 5.3, whichever is the greater, rather than the values given in *WWDG*.

Table 5.2 Runoff Coefficients for Specific Designs

Surface Type	C Value
Fully roofed and/or sealed developments	0.90
Asphalt, concrete, and other paved surfaces	0.85
Bare impearmeable clay with no interception channels or runoff control	0.70
Bare uncultivated soil of medium soakage	0.60
Unsealed roads, yards and similar surfaces	0.50
Heavy clay soil types – pasture and scrub cover Parks, playgrounds, reserves, gardens, lawns, etc.– predominantly grassed areas	0.30
Heavy clay soil types – bush cover Parks, playgrounds and reserves – predominantly bush	0.25
High soakage gravel and sandy types – pasture and scrub cover	0.20
Slope of Ground	**Correction**
0-5%	-0.05
5-10%	0
10-20%	+0.05
Steeper than 20%	+0.10

The C values in Table 5.2 shall be adjusted by the slope corrections as appropriate. The initial values given assume an average slope of 5-10%.

Table 5.3 Runoff Coefficient by Zone

Land Use	Zones	C Value
Industrial, commercial, CBD, town house developments	Bus1, Bus2, Bus3, Bus4	0.80
Residential	Res1, Res2, Res3, Res6, Res6A	0.65
Rural, Rural-residential	Res4A, Res4B, Res5, Rural 4B, Rural Pegasus	See Table 5.2

Impervious area estimations shall be based on proposed land use activity. Impervious area is defined as all potential buildings, houses, driveways, sheds, patios, carparks and other impervious or semi-pervious areas. Where alternative porous pavements or other methods that encourage groundwater infiltration are used then appropriate allowances may be made. Historical evidence would need to be submitted that verifies the performance of these alternatives.

A recognised alternative runoff estimation method supported by good hydrological information may be presented for consideration.

Part 5: Stormwater & Land Drainage

5.5.4 Determination of Water Surface Profiles

Design stormwater drainage systems in accordance with *WWDG Part B* sections 14.6 and 22.10, by calculating or computer modelling backwater profiles from the specified outfall water level set by the Council as stated in clause 5.9.9 – Outfall water levels 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 networks at manholes and other nodes, water levels computed at design flow must not exceed finished ground level while allowing existing and future connections to function satisfactorily.

An example of stormwater system analysis including a backwater calculation is provided in *WWDG Part B* Appendix 5.

Stormwater pipelines generally operate in a surcharged condition at full design flow. Pipe diameters chosen on the basis of pipe flow graphs, such as *WWDG Part B* Appendix 9 (which uses pipeline gradient rather than hydraulic gradient), are likely to be conservative in parts affected by free outfall conditions.

5.5.5 Secondary Flowpaths

Shape lots generally so that they fall towards roadways, which may be used as secondary flow paths. The use of strategic or arterial roads for this purpose shall not be approved. Ponding or secondary flow on roads must not exceed 100 mm at the crown, and velocities must be sub-critical other than where it is unavoidable on hillsides. On hillsides, convey secondary flows safely and as directly as possible into permanent open waterways.

Surface flows on carriageways shall be controlled in order to enable safe and comfortable vehicle and pedestrian access across and along road reserves.

Where secondary flow paths cannot, with good design, be kept on roads, they should be kept on public land such as accessways, parks, and reserves. Secondary flow paths over private land are the least desirable option and will need to be protected by legal easements.

Design secondary flow paths so that erosion or land instability caused by the secondary flows will not occur. Where necessary, incorporate special measures to protect the land against such events.

Avoid shaping roads to create basins with piped outlets. Where basins are created a higher level of service for the primary system may be required.

The secondary flow path sizing and location must be supported by adequate analysis to show:

- That it is of adequate capacity to handle the full flow of events up to 2% AEP, assuming the primary system is not functioning (this may be relaxed at the Council's discretion); and
- That it discharges to a location that does not detrimentally affect others and can safely dissipate via a controlled disposal system as the storm peak passes.

Consider the secondary flow path under conditions of total inlet blockage at critical culverts and other critical structures.

Part 5: Stormwater & Land Drainage

5.6 PIPELINE DESIGN

5.6.1 Pipe Flow

Determine pipe diameters, flows and gradients from *WWDG Part B* Appendix 11.

For pipes not flowing full, use Manning's equation adopting 'n' values from *WWDG Part B* Table 22-1. Determine part full pipe flow relationships from *WWDG Part B* Appendix 9.

The primary piped system shall be designed to cater for the peak design flow, without surcharge, based on the "Colebrook-White" equation. The pipe roughness coefficient shall be:

- For pipes up to and including 300 mm diameter – Ks = 1.50 (n = 0.013).
- For larger pipe diameters – Ks = 0.60 (n = 0.012).

Refer to *WWDG Part B* chapter 22 for guidance on energy loss through structures.

5.6.2 Pipeline Connections

Make pipeline connections in accordance with CCC *CSS: Part 3*.

Design the stormwater drainage system as a separate system (i.e. with no inter-connections whatsoever with the wastewater system).

Submain and lateral lines may be saddled directly onto larger pipelines, if and only if the main line is greater than twice the diameter of the branching line, and provided that a manhole or other surface opening is supplied on the branching line within 50 m of the main line. If this is not possible, then a manhole shall be installed.

5.6.3 Minimum Pipe Sizes

The minimum pipe diameter is 225 mm diameter.

5.6.4 Material Selection

Select stormwater pipe materials in accordance with this document. Other materials shall be considered on a case-by-case basis.

The following pipe materials currently available in New Zealand are acceptable for gravity stormwater lines:

- Polyvinyl Chloride: PVC-U
- Reinforced Concrete with Rubber Ring Joint (RCRRJ)

The following pipe materials currently available in New Zealand are acceptable for pressure stormwater lines:

- Polyvinyl Chloride: PVC-U and PVC-O
- RCRRJ;
- Polyethylene: PE 100B and PE 80B;
- Ductile iron (DI);
- Concrete-lined steel.

Part 5: Stormwater & Land Drainage

Each material has specific design and installation issues, as identified in the manufacturers' design manuals, specifications and other literature. Consider these issues, as listed below, when specifying materials.

- Polyvinyl Chloride: PVC-U, PVC-O
  - UV degradation after more than 2 years exposure.
  - Depth of scratching, gouging and impact damage limited to 10% of the wall thickness.
  - Proper bedding and installation required.
  - Possible permeation by contaminants.
- Polyethylene: PE80B, PE100
  - Sophisticated equipment and highly skilled workers required.
  - Depth of scratching, gouging and impact damage limited to 10% of the wall thickness.
  - UV degradation (Blue pipe).
  - Bedding support required to prevent excessive deformation.
  - Pulling forces for PE are not to exceed the manufacturer's recommendations.
  - Vulnerable to permeation by contaminants (e.g. hydrocarbons).
- RCRRJ and Concrete-lined Steel
  - Internal lining and external coatings must be undamaged or fully restored after repairs or fabrication work.
- Ductile Iron
  - Internal lining and external coatings must be undamaged or fully restored after repairs or fabrication work.
  - Potential problems with stray electric currents and bimetallic corrosion.

The effect of fatigue on the pipe is important for all pressure lines subject to cyclic pressure changes.

All fittings shall have a rating at least equal to or greater than the pipe rating. Pressure pipe fittings may not have a rating less than PN12.

The highest class determined for any point on a line is required for the entire section, manhole to manhole.

5.6.5 Minimum Cover

Pipelines must have pipe protection complying with CoP Part 6 clause 6.6.8 – *Pipe Protection & Cover*, where the minimum cover specified in CCC *CSS: Part 3* is not available.

5.6.6 Gradients and Acceptable Flow Velocities

Refer to *WWDG Part B* clause 14.2.4.

5.6.7 Steep Gradients

Where gradients are steeper than 1:3 over lengths greater than 3.0 metres or where velocities are higher than 4.0 m/s, and when flows are continuous or frequent, specify wear-resistant pipes such as ABS, or PVC-U pressure pipe with a minimum class of SN12. This requirement may extend past the termination of the steep grade. Sacrificial layers can be used in special concrete pipes, or in in-situ structures.

Avoid lateral junctions on these sections of pipeline. If PVC-M pipes are used and junctions can not be avoided, specify factory-moulded fittings. Take care to provide adequate anchorage for the pipes.

Part 5: Stormwater & Land Drainage

5.6.8 Scour

Hilly areas, and areas adjacent to them, may have large variations in groundwater levels. These variations can cause sufficient water movement within the trench for bedding scour to develop. Allow for scour in flat areas where pipe gradients are steeper than 1:10 and immediately below hill areas. Refer to *CSS: Part 3* clause 8.6 for details of requirements. Fill any under-runner voids encountered during the work with either 'foam concrete' or 'stiff flowable mix' as defined in CCC *CSS: Part 1*. This treatment must be carried out under the direction of the engineer.

Haunching and backfill materials for areas prone to scour include lime-stabilised loess (40 kg/m^3), lime stabilised SAP20 (40 kg/m^3), lime stabilised SAP40 (40 kg/m^3), 'firm mix' as defined in CCC *CSS: Part 1* or concrete haunching (if bedrock is encountered).

Confirm the suitability of loess for backfill. Loess can only be used in areas outside carriageways and where there is adequate control of moisture content and mixing on site. Use lime stabilised SAP40 for backfilling all carriageways, and lime stabilised SAP20 in all areas outside carriageways where loess is not suitable.

Specify water stops on all pipelines with gradients steeper than 1:3, where the pipe is concrete haunched. Where 'firm mix' is used for haunching, water stops are not required. *WWDG Part B* clause 14.2.3 details the design criteria, and construction must comply with SD 600-347.

5.6.9 Inlet and Outlet Structures

Design inlets and outlets in accordance with *WWDG Part B* sections 14.6 and 14.7. Install safety grills where pipe diameter is greater than 525 mm. Install debris grills where blockage is a potential problem. Provide for operational requirements.

Consider the effects of inlet and tailwater controls when designing culverts, as set out in *WWDG Part B* section 22.9.

Take backflow effects into account in design. Consider outlet design and water level conditions in the design of discharges to existing stormwater systems and waterways and incorporate backflow prevention if necessary.

Where pipes discharge onto land or into a waterway outlet, design structures to dissipate energy and minimise erosion or land instability. Ensure velocities are non-scouring at the point of discharge. Acceptable outlet velocities will depend on soil conditions, but should not exceed:

- 0.5m/s where the substrate is cohesive; or
- Velocities given in *WWDG Part B* section 22.7 Table 22-5.

5.6.10 Manholes

Provide manholes in accordance with *WWDG Part B* section 14.4 and CCC *CSS: Part 3*. Consult the Council before embarking on any part of the system design where the velocity is such that the flow will not progress smoothly through the manhole into the discharge pipe.

No feature should impede flow through a manhole. If circumstances necessitate such a feature, widen the cross section of the manhole to counteract any potential head loss. The design must be accepted by the Council.

Check the effects of turbulence or hydraulic grade on pressure within manholes. Manhole depths must prevent the lifting of manhole lids and tops.

Part 5: Stormwater & Land Drainage

Manholes shall normally be provided on all drainage pipelines as follows:

- At each change of direction, pipe size or gradient;
- At each branching line or intersection;
- At the end of all terminal lines other than those with headwalls;
- At a spacing of not more than 90 m for pipes of diameter 1500 mm or less;
- At a spacing of not more than 150 m for pipes of diameter in excess of 1500 mm, with the approval of the Drainage Asset Manager.

Access chambers or sumps may be used in place of manholes where appropriate.

5.6.11 Sumps

Sumps shall be generally constructed to accord with *WWDG Part B* section 14.5 and with the standard drawings. Sump grate bars shall be aligned with the direction of flow.

Sumps shall be installed at every intersection and dip , and located such that channel flows do not exceed the limits stated:

- 55 L/s for a single sump
- 90 L/s for a double sump

Maximum sump spacing shall be as described for manholes in clause 5.6.10. In addition to the requirements above, note that intersection sumps are generally located on the kerb-line tangent point.

Sumps shall be sited so that they do not impede accessways or kerb crossings due to any ponding that may occur in rainfall events less than 10% AEP.

Design consideration shall also be given to the effect of stormwater flows from and along the road surface, for example flow around corners and at intersections.

Terrain with a slope of greater than 10% is considered hilly. In this situation sump efficiency and effectiveness decreases and the Council will require specific design to be submitted for approval.

Connections to sumps shall be made in accordance with SD 600-341A/B/C. Minimum 225 mm diameter pipes shall be used to connect a sump to any adjacent manhole in the primary stormwater reticulation system. Direct saddle connections from any sump outlet pipe to an adjacent stormwater system may be approved provided the adjacent system uses 600 mm diameter pipes or larger, and an existing manhole is not conveniently located. The diameter of the connecting pipe shall be less than half the diameter of the pipe used by the adjacent system.

During road works or construction a suitable means of preventing debris entering the stormwater system must be used. Any gravel or debris entering sumps or the stormwater system shall be removed or flushed from the system prior to acceptance by the Council.

Sump filters may be used, provided that a specific design and a maintenance plan are submitted to the Council. Written approval from the Council shall be required to proceed.

5.6.12 Subsoil Drains

Design subsoil drains, which are installed to control groundwater levels, in accordance with *WWDG Part B* clause 5.3.1.

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

Part 5: Stormwater & Land Drainage

5.6.13 Pipelines in Permeable Ground

Where a buried pipeline is likely to encounter an underground source of water, ensure that the groundwater in the water bearing layers will not be diverted to a new exit point through the backfill. Specify backfill material with the same permeability as the surrounding ground and detail water migration barriers at any change of ground permeability.

5.6.14 Concrete Waterstops

WWDG Part B clause 14.2.3 details the design criteria to consider before installing concrete waterstops, additional to those relating to permeable ground. Space waterstops as detailed in *WWDG Part B* Table 14.2. Specify waterstops constructed to comply with SD 600-347.

Also specify waterstops on all pipelines with gradients steeper than 1:3 where the pipe is concrete haunched. Where 'firm mix' is used for haunching water stops are not required.

Part 5: Stormwater & Land Drainage

5.7 WATERWAY DESIGN

Design waterways in accordance with *WWDG Part B* chapters 7 to 13 inclusive.

Where a natural waterway, open stream, or formed drainage channel is incorporated in a land drainage system, then it shall:

- Accommodate the design freeboard including the required factor of safety;
- Be designed to prevent scour effects resulting from a 2% AEP storm.

Provide access along at least one side of any waterway for maintenance, taking into account the "reach" of cleaning machinery. Vegetate berms and banks and lay at slopes that are stable, maintainable, and not prone to scour in flood flows.

Buildings and other structures are to be subject to a 10m offset from a waterway, and any proposed reduction will require approval by the Drainage Asset Manager.

Maintain fish passage, unless otherwise authorised by the Council or ECan. Refer to *WWDG Part B* section 2.2 and clause 13.2.5

5.7.1 Constructed waterways

Design constructed waterways to meet the aesthetic and amenity criteria of the Council (see *WWDG Part B* chapters 7 to 9, 11 and 12). These waterways must form part of a surface water management system.

Public constructed waterways will be maintained by the Council.

5.7.2 Natural waterways

Restore and enhance the natural features and amenity values of highly modified natural waterways wherever possible.

Avoid the piping or filling-in of natural waterways. A resource consent from the Council and ECan will be required for this activity.

Provide for drainage, landscape, ecology heritage, recreation and cultural values when enhancing these waterways. Refer to *WWDG Part A* for an understanding of the principles underpinning these values and *WWDG Part B* Chapters 7 to 9, 11 and 12 for information about specific criteria. For information about riparian planting refer also to the *Streamside Planting Guide*.

Create Local Purpose (Esplanade) Reserves around significant natural waterways.

5.7.3 Fencing

The *Stormwater and Land Drainage Bylaw* requires consent for the erection of a fence across a waterway. Fences must not significantly impede flood flows up to the minimum protection standards (Refer *WWDG Part B* section 13.9).

Part 5: Stormwater & Land Drainage

5.8 DISPOSAL AND TREATMENT DESIGN

5.8.1 Approved outfall

The outfall for a development must be either the public stormwater drainage system or an approved alternative stormwater disposal system, subject to the following conditions:

- Development in areas zoned Residential 1 or 2 shall discharge either directly or indirectly to a reticulated system, through an approved soakage or detention system as appropriate;
- Development in areas zoned Residential 4A or 4B, but not in a rural drainage area, shall discharge to a public drain, a natural drainage system or to ground, where the subsoil strata permits;
- In rural drainage areas, all lots shall be provided with access to a common or public drain. This may require passage via a reticulation system that includes a private drain across third party property, in which case easements and rights of way shall be required. In all cases, the existing drainage system and use rights shall be retained. Where practicable and approved, disposal may be via soakage to ground.
- A suitable headwall and dissipating structure must be constructed at the outlet to ensure no erosion occurs in the immediate vicinity of the waterway;
- No obstruction which will impede the natural flow may be placed in the channel;
- The discharge must be authorised by ECan.

All primary piped reticulation outlets that discharge into a natural waterway, swale, pond, or open drain, and are also subject to tidal effects or backflow, shall be fitted with an approved flap valve.

All primary piped reticulation outlets in Residential or Business Zone areas and using pipes greater then 600 mm in diameter, or if otherwise required by the Drainage Asset Manager, shall have an approved safety grill that is secured to prevent unauthorised access.

5.8.2 Discharge to ground

The Council encourages discharging to ground where soil conditions are suitable for soakage. Note that soakage cannot be relied on to reduce the capacity required by the system (refer to *WWDG Part B* section 6.5). The stormwater system should be designed to handle the full stormwater discharge at the required level of service, with the assumption that the soakage is not functioning. Offset of reticulation capacity may be allowed at the Council's discretion.

A geotechnical investigation shall be carried out when considering the use of soakage in a development.

A discharge consent may be required from ECan for discharge to soakage.

All roadside soakpits shall comply with the requirements of this Code. Example designs are shown in SD 600-330A/B and 600-390. Soakpits for roading purposes shall be marked using one blue post of a type to be approved by the Council.

Silt traps and standard sump and gratings may be installed upstream to protect soakpits from excess sediment entering the soakpit system.

Soakpit design will take into account any effects of the location and inflow source. Pre-treatment shall be designed and installed where needed to prevent silting up and other problems. The systems shall be designed and located for ease of maintenance and replacement as required.

Discharge to ground on private property is acceptable, but in urban areas the soakpit must be protected by a consent notice requiring the property owner to maintain and protect the system. This does not apply for rural developments.

Part 5: Stormwater & Land Drainage

5.8.3 Stormwater Tanks

Stormwater tanks on private properties can regulate stormwater discharge from connected impervious areas such as roofs, hardstand areas and driveways. The Council may recommend or require a stormwater tank when:

- The public stormwater system downstream has no capacity for a new connection and it is uneconomic to upgrade it;
- Direct discharge to a hill gully or slope is likely to cause erosion.

Tanks are unlikely to be approved if an economic alternative system is available.

The Council may approve a request from a private property owner to install a stormwater tank for water conservation or other reasons.

Refer to the CCC leaflet *Stormwater Tanks on Private Properties* for further guidance, including installation guidelines.

5.8.4 Treatment

Design for discharge quality in accordance with *WWDG Part B* chapter 6 and ARC TP10. The designer may propose alternative design elements with supporting evidence from recognised authorities.

All stormwater that outfalls from a development to a centralised system shall be treated prior to entry to the Council's stormwater system. Discharge quality shall not breach the ECan Pollution and Sediment Control guideline, and shall also comply with the specific conditions of the discharge consent. Note that ECan currently has a minimum threshold of 30 lots.

The Council may consider alternative methods that provide adequate treatment of discharge. The developer is encouraged to explore ground infiltration and non-structural methods of water quality protection. Such methods include reduction of impervious area, providing sheet flow through vegetated buffer strips, bio-retention and maximising vegetation cover. Use of the above suggestions may reduce the size of stormwater treatment facilities required.

Part 5: Stormwater & Land Drainage

5.9 NETWORK LAYOUT DESIGN

5.9.1 Topographical Considerations

In steep terrain, the location of pipes is governed by topography. Gravity pipelines operating against natural fall create a need for deep excavations, which can be very expensive. They can also create basins with piped outlets.

The pipe layout must conform to natural fall as far as possible. Where basins are created, provision of a fail-safe outlet and a higher level of service for the primary system may be required.

5.9.2 Location of Open Waterways

Open drainage systems shall generally be located within a drainage reserve, easement or road reserve. Using drainage easements or road reserves in Residential or Business zones is subject to approval by the Drainage Asset Manager.

5.9.3 Location and Alignment of Stormwater Pipelines

Locate stormwater pipeline mains within the legal road (but not under the crown of the carriageway) or within other public land. Allow for access for construction or future maintenance.

Position pipes as follows:

- Within the road formation (refer *WWDG Part B* clause 14.2.1);
- Within public land with the approval the Council;
- Within drainage reserves;

Pipes should not be placed within private property where other options are available. If this is unavoidable, the pipe shall be placed adjacent to and, if possible, parallel to boundaries, with a minimum offset to the pipe centreline of one metre. Clause 5.9.12 – *Easements* shall apply.

Make crossings of roads, railway lines, creeks, drains and underground services at right angles, as far as practicable.

Allow for possible future building plans when locating proposed pipes and avoid maintenance structures within the property. This may include specifying physical protection of the pipe within or adjacent to the normal building areas or any engineering features (existing or likely) on the site e.g. retaining walls.

Specific design and approval from the Council is required for the use of curved pipelines.

Note that pipes with diameter 450 mm or less, within the road reserve, shall be located under the kerb & channel (where present). Pipes with diameter 525 mm or greater shall be located in the carriageway. See also SD 600-245A/B/C.

5.9.4 Service Lateral Connections

In Residential or Business Zone areas, all primary piped reticulation inlets shall be via either a service connection, a sump or an approved grated entry structure. Those fitted with a grate shall offer a maximum bar spacing of 150 mm. The approach slope of any fitted inlet grill shall be at a slope of no more than 30 degrees above the horizontal.

Connections of laterals to mains must be in accordance with CCC *CSS: Part 3*.

Part 5: Stormwater & Land Drainage

The connection of individual lots and developments to the public system must meet the following requirements:

- Connection must be by gravity flow via laterals to mains or waterways, or to a roadside kerb or swale or rain tanks, or (in certain situations) on site detention tanks;
- Provide all new urban lots with individual service laterals;
- Each connection must be capable of serving the entire building area of the lot (unless approval is obtained from the Council to do otherwise);
- Provide stormwater connections at such depth at the boundary of urban lots that a drain is able to be extended from the connection to the farthest point on the lot, at grades and cover complying with the Building Act 2004;
- The minimum diameter of connections must be:
    - 100 mm for residential or commercial lots.
    - 150 mm for industrial lots.
    - 150 mm for connections serving three or more dwellings or premises (unless otherwise approved by the Council);
- Where the public system is outside the lot to be served, extend a connection pipeline a minimum of 0.6 m into the main area of the lot;
- The connection shall be positioned so as not to compromise the lot's available building area. Generally this position will be on the road frontage, clear of street trees and vehicle crossings, approximately 0.6 m from a side boundary and within 0.6 m of the final ground surface;
- Connection to features such as vegetated swales, soakpits, or soakage basins is acceptable provided the system is authorised by ECan and adverse effects and potential nuisances are addressed;
- Seal all connections to pipelines or manholes by removable caps at the upstream end until such time as they are required.

Where a design for a residential lot requires a 150 mm diameter service connection pipe or larger:

- Connection to a kerb or roadside drain outfall shall require two 100 mm diameter pipes.
- The 100 mm diameter pipes shall outfall from an approved sump located inside or adjacent to the roadside boundary.
- Where outfall is to kerb and channel, two kerb adapter connections shall be used and be located not less than 300 mm and not more than 500 mm between centres.

Service connections shall, wherever possible, be laid at right angles to the main reticulation system, and shall be of a type as detailed in Table 5.4.

Table 5.4 Service Connection Type

Zone	Reticulation	Connection Type
All Residential except 4A and 4B	Kerb and channel	PVC-U Kerb adapter
	Piped main available	Direct saddle connection to main, or to ground soakage where soil conditions are suitable (overflow pipe to kerb & channel may be required)
Residential 4A or Residential 4B	With Reticulated drainage system	To provide retention, drains, natural waterways or ground soakage where soil conditions are suitable.
	Without reticulated drainage system	To natural waterway or ground soakage where soil conditions are suitable.

Where the reticulation is laid deeper than 3 metres below ground level, service connections should not be via direct connection to the reticulation. In this situation, connections shall be made via a manhole, sump or similar structure.

Part 5: Stormwater & Land Drainage

Footpaths and kerbs shall be sawcut at the position of the service connection to allow controlled cracking.

5.9.5 Location and Design of Basins

Ponding basins are being used throughout the district as stormwater treatment and detention devices to improve water quality and to mitigate increased stormwater flows. These structures are important landscape features in public open space. Carefully consider their location, design, construction, and ongoing maintenance requirements, including full vehicle access, during the early stages of planning.

Ponding basins must be constructed on land vested in the Council. If the land is not to be vested immediately, the area must be protected by an easement, a bond, and an agreement for the land to be vested at a later date.

From a landscape perspective, these types of basins are highly designed and managed in order to protect their primary functions (e.g. stormwater storage capacity, soil infiltration). Design solutions should build on the features of the local landscape, features associated with the proposed development and the wider planning context. As the Council will generally take on the responsibility for these structures, it needs to have input into the design of these structures from the outset.

Co-locate basins with public open space having a similar appearance and maintenance approach (i.e. road reserves and recreation reserves with a garden approach to maintenance). Basins should not be located in areas that are being managed primarily for their ecological values (such as esplanade reserves). The management approach for ecological areas aims to support natural processes through encouraging natural regeneration with limited maintenance that focuses predominantly on managing for weed species.

Design and construct swales and basins so that they replicate natural landforms. Where possible, create organic, undulating landforms with meandering inverts and mid-slope terraces. Avoid slopes that have a gradient steeper than one-in-four. Round off all tops and toes of slopes to blend imperceptibly with adjoining landforms. For safety reasons, ensure open sightlines from surrounding public and private land. Provide sufficient areas of land to achieve this land shaping and to enable public access, as well as to provide for stormwater capacity.

The flow characteristics of natural open stream systems shall be based on their likely long-term state, particularly in terms of density of vegetation. The flow characteristics shall also consider peak flood conditions such as surcharge and blockage.

Refer to *WWDG Part B*, Chapter 6 for more information on the design of stormwater treatment systems.

5.9.6 Location and Design of Swales

Use swales for temporary water storage or retention, as this provides attenuation of stormwater peaks and may also reduce the downstream flood peak. Normally this design consists of shaped grass berms, with no permeability built into the construction materials.

Primary treatment is achieved by a detailed design that uses suitable permeable material to allow soakage to subsoil levels. Volumes undergoing primary treatment through infiltration can be increased through longer resident times in permeable swales. Provide opportunities for sediment to settle out in swales through slower velocities, longer resident times and dense grass cover, as these all slow overland flows.

Part 5: Stormwater & Land Drainage

Design longitudinal gradients steeper than 1 in 70 unless:

- There is an effective subsoil drainage system either under or in the swale invert or;
- The invert contains gravel mulch, a narrow concrete invert or landscape planting.

Planting material installed in the swale should not include bark, similar organic mulch or other loose easily transported material.

Take into account repeated use of vehicles or heavy ride-on mowers, which will substantially reduce the permeability of swales that have been constructed for primary treatment. See also clause 5.9.5 and CoP Part 10: *Reserves, Streetscape & Open Spaces* for guidance on design.

5.9.7 Bridges and Culverts

Refer to the *Bridge Manual* and *WWDG Part B* chapter 13 for waterway design at bridges and culverts.

The minimum design storm AEP for systems or structures shall be as shown in Table 5.1.

5.9.8 Protection of road subgrade

The potential risk of carriageway damage from a saturated sub-base is a design issue. Early discussion with the Council is needed when the maximum level of detained water in any ponding area is greater than 200 mm below any carriageway or right of way within a horizontal distance of 80 metres. Provide evidence that the road subgrade will not be compromised. Special pavement or pond design may be necessary.

5.9.9 Outfall water levels

Where possible, the Council will provide the start water level at the point of connection to the public stormwater system or at some point downstream where design water levels are known, as a subdivision consent parameter. If this information is not known to the Council, the applicant's engineer shall determine this figure.

When a tributary drain or a waterway flows into a much larger drain or a much larger waterway, the peak flows generally do not coincide. Check both the situation where the tributary has reached peak flow but the receiving waterway has not and where the receiving waterway is at peak flow but the tributary has passed it. Take the worst case as the design case (refer to *WWDG Part B* clause 22.5.2).

5.9.10 Clearances from Other Services or Structures

CoP Part 9 clause 9.5.4 – *Typical Services Layout and Clearances* summarises clearances for utility services. Confirm these clearances with the network utility operators, before deciding on any utility layout or trench detail.

Locate pipes that are adjacent to existing buildings and structures clear of the "zone of influence" of the building foundations. If this is not possible, undertake a specific design covering the following:

- Protection of the pipeline;
- Long term maintenance access for the pipeline;
- Protection of the existing structure or building.

Specify the protection on the engineering drawings.

Part 5: Stormwater & Land Drainage

5.9.11 Building over Pipelines

The Council prefers not to have public stormwater mains under buildings because of the potential difficulties with maintenance, replacement and repairs. In some situations it is permitted to construct buildings over the stormwater mains, however, this would be considered on a case by case basis.

Approval may be given provided:

- There is no reasonable alternative for the property owner; and
- The existing pipeline is not greater than 225 mm diameter; and
- The length under the building is minimised; and
- The Council is advised and approves each individual proposal, in writing, prior to obtaining a building consent; and
- One of the following solutions is used:
    - The length of pipe under the building is replaced with an equivalent diameter PVC main laid inside a carrier pipe of the next appropriate larger size or as specified to facilitate future size upgrading. Manholes are to be placed on each side of and clear of the building, with no lateral connections permitted between these points. The foundations of any building must be designed and constructed so that no additional load is placed on the pipe. All backfill must be thoroughly compacted and certified by an appropriately competent person; **or**
    - There is still access for repairs or replacement without disturbing the building, e.g. high open foundations on poles or cantilevered with a minimum of 2 metres vertical clearance from ground level and 1.5 metres vertical clearance from the centreline of the main.

Where the pipeline is covered by an easement, the property owner shall:

- Where there is no subdivision planned, request a waiver letter from the Council seeking permission to encroach upon the easement; **or**
- Where a subdivision is planned, adjust the easement document to record the encroachment and pay associated costs.

5.9.12 Easements

Provide easements for public pipelines, subsoil drains and waterways through private property or where private pipelines serving one lot cross another lot.

For a pipeline, the minimum width of a drainage reserve or easement shall be 3 m or twice the depth from ground level to the buried pipe, whichever is greater. The easement shall be centred on the pipe.

For a waterway, the minimum width of a drainage reserve or easement shall be annual bank full width plus 10 metres on one side of the drain from the top of bank and along the full length of the drain.

The easement may also provide for public right of way or other legal access.

Where it is on one side of the drain only, the reserve shall be continuous on that side from one road/public legal corridor to the next upstream or downstream road/public legal corridor.

Part 5: Stormwater & Land Drainage

5.10 MATERIALS

The Council has an asset service life requirement of 100 years. Pipes and fittings must have a minimum required design life of 100 years and a minimum warranty period of 50 years. All products must be fit for their respective purpose and comply in all respects with the Council's current specification for the supply of that material and the standards referenced.

Where a material or product is proposed that is not approved in the district the Council may require assurance that demonstrates the durability of that material prior to approval. Where there is no current standard, the manufacturer will be required to supply copies of their Quality Assurance procedures and producer statements to support their performance and composition claims for the products concerned.

5.10.1 Bedding, Haunching and Backfill

Bedding and haunching materials must comply with CCC *CSS: Part 3* and the pipe manufacturer's specifications.

Specify backfill materials individually. The material used must be capable of achieving the backfill compaction requirements set out in CCC *CSS: Part 1*.

5.10.2 Corrosion Prevention

Contaminated sites and areas with the potential for corrosion may produce a reduction in expected life and should be specifically designed for. The developer will be required to submit for approval their proposed list of materials such that the Council can determine material suitability.

Potential problems may include:

- Mildly corrosive soils
- Higher than normal operating pressures
- Potential for liquefaction

Corrosion can be caused by hydrogen sulphide, aggressive groundwater, saltwater attack, carbon dioxide or oxygen rich environments. **Before** specifying concrete pipes within potentially corrosive areas, test the groundwater to check whether concrete piping is appropriate. Regard groundwater as aggressive to ordinary Portland cement if any of the criteria in Table 5.5 are met.

Table 5.5 Criteria for Aggressive Groundwater

Options	Measure	Condition
1)	Calcium carbonate alkalinity	$CaCO_3$ > 35 ppm
	Aggressive carbon dioxide	CO_2 > 90 ppm
2)	Calcium carbonate alkalinity	$CaCO_3$ < 35 ppm
	Aggressive carbon dioxide	CO_2 > 40 ppm
3)	Acidity	pH < 6
4)	Sulphate	SO_4 > 1,000 mg/L

Design to minimise corrosion through:

- Selecting materials which will resist corrosion;
- Designing in an allowance for corrosion over the 100-year life-cycle of the asset;
- Providing protective coatings, such as polyethylene film or coal tar epoxy;
- Increasing cover to reinforcing;
- Laying concrete pipes in concrete haunching (see SD 600-344A Type C or H).

Bolts and fittings must be hot dip galvanised and incorporate zinc anodic protection. Do **not** use stainless steel where it may fail as a result of crevice corrosion in the presence of sulphides and chlorides.

Part 5: Stormwater & Land Drainage

5.11 INSTALLATION

5.11.1 Authorised Installers

Only Waimakariri District Council Authorised Drainlayers are permitted to install pipework that will be vested into the Council and any pipework that is located within legal roads. A full list of authorised drainlayers and conditions of approval may be obtained on request from the Council.

Registered drainlayers who have tendered for a Council contract as a contractor or sub-contractor shall be evaluated on their ability to complete the works, and accepted or rejected accordingly.

Construction of the stormwater system must not start until acceptance in writing has been given by the Council.

Wherever works are installed within existing legal roads, a Road Opening Notice (RON) must be obtained for that work. The work must comply with requirements as set out in the Council standard specification QP-C843 for this type of work.

No work may start until the RON has been approved in writing by the Council.

5.11.2 Connection to the Public System

Only Council approved contractors may make connections to the Council utility system. Connection of any part of the works into the Council system shall only be made with prior approval of Council in writing.

5.11.3 Handling

Both the developer and the contractor are responsible for ensuring the appropriate handling, storage, transportation and installation of pipes and fittings to avoid damage and to preserve their dimensions and physical properties. The total exposed storage period from the date of manufacture to the date of installation for all PVC pipe must not exceed 12 months. Store fittings under cover at all times.

5.11.4 Approved Plans

The contractor shall work from the most up-to-date, Council-authorised plans.

5.11.5 Confined Spaces

Contractors shall work within the Council's *Guidelines for Entering and Working Within Confined Spaces* (QP-C606). Contractors that do not hold the relevant qualifications shall not work within confined spaces. The Council Water Unit may be engaged at the Contractor's expense.

Part 5: Stormwater & Land Drainage

5.12 TESTING & COMMISSIONING

Testing of all pipelines, manholes and other structures must be carried out as specified in CoP Part 3: *Quality Assurance* in the presence of the Council Representative.

Any particular network facility (e.g. pumping station or other complex item) shall have a specific testing and commissioning procedure prepared and submitted to the Council for approval. It shall then be tested & commissioned in accordance with this approved procedure.

Part 5: Stormwater & Land Drainage

5.13 AS-BUILT INFORMATION

Provide as-built information which complies with CoP Part 12: *As-Builts* and this Part.

Part 5: Stormwater & Land Drainage

5.14 ASSOCIATED DOCUMENTS

Appendix A Rainfall Intensity Tables (QP-C814-AA)

Rainfall Intensity Tables

This data has been generated from HIRDS V4 software, Scenario RCP 8.5 (2081-2100). For areas not covered by the tables, interpolate between the nearest points given. If required, more precise data may be obtained by using HIRDS V4 Scenario RCP 8.5 (2081-2100) or by requesting the data from WDC. To be conservative, values should be increased for hill catchments.

Rainfall Intensities (mm/hr) for 20% AEP Event (HIRDS V4 Scenario RCP 8.5 (2081-2100))

Location	Northing	Easting	Duration									
			10m	20m	30m	1h	2h	6h	12h	24h	48h	72h
Ashley Gorge	5775086	2447402	63.2	41.5	33.2	23.1	16.3	9.28	6.39	4.27	2.76	2.1
Ashley Township	5770187	2477408	49.5	33.7	27.3	19.5	14	8.02	5.5	3.64	2.31	1.73
Cust	5766018	2459305	56.3	37.1	29.7	20.8	14.7	8.4	5.79	3.88	2.51	1.91
Kaiapoi	5758066	2482037	38.6	27.4	22.7	16.8	12.4	7.35	5.11	3.41	2.18	1.63
Lees Valley	5785117	2444245	51.3	36.5	30.3	22.2	16.2	9.5	6.55	4.34	2.76	2.07
Loburn	5772950	2470718	50.9	35.1	28.7	20.7	15	8.7	6	3.99	2.54	1.91
Mandeville / Ohoka	5758585	2472200	49.5	33.6	27.2	19.3	13.8	7.81	5.32	3.5	2.21	1.65
Okuku	5773640	2463277	49.6	34.9	28.8	21	15.3	8.86	6.05	3.96	2.47	1.82
Oxford	5767328	2444164	60.8	40.3	32.2	22.5	15.7	8.77	5.91	3.85	2.42	1.8
Pines/Kairaki	5758567	2485933	38.5	28.2	23.7	17.5	12.8	7.38	5.03	3.29	2.08	1.55
Rangiora	5766688	2476775	51.2	34.8	28.2	20	14.3	8.12	5.53	3.62	2.28	1.7
Sefton	5773365	2483100	46.6	32	26.1	18.7	13.5	7.8	5.36	3.55	2.26	1.69
Tuahiwi	5763950	2480958	45	31.1	25.5	18.4	13.3	7.65	5.24	3.45	2.18	1.62
View Hill	5767298	2433696	56.3	37.4	30	21.1	15	8.59	5.92	3.96	2.56	1.94
Waikuku Beach	5768888	2486675	43.3	30.2	24.8	18	13.1	7.64	5.27	3.49	2.21	1.65
West Eyreton	5761881	2458060	55.1	36.4	29.2	20.4	14.4	8.15	5.58	3.7	2.37	1.78
Woodend	5765047	2482873	43.8	30.7	25.2	18.4	13.3	7.72	5.28	3.46	2.17	1.61

Rainfall Intensity Tables

Rainfall Intensities (mm/hr) for 2% AEP Event (HIRDS V4 Scenario RCP 8.5 (2081-2100))

Location	Northing	Easting	Duration									
			10m	20m	30m	1h	2h	6h	12h	24h	48h	72h
Ashley Gorge	5775086	2447402	124	80.3	63.5	43.6	30.2	16.8	11.4	7.47	4.76	3.58
Ashley Township	5770187	2477408	97.7	65.3	52.5	36.8	25.9	14.5	9.76	6.34	3.97	2.93
Cust	5766018	2459305	112	72.5	57.4	39.4	27.4	15.2	10.3	6.76	4.31	3.23
Kaiapoi	5758066	2482037	77.1	53.6	44	31.8	22.9	13.2	9	5.88	3.68	2.71
Lees Valley	5785117	2444245	99.3	69.6	57.2	41.3	29.7	17	11.5	7.49	4.7	3.49
Loburn	5772950	2470718	100	67.9	54.9	39	27.7	15.7	10.7	6.96	4.38	3.24
Mandeville / Ohoka	5758585	2472200	98.8	65.8	52.7	36.7	25.6	14.1	9.42	6.06	3.77	2.78
Okuku	5773640	2463277	97.8	67.7	55.3	39.6	28.3	16	10.7	6.86	4.21	3.07
Oxford	5767328	2444164	119	77.8	61.7	42.4	29.3	16	10.6	6.82	4.23	3.11
Pines/Kairaki	5758567	2485933	77.2	55.5	46	33.4	23.9	13.4	8.91	5.71	3.53	2.6
Rangiora	5766688	2476775	101	67.4	54.1	37.9	26.5	14.7	9.85	6.34	3.93	2.89
Sefton	5773365	2483100	92	62.1	50.1	35.4	25	14.1	9.53	6.19	3.88	2.87
Tuahiwi	5763950	2480958	89.2	60.5	49	34.7	24.6	13.8	9.29	5.99	3.72	2.73
View Hill	5767298	2433696	111	72.3	57.5	39.8	27.8	15.6	10.6	6.94	4.42	3.31
Waikuku Beach	5768888	2486675	85.9	58.8	47.8	34.2	24.4	13.9	9.37	6.08	3.79	2.8
West Eyreton	5761881	2458060	110	71.3	56.5	38.7	26.8	14.8	9.91	6.44	4.05	3.02
Woodend	5765047	2482873	86.6	59.6	48.6	34.8	24.8	14	9.42	6.07	3.74	2.74