

PART 6: WASTEWATER DRAINAGE**CONTENTS**

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6.1 REFERENCED DOCUMENTS

Planning and Policy

- The *Selwyn District Plan (District Plan)*
www.selwyn.govt.nz/services/planning
- Canterbury Regional Council *Natural Resources Regional Plan* (NRRP)
www.ecan.govt.nz/our-responsibilities/regional-plans/nrrp/Pages/read-plan.aspx%20
- Selwyn District Council *Development Contributions Policy* - [Long Term Council Community Plan – Selwyn Community Plan 2009-2019](http://www.selwyn.govt.nz/council-info/selwyn-community-plan)
www.selwyn.govt.nz/council-info/selwyn-community-plan
- Selwyn District Council Wastewater Drainage Bylaw (2009)
- Selwyn District Council Trade Waste Bylaw 2009
www.selwyn.govt.nz/council-info/key-documents/bylaws/current-bylaws
- Selwyn District Council *5Waters* – Strategies and Policies (2009)
www.selwyn.govt.nz/data/assets/pdf_file/0016/14047/5Waters---Strategies-and-Policies---Final.pdf

Design

- Christchurch City Council *Sewage Pumping Station Design Specification*
- Christchurch City Council *Private Wastewater Pumping Station Design Specification*
- Christchurch City Council *Waterways, Wetlands and Drainage Guide*, Ko Te Anga Whakaora mö Ngä Arawai Rēpo 2003 (WWDG)
- AS/NZS 1546.1: 2008 *On-site domestic wastewater treatment units - Septic tanks*
- New Zealand Building Code Compliance Document *G13Foul Water*
www.dbh.govt.nz/building-code-compliance-documents
- AS/NZS 1547: 2000 *On-site domestic wastewater management*
- NZS 4404:2010 *Land Development and Subdivision Engineering*
- Transit New Zealand Bridge Manual (2003)
- Water Industry Specification 4-34-04 *Specification for renovation of gravity sewers by lining with cured-in-place pipe*

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>

- Selwyn District Council *CCTV Specification for New Sewers*

Where a conflict exists between any Standard and the specific requirements outlined in the Infrastructure Design Standard (IDS), the IDS takes preference (at the discretion of the Council).

6.2 INTRODUCTION

6.2.1 History of the districts wastewater system

The districts wastewater system differs from most other districts cities in New Zealand in that, due to the terrain, flatter than normal sewer grades are quite common.

The standard of specification and supervision of construction has always had a high priority, meaning that, on average, the system is in good condition despite its age.

Because of the flat grades, traditional maintenance methods involved regular flushing and cleaning of pipelines with water supplied from shallow wells. Mains-supplied water is now used for flushing and consequently the cost and conservation of water is important.

6.2.2 Council bylaw on water related services

The *Wastewater Drainage Bylaw* defines the Council's requirements and protection for the drainage works.

6.2.3 New developments

Gravity reticulation, with conventional pumped systems where necessary, remains the preferred method of reticulation for most developments but some new developments may require pumping systems.

Standard plans (subject to charge) and specifications for submersible pumping stations are available from the Council.

In areas where gravity reticulation systems are not achievable due to grades or long distances, common pressure main systems, including small privately operated and municipal systems, are an option subject to the Council's approval. Each lot must have an individual wastewater pump connected to a common pressure main system.

Biofilter design is included in this Part of the IDS. Biofilters are required at the terminal of all pressure mains likely to generate hydrogen sulphide.

6.2.4 Design lifetime

All wastewater reticulation systems are expected to last for an asset life of at least 50 years with appropriate maintenance. Design the systems accordingly, to minimise life cycle costs for the whole period.

6.2.5 Alternative technology

The Council will consider alternative technologies on a case-by-case basis. Examples of such technologies are vacuum wastewater collection systems and reticulated septic tank gravity and pressure systems.

6.3 QUALITY ASSURANCE REQUIREMENTS AND RECORDS

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

6.3.1 The designer

The designer of all wastewater systems that are to be taken over by Selwyn District Council 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.

6.3.2 Design records

Provide the following information to support the Design Report:

- all options considered and the reason for choosing the submitted design;
- hydraulic calculations, preferably presented in an electronic form;
- all assumptions used as a basis for calculations, including pipe friction factors;
- design checklists or process records;
- design flow rate; sewer main gradients;
- system review documentation as detailed in clause 6.4.8 – System review;
- thrust block design calculations, including soil bearing capacity;
- trenchless technology details, where appropriate;
- calculations carried out for the surge analysis of pressure pipes where appropriate.

6.3.3 Construction records

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

- performance test results;
- material specification compliance test results;
- compaction test results;
- subgrade test results;
- confirmation of thrust block ground conditions and design;
- site photographs.

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-Built including manufacturer, diameter, type, class, jointing and contractor who laid the pipe.

6.3.4 Acceptance criteria

All pipelines must be tested before acceptance by Council. Provide confirmation in accordance with the Contract Quality Plan that they have been tested, inspected and signed off by the engineer. Perform testing in accordance with NZS4404.

All new sewers shall be inspected with CCTV in accordance with the SDC CCTV Specification for New Sewers, to confirm construction has been completed in accordance with the approved engineering drawings. Pipes shall be flushed prior to CCTV inspections.

6.4 SANITARY SEWER DESIGN FLOWS

Sanitary sewer flows vary with the time of day, the weather and the extent and type of development within the catchment. Design systems to carry maximum flows without surcharging.

The maximum wastewater flow is given by:

Equation 1 Maximum flow

$$MF = P / A \text{ ratio} \times SPF \times ASF$$

where MF = Peak wet weather flow (ℓ/s)

P / A = Dry weather diurnal peaking ratio (clause 6.4.1)

SPF = dilution / infiltration factor (clause 6.4.2)

ASF = Average Sewage Flow (clause 6.4.3 or 6.4.5)

Design pipelines with sufficient capacity to cater for all existing and predicted development within the area to be served. Make allowance for all areas of subdivided or unsubdivided land that are capable of future development. Refer to the *Development Contributions Policy*.

When calculating the unit ASF, the net area used includes roads but excludes reserves.

All diameters are nominal internal, unless otherwise noted. PE only is specified by a nominal outside diameter (OD).

The minimum size of public sewer pipelines in residential zones is 150mm diameter and in commercial and industrial zones is 225mm diameter.

6.4.1 Peak to average ratios

Use a peak/average ratio (P/A) of 2.5 for wastewater reticulation design.

6.4.2 Dilution from infiltration and inflow

Infiltration is the entry of subsurface water into the pipeline through cracks and leaks in the pipeline. Inflow is the direct entry of surface water to the pipeline from low gully traps, downpipe discharges and illegal stormwater connections.

For new developments, apply a storm peak factor (SPF) of 2.0 to the peak wastewater flow to allow for infiltration and storm inflow.

Infiltration from existing reticulation can vary significantly throughout the district. Please contact SDC to confirm infiltration rates where new reticulation will receive flows from existing reticulated areas.

6.4.3 Average residential wastewater flows

Residential flows are derived from a water use of 220 litres per person per day. The unit average wastewater flow is given by:

Equation 2 Unit ASF

$$\text{Unit ASF} = \text{persons} / \text{hectare} \times \text{litres} / \text{person} / \text{day}$$

And

6.4.4 Maximum flows for new developments

Where the actual number of lots is known, use Equation 3. If there is any scope for further infill development, increase the number of lots to allow for this.

e.g. For a residential subdivision of 200 lots:

Equation 3 Maximum flow calculation example based on number of lots

$$\begin{aligned} \text{ASF} &= \text{number of lots} \times 220 \text{ l/person/day} \times 2.7 \text{ people/lot} \\ &= 200 \times 220 \text{ l/person/day} \times 2.7 \text{ people/lot} \\ &= 118800 \text{ l/day} \\ &= 1.38 \text{ l/s} \\ \\ \text{MF} &= 1.38 \text{ l/s} \times 2.5 \times 2 \\ &= 6.90 \text{ l/s} \end{aligned}$$

6.4.5 Average commercial and industrial wastewater flows

Commercial and industrial zones shall provide capacity for a design flow of 1l/s/ha.

For known industries, base design flows on available water supply and known peak flows.

When assessing whether a wet industry can be reasonably accommodated in an area that is reticulated but not fully developed, leave sufficient flow capacity in the pipeline to serve remaining developing areas at a unit ASF of 0.15 l/s/ha (provided that no other wet industries are being planned).

6.4.6 Total design flows for existing developments

Base the design of major renewal and relief sewers (greater than 375 ID) serving older catchments on actual catchment performance. As the performance, which is derived from flow monitoring, is not always available, discuss larger reticulation requirements with Council.

6.4.7 Size of private sewer drains

The minimum size of private sewer drains must be 100mm diameter.

For major industrial users, determine the size of the lateral using the maximum flow requirements and the available grade.

6.4.8 Private sewer drains – industrial lots

Private sewer lines serving industrial lots or carrying trade waste as defined in Council's Trade Waste Bylaw shall be provided with an inspection chamber adjacent to the property boundary. Intermediate inspection chambers shall be provided for multi unit sites likely to carry trade waste as approved by Council.

6.4.9 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 IDS. 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 materials;
- pipe class is suitable for the pipeline application (including operating temperature, surge and fatigue where applicable);
- seismic design – all infrastructure is designed with adequate flexibility and special provisions to minimise the risk of damage during an earthquake, and with consideration for the cost and time to repair any potential damage. Provide specially designed flexible joints at all junctions between rigid structures (e.g. pump stations, bridges, buildings, manholes) and natural or made ground;
- layout and alignment meets the Council's requirements;
- maximum operating pressure will not be exceeded anywhere in the pressure pipe system;
- capacity is provided for future adjacent development.

6.5 GRAVITY PIPELINES

6.5.1 Alignment

Lay gravity pipelines in straight lines and at a constant gradient between access points such as manholes and inspection chambers. Discuss major reticulation and its potential for significant traffic disruption at an early stage with Council.

Lay wastewater pipes in the centre of the road in general, with a minimum vertical cover of 1.2m. This makes the sewer equidistant from the properties it serves, and, being at a relatively high point on the road surface, vented manholes are less subject to surface floodwater entry. Refer to clause 6.12 – Haunching and Backfill for further information regarding depths of pipes.

In curved roads, straight lengths of wastewater pipelines must clear kerbs by 2.0m and manholes should be on the centreline. To minimise manhole numbers, they may be sited between the quarter point and the centreline.

The preferred solution for wastewater reticulation is to avoid easements over private property.

Equation 3 Easement width

The easement width is the greater of :

$$\triangleright 2 \times (\text{depth to invert}) + OD$$

$$\triangleright 3.0 \text{ m}$$

where OD = outside diameter of pipe laid in easement

Where easements are agreed with Council the easement registration must provide the Council with rights of occupation and access and ensure suitable conditions for operation and maintenance.

6.5.2 Temporary ends

Extend wastewater sewers to the upstream boundary of new developments, to allow for connection of any future upstream catchments. Terminate the main at an access point.

6.5.3 Hydraulic design

Gravity pipelines maintained by the Council must have a minimum diameter of 150mm for residential and 225mm for industrial or commercial applications.

Base the hydraulic design of sanitary sewer pipelines on the Pipe Nomograph in Appendix I – Pipe Flow Nomograph or other representations of the Colebrook White equation. Use a pipe roughness coefficient k_s in the design of 1.5mm for pipelines 300mm and smaller, and 0.6mm for pipelines 375mm and larger. This allows for long-term grit deposits, slime growth etc.

Size pipelines to cater for future flows from the upstream catchment, when fully developed.

6.5.4 Flows

Design wastewater pipelines on a uniform flow basis, without surcharging, so that at times of normal flow (non-peak) there is a uniform airspace for ventilation.

6.5.5 Minimum gradients

Flat gradients, which have been traditionally used in the district, resulted in velocities significantly lower than the widely used self-flushing velocity of 0.7m/s.

Lay pipes at the steepest grade available, with a minimum half-pipe velocity of 0.65m/s, to minimise deposition and transit time of wastewater. If 0.65m/s cannot be achieved, due to insufficient grade being available, detail an alternative solution in the Design Report for Council acceptance.

In general the minimum grades allowable by Council are as shown in Table 1.

Table 1 Minimum grades

| | Diameter (mm) | Unflushed grade | Minimum number of houses above the reduced gradient |
|---------|---------------|-----------------|---|
| Private | 100mm | 1:120 | ≤ 5 |
| Public | 150mm | 1:180 | ≤ 5 |
| Public | 150mm | 1:200 | > 5 |

Note 1) For pipes larger than 150mm, discuss grades with Council.

Avoid the use of flush tanks by grading the upper manhole lengths of sewer at 1:160. In general, 15 dwellings connected to the 1:160 graded portion are sufficient to generate a self-cleansing flow.

Temporary flushing may be required in some areas until sufficient dwellings are complete.

6.5.6 Deep pipelines

Limit the maximum pipe depth to 3.5m to invert.

6.5.7 Inverted siphons on sanitary sewers

Inverted siphons are sometimes necessary when passing major obstacles such as rivers and large drains. Problems associated with inverted siphons derive primarily from an accumulation of solids when velocities are reduced during low flow. Accumulated solids can give rise to odour problems, make the wastewater more septic, and restrict peak flows. Remember that the water seal blocks airflows and can affect the ventilation pattern.

Size the pipes to give peak daily velocities of at least 0.6m/s. If flows are expected to increase significantly with time, install two different sized pipes, giving three possible modes of operation. These modes of operation may be used progressively in steps, as flows build up over time, by the removal of plugs. Design the plugs to be easily removable and provide details in the Design Report.

To improve the transmission of solids, the maximum pipeline slopes must be 45° and 22.5° on the downward and upward legs respectively, with manholes placed to make cleaning easier. Because bedding conditions are often difficult, concrete-lined steel pipes and bends of cast iron are commonly used. Differential settlements are likely to occur between the manhole and the siphon piping so give special attention to the joints in these areas.

It may be necessary to surround piping with concrete under waterways that are dredged from time to time. It may also be necessary to provide isolation valves to help flush siphons.

6.5.8 Deep Laterals

Where the sewer main is deeper than 2.5m and laterals would discharge to the sewer main install a manhole instead of a junction to approval of Council to connect lateral to.

6.5.9 Pipe Stiffness Rating

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

6.6 MANHOLES

6.6.1 Location and spacing

Manholes should, preferably, be positioned on roadways or where there is vehicle access. The flow deviation angle between the inlet and outlet pipes must not be greater than 90 degrees, as shown in Figure 1.

Building over sewer connections, junctions or manholes is not permitted. It is possible to relocate sewer mains through consultation with Council at the applicant's expense. Council allows building over straight lengths of sewer lines subject to the following criteria being satisfied:

The owners/occupier shall, at their expense:

- a) Prior to any construction being undertaken:
 - i). Inspect the line through a video camera and submit the tape with a site plan to Council. Any repairs as assessed by Council at this stage are to be the responsibility of Council.
 - ii). Provide an engineer's certificate stating that the building will not impart any loads to the line.
- b) After consent from Council for construction is granted, and construction has been undertaken:
 - i). Re-inspect the line by video camera and submit the tape to Council. Any damage as assessed by Council shall be remediated at the owner occupiers expense to the satisfaction of Council.
- c) Be aware that council requires access to all manholes 24 hours a day.

On sites that are empty with sewer lines through the building platform and there are faults on Councils' lines, repairs may not always be undertaken immediately (e.g. a wide joint that is not leaking). Those will be acknowledged to be fixed by Council should a problem arise at a later stage. Developers must repair damage caused by construction however.

Figure 1 Flow deviation

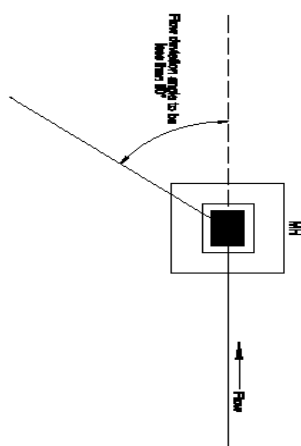


Table 2

specifies the range of maximum spacings.

Table 2 Spacing for manhole covers

| Diameter in mm | Maximum spacing (m) |
|----------------|---------------------|
| 150 – 225 | 100 |
| 300 – 900 | 120 |

6.6.2 Vented manholes

Vented manholes are designed to serve as intakes for fresh air, which passes through the sewers and laterals to the main vents on individual houses, disposing of corrosive and foul air in a way that causes minimal offence. However, occasional temperature inversions cause the air to flow in reverse and inlet vents should also be located so that any foul air coming from them causes minimal offence.

Use vented manholes on each alternate manhole cover and place them where there is minimal turbulence, to avoid undue odours. Trash collectors shall be installed beneath the vents (design available from SDC). Avoid features such as angles, junctions and summit manholes, and pressure main outlets.

Manhole lids shall be of a circular hinged nature constructed of ductile iron construction, and shall have an opening of at least 590mm. Ladders shall be fixed to the wall of the man holes, stirrups shall not be used.

To avoid surface water entry and the associated gorging of pipelines, site vented manholes away from areas where ponding of stormwater is likely to occur. Likewise, avoid road intersections because gravel and grit entry is greater at these locations.

Special consideration must be given to large trunk sewers (larger than 450 mm ID) as these may be inadequately vented by house connections. To ensure that air movement adequately serves all parts of a sewer, it may be necessary to use special air inlets, special vent stacks and/or a forced draught with designed circulation, possibly in conjunction with odour control (Refer to clause 6.9 - Biofilters). Note that siphons cut off all airflow, unless special air ducting is incorporated.

6.6.3 Structural design

Design structures to withstand all loads, including hydrostatic and earth pressure and traffic, in accordance with the *Bridge Manual*. Design structures exposed to traffic to HN-HO-72 loading.

Manholes must comply with *CSS: Part 3* SD 302, 303, or 304, or with other Council approved designs. Provide yield joints between manholes and pipes in accordance with *CSS: Part 3* SD 341. Where the structure is likely to experience differing movement 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 movements at the structure.

A specific design is required for larger pipes, especially where changes of direction are involved. The design must incorporate a standard manhole opening and be able to withstand a heavy traffic loading HN-HO-72.

Check all manholes for flotation. The factor of safety against floating should be at least 1.2 excluding skin friction in the completed condition, with an empty manhole and saturated ground. Counter increased forces resulting from greater depths and spans by thicker walls or reinforcing.

Unreinforced vertical concrete panels, provided for future connections in manholes or other underground structures, which are subject to soil and traffic loading should be specifically designed. Alternatively, in the case of a square panel, ensure that the length of the side does not exceed seven times the panel thickness.

Consider the foundation conditions as part of the design. If there is a possibility of soft ground, carry out ground investigations and a full foundation design.

6.6.4 Drop structures in manholes

Drop manholes are a potential source of blockages. Lay pipelines as steeply as possible to avoid any need for a drop.

When a wastewater pipe must enter a manhole with its invert level more than 200mm higher than the soffit of the outlet pipe, provide a drop manhole as detailed in CSS: Part 3 SD 305. Clause 6.5.8 – Collector sewers modifies these requirements on collector sewers.

6.6.5 Fall through manholes

The minimum fall in the invert of angled wastewater manholes is set out in Table 5.

Table 3 Minimum fall in manhole

| Angle of deviation | Minimum fall (mm) |
|--------------------|-------------------|
| 60° - 90° | 50 |
| 30° - 60° | 25 |
| 0° - 30° | 10 |

Note: 1) Falls less than those in the table can only be specified if a half round former pipe is used in the invert to construct the manhole benching.

When there is an increase in the pipe size at a wastewater manhole, the soffit of an inlet pipe must not be lower than the soffit of the outlet pipe.

6.6.6 Manhole Connections

Manhole corbel construction shall be completed in accordance with Standard Drawing SW16.

6.7 WASTEWATER PUMPING STATIONS

Council currently has standard layout designs which are going through a process of review. Standard designs do not negate the requirement of the designer to take into account site specific details of proposed pump stations. Additionally all permanent surfaces shall be adequately protected against the corrosive nature of wastewater. Given the potential for changes to the reticulation layout within the design, suitable protection of all surfaces and key fittings and pipework shall be required on all pump stations.

Council preference when a concrete wet well is used is for a mechanically fastened plastic coating to be installed at the time of manufacture to protect against hydrogen sulphide attack.

Consideration shall be made to install a groundwater level monitoring bore at pump station sites.

The site telemetry requirements for new sewer pump stations are detailed in Part 14: Telemetry.

An operation manual in a form acceptable to Council shall be provided covering in detail the operation of the sewer pump station.

6.8 PRESSURE PIPELINES

Pumping systems for conveying wastewater are the least preferred option and will not be accepted by Council where gravity reticulation is practical.

Pressure pipelines up to and including 560mm OD are normally constructed from PE pipe.

Once pipe diameters are selected, match pipe class selection to pump, flow and surge characteristics. Try to minimise the time fluids spend in a pressure main, and maintain velocities high enough to transport solids. Both these objectives can be achieved by minimising the length and diameter of the pipe.

The pipeline will also need to withstand static and friction heads of long duration, together with short duration water hammer pressures. Consider seismic effects temperature differentials and the Poisson's effect in flexible pipes. Design end restraints to compensate for this, where necessary.

The standard connection of a private pressure line to a sewer main is shown in drawing SW 5.0.

6.8.1 Maximum operating pressure

Design the components of a pressure pipeline to withstand a maximum operating pressure that is no less than any of the following:

Equation 4 Maximum operating pressure

| |
|--|
| <p>Maximum operating pressure is greater of :</p> <ul style="list-style-type: none"> ▷ 400 kPa ▷ $1.5 (H_s + H_f)$ ▷ pumpshut off head ▷ positivesurge pressure <p>where H_s = static head H_f = friction head</p> |
|--|

Ensure that external loads on the pipeline are included in all load cases, especially when pressure testing large diameter pipes. Provide a factor of safety of at least 2.0 against buckling under negative or external pressures.

For flexible pipes, such as glass reinforced plastic (GRP), PVC or polyethylene, the fatigue effects may define the pressure rating, which must be the greater of the maximum operating pressure calculated above, the minimum pressure rating in Table 6 or the equivalent operating pressure. To calculate the equivalent operating pressure

(P_{eo}) use the methodology described in Appendix V - Design for Surge and Fatigue (Water Supply).

Table 4 Minimum pressure ratings for flexible pipes

| Material type | Pressure rating (kPa) |
|----------------------|-----------------------|
| PVC-U | 900 |
| PVC-O | 900 |
| PE 80B | 800 |
| PE 100 | 800 |
| GRP | 800 |
| Concrete lined steel | 800 |
| DI | 800 |

6.8.2 Water hammer and surges

Water hammer and surges can arise from a number of different operations, e.g. the sudden starting or stopping of a pump or closure of a non-return valve. Water hammer can be critical in pumping systems, especially in large diameter mains and high static head systems.

Submit the design for pressure mains, including levels and layout, with the Design Report. Submit a detailed hydraulic surge and fatigue analysis report, including all assumptions and all calculations.

When choosing the pipe class for pressure pipelines, ensure that the effect of water hammer and fatigue from a large number of stress cycles over a 100-year lifecycle is also taken into account. For details on surge and fatigue see Appendix V - Design for Surge and Fatigue (Water Supply).

Consider soft closing, non-return valves for installations in high head situations.

Allow for issues such as operation and maintenance and consider failure of any mechanical surge protection measures and protection from damage during these situations.

6.8.3 Velocity

The pipe velocity must be at least 0.9m/s on all pressure mains.

6.8.4 Gradients

Ideally pressure mains should slope continually upwards from the pumping station to termination. Surcharge all lengths sufficiently to keep the pipe full and prevent sudden discharges of foul air at pump start. Avoid creating summits since they trap air, reducing capacity, and allow the build up of sulphides, which convert to droplets of sulphuric acid and may cause pipe corrosion.

If a summit is unavoidable, provide automatic air release valves with drains to a sanitary sewer. Design the air valves specifically for wastewater operation. Mount air valves vertically above the pipeline to which the air valve is connected. (Fat or solids will block the connecting pipe if the valves are mounted to one side of the vented pipeline.) Fit an isolating gate valve between the air valve and the vented pipeline and mount the valves in a concrete valve chamber. The chamber must be large enough to allow easy access for maintenance staff to operate the isolating valves or remove all valves from the chamber. Consideration shall be given to treating foul air at air valve locations in built up areas.

Gradients are less important for temporary pressure mains but consider creating vertical sections to provide pump starting head and pipeline charging. Wherever there are undulations in the line, consider installing air release valves.

6.8.5 Valves

Consider detailing sluice and scour valves, particularly at troughs in the gradient. Consider isolation valves on long lengths of pressure pipe, particularly where there is insufficient capacity to store flows.

6.8.6 Thrust blocks

Specify thrust blocks to withstand the maximum operating pressure and the test pressure. Confirm the bearing capacity of the in-situ soil and the thrust block design and record as detailed in the Contract Quality Plan prior to installation.

Design and detail thrust blocks individually for any of the following situations, as the thrust block detailed in CSS: *Part 3* SD 346 is not appropriate:

- The test pressure or maximum operating pressure is greater than 390 kPa.
- The ultimate ground bearing capacity is less than 100 kPa.

6.9 BIOFILTERS

A biofilter is a device used to treat odours arising from the wastewater system. Prevent odours by:

- avoiding the use of pressure mains;
- reducing turbulence generally;
- minimising retention times.

The usual form of biofilter used in sewerage systems is a media bed, through which the odorous gas is passed. The principal odour component of wastewater is H₂S (hydrogen sulphide) and the biofilter operation makes use of the ability of naturally occurring bacteria to convert the H₂S to acid and elemental sulphur.

Typically, the situations where odours cause nuisance are where the wastewater is more than eight hours old, held in anaerobic conditions in pressure mains and where there is high turbulence that encourages H₂S to come out of solution.

6.10 LATERALS

6.10.1 Sanitary junctions and laterals

Each front lot must be provided with a separate lateral connection. Lay laterals at least 0.6m clear from property side boundaries, to terminate 0.6m inside the net site area of the lot. Haunch laterals, laid as part of a development, in accordance with this Part of the IDS. All materials used must be Council-approved.

Wherever possible, position each junction opposite the centre of each lot frontage, unless the position of the sanitary fittings is known and indicated otherwise. Where the depth to soffit of the main sewer is more than 2.0m, risers may be used, subject to

the requirements of other services and land levels. All other junctions must be side junctions. Do not lay junctions on pipelines deeper than 4.0m.

Do not lay junctions on sewer mains deeper than 2.5m. Where junctions could be deeper than 2.5m, or where they are shallower and in areas with difficult ground conditions, design collector sewers parallel to the sewer main as detailed in clause 6.5.8 – Collector sewers.

Form all junctions with a Y or riser junction so that the side flow enters the main at 45°, to reduce deposition of solids.

Gradients are subject to the New Zealand Building Code but the minimum gradient for a 100mm diameter pipe in roads shall be 1:120. Do not install siphons on any lateral without Council approval.

Avoid lateral connections to manholes at the top of a line where minimum gradients are involved.

The standard connection of a private pressure line to a sewer main is shown in drawing SW 5.0.

6.10.2 Cover

Design the lateral grade and invert level to serve the lot adequately. To provide clearance from other services in the footpath, the lateral must have at least 0.8m cover at the kerb or 0.6m cover at the start of a right of way. If there could be conflict with other services, it may be necessary to lower the lateral.

The minimum level for a gully trap is calculated by starting from the soffit level of the main at the connection point. Add the minimum cover to the lateral and the elevation increase of the lateral to this soffit level. The minimum cover is set in the BIA regulations. The elevation increase over the lateral length is calculated assuming the lateral is laid at a gradient of 1 in 120 from the main to the gully trap.

Gully traps must be at least 1.0m above the soffit level of the sewer main. If the gully is lower than the crown of the road, ensure that the gully does not become an overflow for the sewer main in the event of a system blockage. Consider installing non return valves or backflow prevention in places where this cannot be achieved.

On sewer renewal work, when a lateral is identified for renewal and runs close to trees as defined in *CSS: Part 1* clause 16.4 – Protection of Existing Trees, either reroute the lateral around the tree by repositioning the junction on the main, or use pipe bursting or similar techniques to relay the lateral in its present position. Specify jointing in accordance with *CSS: Part 3*, clause 11.1 – Laterals in Close Proximity to Trees.

6.10.3 Common drains

In addition to the NZ Building Code.

Sewer 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 sewer main in private property should be vested, request this at the time of applying for a subdivision consent.

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

- minimum pipe diameter 150 mm
- end in a manhole or inspection chamber
- service 5 lots or greater in number

Size the private common main using discharge units as specified in *Compliance Document G13 Foul Water*.

Limit the use of manholes on the public sewer main by installing direct connections that comply with *CSS: Part 3 SD 363*. Where a manhole is not installed, specify an inspection point at the road boundary. On laterals over 50m in length, provide a trafficable inspection chamber over the junction of the last two laterals.

In developments serviced by sewer mains located at the rear of the lots (typically hill developments) extend the sewer main to the boundary of the last lot.

Haunch laterals laid at the time of development, including those in rights of way, in accordance with *CSS: Part 3 SD 344*.

Provide Y junctions and laterals extending clear of the right of way for all lots. All laterals must finish 0.6m inside the net site area of the lot.

6.11 MATERIAL SELECTION

6.11.1 Reducing waste

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

- Plan to reduce waste during demolition 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 www.rebri.org.nz/.

6.11.2 Corrosion prevention

Corrosion can be caused by hydrogen sulphide, aggressive groundwater, saltwater attack, carbon dioxide or oxygen rich environments.

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;
- using the measures suggested in clause 6.11.4 - Aggressive groundwater.

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 caused by cyclic stress in the presence of sulphides and chlorides.

6.11.3 Aggressive groundwater

Aggressive Groundwater is generally not encountered in the Selwyn District. Where additional investigations highlight the presence of aggressive groundwater the following requirements apply.

Before specifying concrete pipes within 1km of these known areas, test the groundwater to check whether concrete piping is appropriate.

Regard groundwater as aggressive to ordinary Portland cement if any of the following criteria are met:

- over 35ppm calcium carbonate (CaCO_3) alkalinity and over 90ppm aggressive carbon dioxide (CO_2).
- under 35ppm calcium carbonate (CaCO_3) alkalinity and over 40ppm aggressive carbon dioxide (CO_2).
- pH less than six.
- sulphate greater than 1,000mg/l.
- Measures to counter aggressive groundwater include:
 - laying concrete pipes in concrete haunching (see *CSS: Part 3 SD 344 Type C or H*).
 - wrapping pipes with polyethylene film.
 - providing a sacrificial layer of concrete.
 - increasing cover to reinforcing.
 - using special cements.
 - coating pipes with coal tar epoxy, or similar, before installation.
 - use of alternative pipe materials.

6.11.4 Trade waste sewers

Concrete pipes 450mm ID and larger may be used only with approval from the Council and may require an internal sacrificial layer up to 25mm thick. This layer should not be taken into account in strength calculations. Using additives that promote chemical resistance may be an alternative. Refer to Council's *Trade Waste Bylaw* for regulations relating to Trade Waste.

6.11.5 Gravity sewers immediately downstream of pressure mains

PVC, PE and ceramic pipes are suitable for use in gravity sewer pipelines. Concrete pipes must not be used because of the risk of attack from hydrogen sulphide.

Do not specify concrete pipes where it is likely that, in the future, a pressure main will discharge to the top end of a gravity system.

Where a new pressure main will discharge to an existing concrete pipe gravity system, use measures that will reduce the level of dissolved sulphides and remove hydrogen sulphides. These measures could include any one, or a combination, of:

- laying a length of new gravity main to which the pressure main discharges.
- lining the first length(s) of the existing concrete gravity mains.
- installing a biofilter.

6.11.6 Steep gradients

Where gradients are steeper than 1:3 over lengths greater than 3.0m or where velocities are higher than 4.0m/s, and when flows are continuous or frequent, specify wear-resistant pipes such as cast iron, ABS or PE100. 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. Take care to provide adequate anchorage for the pipes.

6.12 HAUNCHING AND BACKFILL

Consider the whole trench, including the pipe, the in-situ material, the haunching and the backfill as a structural element. Design it to withstand all internal and external loads.

Specify wrapping of the joints in all rubber ringed 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 wastewater 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.

Use the manufacturer's material specifications, design charts or computer models to design bedding and haunching, unless these provide a lesser standard than would be achieved through applying the requirements of *CSS: Part 3*. Provide details in the Design Report.

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.

Earth loads on deep pipelines can significantly increase when pipes are not laid in narrow trenches e.g. embankments. However, where there is a danger of the surrounding soils or backfill migrating into the haunching or foundation metal, protect the haunching and foundation metals with an approved geotextile.

6.12.1 Pressure pipes

Haunch pressure pipelines as detailed in *CSS: Part 3* and design thrust blocks as detailed in clause 6.8.6 - Thrust blocks. In the case of upward thrust, reliance must be placed on the dead weight of the thrust block. Special design may be warranted where there are high heads, large pipes or unusual ground conditions.

6.12.2 Difficult ground conditions

Consider the ground conditions as part of the design. If there is a possibility of soft ground, carry out ground investigations.

Replacing highly compressible soils (such as peat) with imported granular fill material can cause settlement of both the pipeline and trench surface, because of the substantial increase in weight of the imported material. Refer to clause 4.6.4 – Peat (Geotechnical Requirements) for further information.

Haunching and backfill in these areas may need to be wrapped in filter cloth to stop the sides of the trench pushing out into the softer ground. Wherever the ultimate ground bearing strength is less than 150 kPa, design structural support for the pipe and any structures.

Consider using a soft beam under the pipe haunching for support or using a flexible foundation raft. Retain joint flexibility. Difficult bedding conditions may warrant the use of piling, in which case smaller pipes may require some form of reinforced concrete strengthening to take bending between piles.

6.12.3 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 – Pipe Installation on Hillsides for details of requirements.

Fill any under-runner voids encountered during the work with either ‘foam concrete’ or ‘stiff flowable mix’ as defined in *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 (40kg/m³), lime stabilised SAP20 (40kg/m³), lime stabilised SAP40 (40kg/m³), ‘firm mix’ as defined in *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 1:5, 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 *CSS: Part 3* SD 347.

6.13 CLEARANCES

Part 9: Utilities summarises clearances for utility services. Confirm these clearances with the network utility operators before deciding on any utility layout or trench detail. Maintain the clearances unless the utility operator grants approval otherwise.

6.14 TRENCHLESS TECHNOLOGY

When working in high volume roads, public areas, adjacent to trees or through private property, consider using trenchless technologies. Factors that need to be considered when making this decision include minimising disruption and environmental damage, social costs, design life of the proposed method, and the economic impact of the work.

Thorough surveys and site investigations, which minimise the risk of encountering unforeseen problems during the work, are essential for the success of trenchless construction. Ensure that the method used complies with the pipe manufacturer’s specifications.

Options available include the following:

- Pipe bursting;
- Cured in Place Pipe Lining (CIPP);
- Directional drilling and Guided boring;
- Slip lining.

The Council may approve other technologies on a case-by-case basis as they are considered or developed. When proposing a new trenchless technology, submit a full specification to the Council that covers the design and installation process.

Submit the following, with the Design Report:

- how the required clearances from other services and obstructions will be achieved;
- the location of access pits and exit points;
- the depth at which the pipeline is to be laid and the effects of any possible ground heave;
- invert levels and grade and the construction tolerances on them;
- how pipe support and reinstatement of pits will be addressed;
- details of pipe materials and jointing.

6.14.1 Pipe bursting

Pipe bursting is suitable only for replacing sewers that are constructed of brittle pipe material, such as unreinforced concrete and vitrified clay. Generally, this method is not suitable for replacing reinforced concrete pipes.

Obtain accurate information about the original construction material and the condition of the existing pipeline, including whether there have been any localised repairs, and whether sections of the pipeline have been surrounded or haunched in concrete. Take special care when the existing pipe has been concrete haunched, as this will tend to raise the invert level of the new pipeline and cause operational problems. Shallow pipes or firm foundations can also disturb the ground above the burst pipe.

Replace the entire pipe from manhole to manhole. The number and frequency of lateral connections may influence the economic viability of this technique.

Grouting of the annulus, especially on the hills, is an essential part of this technique. Where special techniques are required, ensure these are approved **before** the work commences.

6.14.2 Cured in Place Pipe Lining (CIPP)

Cured in place pipe (CIPP) lining systems are preferable for renovating gravity sewers. Before undertaking CIPP, check the structural integrity of the host pipe and ensure that the hydraulic capacity is sufficient for projected future peak flows.

The CIPP liner must produce a durable, close fit with a smooth internal surface. The liners must be resistant to all chemicals normally found in sewers in the catchment area. The manufacturer must submit guarantees to this effect to the Council.

The design of the CIPP liner, including the required wall thickness under different loading conditions, must comply with the manufacturer's recommendations and specifications. Submit a liner specification to the Council that addresses the design procedure and installation methodology. Follow the layout of the *Specification for renovation of gravity sewers by lining with cured-in-place pipe*.

As the host pipe is blocked during the insertion and curing operations, adequate flow diversion is essential for this method. Repair any structural problems at the junctions by open dig prior to CIPP installation.

The opening of connections must be carried out remotely from within the lined sewer. For this purpose, prepare accurate location records by detailed surveys prior to CIPP installation. Additional grouting of junctions may be required after opening.

6.14.3 Directional drilling and guided boring

Restrict sewer installation using guided boring or directional drilling to instances where their construction tolerances are acceptable. Consider possible ground heave over shallow pipes.

Take into account the space requirements for the following:

- drill pits, including working space;
- drill rigs, including access paths for drill rigs;
- drill angle (the drill rig may need to be placed some distance away from the sewer starting point, depending on the angle);
- placement of an appropriate length of the joined sewer on the ground for pulling through the preformed hole;
- erosion and sediment control.

Surface-launched drilling machines require larger construction and manoeuvring spaces compared to pit-launched drilling machines. Consult specialist contractors before selecting this technique.

6.14.4 Slip lining

It is essential to carefully consider the effect that the work will have on the system operation **before** using a slip-lining technique, especially in relation to finished invert levels and capacity.

Carefully inspect and prepare the host pipe prior to the installation of the new pipe. Use a sizing pig at the investigation stage, to confirm clearances.

Replace the entire pipe from manhole to manhole. Reconnect lateral connections to the new sewer as set out in *CSS: Part 3*, clause 7.3 – Thermoplastic Jointing of Polyethylene Pipe by Electrofusion Welding. The number and frequency of lateral connections may influence the economical viability of this technique.

Carry out grouting of any annulus after installing the new pipeline and gain approval for the technique to be used **before** the pipe is installed. Ensure that grouting doesn't cause buckling or flotation of the internal pipe.

Slip lining of 150mm diameter sewers is not permitted.

6.15 ON-SITE WASTEWATER TREATMENT SYSTEMS

In rural residential areas, where ground conditions and terrain are suitable, wastewater disposal may be catered for using on-site septic tanks or wastewater treatment systems.

The *Natural Resources Regional Plan (NRRP)* contains policies and rules relating to the discharge of wastewater effluent.

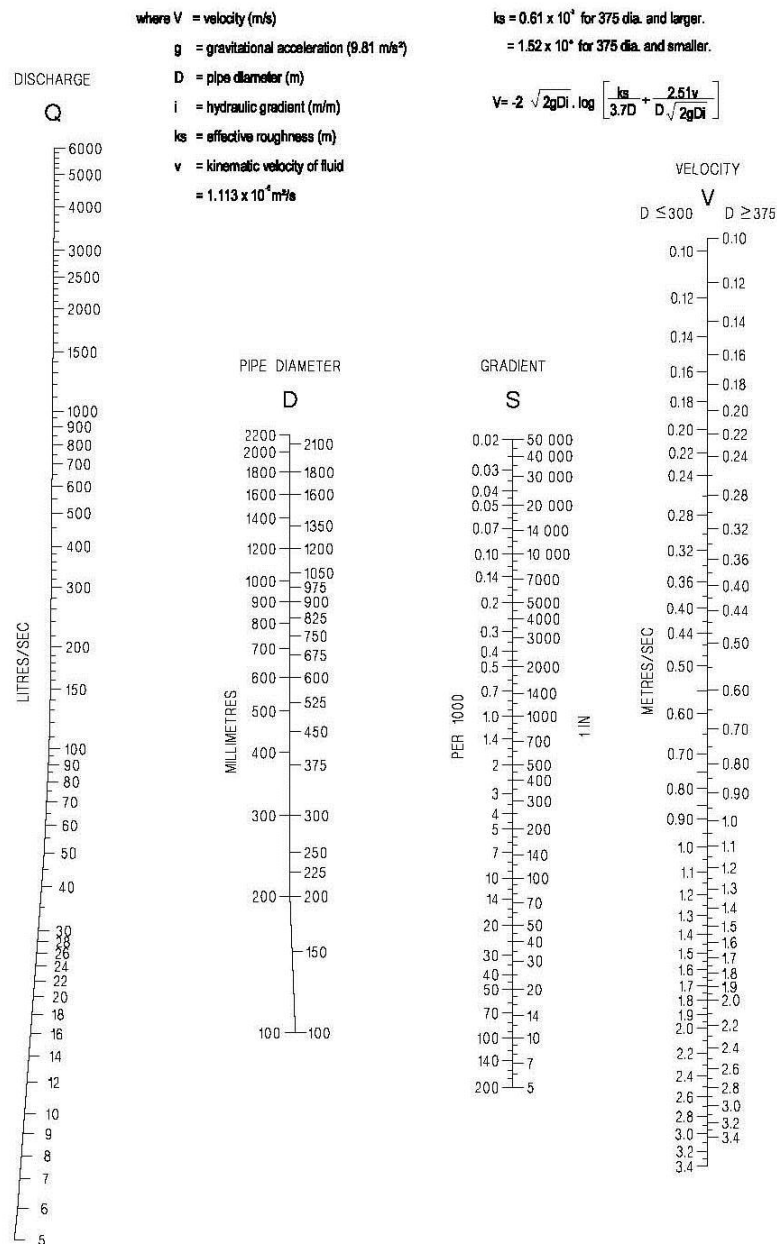
If compliance with the *NRRP* rules is not achieved, a resource consent is required from Canterbury Regional Council (Environment Canterbury). Contact Canterbury Regional Council for information on their requirements.

In all instances, obtain a Building Consent from the Selwyn District Council to install, modify or renew an on-site wastewater treatment and distribution system. A consent is also required when the on-site wastewater treatment is decommissioned or removed from service.

6.16 AS-BUILT INFORMATION

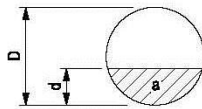
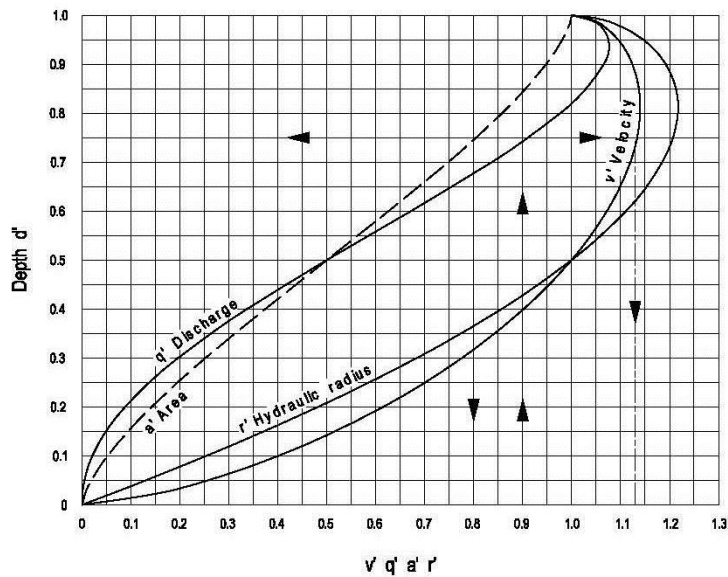
Present as-built information which complies with Part 12: As-Builts and this Part.

APPENDIX I. PIPE FLOW NOMOGRAPH¹



¹ From Ministry of Technology Research Paper No. 4, Tables for the hydraulic design of storm drains, sewers and pipelines.

APPENDIX II. PART FULL PIPE FLOW DATA



$$\begin{aligned} d' &= \frac{d}{D} = \frac{\text{Actual depth}}{\text{Pipe diameter}} \\ v' &= \frac{v}{V} = \frac{\text{Actual velocity}}{\text{Full pipe velocity}} \\ q' &= \frac{q}{Q} = \frac{\text{Actual flow}}{\text{Full pipe flow}} \\ a' &= \frac{a}{A} = \frac{\text{Area of liquid}}{\text{Area of pipe}} \\ r' &= \frac{r}{R} = \frac{\text{Actual hydraulic radius}}{\text{Full pipe hydraulic radius}} \end{aligned}$$

Example:

With design flow q known and pipe diameter D and full pipe Velocity V and full pipe flow Q from pipe flow nomograph.

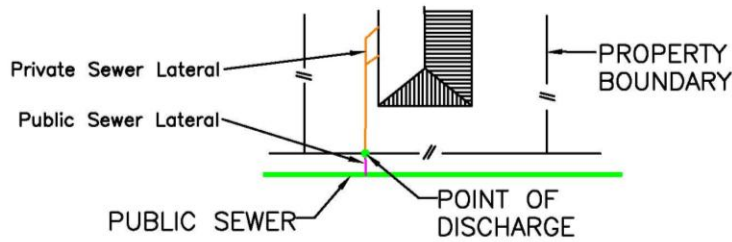
say for $q=8$ l/s, $Q=10$ l/s, $D=150$ mm and $V=0.58$ m/s

$$\begin{aligned} q' &= \frac{q}{Q} = 0.8 & \text{Determine from graph therefore} & \quad V' = 1.13 \\ & & & \quad V = 1.13 \times 0.58 = 0.65\text{m/s} \\ & & & \quad \text{Size okay} \end{aligned}$$

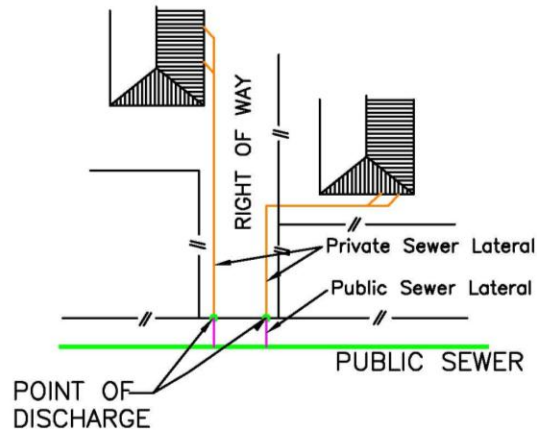
(Adapted from ASCE 37, p.95)

APPENDIX III. STANDARD DRAWINGS

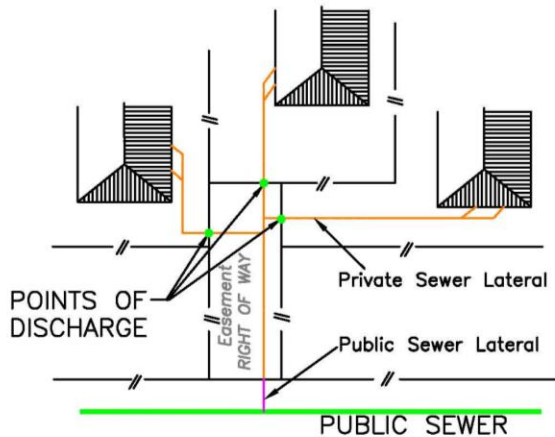
| | | |
|----|------|---|
| SW | 1.0A | Sewer connection policy – sheet 1 of 3 |
| SW | 1.0B | Sewer connection policy – sheet 2 of 3 |
| SW | 1.0C | Sewer connection policy – sheet 3 of 3 |
| SW | 2.0A | Lateral connections |
| SW | 2.0B | Lateral Connections (PVC) |
| SW | 3.0 | Lateral Connections (Concrete) |
| SW | 5.0 | Connection to sewer pressure mains with acuflow jumbo |
| SW | 7.0A | Sump |
| SW | 16.0 | Corbel construction for a Manhole |



WITH STREET FRONTAGE



REAR LOTS ON RIGHT OF WAY (up to 2 customers)



REAR LOTS ON RIGHT OF WAY (multiple connections)

NOTES:

- 1/ Sewer In R.O.W. shall comply with S.D.C. Design & Construction Standards.
- 2/ Easements in favour of the Council is required over the length Council Main in R.O.W.

Map 1 OF 3



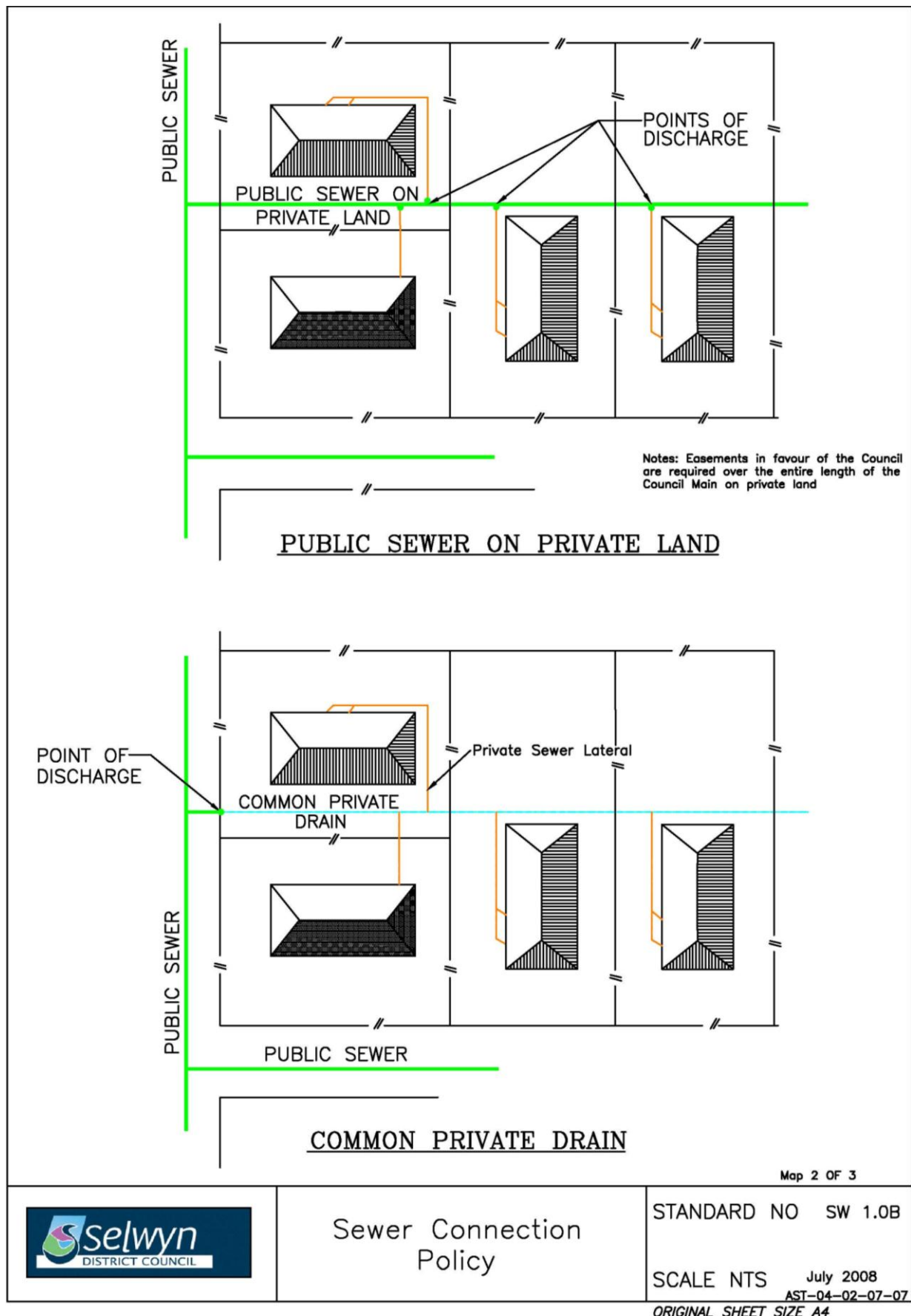
Sewer Connection Policy

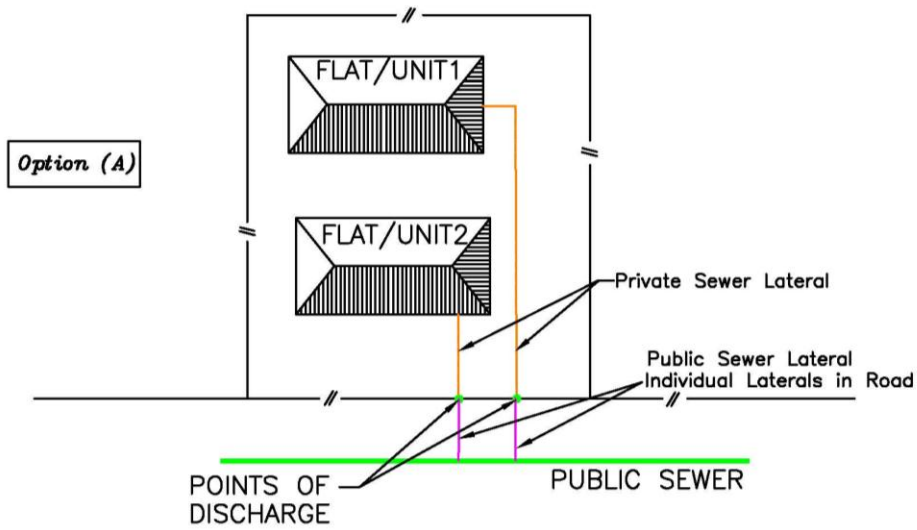
STANDARD NO SW 1.0A

SCALE NTS July 2008

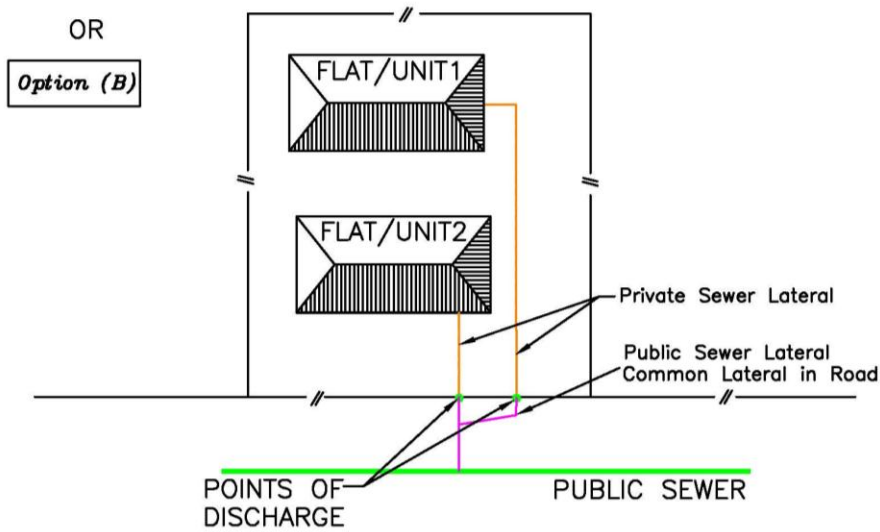
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ORIGINAL SHEET SIZE A4





**INDIVIDUAL CONNECTION TO PUBLIC SEWER
FOR MULTIPLE DWELLINGS**



Map 3 OF 3



**Sewer Connection
Policy**

STANDARD NO SW 1.0C

SCALE NTS July 2008

AST-04-02-07-07
ORIGINAL SHEET SIZE A4

