PART 5: STORMWATER AND LAND DRAINAGE

CONTENTS

FIGURES

TABLES

5.1 REFERENCED DOCUMENTS

Planning and Policy

- Resource Management Act (RMA) (1991)
- Building Act (2004)
- The Selwyn District Plan/

  www.selwyn.govt.nz/services/planning/district-plan
- Selwyn District Council *5Water Strategy*

  www.selwyn.govt.nz/council-info/key-documents/selwyn-community-plan/activity-management-plans2/water
- Canterbury Regional Council *Natural Resources Regional Plan* (NRRP)

  www.ecan.govt.nz/our-responsibilities/regional-plans/nrrp/Pages/read-plan.aspx%20
- Canterbury Regional Council *Transitional Regional Plan* (TRP) 1991

  www.ecan.govt.nz/our-responsibilities/regional-plans/trp/Pages/Default.aspx

Design

- Selwyn District Council 'Subdivision Design Guide - Design Guide for residential subdivision in the Living 1 zones'

  www.selwyn.govt.nz/services/planning/policy-strategy/design-guides/subdivision-design-guide
- Auckland Regional Council Stormwater Treatment Devices: *Design Guideline Manual* (TP10).

  www.arc.govt.nz/plans/technical-publications/technical-publications-1-50.cfm
- Christchurch City Council *Waterways, Wetlands and Drainage Guide*, Ko Te Anga Whakaora mö Ngä Arawai Rëpo (WWDG) (2003) Part A and B
- Christchurch City Council Streamside Planting Guide

  www.ccc.govt.nz/cityleisure/parkswalkways/environmentecology/streamsideplanting/index.aspx
- Christchurch City Council Bush Birds

  www.ccc.govt.nz/cityleisure/parkswalkways/faq.aspx

- Christchurch City Council leaflet Stormwater Tanks on Private Property

  http://www.ccc.govt.nz/homeliving/wastewater/faq.aspx

- Canterbury Regional Council Erosion and Sediment Control Guidelines 2007

  www.ecan.govt.nz/publications/Pages/erosion-sediment-control-guidelines.aspx

- NZS 4404: 2004 Land development and subdivision engineering

- Transit New Zealand Bridge Manual (2003)

- Opus International Consultants Ltd, 2009 report '*Selwyn District - Design Rainfall'*.

Construction

- Christchurch City Council Civil Engineering Construction Standard Specifications Parts 1-7 (CSS) https://ccc.govt.nz/consents-and-licences/construction-requirements/construction-standard-specifications

- NZWWA 'New Zealand Pipe Inspection Manual'

- SNZ HB 2002:2003 Code of Practice for Working in the Road

Where a conflict exists between any Standard and the specific requirements outlined in the Engineering Code of Practice (COP), the COP takes preference (at the discretion of the Council).

5.1.1 Source documents

This Part of the Engineering Code of Practice is based on Part 5 of the CCC Infrastructure Design Standard, by agreement, and with the consent of Christchurch City Council.

Specific requirements provided in this document shall take preference over general requirements provided in the Christchurch City Council Waterways, Wetlands and Drainage Guide.

5.2 INTRODUCTION

Selwyn's urban design philosophy, objectives and purpose is outlined in the Selwyn District Council Urban Design Strategy and takes preference over Christchurch City Council documents.

5.2.1 Philosophy

The Selwyn District Council is adopting a similar approach to Christchurch City Council by taking a values-based approach to management of the natural and physical resources that make up the Districts network 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 together values that are important to the community while addressing drainage issues associated with individual developments.

Selwyn District Council has recently adopted a methodology for Strategic Asset

Management Planning for the 5Waters reflecting and defining the four well-beings (environmental, social, economic and cultural) referred to in the Resource Management Act 1991 (RMA) and the Local Government Act 2002 (LGA).

The well-beings are consistent with those that Environment Canterbury previously defined in their Long Term Council Community Plan 2006-2016.

The emphasis on each value at a particular site will be dependent on the objectives of the project.

5.2.2 Objectives

The objective of a stormwater drainage system is to regulate the storm surface run-off rate of flow and volume (***quantity***) and control groundwater levels and to protect the ***quality*** of both; to the extent that agreed levels of service are maintained and any adverse effects on the environment are no more than minor. To satisfy the latter, remedial or mitigation works will often need to be incorporated within the stormwater drainage system (see *WWDG Part B* clause 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.

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

5.2.3 Four purposes

The stormwater drainage system serves four purposes: the conveyance of storm surface run-off with minimal flood damage including quantity control; water quality control; protection of bio-diversity and ecological function; groundwater control and protection. Consider all four aspects in the engineering design and endeavour to achieve them with minimal adverse effects on the environment. An assessment of the four purposes shall be included within the design report.

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. Low Impact Urban Design & Development (LIUDD) is one means of achieving these four purposes along with other sustainability objectives.

5.3 CONSENT AND COMPLIANCE ISSUES

5.3.1 Legislation

The *Resource Management Act* (RMA) is the principal statute that controls land development, including stormwater drainage aspects.

5.3.2 Approval process

New stormwater drainage systems require approval from the District Council and consent from the Canterbury Regional Council (Environment Canterbury). Approval may be by way of a permitted activity or rule in a regional plan or by a discharge permit. A land use consent and a discharge permit are generally required for subdivisions and capital works projects and when significant water quantity and quality issues need to be addressed.

Consult with authorising officers from both Councils prior to consent application. It is good practice for the Council and the Canterbury Regional Council to process subdivision and water-related resource consents simultaneously and deal with land and water issues at a joint hearing pursuant to section 102 of the *RMA*.

5.3.3 Consent from the Canterbury Regional Council

Consent from Canterbury Regional Council will be required for the discharge of stormwater unless the discharge is to an authorised existing utility stormwater drainage system and meets any conditions that apply to the existing system. Regional plan requirements will generally be limited to effects on the natural environment. However, territorial authorities have a responsibility to manage land and adverse effects under section 31 of the *RMA*.

Other activities often associated with stormwater drainage works which must be authorised by the Canterbury Regional Council include: the diversion of natural water during construction work; the permanent diversion of natural water as a consequence of the development; activities in the bed or on the banks of a natural waterway; damming waterways.

The discharge of clean stormwater and some other activities may be authorised as a permitted activity subject to certain conditions in the regional plan. Authorisation may also be by way of a comprehensive consent held for a large area or entire catchment.

Site-specific discharge permits and water permits must be obtained in other circumstances. Resource consent issues can be complex and the consent process long. Seek the advice of the Canterbury Regional Council at the earliest stage of planning for stormwater drainage works.

5.3.4 Council requirements

There are separate subdivision and landuse resource consent procedures in which stormwater and land drainage issues may arise. The input of appropriate Selwyn District Council staff is required. Early discussion, particularly pre-application meetings between the District Council and the applicant, can be an effective way of moving a proposal forward.

Note that the information given in *WWDG Part B* chapter 17, although useful, may not be directly transferable to the Selwyn District.

5.3.5 Exercising consents

Discharge and temporary water consents and land use consents required during construction must be applied for by, and exercised in the name of, the developer.

Discharge and water permits required for works that are to be transferred to the Council upon completion, must be applied for by, and exercised in the name of the developer. Discuss with the Council any application involving consents intended to transfer to the Council. The Council must approve these prior to application as it will not accept the transfer of a consent unless it has previously approved the conditions of that consent.

Council will accept transfer of the Environment Canterbury consent on:

- Formal approval from Selwyn District Council, at the time of Engineering Approval, that the consent will be accepted by the Council.
- Completion of the two year maintenance period with all defects rectified.
- Receipt of a fully complying Environment Canterbury compliance report.
- Receipt of an Operation and Maintenance Manual for the consent system.
- Completion of all other requirements specified in the District Council resource consent.

5.4 QUALITY ASSURANCE REQUIREMENTS AND RECORDS

Provide quality assurance records that comply with the requirements in Part 3: Quality Assurance, during design and throughout construction.

5.4.1 The designer

The designer of all stormwater reticulation systems and the person undertaking the catchment analysis must be suitably experienced. Their experience must be to a level to permit membership in the relevant professional body. Refer to clause 2.6.1 – Investigation and design (General Requirements) for further information.

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

5.4.2 Information to be provided

The survey datum shall be to New Zealand Transverse Mercator 2000 Projection, the level datum used shall be to mean sea level, Lyttelton Datum.

Specific information to be provided with any concept drawings and/or Resource Consent plans must include and form part of the design report:

- the location of any natural waterways, springs, bores, wells 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 must be indicated;
- the location of existing drainage and overland flow pathways;
- flood risk assessment;
- the location of any archaeological and historical features;
- representative pre-existing and post development cross-sections through any natural waterways or wetlands, including the areas immediately adjacent to the proposed development;
- catchment boundaries by defined surface levels (where the location of the catchment boundary is uncertain, the developer must define the boundary by survey);

- summaries of hydrological and hydraulic modelling as required by the *WWDG* (see *WWDG Part B* chapters 21 and 22), including design parameters and assumptions;
- estimates of catchment imperviousness and the basis for its derivation;
- the proposed proximity of buildings to the water's edge and/or shoulder of the banks;
- clear identification of the extent of any existing and post-development river or coastal floodplains on or in close proximity to the site and overland flow paths within the site;
- identification of any natural or artificially created basins;
- the impact of any proposed filling or excavation on existing surface drainage pathways;
- existing services and easements;
- details of any contaminated ground or historical filling;
- protected trees, other significant vegetation and other features to be protected and retained (e.g. natural landforms, ecological protection areas);
- details of any investigations such as ground water levels, profiles, infiltration testing and effects on the environment and geological or water quality assessments.

5.4.3 Design records

Provide the following information to support the Design Report:

- Details, plans and calculations that demonstrate that levels of service required by TP10 or the *WWDG Part B* chapter 20 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, plans and calculations that clearly indicate any impact on adjacent areas or catchments that the proposed works may have;
- draft versions of operations and maintenance manuals for any water quantity or quality control structures (refer also to clause 5.7.3 - Operations and maintenance manual);
- landscape and planting drawings complying to Appendix I - Standard Draughting Layout and Format Requirements (General Requirements).
- Information required in 5.4.2 if not already provided.

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

Provide the following additional information for detention basins, wetlands 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.

5.4.4 Construction records

Provide the information detailed in Part 3: Quality Assurance and the *Construction Standard Specifications (CSS)*, including:

- Environment Canterbury compliance monitoring reports;
- all performance test results;
- CCTV inspection DVD of all pipelines 225mm dia and greater
- material specification compliance test results;
- compaction test results;
- subgrade test results;
- infiltration test results.

Provide the Council with a certificate for each pipeline tested including the date, time and pressure of the test. Provide details of the pipes in a form complying with the requirements of Part 12: As-Builts, including manufacturer, diameter, type, class, jointing and contractor who laid the pipe.

5.4.5 Post-Construction Records

Provide the information detailed in Part 3: Quality Assurance, Part 12: As-Builts, and the Construction Standard Specifications (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;
- finished ground contour levels typically to 200mm accuracy over the whole site;
- as-built plans and records;
- ECan compliance report;

5.5 CATCHMENT ISSUES

5.5.1 Catchment management planning

Carry out stormwater planning on a coordinated and comprehensive catchment-wide basis. Although this is primarily the responsibility of the Council, consider catchment-wide issues at the concept design stage and comply with the catchment management plan, if one exists.

The implications of future upstream development on 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).

5.5.2 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 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. The modification to stream hydrology is generally minor. However, any reduction in riparian vegetation increases sediment loads and nutrient concentrations are likely to reduce aquatic biodiversity.

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

5.5.3 Catchments and off-site effects

All drainage systems, including waterways, must provide for the collection and controlled disposal of surface and ground water from within the land being developed, together with run-off from upstream catchments. In designing downstream facilities, consider the upstream catchment to be fully developed and comply with any Catchment Management Plan. Consult the Council about mechanisms for assigning costs associated with off-site effects.

Ground water is a precious resource. Carry out development in a way that avoids adverse effects on ground water quality and levels. Refer to clause 4.5 - Ground Investigations (Geotechnical Requirements) and *WWDG Part B* clause 5.3.1.

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 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.

5.5.4 Stormwater pumping

Permanent stormwater pumping will only be permitted under exceptional circumstances. Refer to *WWDG Part B* clause 13.6 pages 13-15.

5.5.5 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 be relevant bodies, discussions with the local inhabitants or appropriate field investigations.

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.

5.6 DRAINAGE SYSTEM DESIGN

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 standard. Protection standards are set by the *RMA*, the *District Plan* and the *Building Act* and are discussed in *WWDG Part B* chapter 20.

The primary system must cater for the more frequent rainfall events (10 year critical duration) and the secondary system must cater for over-design events and occasions when there are blockages in the primary drainage system (50 year +).

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

- The four well beings (refer to clause 5.2.1);
- 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 clause 5.12 and *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 made ground;

- geotechnical investigations - take into account any geotechnical requirements determined under Part 4: Geotechnical Requirements;

- major reticulation and its potential for significant traffic disruption. Discuss at an early stage with Council.

The side slope of any swale, basin or other stormwater management device shall be no steeper than 1:5 (grassed) or 1:3 (planted). Swale base shall have a minimum width of 0.8m and maximum width of 2m. Swales on private property as part of a subdivision or beside accessways not maintained by Council may be formed with a different profile as agreed with Council.

Drowned stormwater mains will only be approved, at Council's discretion, once all other practicable options have been exhausted to achieve a free draining system. Additional maintenance clauses may be added to the Council engineering approval if drowned systems are proposed.

5.6.1 Design life

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

5.6.2 Integrated Stormwater Systems

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.

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.

5.6.3 Secondary flow paths

Shape lots generally so that they fall towards roadways, which may be used as secondary flow paths. Secondary flow velocities must be sub-critical except where it is unavoidable on hillsides. On hillsides, convey secondary flows safely and as directly as possible into permanent open waterways.

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 require protection 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.

In most circumstances, limit ponding or secondary flow on roads in height and velocity such that the carriageway is passable.

The secondary flow path sizing and location must be supported by adequate analysis, taking into account extreme events, to show:

- that it is of adequate capacity to cope with the anticipated flow;
- 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.

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 desirable standard for ponding or secondary flow on roads is that they are passable to light vehicles in the 2% AEP (annual exceedence probability) event and to 4WD vehicles in a more extreme event.

5.6.4 Location and design of stormwater management devices

Basins, wetlands and swales 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 during the early stages of planning.

From a landscape perspective, these types of systems are often very specifically designed and managed in order to optimise their primary functions (e.g. stormwater storage capacity, soil infiltration, etc.). 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 stormwater systems 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 stormwater management devices so that they replicate natural landforms. Avoid regular shapes, 'bathtubs' and even slopes: instead create organic, undulating landforms with sinuous 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.

Refer to *ARC TP10* and the *WWDG Part B* chapter 6 for specific design criteria regarding the design of stormwater treatment systems.

Council encourages preserving and adding life-containing materials such as humus in the soils of soakage basins. Soil structure and permeability can be maintained and improved by soil biological communities.

5.6.5 Minimum protection standards for new developments

Current practice places many residential buildings on slabs 150 mm above the ground. For the protection of buildings, design and build the stormwater system of water pathways and ponding areas so that every new building platform is at less than 2% annual exceedance probability (AEP) risk of flooding. Include a minimum freeboard height above computed flood levels as shown in Figure 1, complying with Table 1. Any relevant building floor protection specified in the *District Plan* must also apply.

Figure 1 Minimum floor levels

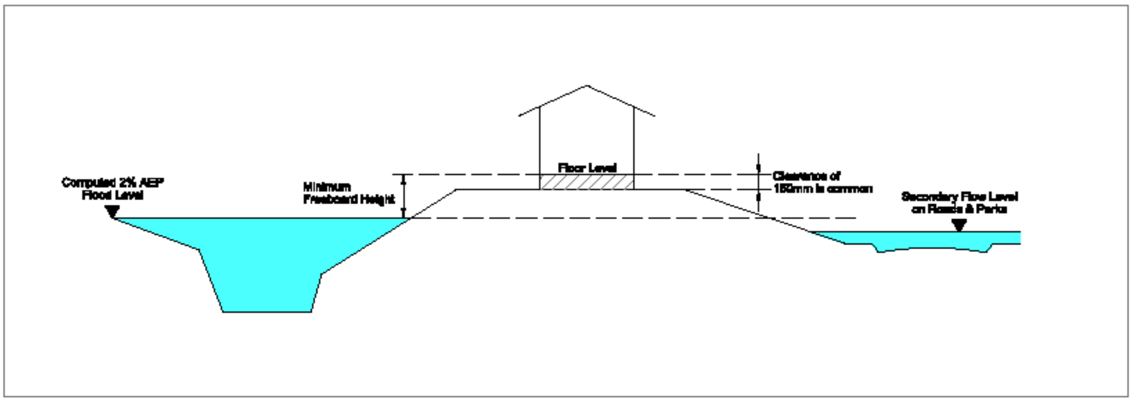


Table 1 Minimum freeboard

Building type	Minimum freeboard height (m)
Habitable building floors	0.4
Commercial and industrial buildings	0.3
Habitable building platforms	0.25

Note: 1) 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.

2) Discuss commercial and industrial developments with special circumstances with the Council.

3) In circumstances where ponded water on roads will exceed 100mm a greater freeboard may be required.

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

5.6.6 Bridges and culverts

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

Where a structure (culvert or bridge) is to be installed within the land drainage network approval shall be obtained from the Council Engineer. As a general rule, the cross-sectional area of the proposed structure shall be no smaller than that of the nearest structure up or down stream.

5.6.7 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 higher than 200mm 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.

5.6.8 Outfall water levels

The Council will provide, where available, 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.

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).

5.6.9 Alternative technologies

Alternative technologies will be considered on a case by case basis.

5.6.10 Common drains

New stormwater mains installed in private property as part of a development and that serve only that development will be private common drains, unless Council specifies through a consent condition that they must be vested. If the developer considers a stormwater main in private property should be vested, request this at the time of applying for subdivision consent.

Stormwater reticulation that is to be vested shall meet Council requirements as follows:

- minimum pipe diameter 225 mm
- end in a manhole or inspection chamber
- service 5 lots or greater in number
- Size the private common main using Christchurch City Council Waterways, Wetlands and Drainage Guide, Ko Te Anga Whakaora mö Ngä Arawai Rëpo (WWDG) (2003) Part A and B

5.7 WATERWAYS

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

Maintain fish and invertebrate passage, unless otherwise authorised by the Council or by the Canterbury Regional Council. Refer to *WWDG Part B* clauses 2.2 and 13.2.3.

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, not prone to scour in flood flows and maintainable.

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 Asset Engineer.

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.

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 and TP10). These waterways must form part of a surface water management system.

Protect constructed waterways, which will be maintained by the Council, by easement where they will not be placed in public ownership.

5.7.2 Natural waterways

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

Where it is possible, avoid the piping or filling in of natural waterways. Where the activity is unavoidable, a resource consent from the Council and the Canterbury Regional Council 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 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. Amend Appendix II - Generic Guides for Riparian Maintenance (Reserves, Streetscape and Open Spaces), to show the required maintenance regime for all plantings. Clause 10.10 – Establishment (Reserves, Streetscape and Open Spaces) expands on these requirements.

Submit the manual for engineering acceptance as part of the Design Report.

5.7.4 Fencing

Consent from Council shall be obtained 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* clause 13.9).

5.8 STORMWATER DISPOSAL

5.8.1 Approved outfall

The discharge for a development must be authorised by Environment Canterbury (ECan). This can be achieved by conforming to an *Integrated Catchment Management Plan* (ICMP) or complying with the conditions of the discharge consent held by council where available.

The outfall for a development must be either the public stormwater drainage system or an approved alternative stormwater disposal system.

A suitable outfall and if required a energy 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.

5.8.2 Discharge to ground

Surface water infiltration systems may be used for developments in rural areas or for developments in urban areas, if connection to the public system is not feasible and ground conditions are suitable for soakage (Refer to *WWDG Part B* 6.5). Carry out a geotechnical assessment including soakage tests when considering the use of infiltration systems. On completion, the soakage system shall be tested to confirm design soakage rates are achieved.

A discharge consent may be required from the Canterbury Regional Council for discharge to soakage.

Design and locate infiltration systems to allow easy access for maintenance.

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. 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 Christchurch City Council's leaflet *Stormwater Tanks on Private Properties* for further guidance, including installation guidelines.

5.9 RETICULATION LAYOUT

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 installations, which can be very expensive.

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

5.9.2 Location and alignment of stormwater pipelines

Locate stormwater pipeline mains within the legal road (but not under the crown of the carriageway unless the wastewater sewer is located elsewhere) 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) and generally stormwater pipes shall be located between the sewer and 1.5m inside the kerb or directly under the kerb and channel or under the median swale or the side berm swale where these exist.
- within public land with the approval the Council.
- within drainage reserves.
- within private property (if unavoidable) adjacent to, and if possible parallel to, boundaries, with a minimum offset to the pipe centreline of one metre.

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.

5.9.3 Clearances from other services or structures

Clause 9.5.3 – Typical services layout and clearances (Utilities) 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.

5.9.4 Curved pipelines

The straight-line pipe is usually preferred as it is easier and cheaper to set out, construct, locate and maintain in the future.

Curved pipes must be to the manufacturer's design and construction standards and be used only where approved by the Council.

5.9.5 Building over pipelines

Building over pipelines and pipeline easements are not accepted practice, and will not be approved where alternative options such as relocating or re-sizing the building or diverting the pipeline around the building are available. If accepted, it will be subject to at least the following minimum conditions:

- Provide an alternative route protected by easement;
- Provide manholes both sides of the building on the stormwater pipeline;
- The pipeline must be on an even vertical grade and in a straight horizontal alignment;
- There must be no entry points or junctions to the line under the building;
- Check the pipeline by closed circuit television (CCTV) before and after the works;
- Provide specific foundation design to ensure structures do not impose loadings on the pipeline;
- A memorandum of encumbrance will be drawn up at the applicant's expense to protect the Council.

5.9.6 Easements

Easements are required for constructed waterways and in those instances when there are secondary flow paths through private property. Provide easements for public pipelines and public subsoil drains through private property or where private pipelines serving one property cross another.

Figure 2 Equation Easement Width

$$\begin{aligned}&\textit{The easement width is the greater of:}\\&\quad \triangleright\ 2\times(\textit{depth to invert}) + OD\\&\quad \triangleright\ 3.0\,m\\&\textit{where } OD = \textit{outside diameter of pipe laid in easement}\end{aligned}$$

The easement registration must provide the Council with rights of occupation and access and ensure suitable conditions for operation and maintenance.

5.10 RETICULATION DETAILING

5.10.1 Pipeline connections

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

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

5.10.2 Minimum pipe sizes

The minimum diameter for Council stormwater pipe within the carriageway is 225mm.

5.10.3 Minimum cover

Where the minimum cover complying with the manufacturer's specifications is not achieved, pipelines must be adequately protected from external loadings. Include calculations in design report.

5.10.4 Gradients and acceptable flow velocities

Refer to *WWDG Part B* clause 14.2.4. Include calculations in design report.

5.10.5 Structures

Design inlets and outlets in accordance with *WWDG Part B* clauses 14.6 and 14.7. 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* clause 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, if required 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* Clause 22.7 Table 22-5.

Include calculations in design report.

5.10.6 Manholes and sumps

Provide manholes and sumps in accordance with *WWDG Part B* clause 14.4 and 14.5 and *CSS: Part 3*. Where the manhole is likely to experience differing movements from the pipeline under seismic loading, replace the yield joints with flexible joints e.g *CSS*: *Part 3* SD 341/4. These may mitigate against the potential for damage by allowing some longitudinal movement at the structure.

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.

Check the effects of turbulence or hydraulic grade on pressure within manholes. No feature should impede flow through a manhole. The flow deviation angle between the inlet and outlet pipes must not be greater than 90 degrees as shown in Figure 1 in clause 6.6.1 – Location and spacing (Wastewater). 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.

Secure manholes against uplift in accordance with *WWDG Part B* clause 14.4.

Where a special manhole cannot be constructed with a standard riser the lid must:

- meet the *WWDG Part B* clause 14.4 requirements for structural design, confirmed by a Design Certificate;
- have minimum concrete strength and cover of 40 MPa and 50mm respectively;
- conform to the geometric requirements of SD 302 or SD 303, whichever is relevant.
- 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 90m for pipes of diameter 1500mm or less.
- At a spacing of not more than 120m for pipes of diameter in excess of 1500mm, with the approval of Council.

5.10.7 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.

5.10.8 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.

5.10.9 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 CSS: Part 3* SD 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.

5.10.10 Sumps

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

Sumps shall be located as necessary (with a maximum spacing of 100m) to ensure the total design flow can enter the stormwater system without surcharging. The intake capacity of a road sump with grating, back entry, and acceptable ponding, is approximately 28 L/s.

In addition to the requirements above, note that intersection sumps are generally located on the kerb-line tangent point. Where double side entry sumps are required, they shall be placed at all valley positions.

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 SD341. Minimum 200mm 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 600mm diameter pipes or larger, and an existing manhole is not conveniently located. The diameter of the connecting pipe shall not be greater 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.

5.10.11 Pipe Stiffness Rating

Stormwater PVC pipes shall generally have a stiffness rating of SN 8or greater in trafficable areas. Lower ratings may be used in non-trafficable areas.

5.11 CONNECTION TO THE PUBLIC SYSTEM

5.11.1 Individual lots and developments

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, except where roof water can be satisfactory disposed to ground;

- 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, at grades and cover complying with the *Building Act*, to the farthest point on the lot;
- The minimum diameter of connections must be:
- 100mm for residential lots.
- 150mm for commercial/industrial lots.
- 150mm 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 0.6m into the net site area of the lot;
- Connection to features such as vegetated swales, soakpits, or soakage basins is acceptable provided the system is authorised by the Canterbury Regional Council 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.

Only Registered Drainlayers approved by the Selwyn District Council are permitted to install pipework that will be vested into the Council and any pipework that is located within legal roads. The public register of registered drainlayers can be searched at *https://www2.pgdb.co.nz/PGDB/PublicRegister.aspx*, and conditions of approval may be obtained on request from the Council.

5.11.2 Connection of lateral pipelines to mains

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

5.12 MEANS OF COMPLIANCE

5.12.1 Estimation of surface water run-off – peak flow rate

Surface water hydrology and the estimation of the peak flow rate for localised urban catchments shall be in accordance with one of the following techniques

(a) IPENZ '*Procedure for Hydrological Design of Urban Stormwater Systems'*, December 1980 (limited to 10 hectares); or
(b) an approved catchment/stormwater computer modelling system.

For (b) above the Council's Asset Manager can confirm an acceptable modelling system on request. Furthermore, Christchurch City Council *WWDG Part B* chapters 21, 22 also provides good guidance for the estimation of surface water run-off.

5.12.2 Design Rainfall

A series of design rainfall tables have been developed for rainfall gauges having high resolution temporal data within close proximity to the Selwyn District. To allow these design rainfalls to be applied in a reliable and consistent manner across the district a series of scale factors were compiled. These scale factors allow the adjustment of the design rainfalls from the nearest site to each of the communities within the district.

The following procedure to calculate design rainfall depths for a given township within the Selwyn District should be followed:

1. Using table 1, select the appropriate 'Rainfall gauge' and 'Scale factor' for the township of interest.

2. Using the appropriate 'design rainfall table' [tables 2 – 8] multiply the given values by the 'scale factor' to calculate township specific rainfall depths.

3. The township specific rainfall depths should then be multiplied by a factor to allow for climate change. In the Selwyn District, a scale factor of 1.16 is generally accepted.

The above procedure shall be used for all urban development within the Selwyn District. Council reserves its right to use discretion when applying this rainfall data and during assessment of applications for engineering acceptance.

Table 2 Scale factors for each township within the Selwyn District

Township	Rainfall Gauge Location	Scale Factor
Arthurs Pass	Arthurs Pass	1.00
Burnham	Christchurch Aero	1.06
Castle Hill	Cheeseman	1.02
Coalgate	Whitecliffs	0.91
Darfield	Ridgens Road	1.20
Doyleston	Christchurch Aero	1.01
Dunsandel	Ridgens Road	1.05
Glentunnel	Whitecliffs	0.92
Hororata	Ridgens Road	1.06
Kirwee	Christchurch Aero	1.06
Lake Coleridge	Highpeak Station	0.72
Leeston	Christchurch Aero	1.01
Lincoln	Christchurch Aero	0.96
Lower Selwyn Huts	Christchurch Aero	0.98
Motukarara	Christchurch Aero	1.01
Prebbleton	Christchurch Aero	1.03
Rolleston	Christchurch Aero	1.03
Sheffield	Whitecliffs	1.00
Southbridge	Christchurch Aero	0.98
Springfield	13 Mile Bush	0.83
Springston	Christchurch Aero	0.99
Tai Tapu	Christchurch Aero	0.98
Templeton	Christchurch Aero	1.02
Terrace Downs	Highpeak Station	1.01
Upper Selwyn Huts	Christchurch Aero	0.96
Waddington	Whitecliffs	1.00
West Melton	Christchurch Aero	1.03
Whitecliffs	Whitecliffs	1.00
Windwhistle	Highpeak Station	0.92

Table 3 Arthurs Pass design rainfall table (1955-2009) (rainfall depths in mm)

	Duration							
ARI	10-min	20-min	30-min	1-hr	2-hrs	6-hrs	12-hrs	24-hrs
2.33	7.1	12.2	16.9	28.3	49.0	106.7	160.8	225.9
5	9.7	15.5	20.6	33.5	57.5	125.2	189.2	265.7
10	12.1	18.4	23.5	37.4	63.8	139.1	211.5	296.6
20	14.4	21.2	26.2	41.0	69.2	151.6	232.1	324.9
50	17.5	24.8	29.7	45.4	75.6	166.6	257.7	359.9
100	19.9	27.4	32.2	48.6	80.0	177.1	276.3	385.2

Table 4 Cheeseman design rainfall table (1990-2009) (rainfall depths in mm)

	Duration							
ARI	10-min	20-min	30-min	1-hr	2-hrs	6-hrs	12-hrs	24-hrs
2.33	4.2	7.1	9.5	14.3	22.2	43.6	62.7	79.3
5	5.5	9.1	11.9	16.9	25.9	51.7	75.0	94.9
10	6.8	11.1	14.2	19.1	28.9	58.2	84.7	107.6
20	8.5	13.3	16.8	21.3	31.8	64.6	93.9	119.8
50	11.1	16.8	20.6	24.2	35.5	72.8	105.7	135.5
100	13.6	19.9	24.0	26.5	38.2	79.0	114.4	147.3

Table 5 Christchurch Aero design rainfall table (1955-2009) (rainfall depths in mm)

	Duration							
ARI	10-min	20-min	30-min	1-hr	2-hrs	6-hrs	12-hrs	24-hrs
2.33	4.4	6.9	8.5	12.0	16.3	27.8	39.2	51.8
5	6.2	9.7	11.7	15.9	22.1	36.1	51.0	66.9
10	7.7	11.9	14.2	19.0	27.2	44.1	61.5	79.3
20	9.1	14.1	16.7	22.0	32.3	53.1	72.5	91.1
50	10.9	16.9	19.9	25.9	38.8	66.8	89.0	106.3
100	12.3	19.0	22.2	28.8	43.8	78.9	101.0	117.8

Table 6 Highpeak Station design rainfall table (1987-2009) (rainfall depths in mm)

	Duration							
ARI	10-min	20-min	30-min	1-hr	2-hrs	6-hrs	12-hrs	24-hrs
2.33	5.1	7.7	9.4	13.0	19.7	34.1	49.5	62.0
5	6.8	10.5	13.0	17.2	25.7	43.1	65.2	88.4
10	8.0	12.6	16.1	20.6	30.7	50.3	78.2	111.7
20	9.2	14.6	19.0	23.9	35.6	57.2	90.5	134.8
50	10.6	17.1	22.8	28.1	41.8	65.9	106.5	164.9
100	11.6	18.9	25.6	31.3	46.4	72.4	118.5	187.6

Table 7 13 Mile Bush design rainfall table (1988-2009) (rainfall depths in mm)

	Duration							
ARI	10-min	20-min	30-min	1-hr	2-hrs	6-hrs	12-hrs	24-hrs
2.33	5.6	8.9	10.9	14.4	21.2	35.4	47.5	64.0
5	8.2	12.8	15.3	19.3	25.8	42.8	60.7	86.4
10	10.6	16.4	19.3	23.9	29.5	48.8	72.1	106.2
20	13.0	19.9	23.3	28.4	33.1	54.4	83.2	125.7
50	16.2	24.5	28.5	34.5	37.7	61.5	97.7	151.2
100	18.6	28	32.5	39.0	41.2	66.7	108.4	170.4

Table 8 Ridgens Road design rainfall table (1990-2009) without the 15/11/09 storm event (rainfall depths in mm)

	Duration							
ARI	10-min	20-min	30-min	1-hr	2-hrs	6-hrs	12-hrs	24-hrs
2.33	3.8	5.3	7.3	9.9	14.6	25.6	38.4	50.7
5	5.6	7.8	10.5	13.1	18.0	30.5	45.1	62.7
10	7.4	10.2	13.4	15.9	20.9	34.5	49.9	72.2
20	9.2	12.6	16.2	18.6	23.6	38.3	53.9	81.1
50	11.7	15.7	19.9	22.2	27.1	43.1	58.5	92.5
100	13.6	18.1	22.7	24.8	29.8	46.6	61.5	100.8

Table 9 Whitecliffs design rainfall table (1988-2009) (rainfall depths in mm)

	Duration							
ARI	10-min	20-min	30-min	1-hr	2-hrs	6-hrs	12-hrs	24-hrs
2.33	4.9	6.4	8.1	12.2	19.2	34.8	46.2	55.9
5	6.5	8.8	11.3	15.9	23.9	40.2	56.5	75.4
10	8.0	11.1	14.2	19.2	27.6	43.7	64.9	94.4
20	9.6	13.3	17.1	22.5	31.1	46.5	72.9	114.2
50	11.8	16.2	21.0	26.8	35.3	49.8	83.4	141.1
100	13.3	18.4	23.9	30.0	38.3	51.9	91.2	161.8

5.12.3 Design Runoff Coefficients

The runoff coefficients shown below are provided as a guide for initial calculation of system requirements (based on a 10yr event, average slope 5% - 10%, saturated soils).

More accurate investigations into appropriate return periods and runoff coefficients will be necessary for detailed design. Detailed design should involve calculating a weighted average runoff coefficient by averaging the value for individual parts of the catchment. This may be done for a representative sample area or the whole catchment. The formula for this calculation is shown in the publication IPENZ ‘Procedure for Hydrological Design of Urban Stormwater Systems’, December 1980.

In refining the estimate of runoff coefficient, the coefficients provided in IPENZ ‘Procedure for Hydrological Design of Urban Stormwater Systems’, clause 4.3.2 shall be used. The following coefficients are provided as a guide and are inkeeping with those provided by the *New Zealand Building Code* – Verification Method E1/VM1 which should also be referenced.

(i)	Roofs	C = 0.90
(ii)	Asphaltic & Concrete Areas	C = 0.85
(iii)	Parks, playgrounds and reserves	C = 0.30
(iv)	Gardens, lawns etc	C = 0.25

Composite runoff coefficients for developed urban areas or land that is expected to be developed as a residential area are typically:

(i) 0.55 for a 10 year return period storm
(ii) 0.65 for a 50 year return period storm

Note:
The run-off co-efficient C is the variable in the rational formula least able to be

precisely determined and has a direct result on the estimation of the discharge. Thus care is required in selecting a value for the co-efficient. The co-efficient represents the integrated effects of infiltration, storage, evaporation, natural retention, interception etc, which all affect the time distribution and peak rate of run-off. The factors required to determine a value for C are surface type, characteristics topography and land use.

In all cases the assumptions used (and the basis of these assumptions) in the calculation of run-off shall be clearly stated. Specifically, the calculation of impervious area and runoff coefficients shall be based on site specific data and account for the ultimate development of the site.

5.12.4 Sizing of the stormwater drainage system

Drainage system hydraulics shall be in general accordance with *WWDG Part B* chapter 22 and Appendix 5. In addition, Council has the following level of service requirements:

▪ Primary piped system	10 year storm (10% AEP)
▪ Overall system (primary & secondary)	50 year storm (2% AEP)
▪ Bridge structures	100 year storm (1% AEP)

5.12.5 Soakage systems

Design of the soakage systems must be in accordance with *WWDG Part B* chapter 6.

All roadside soakpits shall comply with the requirements of this Code. Example details are provided in Appendix 1 of *Part:8 Roads and Transport*.

Soakpits shall be designed for ease of maintenance and replacement as required.

Additional soakpits for roading purposes shall be marked using one marker post of a type to be approved by the Council.

5.12.6 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.

5.12.7 Energy loss through structures

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

5.12.8 Determination of water surface profiles

Design stormwater drainage systems in accordance with *WWDG Part B* clauses 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 5.6.7 - 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 and *NZS 4404:2004 Land Development and Subdivision Engineering.*

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.

5.12.9 Water Quality

The design of water quality devices shall be in general accordance with ARC TP10 and WWDG Part B chapter 6 or specific Council guidelines as and when developed.

The developer is encouraged to explore ground infiltration and non-structural methods of water quality treatment. 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.

The water quality rainfall depth is generally accepted to be the first 15 – 25mm of rainfall (first flush) within the Canterbury Region. There are numerous means for calculating this depth with no specific requirements from the Regional Council.

Within the Selwyn District, where the water quality depth is calculated to be greater than 25mm then 25mm shall be adopted. Conversely, where the water quality depth is calculated to be less than 15mm the water quality depth shall be taken as 15mm.

Higher risk developments e.g. Industrial development shall adopt 25mm as the water quality depth regardless of the calculated water quality depth.

For stormwater management devices designed based on flow rate, the design rainfall intensity shall be no less than 10 mm/hr.

The designer may propose alternative design elements with supporting evidence from recognised authorities. The Council will consider alternative technologies on a case-by-case basis.

5.12.10 Water Quantity

Control of peak storm discharge is required for systems discharging to ***surface water***. Post development flows shall be no greater than pre development flows for the following events:

- During 50% AEP - Critical duration storm (2-year event)
- During 10% AEP - Critical duration storm (10-year event)
- During 2% AEP - Critical duration storm (50-year event)

The District Council or Environment Canterbury may also specify additional attenuation requirements specifically aimed at providing flood, erosion and scour protection.

Where the discharge of stormwater is to ***ground***, the system should be designed for 'total detention' (combination of storage and overflow soakage) of the 2% AEP critical duration storm event. The suitability of the natural ground to receive and dispose of the stormwater without causing damage or nuisance to neighbouring property, shall be determined by a suitably qualified person/engineer

This requirement may be relaxed, at the discretion of the Council, provided that a well defined secondary overland flow path is available (refer section 5.6.2).

5.13 CONSTRUCTION

Construction must be carried out in accordance with *CSS: Part 3*.

Wherever works are installed within existing legal roads, the developer must obtain a Road Opening Notice (RON) for that work. The works must comply with requirements as set out in *CSS: Part 1* for this type of work.

5.13.1 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.
- 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 http://www.rebri.org.nz/

5.13.2 Materials

The Council has an asset service life requirement of 100 years. 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 Council reserves the right to require full details of the manufacturer's means for demonstrating compliance. Irrespective of the means of demonstrating compliance and the supplier's and manufacturer's quality assurance systems, responsibility remains with the developer to ensure the installation of products that conform with the requirements of the COP and the appropriate standards. The Council may arrange for independent testing to be carried out on randomly selected samples or assembled joints.

Positive verification inspections or testing results obtained by the Council shall not limit the supplier's responsibility to provide an acceptable product, nor shall it preclude subsequent claims made under warranty due to manufacturing defects, faulty design, formulation or processing.

Proposed pipes and concrete structures that are likely to lie within Aggressive Groundwater zones will need additional protection such as an external plastic wrapping membrane.

5.13.3 Bedding, haunching and backfill

Design bedding, haunching and backfill to conform to *WWDG Part B* clause 14.2.3. Bedding and haunching materials must comply with *CSS: Part 3* and the pipe manufacturer's specifications.

Specify wrapping of the joints in all rubber ring jointed pipes and laterals with a geotextile that complies with TNZ F/7 strength class C. Select a geotextile that will prevent the infiltration of backfill or natural material into the stormwater system where pipes break under seismic loading. Specify wrapping of the haunching for plastic pipes and laterals in liquefaction prone areas with a geotextile that complies with TNZ F/7 strength class C. This may improve the longitudinal strength of the pipeline, reducing potential alterations in grade.

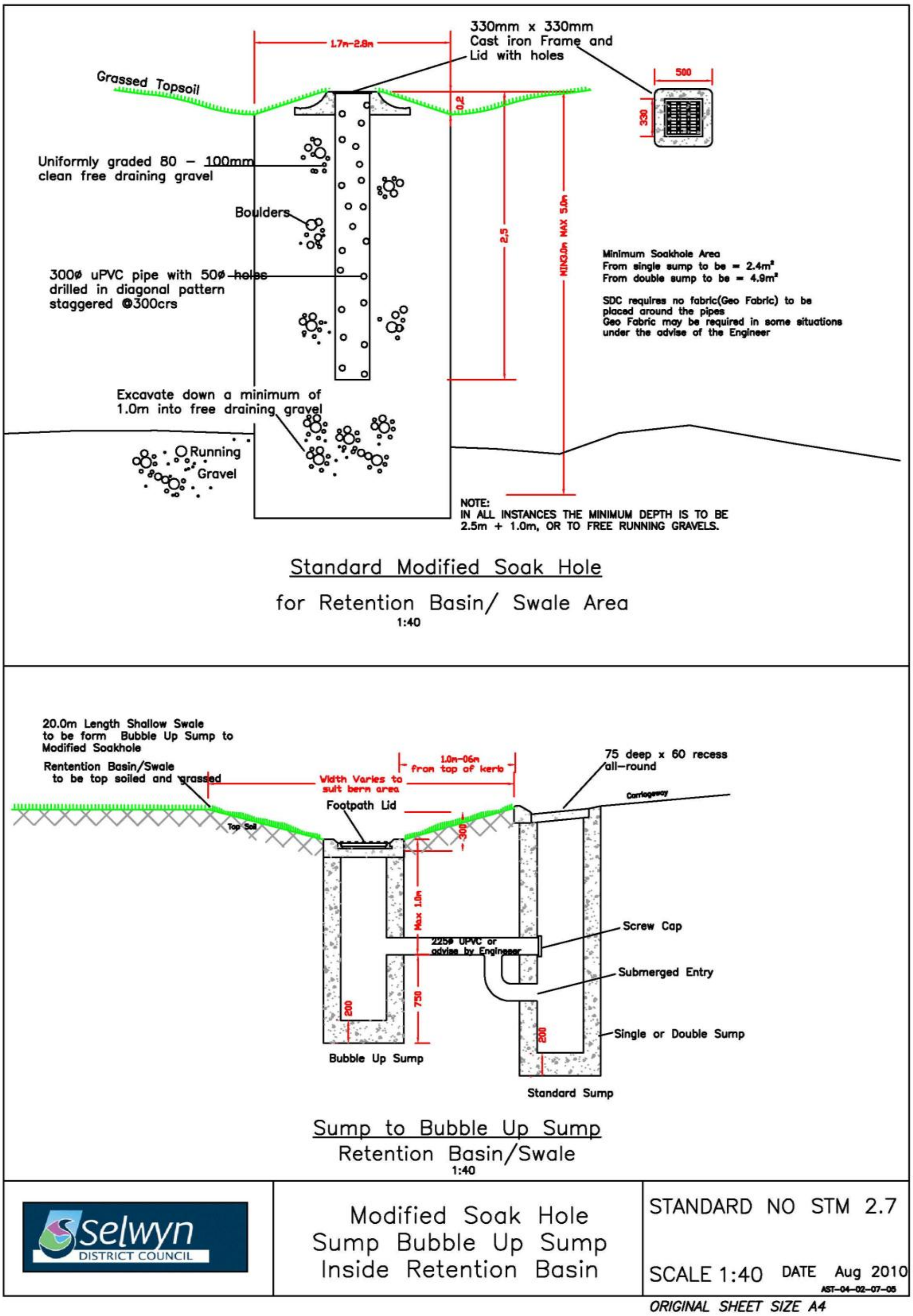
Specify backfill materials individually. The material used must be capable of achieving the backfill compaction requirements set out in *CSS: Part 1* clause 23.0 - Backfilling and clause 5.10.8 - Pipelines in permeable ground.

5.14 AS-BUILT INFORMATION

Present as-built information which complies with Part 12: As-Builts and this Part.

APPENDIX 1 STANDARD DRAWINGS

STM 2.7 Modified Soak Hole Bubble Up Sump Inside Retention Basin


330mm x 330mm
Cast iron Frame and
Lid with holes
1.7m-2.8m
Grassed Topsoil
0.2
500
330
Uniformly graded 80 – 100mm
clean free draining gravel
Boulders
2.5
MIN3.0m MAX 5.0m
300ø uPVC pipe with 50ø holes
drilled in diagonal pattern
staggered @300crs
Minimum Soakhole Area
From single sump to be = 2.4m²
From double sump to be = 4.9m²
SDC requires no fabric(Geo Fabric) to be
placed around the pipes
Geo Fabric may be required in some situations
under the advise of the Engineer
Excavate down a minimum of
1.0m into free draining gravel
Running
Gravel
NOTE:
IN ALL INSTANCES THE MINIMUM DEPTH IS TO BE
2.5m + 1.0m, OR TO FREE RUNNING GRAVELS.
Standard Modified Soak Hole
for Retention Basin/ Swale Area
1:40
20.0m Length Shallow Swale
to be form Bubble Up Sump to
Modified Soakhole
Rentention Basin/Swale
to be top soiled and grassed
Width Varies to
suit bern area
1.0m-06m
from top of kerb
75 deep x 60 recess
all-round
Carriageway
Footpath Lid
Top Soil
300
Max 1.0m
225ø UPVC or
advise by Engineer
Screw Cap
Submerged Entry
750
200
200
Single or Double Sump
Bubble Up Sump
Standard Sump
Sump to Bubble Up Sump
Retention Basin/Swale
1:40
Selwyn
DISTRICT COUNCIL
Modified Soak Hole
Sump Bubble Up Sump
Inside Retention Basin
STANDARD NO STM 2.7
SCALE 1:40
DATE Aug 2010
AST-04-02-07-05
ORIGINAL SHEET SIZE A4