User's Guide

IDSM - Section 6 Wastewater

Infrastructure Design Standards (IDSM) - Issue 10, 2009

Contents

CHAPTER 1

Section 6 - Wastewater

In This Chapter

6.1 Scope

Section 6 of the Infrastructure Design Standards covers the design and construction requirements for all wastewater system works within North Shore City.

Note: The Long Bay Structure Plan (Variation 66 of the District Plan) has special requirements. Accordingly, a set of Practice Notes has been developed for works within the Long Bay Structure Plan area. These are to be read in conjunction with this standard and are available on request from Water Services, and will become available on the Council's Website.

6.2 Council's Goals And Objectives

To provide an environmentally sustainable wastewater system, which produces no objectionable odour, does not overflow or adversely affect receiving waters, and is affordable.

6.2.1 Legislation

The legislation that controls the management and operation of the Council's wastewater system includes:

a Building Act, 2004.

b Health and Safety in Employment Act, 1992

c Land Drainage Act, 1908

d Local Government Act, 1974 and 2002

e Hauraki Gulf Marine Park Act, 2000

f North Shore Drainage Act, 1963

g Plumbers, Gasfitters and Drainlayers Act, 1976

h Public Works Act, 1981

i Resource Management Act, 1991

j Health Act, 1956

k Consumer Guarantees Act, 1993

l Auckland Regional Policy Statement, 1999

m Auckland Regional Growth Strategy, 1998

n Proposed Auckland Regional Plan: Coastal, 1995

o Proposed Auckland Regional Plan: Air, Land and Water, 2001

p Auckland Regional Plan: Sediment Control, 2001

q North Shore City District Plan

r NSCC Bylaws – Part 9 Trade Waste and Part 20 Wastewater

s NSCC Strategic Plan

t NSCC City Blueprint

u NSCC Policy Manual

v NSCC Water Services Customer Charter, 2002

The above documents are available electronically at the following web sites:

- Government Acts: ***http://www.legislation.govt.nz*** (http://www.legislation.govt.nz)
- ARC Documents ***http://www.arc.govt.nz*** (http://www.northshorecity.govt.nz)
- North Shore City Documents ***http://www.northshorecity.govt.nz*** (http://www.northshorecity.govt.nz)

6.2.2 Council (Council) and Auckland Regional Council (ARC) Responsibilities

The powers of North Shore City Council to discharge wastewater from the public network are subject to comprehensive discharge consents ("Network Consents") granted by the Auckland Regional Council (ARC). Conditions may be imposed by these consents to control pollution and contamination consistent with the sustainable management objectives of the Resource Management Act.

Council may own, operate and maintain the wastewater infrastructure necessary for the efficient management and treatment of the wastewater discharges within its boundaries; however it is not obliged to extend its infrastructure.

To enable the Council to fulfil its day-to-day obligations to manage and treat wastewater discharges within its boundaries, the ARC lists "Permitted Activities" in the Proposed Auckland Regional Plan; Air, Land and Water. Council may control these activities through its consenting process while those other than permitted activities require resource consent from the ARC. Further details are available from the ARC. (Tel. 366-2000, email ***info@arc.govt.nz*** (mailto:info@arc.govt.nz), ***http://www.arc.govt.nz*** (http://www.arc.govt.nz/))

A process is underway between Council and the ARC to finalise the "Network Consent" which will cover the future operation, maintenance and upgrading of the stormwater and wastewater networks throughout the city in an integrated way. The city has been divided into seven "combined drainage catchments" (CDCs), each of which will have an integrated catchment management plan (ICMP) covering wastewater and stormwater. Once the Network Consent has been granted, the conditions of that consent shall be deemed to be part of this standard where appropriate.

As the network utility operator, Council reserves the right to impose restrictions on connections to its network so that the wastewater system can be managed effectively.

Resource consents will be required for some new wastewater projects, where they are not provided for as part of the network resource consent.

ARC resource consents are required for on-site disposal systems except as allowed as permitted activities under the Proposed Auckland Regional Plan: Air, Land & Water October 2004. Except for very large lots with up to three dwellings and some existing use right situations ARC consents are required if either:

$\frac{A}{q} < 1.5$ or $q > 2000$

Where: A is the gross lot area (m2)

q is the total daily wastewater discharge (litres per day)

6.2.3 District Plan Requirements

The North Shore City District Plan contains requirements relating to wastewater system management. Applicants for any proposed wastewater works shall consider these.

In addition, applicants for any proposed wastewater works in the Long Bay structure plan area shall consider the requirements of the Long Bay Structure Plan and the associated ***Long Bay Practice Notes*** (http://www.northshorecity.govt.nz/?src=/our_environment/long_bay/introduction.htm).

6.2.4 Key Documents

The key documents that shall be read in conjunction with this manual shall be as follows:

- Health & Safety in Employment Act 1992 and associated OSH guidelines on safe work practices
- NSCC District Plan
- NSCC Bylaws
- North Shore Drainage Act, 1963
- North Shore City standards for Rehabilitation Works and Major Network Improvements Projects (These are documents that are updated regularly. The current versions are available for reference from the Wastewater Network Projects Manager)
- North Shore City standards for Storage Tanks (This is a document that is updated regularly. The current version is available for reference from the Wastewater Network Projects Manager)
- NSCC Water Services Customer Charter, September 2002
- Resource Management Act, 1991
- Local Government Act, 1974 and 2002
- Building Act, 1991
- Plumbers, Gasfitters and Drainlayers Act, 1976
- New Zealand Building Regulations, 1992
- Code of Practice for Working in the Road (Auckland Region)

New Zealand, other national and international standards listed in clause 6.5.8.1

Should there be a discrepancy between the key documents and this manual, the Design Engineer shall seek clarifications in writing from the Council's Wastewater Network Operations Manager and the Wastewater Network Operations Manager's determination shall be final and binding on all parties.

6.3 Approval Of Proposed Works

For any proposed works affecting wastewater, such as new connections, relaying, diversions, raising or lowering of manhole lid levels, developments, subdivisions and building works, approval is required from Council.

6.3.1 Information Required

Applications to Council shall include sufficient information to demonstrate that the proposed works meet the requirements of this manual. The requirements outlined in clause 1.6: Engineering Design Requirements, must also be met including:

a A plan showing the proposed location of existing and proposed wastewater system works. Typical scales 1.500, 1:1000, A1 size and reduced to A3 size.

b Detailed longitudinal sections showing the levels and grades of proposed pipelines in terms of LINZ datum. Typical scales, 1:100 vertical, 1:500 horizontal, size A1 reduced to A3.

c Details and calculations prepared by persons experienced in wastewater system design demonstrating that the proposed system is adequate.

d Details and calculations prepared by persons experienced in catchment analysis showing any impact on adjacent areas or catchment of proposed works, and their respective remedies.

e As-built data of completed works shall be supplied. It shall conform to the Council's requirements, as specified in the Asset Data Standards Manual (ADSM). Drawings may also be required in Civil-CAD or AutoCAD format.

f Where it is proposed to install pipelines in private property, the following additional information is required (refer clause 6.4.4):

- plans of the preferred and alternative solutions
- a Council aerial photo of the area with pipeline routes shown
- colour photographs of the pipeline routes through properties marked on the photographs
- details of each pipeline route considered
- estimated costs of each route
- advantages and disadvantages of each route
- names, addresses and contact details of adjacent landowners and occupiers and their levels of support for each solution.

6.3.2 Other Interested Parties

A proposed wastewater system may affect other parties. These shall be considered and consulted prior to the applicant's submission to Council. This process may require approvals or consents as appropriate e.g. under the Resource Management Act. The parties may include but are not limited to:

a The Auckland Regional Council

b The Tangata Whenua and local iwi

c The New Zealand Historic Places Trust

d Transit New Zealand

e Adjoining or adjacent local authorities (Rodney District Council, Waitakere City Council, Auckland City Council)

f Utility network operators, such as water suppliers, (including Watercare Services Ltd) electric companies, telecommunications, roading and gas.

g Department of Conservation

h Land Information of New Zealand (LINZ)

i Adjacent landowners, including the Council itself.

6.3.3 Consents

Generally, applicants shall apply for consents under their own name for temporary works e.g. natural water diversion during construction. Where the consents are for permanent works, the application shall be made in the name of the developer and once the asset is vested to Council, the consent shall be transferred. The developer is responsible to ensure all other approvals have been obtained and submitted with the consent application. Consents that require an Operation and Maintenance Manual to be supplied to the ARC should be developed in conjunction with Council so as to ensure that the transfer of consents from the developer to Council can occur smoothly. Council will accept transfer of the consent once the ARC have confirmed that all conditions have been met and that any on going operations and maintenance conditions are to the satisfaction of the ARC. All consents must be transferred to Council prior to the end of the defects liability period.

6.3.4 Property Owner Consents

Where works are envisaged on neighbouring properties the applicant is expected to make every reasonable effort to obtain the necessary property owner consents.

If Council support is required to achieve property owner consent under Section 181 of the Local Government Act 2002 (public drains) or Section 460 of the Local Government Act 1974 (private drains), then the following approach shall be followed:

a All feasible options for drainage shall be considered and the option proposed shall be the most practical solution that achieves compliance with the Council's requirements detailed in this standard.

b A detailed plan showing the alternative and proposed options must be submitted to the responsible Development Engineer at Environmental Services.

c The applicant shall demonstrate that all reasonable endeavours to gain approval have been made. If necessary, the request shall be made to the affected property owners in writing via registered mail. Council shall be provided with copies and proof of mailing of such registered letters. All relevant names, addresses and contact details of affected landowners must be provided.

d Once satisfied with the completeness of the submitted information, the Development Engineer may submit the application to the Wastewater Operations Manager for further processing, *at the Wastewater Operations Manager's discretion*.

e The applicant shall pay all costs associated with the Council's involvement. A $1,000 deposit will be required with the application.

f The Council's involvement will be assessed on a case-by-case basis, including a review at any stage of the process. It must be clearly understood that the Council is unable to guarantee any specific outcome.

g Upon obtaining consent and to ensure satisfactory completion, a bond or deposit shall be provided prior to commencement of any construction work.

h Restoration approval shall be sought from the affected landowners before the bond or deposit is returned. The Council may agree to release the bond if it considers that approval is being unreasonably withheld.

Note: Obtaining property owner consent either directly or through the above-mentioned local government act processes does not obviate the need to obtain any statutory consents required under the RMA or Building Act.

Wastewater Policies

6.4.1 General

The policies for proposed wastewater systems in North Shore City are:

a For new works that affect wastewater e.g. developments, subdivisions, or construction, approval shall be obtained from the Council by the applicant. This shall include any connections to developments or building works associated with pipelines.

b For all new works, proposed improvements, developments, extensions or alterations affecting the wastewater system the applicant shall obtain necessary approvals or consents to the satisfaction of the Council's Wastewater Network Operations Manager prior to commencing any works. This shall include approvals and / or consents from any other interested party. The applicant shall comply with all conditions of approval or consent. The Council may at its discretion, vary policy or design requirements during the approval process and give due consideration to submissions. No application may be approved as of right and the Council reserves the right to withhold approval for any proposed works.

c All new works shall take account of Regional and Local Council Bylaws, statutory requirements, current practices, specifications and standards details.

d The proposed system to be taken over by Council shall be constructed in accordance with Council policies, standards and approved consents, and be inspected and tested to the satisfaction of the Council's Wastewater Network Operations Manager prior to it being declared "public" (refer clause 6.5.12(a)).

e Each lot shall be provided with a wastewater connection and each development shall be provided a piped wastewater system connected to the Council's wastewater system, unless otherwise approved in writing.

f The applicant shall meet all costs of the proposed system and / or upgrading. The Council may at its discretion contribute to proposed works.

g North Shore City Council endeavours to maintain a high level structure plan in high growth areas, that NSCC calls a “Strategic Network Layout Blueprint”. These documents contain information to be used in the design, such as flows, sizing, upstream controls, optimal pipe layout for the entire catchment area, and any other requirements. If the Council holds a Strategic Network Layout Blueprint for the area of the proposed development, then proposed system must comply with it.

h The wastewater system shall be designed to be consistent with the optimum design for the entire catchment area and any future extension of the wastewater system. Where future extension upstream or downstream of the proposed development is possible, the council may require the Developer to carry out preliminary designs for the larger area of subdivided and unsubdivided land. This design shall use the Ultimate Future Development Scenario as provided by NSCC for both the future flow and service layouts to determine the depth and size required for the extension.

i Where future extension upstream of the proposed development is possible, the pipes must be extended past the property boundary to the satisfaction of the Council’s Asset Consents Engineer. This ensures that a future extension of the network does not require unnecessary excavation of the already developed lots or streetscape.

j The proposed system shall minimise environmental impacts, including erosion, pollution of waterways, coastal and marine environments, and habitats. Development of alternative wastewater systems that minimise environmental concerns and/or maintenance expenditure will be encouraged.

k Where a developer is required to construct wastewater systems that are larger than the requirements of the developments own requirement due to upstream catchment requirements, then the Council may contribute to a part of the cost subject to agreement prior to the design of the system.

l The applicant shall identify areas of limited wastewater service, for which building restrictions may apply. The applicant shall specify how these areas are to be serviced, e.g. private pumping stations or building restrictions.

m Any connection to an operational wastewater system, or the construction of any public sewer, manhole, access point or related work, must be carried out by a North Shore City Council Approved Drainage Contractor (refer clause 6.4.2) at the cost of the applicant. The current list of ADCs and the required application forms for such work are available from the Council’s Division of Environmental Services. The applicant shall obtain prior approval from the Council for any of the above-mentioned work.

n Any proposed system shall be compatible with the existing wastewater system and comply with current requirements of the Council.

o The proposed system shall incorporate current infrastructure management requirements.

p The proposed system design shall identify and incorporate downstream improvements required as a result of the proposed works.

q The proposed system shall minimise Heath and Safety related risks.

r The applicant shall provide as-built drawings to the requirements of Council’s Asset Data Standards Manual prior to the works being accepted.

6.4.2 Approved Drainage Contractor (ADC)

Approved Drainage Contractors (ADCs) are Companies/Persons which have been approved by the Council's Division of Infrastructure Services to carry out all physical work relating to any drainage assets (wastewater and stormwater) owned by the Council's Division of Infrastructure Services. The current list of ADC's can be found on the Council's Website.

Approved Drainage Contractors list http://www.northshorecity.govt.nz/PDFs/water/approved-contractors.pdf

Private and Public Drains, or Customer's Wastewater Drains and Water Service's Wastewater Drains

Private Drains or Customer's Wastewater Drains

A customer's wastewater drain (private drain) is the wastewater pipe and drain from the customer's property to the point of connection with Council's (public) sewer, or up to the boundary of the legal road reserve (whichever is nearer). Where a private drain enters a public reserve, the section of drain within the reserve will normally, in most cases, be taken over by the Council's Division of Water Services and be regarded as a public sewer (refer Drawings WW224 and WW225). A customer's wastewater drain is entirely the customer's responsibility. Private' wastewater drains are sometimes referred to as "private sewers" or as "(private) laterals".

A customer's wastewater drain can cross neighbouring private land at the property owner's risk. The property owner is responsible for obtaining the necessary consents or approvals from the neighbouring private landowner for any maintenance or other work that may need to be performed on such private drains (e.g. repair of damage etc).

A private drain can serve only one lot although one or more residential units on that lot may connect to this private wastewater drain.

6.4.3.2 Public Drains or Water Service's Wastewater Drains

Whether a wastewater drain is to be regarded as "public" (thus owned by Council's Division of Water Services) depends upon a number of factors. A wastewater drain, or part thereof, will normally be regarded as "public" when:

- The drain serves more than one lot; or
- The drain enters public reserve, or a legal road reserve from the property boundary (in most cases); or
- The drain has been declared by the Council to be a "Public" drain.

These are often referred to as “sewers” or “public drains”.

Refer Drawings WW224 and WW225 for a graphical presentation of the definitions of private and public drains.

6.4.3.3 Trunk Sewers

A trunk sewer is a public sewer that has a Nominal Bore (NB) inside diameter equal to, or greater than 300mm (NB >= than 300mm). These are large to relatively large sewers normally serving several smaller reticulation sewers (local sewers).

Thrunk sewers are sometimes referred to as “trunk pipelines”.

6.4.4 Position of Public Sewers

a Public sewers shall be located in public land wherever possible (e.g. within the boundaries of a legal road or Council reserve). This requirement shall be taken into account during the concept planning stage of subdivisions in order to ensure that public sewers would eventually be located in public land.

b The Council’s Wastewater Network Operations Manager’s approval shall be obtained when a public sewer will be located on private land due to unavoidable circumstances (not financial reasons). Public sewers on private land shall be located at least 1m clear from property boundary lines.

c Within a legal road (refer Drawing WW204), the preferred location for public sewers is under the footpath (but not in/under swales). Sections of public sewers may also be located under carriageways, subject to protection requirements of this Standard. However, manholes and access points shall, wherever possible, not be located in carriageways.

d In private access ways:

- with grass verges, public sewers shall be laid within the grass verge.

- without grass verges, public ewers shall be laid under the carriageway, but with a minimal number of public manholes and/or access points in the carriageways.

(See clause 6.5.2 for Layout Rules and clause 6.7.3.2 for minimum cover requirements.)

6.4.5 Private Connections

a All lots in new subdivisions shall be provided with a gravity wastewater connection (refer clause 6.8.2).

b To be adequately serviced by means of a gravity sewer connection, the overflow level of any gulley trap or other overflow fitting must preferably be at least 900mm, but definitely not less than 500 mm above the invert level of the service connection.

On-Site Disposal

a In areas where conventional piped public sewer networks are *not* available, Council may permit the use of on-site sanitation systems provided that the application is supported by appropriate evidence to proof to the satisfaction of Council that the system will perform adequately.

b On-site land application systems shall be designed to have no adverse effects on the environment and downstream properties. The system shall conform to the requirements of Auckland Regional Council Technical Publication No. 58, third edition 2004. As a minimum, secondary treatment shall be provided to any land application area.

c When seeking a NSCC building consent approval for the works, the submission format shall follow TP58 Appendix E. Refer clause 6.2.2 for the lower limit of lot area and the upper limit of discharge that require an ARC resource consent, in addition to a NSCC consent. For other cases, NSCC will be able to process the application for approval as a Permitted Activity.

6.4.7 Building or Other Works Near or Over Pipelines and Other Structures

6.4.7.1 Works within 10m of a trunk sewer

a With reference to Council's Bylaws and the North Shore Drainage Act, consent shall be obtained prior to the performance of any physical work within 10m of a trunk sewer or rising main. The works may only proceed after the required approval has been obtained in writing from Council, and furthermore, Council shall be notified at least 24 hours before the start of the physical performance of the works.

b Consent application forms are available from the Council's Division of Environmental Services.

c In terms of Councils Bylaws, no building, retaining wall or other structure shall be placed, constructed or re-built or extended over a public rising main or trunk sewer, or closer than 1.0 metre from the outer edge of any rising main or trunk sewer unless approved otherwise in writing by Council's Wastewater Network Operations Manager.

6.4.7.2 Works within 5m of public sewers or other public wastewater assets

The following specific requirements (also available separately) are applicable to any proposed building and/or development work over or withing 5m from any public sewer or other public wastewater assets (refer Appendix 6F):

a General: Any building, structure or other development shall be designed and founded so that it will not be adversely affected by the public sewer and trench line, or by any future excavation that may be required for the maintenance of the public sewer or other public asset. The building, structure or other development shall make provision to allow for any future possible settlement of the public trench line and backfill.

b Structural loads: No structural loads shall be placed on, or be transferred to the public sewer line, or other public wastewater assets. All structural loads shall be absorbed (by means of piles where appropriate) outside of the 45º influence envelope and below the invert level of the sewer pipe for the first row of piles (refer Drawing WW202). The first row of piles shall be located at least be 1m clear from the outside edge of the sewer pipe and 1.2 m clear from the centreline of the lid of any public manhole, and be founded at least 1m below invert level of pipe. Subsequent pile rows shall be founded at least 1m below the 45º envelope of the influence line of the sewer pipe at invert level.

c Pile ramming: No pile ramming is permitted within 5m from the centreline of any public sewer, or within the 45º envelope of the influence line of the sewer pipe at invert level. These piles shall be drilled.

NOTE: The guidelines outlined here cover most typical situations. In some instances however, Council may need to apply more conservative criteria e.g. a heavily loaded structure and weak soil conditions adjacent to a trunk sewer.

6.4.7.3 Building close to or over local public sewers

a In general, building or other works over sewers or close to structures should be avoided. Where this is not possible, the building and development shall be so designed that they act independently of the public sewer network. Where required by Council, the affected public sewers or structures shall either be renewed or relocated, as appropriate.

b Closed Circuit Television (CCTV) inspections may be required of Council's assets before, during and/or after the performancy of any work close to or over Council's assets.

c Where building work over local sewers is approved, Council normally requires that the sewer is re-laid as a continuous PE SDR17 pipe sleeved within a PVC, SN16 pipe, extending 2 metres on either side of the proposed building (or up to a boundary or manhole as appropriate). The nominal inside diameter (bore) of the newly re-laid sewer pipe *shall not be less* than that of the sewer pipe being replaced. Any new section of pipe / sleeve shall be laid on properly compacted granular bedding with a thickness of not less than 150mm. The joints between the existing sewer and the replaced section shall be:

- properly anchored against pulling-out, using appropriate adaptors; and

- be embedded in concrete of 17.5MPa up to spring line and extending not less than 500mm on either side of each joint.

d Any Engineering Works Application (refer Appendix 6F) shall be accompanied by appropriate drawings (2 copies) of the proposed works. The exact location of the affected public assets and appropriate details (e.g. cross-sectional drawings of structures, footings or piles within the 45^{o} influence line of the sewer) shall be shown on the drawings.

Refer clause 6.7.2.2 for minimum cover information.

6.4.8 Easements and Covenants

Where necessary, the Council shall require an easement or covenant to be registered on the title of a property affected by the wastewater system, e.g. limited service.

6.5 General Requirements

General

a The applicant shall provide for the design and construction of all works in accordance with the requirements of this Standard. Consultation with Council officers is recommended for all proposals that are not straightforward, or for any aspects not covered by this Standard. The design requirements shall be read in conjunction with NZS 4404, but in case of any discrepancy, the requirements of this Standard shall take precedence.

b The wastewater system shall be capable of serving the entire upstream catchments and new reticulations must extend to the boundary of upstream catchments. The wastewater system design shall take into account land uses likely to occur in the entire upstream catchment during the life of the system (refer clause 6.5.7). Where required by reason of sound engineering practice, the system shall be capable of serving pumped flow from adjacent areas.

c Where a proposed development cannot be adequately serviced by a gravity system, the Design Engineer may propose the construction of a new public wastewater pumping station (refer clause 6.10), but subject to the approval of Council's Wastewater Network Operations Manager. It shall be required that any proposed pump station be located and designed to service the entire area of potential catchment beyond the reach of the gravity system. The land area to be served shall be demarcated on the basis of sound engineering practice.

d The wastewater system shall be so designed and constructed that stormwater and groundwater ingress (inflow or infiltration) into the system, and uncontrolled flows out of the system, are minimised.

e It is not always practicable to avoid all overflows at all cost and as such some overflows can occur from time to time. The Council has adopted a target of reducing the number of wet weather overflow events, as measured over a long period by computer modelling, to a long-term average of not more than two overflow events a year.

f As far as practicable, the network shall be designed and managed so that overflows occur only via designed emergency outfall points approved under the network consent process. No new overflow outfalls shall be considered without the prior written approval of the Council's Wastewater Network Operations Manager and provided the necessary resource consents have been obtained from the ARC.

g All manufactured components for sewers, fittings, manholes, access points and the like shall be manufactured and supplied by an AS/NZS ISO 9001 quality assurance accredited manufacturers/suppliers or a manufacturers/suppliers accredited by other quality assurance systems to the satisfaction of Council's Wastewater Network Operations Manager.

h It is contemplated that compliance with the requirements of this Standard will ensure the design and construction of high quality wastewater systems. A final inspection shall be undertaken by the Council's Representative on completion of wastewater construction works before takeover by Council. Council's Representative shall as a part of the inspection, report about the quality and workmanship on the completed wastewater system. Where any defects are identified during the final inspection, the defects shall be rectified by the developer to the satisfaction of the Council's Wastewater Network Operations Manager and/or Council's representative and the final inspection shall be repeated, as required. Handover procedures as detailed in Environmental Services Quality Assurance Manual (QAM) shall be complied with.

6.5.2 Layout Rules

Public sewers shall be located in public land. Where, due to unavoidable reasons (refer clause 6.4.4), it is not practical to locate the sewer in public land, then the public sewers shall be located in positions clear of potential building sites within lots, i.e. in the front, side or rear yard areas. Sewers shall be a minimum of 1m clear of all boundary lines and 1m clear of edge of foundations (refer Drawing WW202).

As far as practicable, the following rules shall be complied with to the satisfaction of Council’s Wastewater Network Operations:

a Wherever possible, public sewers and manholes shall be located in road reserves under the footpath, or in other reserve land. (Preference for the sewers to be laid under the footpath is because the footpath is generally at a relatively high point in the road reserve. This will ensure that manholes will not be located in areas not subject to water ponding).

b Manholes shall *not* be located in stormwater ponding areas and/or in overland flow paths (e.g. swales). Where this is unavoidable, the manhole point shall be specifically designed to preclude the ingress of surface and groundwater. The specific design shall include the provision and installation of a Type E manhole cover and frame (refer Table 6-16).

c Manholes or *mini-manholes* shall be provided:

- at any significant change of direction (deviation greater than 22½º) and/or gradient (greater than 5% (refer clause 6.7.1). *When appropriate in greenfield areas*, curved sewers (*refer clause 6.7.4*) should be used to avoid the concentration of significant direction changes at any one point;

- where there is a change in pipe diameter; or

- at the junction of all branch sewers servicing more than 10 lots (It should be noted that manholes are not required where laterals join sewers).

d Access points shall be provided at the head of any public sewer, and/or at the head of any public branch thereto.

e Laterals shall, as far as practicable, be located on the low side of the lots, and in such a manner that it will not negatively affect the available building area within the lot.

f Properties on both sides of a road shall be connected to a single sewer line located on one of the sides of the road reserve (the provision of duplicate sewers on both sides of a road shall be avoided).

g Spacing between *mini-manholes and/or manholes* (man-entry points) and access points, shall not be exceed 120m for sewers up to NB diameter 225mm (refer to Drawing WW201).

h Spacing between manholes (man-entry points) shall not exceed 180m for sewers up to including NB diameter 225mm (refer to Drawing WW201).

i Spacing between manholes shall not exceed 240m for sewers larger than NB diameter 225mm and up to, but not including NB diameter 600mm.

j For sewers of NB diameter 600mm or larger, the spacing between manholes/access points shall be agreed with the Council's Wastewater Network Operations Manager.

k Where appropriate in terms of the provisions of this Standard, access points from thermoplastics materials must be used (concrete manholes should not be used in locations where access points from plastics materials would be appropriate).

l The wastewater system layout shall:-

- Ensure access to all parts of the sewer network for inspection and maintenance purposes. Manholes, mini-manholes, access shafts/chambers and rodding eyes shall be provided to ensure access to sewers by modern equipment for CCTV inspection, water jetting, rodding, root cutting and grouting (refer also to Drawing WW201 for permitted maximum spacing of access points).

- Maximise the safety of wastewater system operators. (confined space entries are hazardous and as such the wastewater system should be designed to minimise the need therefore).

- Minimise the potential for inflow, infiltration and exfiltration of liquids (e.g. layout should be optimised to ensure that the number of access points required are minimised, and access points should not be located in rainwater ponding or overland flow path areas).

m In general, sewers shall be laid in a straight line between access points. Where this is not practicable, or where the need for access points could be appropriately minimised, horizontally and vertically curved sewers may be provided in compliance with the requirements of this Standard (refer clause 6.7.4.1).

n Siphons shall not be used unless approved in writing by Council's Wastewater Network Operations Manager.

NOTE: Above ground sewers or pipe bridges should be constructed at grade in preference to inverted siphons, for crossing low lying land/or gullies, or where excavation through unstable land may induce instability, or damage desirable vegetation or bush areas.

6.5.3 Clearances From Other Services

a. herever possible, sewer pipelines shall be located locally at a higher level than the stormwater pipelines. It must be possible to conveniently discharge subsurface drains, if any, servicing the granular bedding of the sewers, into the local stormwater network.

b. The clearance between any sewer pipe and another underground services shall be as follows:

Utility service	*Minimum horizontal clearance for NB diameter sewer pipe:*		*Minimum vertical clearance*(1) *(mm)*
	< NB 300mm	*>= NB 300mm*	

Gas mains Telecommunications conduits & cables Stormwater drains Wastewater drain	300(2)	600(2)	150 / 300(4)
Electricity conduits & cables	500	1000	225 / 300(4)
Water mains	1000(3) / 600	1000(3) / 600	500

Notes:

1. The minimum vertical clearance is applicable to utility services when crossing a sewer pipe. For water mains, the minimum vertical separation shall *always* be maintained even when the water mains and sewer pipes are laid adjacent to each other. The sewer pipe shall always be located below the water main to minimize the possibility of backflow contamination in event of a main break.

2. Clearances may be further reduced to 150mm for distances up to 2m when passing installations such as poles, pits and small structures, providing that structures/buildings are not destabilized in the process. Representation for reduced clearances in other circumstances would be considered, but may proceed only with written authorisation of Council. Stormwater lines installed adjacent to the sewer lines under footpaths should preferably installed on the carriageway side of the sewer and a bit deeper.

3. When the sewer pipe is at the minimum vertical clearance below a water main (500mm), a horizontal clearance of at least 1000mm shall be maintained. This minimum horizontal clearance could be progressively reduced to 600mm as the vertical clearance increases to 750mm.

4. A minimum vertical clearance of 300mm applies if the size of either service is > DN 300mm.

c. Where sewer pipelines will not be located at higher local levels than the stormwater pipelines, or where the above specified will not be provided, the Design Engineer must provide reasons (not only cost considerations) to justify this non-compliance to the satisfaction of Council.

6.5.4 Concrete Works and Steel Reinforcement

All concrete works shall be in accordance with NZS 3109: *Concrete Construction*. Steel reinforcement for concrete shall be in accordance with AS/NZ 4671: *Steel reinforcing materials* and NZS 3109.

6.5.5 Reference and Precedent Documents

Where there are conflicting requirements between this section of the document and any reference or supporting documents nominated, the documents shall take the following precedence:

- Resource Consent and District Plan (including Structure Plans)
- Infrastructure Design Standards
- Engineering Approval and Drawings

6.5.6 Items Requiring the Council's Specific Approvall

An index showing the items that require the specific approval of the Council's Wastewater Network Operations Manager or representative is given in Table 6.1, solely for the purpose of ease of cross-reference. This index may not show all the items that require the Council's approval. It is the responsibility of the Design Engineer and the Developer to ensure that all requirements of this manual are met, irrespective of whether any item is included or not in Table 6.1.

Table 6-1 : Items Requiring the Council's Wastewater Network Operations Manager's Specific Approval

Clause Number	Brief Description
6.4.4	Position of public sewers which are not located in public land
6.4.7.1	Any building, retaining wall or other structure that will be placed, constructed, re-built or extended over a public rising main or trunk sewer, or closer than 1.0 metre from the outer edge of any rising main or trunk sewe
6.5.2	Spacing between manholes/access points for sewers 600mm diameter and larger.
6.5.12	Councils Wastewater Network Operations Manager may arrange additional supervision of the works.
6.5.9.1	Provision of materials or services not covered by a nominated standard.
6.5.9.2	Council’s Wastewater Network Operations Manager’s clarification shall be binding on all parties should there be a discrepancy between the key documents referred to in clause 6.5.9.2 and this manual.
6.6.6.6	Wastewater flows of ‘wet’ industries.
6.7.2	Sewers laid at gradients in the range <1% to to >= 0.55% Hydraulic design of trunk sewers.
6.7.4.1(c)	Curved sewers having a direction change greater than 22½° at any point.
6.7.4.2	Use of bends greater than 22½° .
6.7.5.3 6.7.5.7	RC pipes/sewers shall be subjected to special design against corrosion (e.g. PVC liner, HDPE liner). Details of the special design shall be submitted for the approval of the Council’s Wastewater Network Operations Manager
6.7.5.1	For using different pipe materials other than the preferred material for a given purpose and size range.
6.7.5.6	Trenchless installation of PE pipelines. Gradient of PE trenchless pipelines, other than those specified in clause 6.7.5.6
6.7.8.2	Grading curves for the granular bedding material if different from the specifications in Table 6-9
6.7.10.1	A special design is required for joints of gravity sewers where the depth to the sewer invert

Clause Number	Brief Description
	from the maximum seasonal groundwater table is expected to exceed 8.0m.
6.7.12.1	All trenchless constructions of pipelines.
6.5.14	Lining systems.
6.8.4	New connections to lined sewers.
6.9.1.3	For the use of a different manhole / access point type or material other than the preferred type or material for a given purpose
6.9.2.6(b)	Internal drops on sewers greater than NB diameter 150mm.
6.9.2.7	Dry manholes (Sealed channel manholes).
6.9.2.8	The use of cast-in-situ concrete manholes will not normally be permitted. Specific approval is required to use cast-in-situ concrete manholes under extraordinary circumstances.
6.9.2.10	Manholes without rungs
6.9.2.11	Epoxy mortar brand.
6.9.2.13	Under normal circumstances, manholes from thermoplastics shall not be used in trafficked areas. Specific approval is required, under special circumstances, to use manholes from thermoplastics in areas where high loading is likely.
Table 6-16	Manhole cover design for special loadings.
6.9.3.2	The use of Access Shafts/Chambers in public carriageways, trafficked areas or in kerbside footpaths. Also the use of bends greater than 22½° adjacent to access shafts/chambers from PVC.
6.9.3.2	Change the direction on a lateral using of long radius bends adjacent to access chambers.
Table 6-18	Coating system of interior walls of wet well structures
6.11.2	Rising main size smaller than NB diameter 100mm.
6.11.5.1	Pipe materials for rising mains other than preferred material
6.11.4	Locating a public rising main within private properties.
6.11.5.2	PE welders.
6.11.6	Ductile Iron (DI) rising mains for potentially unstable ground.
6.13	Tunnel proposals shall be initially discussed and approval gained for the concept, prior to the design.

Clause Number	Brief Description
6.15.1	A final inspection shall be undertaken by the Council's Wastewater Network Operations Manager / representative on completion of the construction of the wastewater systems. Completed works shall be tested to the satisfaction of the Council's Wastewater Network Operations Manager / representative.

6.5.7 Submissions

6.5.7.1 For Design Approval

A Design Report shall accompany all proposals.

For Inspection and Release of Subdivision Development Projects

As-built data of completed works shall be supplied. It shall conform to the Council's requirements, as specified in the Asset Data Standards Manual (ADSM Volumes 1 and 2). Drawings may also be required in Civil-CAD or AutoCAD format.

The following documents shall also be provided:

- Copies of consents issued by NSCC and other parties for the works
- Conditions of approval issued for the works originally at the design stage
- Documentation of testing and certification of works in accordance with NSCC Quality Assurance Manual
- Operation and Maintenance Manual/s for Pump Stations and other electromechanical installations.

6.5.8 Terminology

Wherever possible technical terms used in proposals shall be technical terms defined in the glossary contained in Appendix 6B. If it is necessary to use any other technical terms in proposals such terms shall be as defined or implied in NZ standards and other national/international standards.

6.5.9 Standards and Key Documents

6.5.9.1 Nominated Standards

- The current relevant standards that control the design, construction and installation of the Council's wastewater system, which are referred to throughout this manual, include:
- AS 1444 *Wrought alloy steels*
- AS 1631 *Cast grey and ductile iron non-pressure pipes and fittings*
- AS 1646 *Elastomeric Seals for Waterworks purposes*.
- AS 1579 *Arc-welded steel pipes and fittings for water and waste-water*
- AS 1830 *Grey cast iron*
- AS 2832 *Cathodic protection for metallic pipes*
- AS 2837 *Wrought alloy steels - Stainless steel bars and semi-finished products*
- AS 3571 *Glass filament reinforced thermosetting plastics (GRP) pipes - Polyester based - Water supply, sewerage and drainage applications*
- AS 3680 *Polyethylene sleeving for ductile iron pipelines*
- AS 3681 *Guidelines for the application of polyethylene sleeving to ductile iron pipelines and fittings*
- AS 3996 *Metal access covers, road grates and frames*
- AS 4060 *Loads on buried vitrified clay pipes; and Supplement 1 - Commentary*
- AS/NZS 1260 *PVC-U pipes and fittings for drain, waste and vent applications*
- AS/NZS 1462 *Methods of test for plastics pipes and fittings (including pressure test)*
- AS/NZS 1477 *PVC pipes and fittings for pressure applications*
- AS/NZS 1518 *External extruded high-density-polyethylene coating systems for pipes*
- AS/NZS 1547 *On-site domestic wastewater management*
- AS/NZS 1657 *Fixed platforms, walkways, stairways and ladders - Design, construction and installation*
- AS/NZS 2033 *Installation of polyethylene pipe systems*
- AS/NZS 2280 *Ductile iron pressure pipes and fittings*
- AS/NZS 2312 *Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings*
- AS/NZS 2566 *Buried flexible pipelines*
- AS/NZS 2648 *Underground marking tape - Non-detectable tape*
- AS/NZS 2865 *Safe working in a confined space*
- AS/NZS 3725 *Loads on buried concrete pipes; and Supplement 1 - Commentary*
- AS/NZS 3750.10 *Paints for steel structures - Full gloss epoxy (two-pack)*
- AS/NZS 4129 *Fittings for polyethylene (PE) pipes for pressure applications*
- AS/NZS 4130 *Polyethylene (PE) pipes for pressure applications*
- AS/NZS 4131 *Polyethylene (PE) compounds for pressure pipes and fittings*
- AS/NZS 4327 *Metal-banded flexible couplings for low-pressure applications*
- AS/NZS 4331 *Metallic flanges*
- AS/NZ 4671 *Steel reinforcing materials*
- AS/NZS 4680 *Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*

- AS/NZS 5065 *Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.*
- AS/NZS ISO 9001 *Quality management systems - Requirements*
- BS 2594 *Specification for carbon steel welded horizontal cylindrical storage tanks*
- BS 5480 *Specification for glass reinforced plastics (GRP) pipes, joints and fittings for use for water supply or sewerage*
- BS 5493 *Code of practice for protective coating of iron and steel structures against corrosion*
- BS 5911-120: *Precast concrete pipes, fittings and ancillary products. Specification for reinforced jacking pipe with flexible joints.*
- BS 6164 *Code of practice for safety in tunnelling in the construction industry*
- BS EN 124: *Gully tops and manhole tops for vehicular and pedestrian areas. Design requirements, type testing, marking, quality control*
- BS EN 295 *Vitrified clay pipes and fittings and pipe joints for drains and sewers*
- BS EN 976 *Underground tanks of glass-reinforced plastic (GRP). Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels.*
- DD ENV 1998-2&4: *Eurocode 8: Design provisions for earthquake resistance of structures, bridges, pipelines.*
- ISO 6259 3 *Thermoplastic pipes - Determination of tensile properties - Part 3: Polyolefin pipes*
- ISO 13953: *Polyethylene (PE) pipes and fittings -- Determination of the tensile strength and failure mode of test pieces from a butt-fused joint*
- NZS 3104 *Specification for Concrete Production*
- NZS 3106 *Code of practice for concrete structures for the storage of liquids*
- NZS 3107 *Specification for precast concrete drainage and pressure pipes (RC)*
- NZS 3109 *Concrete Construction*
- NZS 3124 *Specification for concrete construction for minor works*
- NZS 4203 *General structural design and design loadings for buildings*
- NZS 4404 *Land development and subdivision engineering*
- NZS 4442 *Welded steel pipes and fittings for water, sewage and medium pressure gas*
- NZS 7643 *Code of practice for the installation of unplasticized PVC pipe systems*
- WIS 4-32-08:1994 *Specification for the Fusion Jointing of Polyethylene Pressure Pipeline Systems using PE80 and PE100 Materials* (WRc Plc, UK)

Stainless steel parts in pipe couplings shall be as per Table 6.2

Table 6-2 : Stainless Steel Grades Required in Pipes and Fittings

Coupling Type	Soil Conditions			
	Inland Cl<1000ppm	Coastal		
		Non-tidal zone Cl<2000ppm	Tidal zone	Extremely aggressive

Jacking pipe	EN1.4404/1.4571 (Grade 316L/Ti)	EN1.4404/1.4571 (Grade 316L/Ti)	EN1.4462	EN1.4547 6% Molybdenum Type
Flexible Coupling	EN1.4401 (Grade 316)	EN1.4401 (Grade 316)	EN1.4401 wrapped in Denso tape	EN1.4401 wrapped in Denso tape
EN = European Standard (European Committee of Standardisation)				

Where any standard named in this manual has been declared or endorsed in terms of the Standards Act 1965, then:

- Reference to the named standard shall be taken to include any current amendments declared or endorsed in terms of the Standards Act, or
- Reference to the named standard shall be read as reference to any standard currently declared or endorsed in terms of the Standards Act as superseding the named standard, including any current amendments to the superseding standard declared or endorsed in terms of the Standards Act.

Note: The date (hereinafter referred to as the proposal date) at which a standard is regarded as "current" is a matter of law depending upon the particular method by which the standard becomes legally enforceable in the Proposal concerned. In general, if the Proposal is by contract the relevant date is the date on which the contract is created, but if the Proposal is by Act, regulation, or bylaw then the relevant date is that on which the Act, regulation, or bylaw is promulgated.

Unless explicitly specified otherwise in this manual, or case-specifically exempted by the Council's Wastewater Network Operations Manager, the requirements of the above standards shall apply to materials and construction of wastewater works.

The word "shall" or the imperative mode indicates a requirement that must be adopted in order to comply with the manual, while the words "should" or "may" indicate a recommended practice.

6.5.9.2 Materials and Workmanship not covered by Nominated Standards

a Where the Design Engineer is proposing the use of new types of material, systems and/or workmanship, then the Design Engineer shall provide proof by way of references to international/national standards, papers and brochures to the satisfaction of Council that that the proposed new material, system and/or workmanship will perform better, in all relevant respects, than than current types of approved materials, systems and/or workmanship.

b Council's Wastewater Network Operations Manager may accept or reject any proposed new materials, systems or workmanship systems and his/her decision is final (reasons may be given). Should Council's Wastewater Network Operations Manager rejects proposed new types of material, systems and/or workmanship, then the Design Engineer shall revise his/her proposal to use existing types of material, systems and/or workmanship that are covered by nominated standards.

c The Council's Wastewater Network Operations Manager shall consider any new systems for acceptance only if they are covered by the Standards/Publications issued by the following organisations:

ANSI	American National Standards Institute
API	American Petroleum Institute
AS	Australian Standard
ASTM	American Society for Testing and Materials
BSI	British Standards Institution
CIRIA	Construction Industry Research and Information Association
DIN	Deutsches Institut fur Normung e.v.
EN	Euronorm
ISO	International Standards Organisation
NZS	New Zealand Standard
WRC	Water Research Centre (Engineering)

6.5.10 Design Service Life

All sewers, manholes, pipe bridges, tunnels, storage tanks, pumping station structures and the like shall be designed for a service life of not less than 100 years. The Design Engineer shall, where required, provide adequate information (referencing national/international standards and other approved publications) as support to proof that the above stated design service life requirements will be complied with.

6.5.11 Sediment Control

a An Erosion and Sediment Control Plan shall be completed as part of any consent applications made for most development projects not subject to related ARC consenting process.

b All sediment and erosion control works associated with wastewater system construction shall be carried out in accordance with Auckland Regional Council Technical Publication No. 90, *Erosion and Sediment Control Guidelines for Land Disturbing Activities*. ARC consents relating to Section 13 of the Resource Management Act may also be required. No sediments shall be allowed to enter the wastewater system.

6.5.12 Inspection and Supervision of Works

a Completed works shall be approved by the Council prior to placing them into service. This shall include the consideration and approval of as-built plans, testing of works, defects liability periods, consents issued by other parties, financial considerations and conditions of approval issued for the works originally. Testing shall be conducted as required by the Council's Quality Assurance Manual (QAM) protocols or on request from Council. Acceptance will be on the basis of the quality of materials and the standard and accuracy of construction. Generally, new pipelines shall be visually sighted to ensure a full bore is viewable for the section being tested. All new pipelines shall be inspected internally with CCTV and recorded on DVD. Inclinometer surveys shall be carried out with all CCTV inspections if required by the Council. On presentation of the DVD and logs to Council, the consultant (owner's representative) shall be advised whether any remediation actions are to be undertaken or investigated. Council will require completion of approved remediation proposals prior to the issue of the s224c certificate or Certificate of Practical Completion. The CCTV DVD shall be of sufficient detail to clearly and accurately show running distances to all pipe jointing, dips, service connections and other fittings. All costs involved in undertaking this CCTV work shall be born by the Developer, as will any remedial work required to be undertaken and a repeat CCTV if required by the Council.

b Any physical work on Council's existing operational wastewater network (e.g. new connections, raising or lowering of access points, renewal of pipes etc.) shall be inspected and be approved by Council's Wastewater Operations Technical Inspector. The inspector shall be notified at least 3 business days before the intended commencing of any such physical work.

c The Council's Wastewater Network Operations Manager may arrange additional inspection and supervision of the works to ensure that the requirements of this standard are fully complied with. The stages of inspection will cover pipeline bedding, jointing, flexible joints adjacent to manholes/structures/surrounds, manhole channel/benching, and connections to operative systems. No backfilling shall be carried out without written approval of Council's Wastewater Network Operations Manager's representative for the Works to be covered.

6.5.13 Health and Safety Requirements

All works shall be designed and constructed to conform to the Health and Safety requirements of the following documents, both during the construction period and while carrying out operation and maintenance activities:

a Health and Safety in Employment Act, 1992

b Health and Safety Regulations, 1995

c AS/NZS 2865 Safe Working in a Confined Space (especially note Clause 6: Design, Manufacture, Supply and Modification)

d OSH guidelines for Health and Safety in Employment, particularly the following:

a) Guidelines for Safe Working in a Confined Space

b) Approved Code of Practice for Excavation and Shafts for Foundations

c) Approved Code of Practice for the Management of Substances Hazardous to Health in the Place of Work

d) Approved Code of Practice for the Safe Erection and Use of Scaffolding

e) Guidelines for the Provision of Facilities and General Safety in the Construction Industry

e NSCC Health and Safety Policies

f Design Engineers shall note that operation and maintenance activities will involve personnel working within live networks. All practicable measures shall be included in the design to facilitate safe working within live networks.

g No construction, operation and maintenance work shall commence prior to the approval of the Contractor's Job Specific Health and Safety Plan, prepared according to the Council's Health and Safety Policy. The Contractor's Job Specific Health and Safety Plan shall cover all potential site hazards including the following:

- Working in confined spaces
- Working in excavations
- Accidental flooding of work places
- Accidental sewage spillages
- Disruptions to existing sewage flows.

6.5.14 Sewer Rehabilitation Works

This manual does not cover sewer rehabilitation works, which shall be designed, constructed and tested in accordance with the *NSCC* Sewer *Rehabilitation Standards*. These documents are available for reference from Council's Wastewater Network Projects Manager.

6.6 Design Flows

6.6.1 General

Specific design and calculations of wastewater design flows and hydraulic capacities are required for all proposed developments having a design population of 100 persons, or more. Generally, the specific design process will involve 5 steps, but for larger buildings or properties with on-site treatment this will involve more steps. The additional steps that may be required are outlined in the flow chart in Figure 1, Appendix 6H in which the points for which design flows needs to be established, are illustrated.

All contact with the North Shore City Council (NSCC) must be directed through the Council's Asset Consents Engineer based at Council's Department of Environmental Services. Council's Asset Consent Engineer will internally discuss and obtain the approval from higher Management where required.

Council has adopted a Level of Service (LoS) of no more than two wet weather overflow events per annum (average, based on modelling). Dry Weather Overflows are never permitted. To achieve Council's Level of Service (LoS) Agreement, Council requires that the public sewer reticulation network is designed to carry wastewater flows to the trunk sewer without additional overflows. Therefore, sewer pipes shall be sized in accordance with the requirements of Clause 6.6.12 to prevent pipes from surcharging (i.e. pipes must be less than full at the Design Flow).

Council has started with the development of detailed catchment models of the wastewater catchments on the North Shore. Some of the models already exist and where available, these can be utilised when design capacity requirements for the sewer network are determined. Hydraulic modelling is regarded by the Council as the most accurate way to assess the capacity of a sewer, and the Council will, at its discretion, utilise or require calibrated hydraulic modelling to be used in the assessment in conjunction with the IDSM. As more catchment models are developed additional information will become available to assess new development requirements (Clause 6.6.16). Where detailed catchment models are not available, the assessment will be based on this IDSM, together with the available catchment wide information and the Council's local knowledge of the catchment performance.

Where identified constraints may affect Council's LoS targets downstream of any proposed development, Council may have to decline all new applications for connections to the existing public wastewater network until the identified constraints have been removed.

6.6.2 Service Life – Design Flows and Upstream Catchments

6.6.2.1 Sewer Capacity and Future Flows

Council requires that all public sewers are designed for a Service Life of not less than 100 years (refer clause 6.5.10). As such, it is also required that the wastewater network is sized to cater for both the existing as well as the potential future flow upstream of the pipe. When determining future flows, the Developer or Design Engineer must assume that the Developer's site and the upstream catchments are fully developed to the Council's Ultimate Future Development Scenario.

The Ultimate Future Development Scenario has been prepared by the Council to enable infrastructure to be planned for very long time horizons (i.e. 100 years), well in excess of the planning horizon of an operative District Plan.

For areas in the city for which the "Ultimate Future Development Scenario" does not exist, the Developer or Design Engineer has to assume that the maximum development permitted under the operative District Plan and / or the City Blueprint (which ever is the highest) will occur. Information can be made available by Council's Asset Consents Engineer to the Developer or Design Engineer when they have to calculate both:

- The total (gross) land area upstream of the pipeline/infrastructure for both existing and future catchments
- The future Equivalent Population (EPdesign, clause 6.6.5) sourced from the Council's Ultimate Future Development Scenario / the operative District Plan / the operative City Blueprint. The Asset Consents Engineer will advise which is applicable for the site.

Deviations to clause 6.6.2.1 must be approved by the Infrastructure Planning Manager.

6.6.2.2 Provision for the Connection of Upstream and Downstream Catchments

To ensure the Design Service Life of the proposed wastewater system is met, the proposed system shall be designed to be consistent with the optimum design for the entire catchment area.

The Council endeavours to maintain a Strategic Network Layout Blueprint for areas of high-growth in the city. Where a Blueprint exists, the Design Engineer must demonstrate that the proposed wastewater system will comply with the Council's Network blueprint.

If the Council does not hold a Strategic Network Layout Blueprint for the Developer's site, the Design Engineer must demonstrate that the proposed wastewater system is consistent with the optimum design for the entire catchment area, and that any future extension of the system, both upstream and downstream of the Developer's site can be accommodated by the design.

Designers shall particularly assess the depth and layout of the proposed system, adopting the best design practice to ensure a system with lowest life cycle cost. The wastewater system shall be laid out spatially and designed with sufficient depth and capacity to cater to all existing and possible future development, both upstream and downstream of the catchment. In order to demonstrate this, it may be necessary to carry out preliminary designs for large areas of subdivided and unsubdivided land, upstream and/or possibly downstream of the Developer's site, in order to demonstrate the proposed wastewater system can be connected into by other developments at a later date.

The optimum design for the full catchment; ability to connect to, and extend the network at later date(s) will be to the satisfaction of the Council's Asset Consents Engineer.

Upstream Catchments

The proposed wastewater system needs to allow for the physical connection of existing and/or potential future upstream developments to the proposed wastewater system with minimal disruption to the Developer's site, and any subsequent renter(s), lessee(s), sub-leasse(s), and/or subsequent property owners of the site. To ensure this occurs, the Council requires the Developer to extend the wastewater network to the upstream side of the project area's property boundary.

The upstream wastewater connection points constructed by the Developer will comply with the Council's Strategic Network Layout Blueprint for the wider area, if available. If the Council does not have a Strategic Network Layout for the area, then the Design Engineer will be required to demonstrate that the wastewater system within the project area is designed to by consistent with the optimum design for the entire catchment area.

The cost to extend a nominal 150mm wastewater service (refer clause 6.7.3.1. minimum Size of Pipes) to the upstream side(s) of the property boundary will be borne by the Developer. If the Design Flow from the upstream catchment(s) or developments requires a pipe larger than a nominal 150 mm (as calculated under clause 6.6.12), then the Developer may apply to the Council for consideration for an Extra Over Contribution towards the cost of providing additional capacity over and above the capacity of a 150 mm nominal wastewater service to the upstream boundary. Refer Clause 6.6.17 for full details on Extra Over Contributions.

Only in special cases will provision of interim capacity or staged development be considered, and must be approved by the Infrastructure Planning Manager.

Downstream Catchments

If the proposed development is to be connected to the municipal wastewater network, then it is the Developer's responsibility to convey the wastewater from the proposed development to the Council's Trunk Sewer. Occasionally, the distance between the Developer's site and either the Trunk Sewer, or an existing local sewer with available capacity to which the proposed wastewater system can be connected will be a significant distance. In such circumstances there may be the possibility for other developments to connect into the proposed wastewater system downstream of the Developer's site.

In order to ensure that the Service Life of the proposed system is met, the Design Engineer must design this downstream section of the proposed wastewater system to be consistent with the optimum design for the entire catchment area. The Design Engineer must satisfy the Council's Asset Consents Engineer that the proposed wastewater system downstream of the Developer's site complies with the Council's Strategic Network Layout Blueprint, if the Council holds a blueprint for the area. If the Council does not have a strategic network layout for the area, then the Design Engineer will be required to demonstrate that any areas of land for which the possibility of a subsequent connection exists can both be connected to, and serviced by the proposed wastewater system.

6.6.3 Consultation with NSCC

At the commencement of the Scheme Plan Stage of a subdivision, the Developer or the Design Engineer must contact the Asset Consents Engineer at Environmental Services to obtain appropriate information that is to be used for the determination the required design capacity and network layout, such as the Ultimate Future Development Scenario and Catchment; the pre-existence of a Strategic Network Layout Blueprints and wet weather inflow/infiltration data.

At the initial stage, the Design Engineer should propose the point of connection to the existing public wastewater network. In the early stages, Council may provide non-binding feedback regarding the proposed point of connection. More conclusive feedback whether Council will accept a connection into the existing network may only be possible at the later stages of the design when sufficient information could be made available to Council.

Equivalent Population

Two different catchment areas are required for design purposes, depending on whether new infrastructure is being designed, or the available capacity of existing infrastructure is being assessed. The two differing catchment areas are described in Clauses 6.6.4.1 and 6.6.4.2, and are illustrated in Example A1, Example A2 and Example A3 in Appendix 6I.

6.6.4.1 Catchment Area for Sizing New Infrastructure

When assessing new infrastructure, the Design Engineer use what will be referred to as “the Ultimate Future Catchment” and is depicted in Example A1, and Example A2 in Appendix 6I.

Definition of Ultimate Future Catchment:

- The Ultimate Future Catchment boundary is determined by the Developer’s Proposed Site / property plus any existing or potential future catchments upstream of the pipe / infrastructure being designed.
- The Ultimate Future Catchment’s population is determined by the Ultimate Future Development Scenario. Population densities from the Ultimate Future Development Scenario are applied to the Ultimate Future Catchment.
- The Ultimate Future Catchment boundary encompasses undeveloped land and any planned upstream catchment (pipe) diversions. The Council’s Asset Consents engineer will provide the Design Engineer with advice on the extent of the Ultimate Future Catchment, and advise if there are any planned catchment diversions upstream of the pipe(s) being designed.

6.6.4.2 Catchment Area for Assessing the Capacity of Existing Infrastructure

When assessing existing infrastructure, the Design Engineer must use what will be referred to as “the Proposed Catchment” and is depicted in Example A3 in Appendix 6I.

Definition of Proposed Catchment:

- The Proposed Catchment comprises of the existing catchment upstream of the pipe being designed plus the full extent of the developer’s proposed site and/or catchment.
- The Proposed Catchment’s population is determined:
  - For the existing catchment upstream of the pipe being designed:

    - The population is determined from the latest NZ census data available, or in the absence of this, the population is to be calculated as described in Clause 6.6.5 based on the number of properties and buildings in the existing catchment.

  - For the Developer’s Proposed Development:

    - The population for the Developer’s site is determined by the methodologies outlined in Clause 6.6.5.

6.6.5 Equivalent Population (EP) for Design Purposes

6.6.5.1 Residential Area - EP to be based on number of households

Design Flows shall be calculated on an Equivalent Population (EP) basis where units (people) represent the daily wastewater flow from an average residential customer. The EP must be calculated for the appropriate upstream catchment area, see Clause 6.6.4.

EP for design purposes is defined as follows:

EP_{design} (people) = $EP_{residential}$ + $EP_{commercial}$ + EP_{other} + $EP_{industry}$* …….. Eq. 6.6.1

Where:

- $EP_{residential}$ = Residential Equivalent Population, as defined in Clause 6.6.6.
- $EP_{commercial}$ = Commercial Equivalent Population, as defined in Clause 6.6.7.
- EP_{other} = Other Activities Equivalent Population, as defined in Clause 6.6.8.
- $EP_{industry}$ = Industrial Equivalent Population, as defined in Clause 6.6.9.

$EP_{industry}$ * - very few assessment will need to consider industrial users, EPindustry need only be included in Equation 6.1 when relevant.

The EP can be calculated from daily wastewater flows using the following formula:

$$EP(people) = \frac{\text{Wastewater Flow } (L/day)}{225(L/person/day)}$$ ……Eq 6.6.2

Where:

- Wastewater Flow (L / day) = the design wastewater flow over a 24 hour period.
- 225 L/person/day = average per capita wastewater generation of a North Shore City residential customer.

6.6.5.2 Return to Sewer Ratio for Potable (Drinking) Water

Where water usage data is used, the return to sewer ratio will be taken as 95% of the water usage for design purposes.

Wastewater Production = Water Consumption x 95% ..... Eq 6.6.3

6.6.6 Calculation of the Residential Equivalent Population (EPresidential)

The Residential Equivalent Population ($EP_{residential}$) must be calculated with the most accurate development information available at the time. As and when more specific details concerning the development become available, the developer will have to update their Design Flow calculations. Calculations must preferably be based on the number of bedrooms. Furthermore, calculations based upon the number of households will be given precedence to those based on site area.

6.6.6.1 EPresidential when the Number of Bedrooms is Known

When the (proposed) number of bedrooms in a dwelling is known EPresidential for design purposes shall be the number specified in Table 6.3.

Number of Bedrooms*	$EP_{residential}$ for Design Purposes
1	2
2	4
3	5
4	6
5	8
6	9
*Where large dwellings are proposed, which have additional rooms beyond those allocated as dining, lounge and bedrooms (e.g. "family", "office", "study", etc.) and which have potential to be used as bedrooms, an additional occupancy allowance should be made on the basis of 1 extra EP times the ratio of the total floor area of the additional room(s) to that of the smallest designated bedroom.	

Source: ARC TP58

Example 6.6.1: If there are twenty (20) proposed households, 10 with three bedrooms and 10 with five bedrooms, the $EP_{residential}$ is (5 x 10) + (8 x 10) = 130.

6.6.6.2 EPresidential when the Number of Households is known - but not the Number of Bedrooms

i) For Detached Residential Development; Town-House Style Residential Development (Semi-Detached and Attached); and Apartments of 3 Floors or less in Height

When the proposed number of households is known, but the number of bedrooms in each household is unknown, the following equation shall be used to calculate $EP_{residential}$:

EPresidential = Number of households x 6 …… Eq. 6.6.4

ii) For Residential Apartments of 4 Floors or greater in Height

When the proposed number of apartment units is known, but the number of bedrooms in each household is unknown, the following equation shall be used to calculate EPresidential:

EPresidential = Number of units x 4.5 ……..…….Eq. 6.6.5

6.6.6.3 EPresidential when only the Site Area of the Development is Known

Table 6.4 below gives estimated design EP per hectare (ha) for different development zones. This Table is approximate and may not cover all potential requirements of the current district plan applicable to particular sites. This Table should be used only as a starting point, and must be refined for particular sites as more accurate information becomes available.

Table 6-4 : Estimated design EP per hectare of development

Zone	Minimum Net Site Area (m2)	Estimated EP per net ha	Estimated EP per gross ha
Residential 1	1200	24	19
Residential 2A1	5000	6	5
Residential 2A	800	36	28
Residential 2B	600	47	38
Residential 2C	350	81	65
Residential 3A	400	71	57
Residential 3B	500	57	45
Residential 3C	600	47	38
Residential 4A	350	81	65
Residential 4B	400	71	57
Residential 5	350	81	65
Residential 6	150	189	151
Residential 7	200	142	114
Area D Varied Residential	250	114	91

Notes:

Net Area (ha) is defined as the total catchment area, less reserve land and legal road boundaries.

Gross Area (ha) is defined as the total catchment area, excluding reserve land, but including land within legal road boundaries.

6.6.7 Calculation of the Commercial Equivalent Population (EPcommercial)

6.6.7.1 General

i) For Sites with 100% Business Use

The Equivalent Population (EP) for 100% commercial use business sites must be calculated as follows:

- Calculate the EPcomm_floor_area based on the business floor area in the proposed development (refer clause 6.6.7.1)
- Calculate the EPcomm_site_area based on the site area of development (refer clause 6.6.7.3)
- If the site is 100% commercial, then EPcommercial is the higher of the above two calculations

ii) For Sites with Mixed Use

The Equivalent Population (EP) for mixed use business sites is calculated as follows:

- Calculate $EP_{residential}$ + EPother + EPcomm_floor_area……Eq 6.6.6
- Calculate the $EP_{comm\_site\_area}$

$$EP_{comm\_site\_area} = \frac{\text{Site area (ha)}}{1\ \text{(ha)}} \text{x EP per net ha} = \frac{\text{Site area (m}^2\text{)}}{10{,}000\ \text{(m}^2\text{)}} \text{x EP per net ha}$$

…….. Eq 6.6.7

If the result of first calculation (Eq 6.6.6) is the higher value, then:

$EP_{commercial} = EP_{comm\_floor\_area}$ …….Eq 6.6.8

If the result of second calculation (Eq 6.6.7) is the higher value, then:

$EP_{commercial} = EP_{comm\_site\_area} – EP_{residential} – EP_{other}$……..……..Eq 6.6.9

Deviations to the methodology for calculation of EPcommercial must be approved by the Infrastructure Planning Manager.

Table 6.5 : Estimated design EP per hectare of Commercial Development

Zone	Minimum Net Site Area (m2)	Floor Area Ratio (FAR)	Estimated EP per net ha	Estimated EP per gross ha
Business 1			116	93
Business 2			187	150
Business 3 Area A		1.5	299	239

Business 3 Area B		3.0	632	505
Business 3 Area C		3.5	769	615
Business 3 Area D		3.0	632	505
Business 4		3.0	656	524
Business 5			187	150
Business 6		2.0	428	343
Business 7 Area A		1.0	201	161
Business 7 Area A Smale's Farm		1.5	315	252
Business 7 Area B			258	206
Business 7 Area C		0.5	100	80
Business 7 Area D			187	150
Business 7 Area G			187	150
Business 8			329	263
Business 9			187	150
Business 10			258	206
Mixed Use Overlay Area	250		114	91

Notes:

Net Area (ha) is defined as the total catchment area, less reserve land and legal road boundaries.

Gross Area (ha) is defined as the total catchment area, excluding reserve land, but including land within legal road boundaries.

6.6.7.2 EPcommercial based on the Floor Area of Business Development

When the business floor area is known, calculate the EP as follows:

$$EP_{comm\_floor\_area} = \left(\frac{\text{Gross floor area for business purposes } (m^2) \text{ x } 0.8}{25} \right) \text{x } 45\% \qquad \text{Eq. 6.6.10}$$

In the above equation, for estimation purposes, the net floor area is taken as 80% of the gross floor area. It is assumed that there is one non-resident working person per 25m2 of net floor area, and the average wastewater generation by a non-resident working person is 45% of the residential wastewater generation.

Example 1: For a 1,000m2 of business gross floor area, the design EPcomm_floor_area is:

$$\left(\frac{1000 \text{ x } 0.8}{25} \right) \text{x } 45\% = 14.4$$

6.6.7.3 EPcommercial based on the Site Area of Business Developmen

Table 6.5 gives the Design EP per hectare (ha) for different commercial development zones. This Table is approximate and may not cover all potential requirements of the current district plan applicable to particular sites. This Table should be used only as a starting point, and must be refined for particular sites taking into account all potential requirements.

Example 2: A development of 3,000m2 net site area located in Business 3 Area B would have a design EPcomm_site_area of: [632 (people) / 10,000 (m2)] x 3,000 m2 = 189.6 people

Example 3: If the gross floor area for the development in Example 6.6.3 were 7500m2 (3 levels of 2500m2 floor area) then the EPcommercial would be the greater of:

(7500 x 0.8 / 25) * 45% = 108 $EP_{comm\_floor\_area}$ based on Floor Area

= 189.6 $EP_{comm\_site\_area}$ based on net site area (from Example 6.6.3 above).

Therefore $EP_{commercial}$ = 189.6 people = $EP_{comm\_site\_area}$

Example 4: A mixed use development with 1500m2 net site area, in Business 3 Area B with 500m2 of gross business floor area, and eight 3 bedroom apartments.

$EP_{residential}$ = 8 apartments x 5 people = 40 people

(Eq 6.6.10) $EP_{comm\_floor\_area}$ = (500m2 x 0.8 / 25) * 45% = 7 people

$EP_{comm\_site\_area}$ = [632 (people) / 10,000 (m2)] x 1500 m2 = 95 people

(Eq 6.6.6) $EP_{residential}$ + EP_{other} + $EP_{comm\_floor\_area}$ = 40 + 0 + 7 = 47 people

(Eq 6.6.7) $EP_{comm\_site\_area}$ = $\frac{1500 m^2}{10000 m^2} \times 632 = 95$ people (larger)

Carrying the larger of the two calculations forward…

(Eq 6.6.9) $EP_{commercial}$ = $EP_{comm\_site\_area}$ – $EP_{residential}$ - EP_{other} = 95 – 40 – 0 = 55 people.

[Note in this example: EPdesign for the proposed site would therefore equal:

EP_{design} = $EP_{residential}$ + $EP_{commercial}$ + EP_{other} = 40 + 55 + 0 = 95]

Example 5: Using Example 6.6.5, but this time with 20 apartments.

$EP_{residential}$ = 20 apartments x 5 people = 100 people

(Eq 6.6.10) $EP_{comm\_floor\_area}$ = (500m2 x 0.8 / 25) * 45% = 7 people

$EP_{comm\_site\_area}$ = [632 (people) / 10,000 (m2)] x 1500 m2 = 95 people

(Eq 6.6.6) $EP_{residential}$ + EP_{other} + $EP_{comm\_floor\_area}$ = 100 + 0 + 7 = 107 people (larger)

(Eq 6.6.7) $EP_{comm\_site\_area}$ = 95 people (from Example 6.6.5)

Carrying the larger of the two calculations forward…

(Eq 6.6.8) $EP_{commercial}$ = $EP_{comm\_floor\_area}$ = 7 people

[Note in this example: EP_{design} for the proposed site would therefore equal:

EP_{design} = $EP_{residential}$ + $EP_{commercial}$ + EP_{other} = 100 + 7 + 0 = 107]

6.6.8 Calculation of "Other Uses" Equivalent Population (EPother)

EPother represents all wastewater generating activities that are not covered by residential, commercial, or industrial (see Clause 6.6.9). Examples include churches; community centres; schools; scout dens; sporting clubs and facilities, and other activities of this nature.

Where required by Council, a job specific analysis shall be carried out for determining the Design Flows. The analysis shall be based on:

- long-term recorded water usage data for similar facilities with appropriate projections and calculations. Where water usage data is used the return to sewer ratio will be taken as 95% of the water usage, or
- Water consumption design standards and / or wastewater production standards recognised by Council.

The Developer or the Design Engineer must contact the Council's Asset Consents Engineer for direction on the required methodology and to obtain relevant data.

If the proposed facility is one that will only have intermittent use less than 25 hours per week then in the Council's Asset Consents Engineer will require the Developer or Design Engineer to account for the intermittent use by establishing the flows from the facility when the facility is being used at maximum capacity.

EP_{other} must therefore be based on derivations of the following formulae:

$$EP_{other} = \frac{\text{Average Water Consumption (L/day)} \times 0.95}{225\,(L/person/day)} = \frac{\text{Average Wastewater Production (L/day)}}{225\,(L/person/day)}$$

Or for facilities that will only be used intermittently:

$$EP_{other} = \frac{\text{Maximum Water Consumption (L/day) x 0.95}}{225\,(L/person/day)} = \frac{\text{Maximum Wastewater Production (L/day)}}{225\,(L/person/day)}$$

……..Eq. 6.6.11

Example: Calculate the EP_{other} for a soccer club room.

Water consumption records show that a typical soccer club room uses 122 m3 (122 kilo Litres, kL) over 6 months. The club rooms are to be used for an average of 14 hours a week. The use of the facility is less than 25 hours per week, therefore the Council's Asset Consents Engineer requires the calculation to be based on that for an intermittent user. It is therefore necessary to calculate the average water consumption for each hour that the club rooms are used.

Step:

1 Calculate the weekly water usage. $\frac{122{,}000\text{ L in 6 months}}{26\text{ weeks in 6 months}} = 4{,}692\text{ L per week}$

2 Calculate the water use per hour . $\frac{4{,}692\text{ L per week}}{14\text{ hrs use per week}} = 335\text{ L per hour}$

3 Calculate the volume that would be used in a day if the hourly rate continued non-stop for 24 hours .

335 L/hr x 24hrs /day = 8,043 L/day

4 Calculate the EPother. $EP_{other} = \frac{8{,}043\,(\text{L/day})\text{ x }0.95}{225\,(L/person/day)} = 34\text{ people}$

6.6.9 Industrial Users

6.6.9.1 General

The way in which Design Flows from industrial premises must be calculated, will depend on whether the particular industry is regarded as “dry” or “wet” in terms of this standard. Industries are regarded as “wet” when process water is discharged into the public wastewater network. In terms of this standard, “dry” industries are classified as being “Light to Medium class” and “wet” industries as “Heavy or Very Heavy class”.

Instantaneous Peak Flow is the maximum flow rate at which an industry will discharge wastewater into the Council network in litres per second over a period of greater than 5 seconds. The instantaneous flow shall not be calculated using the average flow and dividing by the number of seconds.

6.6.9.2 Dry Industrial Users

As dry Industrial users do not discharge process water to the public wastewater network, their Design Flows must be calculated as for normal commercial applications as per Clause 6.6.12. The Design Engineer must establish the instantaneous peak industrial discharge and then convert the discharge to an equivalent population (EP) as follows:

1. Where the domestic waste and trade waste flow from a particular industry is known, then establish known values;
2. Determine whether the industry falls into light or medium category and read the applicable Instantaneous Peak Flow from Table 6.6.
3. The flow that is used for design purposes is the larger of the two values from Step 1 & 2, above.
4. If the larger of the two flows is from Step 1, then obtain EP value from Table 6.6 and then calculate EPindustry, after multiplying the EP in the Table by the net site area for industrial purposes.
5. If the larger of the two flows is from Step 2, then refer to Clause 6.6.10 and from Figure 6-1, Figure 6-2 or Figure 6-3, obtain the EP value which corresponds to the Instantaneous Peak Flow.
6. Calculate EPdesign as per Clause 6.6.5 (EPindustry is included in the formula Eq 6.6.1).
7. Calculate the Design Flow as per Clause 6.6.12.

Example: Calculation of the Design Flow of a Dry Industry

$$\text{Minimum Peak Industrial Flow} = \left(\frac{5000 m^2}{10{,}000 m^2}\right) \text{x } 0.7 \text{ (L/sec/ha)} = 0.35 \text{ L/sec}$$

An industrial site has a 5000m2 medium industrial user, and 1000 m2 of commercial office space. The EPcommercial for the site has already been calculated as per Clause 6.6.7 as 14.4 people, and takes into account the 1000m2 office on the site. There are no residential dwellings on the site, and the Council has advised there are no upstream-catchments to consider. International design guidelines calculate that the industry on the site will produce a peak flow of 0.3 L/sec.

1 Calculate the Minimum Peak Industrial Flow from Table 6.6.

2 International standards indicated that the peak industrial flow is 0.3 L/sec, as provided from the example above.

3 Table 6.6 provides the greater flow, (0.3 L/ sec compared to 0.35 L/ sec). Therefore the industrial design flow is taken from Step 1, 0.35 L/sec.

4 Calculate EPindustrial from Table 6.6:

$$EP_{industrial} = \left(\frac{5000m^2}{10{,}000m^2} \right) \text{x } 26 \text{ (people/ha)} = 13 \text{ people}$$

(Note: Had Step 2 been the larger flow, we would have read 0.3 L/sec off Fig. 6-1 in Clause 6.6.10 to find an EP of 10 people. EPindustrial = 10)

5 As described in the example above, EPcommercial from (Clause 6.6.7) for the office space has already been calculated to be = 14.4 people. The EPindustrial, calculated above, is 13.

6 EPdesign = EPresidential + EPcommercial + EPother + EPindustrial…… Eq 6.6.11

= 0 + 14.4 + 0 + 13 = 27.4 people.

7 There is no need for a more detailed assessment, as per Clause 6.6.11, as the EPdesign is less than 100 people.

6.6.9.3 Heavy and Very Heavy Industrial Users

Wastewater systems for 'wet' industries are treated separately to other uses and their Design Flow must be calculated as follow:

Design Flow Wet industry (L/sec) = Design Flow (as per 6.6.12) + Instantaneous Peak Industrial Discharge (L/sec)

……Eq. 6.6.12

Where:

Instantaneous Peak Industrial Discharge (L/sec) = The minimum discharge allowable (1.3 L/sec/ha from Table 6.6); or flows determined through specific design (or design standards) acceptable to Council, as described in detail below and in notes to Table 6.6.

The Council requires wet industries in the “Very heavy” category to provide detailed process information that clearly and accurately calculates the discharge from the process under normal, abnormal (i.e. maintenance), and (if applicable) “emergency” scenarios.

6.6.9.4 Industrial Flows

Industrial flows must be estimated with reference to Table 6.6 below.

Table 6-6 : Peak Industrial Flows

Industry type based on Water Usage (see notes below)	*Minimum instantaneous peak industrial flow (litres/second/hectare)*	*Minimum EP /* *[net site area for industrial purposes (ha)]* *(EP equivalent to minimum peak industrial flow)*
Light (see note 1)	0.4	13
Medium (see note 2)	0.7	26
Heavy (see note 3)	1.3	Not Applicable
Very Heavy “wet” industry (see note 4)	Specific design required	Specific design required

Notes:

1 A light water usage industry is a relatively dry and clean trade where the good industrial practice does not require the installation of showers in the premises, and there is no process water usage.

2 A medium water usage industry is a dirty trade where the good industrial practice requires the installation of showers in the premises, and there is no process water usage.

3 A heavy water usage industry is a trade that uses process water in moderate quantities. Wherever possible, the design wastewater flow for a heavy water usage industry should be checked against known water consumption and peak factor standards. The Design Engineer shall submit evidence of this checking to the Environmental Services Asset Consents Engineer.

4 A very heavy water usage industry is a trade that uses process water discharges in significant quantities. The design wastewater flow for a very heavy water usage industry shall be checked against known water consumption, wastewater discharge and peak factor standards and shall be specifically approved by the Council's Wastewater Network Operations Manager and the Infrastructure Planning Manager.

6.6.10 Calculation of Equivalent Population from Peak Flows

There will be occasions, such as when working with industrial discharges, that it is necessary to use a Peak Flow to calculate an Equivalent Population. When back-calculating the EP from peak flows, the Council requires the designer to convert the peak flow back to an average 24-hour flow. This conversion must be done using the Babbitt formula (Clause 6.6.13.2 - Eq 6.6.17).

The following three graphs simplify the calculation to back-calculate EP from a peak flow. Peak flow is converted back to EP within the graphs, as required by the Council. The calculations required to take into account the effects of the Babbitt formula are already included within the graphs.

To back calculate EP from an Instantaneous Peak Flow, read the Peak Flow of the x-axis of the graph to find the corresponding EP on the y-axis.

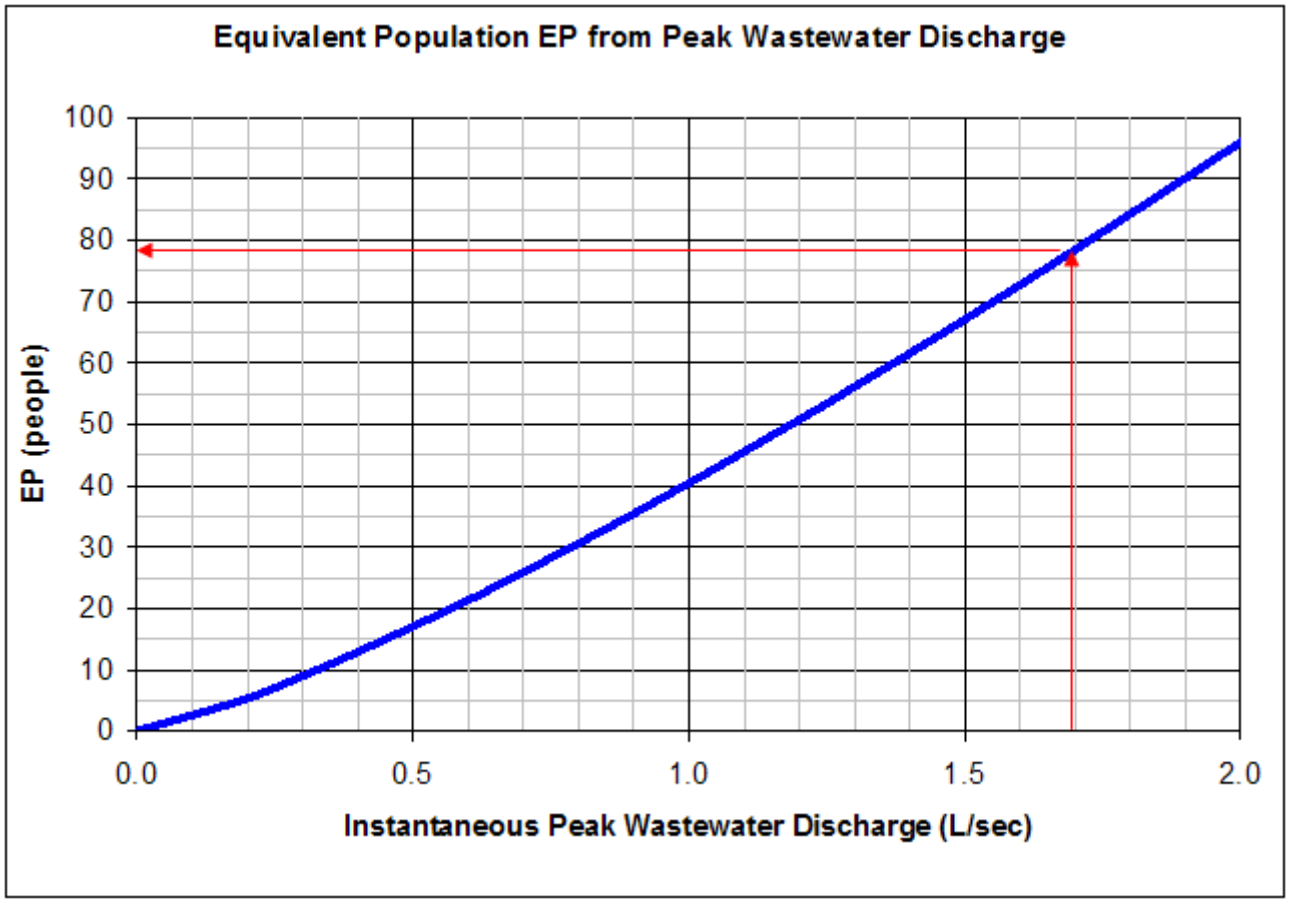


Figure 6-1: Equivalent Population from Peak Flow (0 – 2.0 L/sec)

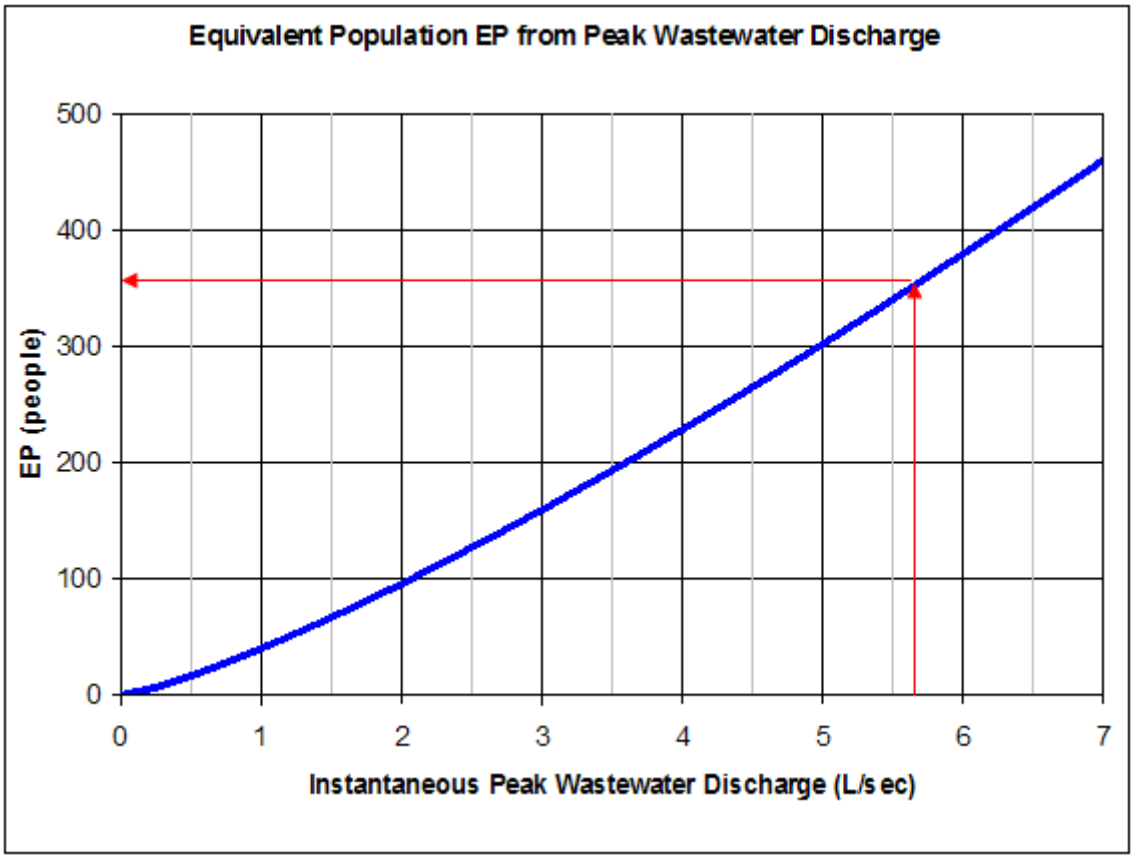


Figure 6-2: Equivalent Population from Peak Flow (0 – 7.0 L/sec)

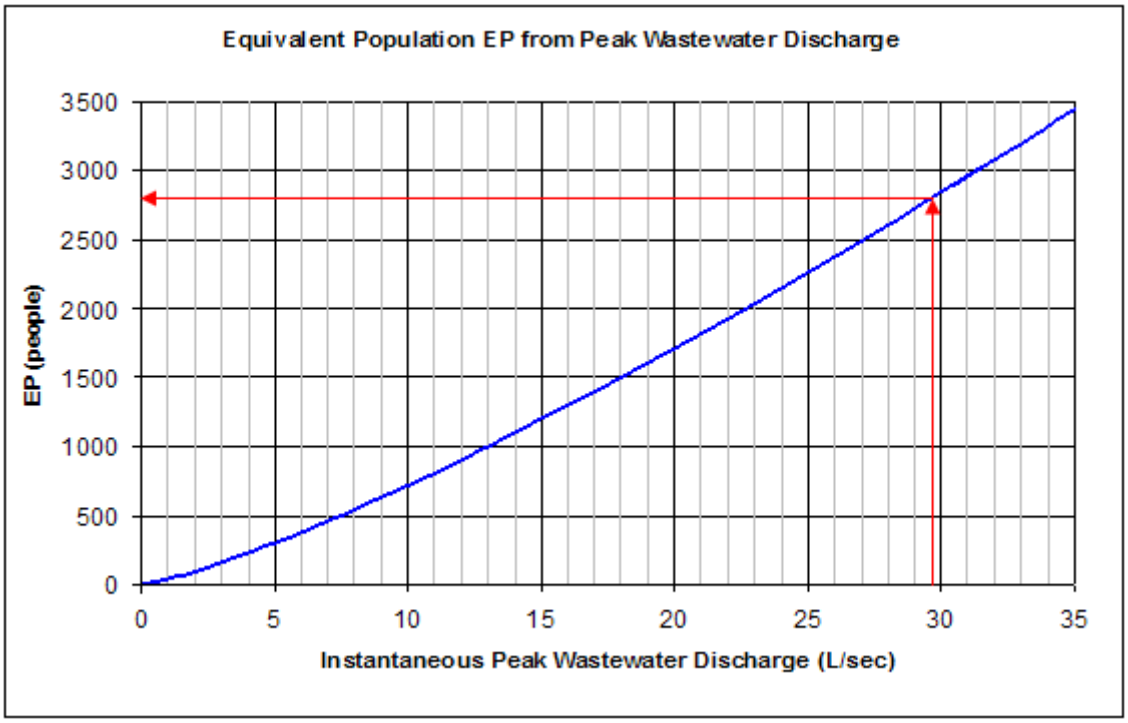


Figure 6-3: Equivalent Population from Peak Flow (0 – 30 L/sec)

6.6.11 Thresholds

If the development meets all of the following criteria:

- EPdesign for the Ultimate Future Catchment for the proposed wastewater system is less than 100 people; and
- No wastewater pumping; and
- Council confirms that there are no specific capacity issues within this wastewater catchment.

Then the Design Engineer:

- Does not have to do a specific design for the hydraulic capacity of the proposed wastewater system, but ;
- Must still consider the spatial layout and depth of the network with regard to the Council's Strategic Network Layout Blueprint. In the absence of a Strategic Blueprint, the Design Engineer must ensure that the proposed wastewater system's spatial layout and depth are consistent with optimum design for the entire catchment area.

6.6.12 Design Flows

The Design Flow is the larger of equations DS (1) or DS (2) described below:

Design Flow (L/sec) = maximum of:

DS (1) .(L/sec) = 2 x PDWF (L/sec) ..... Eq. 6.6.13

Or

DS (2) (L/sec) = PDWF (L/sec) + PWWF (L/sec) ..... Eq. 6.6.14

Where:

- PDWF = Peak Dry Weather Flow as defined in Clause 6.6.13
- PWWF = Peak Wet Weather Flow as defined in Clause 6.6.14

Wastewater sewers shall be sized to accommodate the Design Flow at (or less than) pipe full.

The design of wastewater pipelines shall be based on either: The Colebrook-White formula, or the Manning's formula as described in detail in Clause 6.7.1.1.

If the pipe is calculated to be running full (i.e. pressurised) the developer is required to install the next larger commercially available pipe size as per Clause 6.6.1.

6.6.13 Dry Weather Flow (DWF)

6.6.13.1 Peak Dry Weather Flow (PDWF)

Peak Dry Weather Flow is calculated by the following equation:

PDWF (L/sec) = ADWF (L/ sec) x PF Eq. 6.6.15

Where:

- ADWF = Average Dry Weather Flow (L/sec) as described in 6.6.12.1
- PF = Dry Weather Flow Peaking Factor as described in 6.6.12.2

6.6.13.2 Average Dry Weather Flow (ADWF)

The Average Dry Weather Flow (ADWF) is calculated using the following equation:

ADWF (L/day) = EPdesign (people) x 225 (L/person/day)…….Eq. 6.6.16

Where:

- EP_{design} = Equivalent Population for Design Purposes as described in 6.6.5
- 225 (L/person/day) = the average per capita residential wastewater generation

The 225 L / person / day is based on historical water consumption and wastewater flow measurement data across the city. Subsequent reviews of this rate of wastewater production have reaffirmed 225 L / person / day is the average rate of wastewater production per capita across North Shore City.

6.6.13.3 Dry Weather Flow Peaking Factor (PF)

Although the ADWF is calculated based on an average per capita wastewater generation, the instantaneous wastewater flow varies with time of the day, day of the week and also seasonally. This variation is taken into account in the Design Flow by using a Peaking Factor (PF). The Peak Factor decreases as the population gets larger, and is described by the Babbitt formula:

$$PF(unitless) = \frac{5}{\left(\frac{EP_{design}}{1000}\right)^{0.2}}$$ …… Eq. 6.6.17

Where:

- EP_{design} is the Equivalent Population upstream of the pipe being designed as described in Clause 6.6.5.

Example 6.6.9: If EP_{design} were 3000 people,

The Dry Weather Peaking Factor (PF) = $\frac{5}{\left(\frac{3000}{1000}\right)^{0.2}} = \frac{5}{3^{0.2}} = 4.0$

6.6.14 Wet Weather Flow (WWF)

6.6.14.1 Peak Wet Weather Flow (PWWF)

The Design Peak Wet Weather Flow (PWWF) is one that meets the required Level of Service (LoS), in this case overflow frequency (refer clause 6.6.1). The PWWF is calculated using the following equation:

PWWF (L/sec) = PIIF (L/sec/ha) x Gross Land Area upstream of the pipe (ha)……. Eq. 6.6.18

Where:

- Land Area (ha) = the Gross Contributing Land Area upstream of the wastewater pipe / infrastructure being designed (refer Clause 6.6.2 and 6.6.4).
- Gross Contributing Land Area is defined as the total catchment area, excluding reserve land, but including land within legal road boundaries.
- 1 hectare (ha) = 10,000 m2
- PIIF (L/sec/ha) = Peak Inflow and Infiltration Flow Factor as described in 6.6.13.1

The Developer or Design Engineer must contact Council's Asset Consents Engineer for advice regarding the extent (both present and future) of any upstream catchment boundaries. Refer to the Ultimate Future Catchment as defined in Clause 6.6.4.

6.6.14.2 Peak Inflow and Infiltration Factor (PIIF)

The Peak Inflow and Infiltration Factor (PIIF) with units (L/sec / gross ha) is the allowance for surface/groundwater water leakage into the wastewater network in order for Council to meets their required Level of Service Agreement. The PIIF depends on the condition of the sewer network and a number of associated variables such as the sewer pipe material, age, quality of construction, whether the sewer has been rehabilitated and the quality of rehabilitation. Other factors that influence PIIF include the characteristics of the catchment, the rainfall and groundwater regime.

The PIIF factors must also accommodate the expected degradation of the sewer network over the 100 year Design Service Life (see Clause 6.6.2) and it is for this reason why Council requires that the PIIF factor allows for water infiltration even with modern watertight sewers.

For the design of new wastewater systems with no pre-existing wastewater network upstream of the system, the Developer or Design Engineer need only consider Clause 6.6.14.2 New Sewers with No Existing Wastewater Infrastructure Upstream (below).

When designing a new wastewater system with pre-existing network upstream of the pipe, or assessing the downstream capacity of the wider wastewater network, the wet weather leakage of the pre-existing wastewater system must be taken into account. Clause 6.6.14.3 Peak Wet Weather Inflow and Infiltration Factor (PIIF) for Existing Wastewater Infrastructure (below) describes the methodology that will be used to take into account the wet weather leakage of the pre-existing wastewater network.

6.6.14.3 Peak Wet Weather Inflow for new sewers with no existing Wastewater Infrastructure Upstream

For completely new sewers with no existing wastewater infrastructure upstream, the PIIF factor is:

PIIF = 1.0 (L/sec/ha)…….. Eq. 6.6.19

6.6.14.4 Peak Wet Weather Inflow & Infiltration Factor (PIIF) for Existing Wastewater Infrastructure

Peak Wet Weather Inflow and Infiltration Factors (PIIF) vary across the city. A map is provided that must be used to determine the PIIF for the existing network in the locality of the proposed development. Refer to maps in Appendix J, or for better clarity, please refer to maps provided on the Councils Website (http://www.northshorecity.govt.nz).

The PIIF factors are divided into three Leakage Zones namely Low Leakage (green); Medium Leakage (orange) and High Leakage (red). The appropriate zone must be established from the map and then the following PIIF factor must be applied:

PIIF Factors for North Shore City Leakage Zones

Leakage Zone Map Reference	PIIF L/sec/ Gross Area (ha)
Low Leakage (green)	1.0
Medium Leakage (orange)	2.0
High Leakage (red)	4.0
Gross Area (ha) is defined as the total catchment area, excluding reserve land, but including land within legal road boundaries.	

For complicated assessments, the Council will, at its discretion, utilise or require calibrated hydraulic modelling to improve upon the accuracy of the Wet Weather PIIF factors.

6.6.15 Constraints

Where there are known constraints in the local catchment wastewater network, or where the Trunk Sewer system has not been augmented to cater for the Ultimate Development Scenario, an application for a wastewater connection could be declined or deferred until such time as the required capacity is available.

6.6.16 Hydraulic Modelling

For more complicated assessments, the Council will, at its discretion, utilise or require calibrated hydraulic modelling to:

- Determine the existing sewer capacity;
- Establish required pipe sizes, grades and alignment for new or upgraded infrastructure;
- Determine Wet Weather PIIF and EPdesign.

Hydraulic modelling is regarded by the Council as the most accurate way to assess the capacity of a sewer, the PIIF and the EPdesign factors. Used in conjunction with the IDSM, results from Hydraulic modelling results may supersede the Design Flows which are calculated as per this standard provided if approved by the Infrastructure Planning Manager of Council.

6.6.17 Extra-Over Contributions

6.6.17.1 General

The Council requires that all wastewater systems are sized and constructed to service the Ultimate Future Development Scenario. This requirement is for the benefit of both the Council's ratepayers and the Development community as it ensures that the long-term cost of providing wastewater infrastructure is as low as possible.

Where a Developer has to provide a wastewater system that requires larger pipes / infrastructure than what is required to service their development, Council may contribute to part of the upsizing cost. This contribution is referred to as an Extra-Over Contribution. The assessments of the Extra-Over contribution are based upon the direct additional cost which the Developer will have to incur as result of the required up-sizing (refer 6.6.17.3).

Council's Extra-Over Contribution budget is limited and as such yearly funds are only available on a first in first served basis. The developers must inquire about their qualification for and the availability of Extra-Over Contributions prior to the detailed design of the wastewater system for their proposed development in order to be eligible for an Extra Over contribution.

6.6.17.2 What the Developer is Expected to Pay for

The Developer must pay the full cost for the design and construction of the wastewater network that is required to service the proposed development. This includes the following:

- The design of the wastewater system in compliance with this standard and when sized in accordance with the requirements Council's Network Layout Blueprint for the wider area, or where this doesn't exist, then to be consistent with the optimum design of the entire catchment area (refer Clause 6.6.2.2)
- All construction of the network which is required for the conveyance of the proposed development's wastewater to the existing public network after having obtained Council's permission for the proposed connection.
- All upgrades to the Councils existing network that are required to ensure sufficient capacity for the proposed development.
- If the Design Flow from the Developer's Site requires a wastewater system with a size greater than the minimum size requirements outlined in Clause 6.7.3.1, then the developer will bear the full cost of constructing a wastewater system that will convey the Design Flows required from the Development.

6.6.17.3 Extra-Over Contributions – When and What the Council will Consider for Contribution

i) Where the Developer has to provide New Infrastructure for Upstream or Downstream Catchments:

The assessment of whether a developer will qualify for an Extra-Over Contribution for Upstream or downstream Catchment(s) is best described with a series of examples. Please refer to Examples A4, A5, A6 and Examples A7, A8 respectively in Appendix 6K.

ii) Where Upgrading of the Existing Wastewater System Downstream of the Developer's Site is required

Because of the unique variables attributable to each application, it is not possible to define easy to follow rules within this standard that will cover all circumstances where downstream upgrades may be necessary. As such, Council have to assess the possibility of making Extra-Over Contributions on a case-by-case basis. The Council's assessment will seek to provide a fair outcome and a cost efficient wastewater system. The assessment will be based upon the principals outlined in 6.6.17.1, 6.6.17.2, and the examples in Appendix 6K.

Gravity Sewers

6.7.1 General

a Pipeline gradients steeper than 33% for any length greater than 3m will not be permitted.

b Where an existing or proposed pipeline is more than 5m deep to the top of the pipe, connections shall not be made directly to it, but a new shallower branch pipeline

c North Shore reticulation sewers are generally characterised by steep upper catchment sections discharging to flat lower catchment sections. Experience shows that most of the overflow problems occur at points of change of grade. In order to minimise this problem, where the grade difference is greater than 5%, one of the following shall be adopted:

- The transition from steeper upstream grade to the downstream grade may be accommodated in a purpose made long-radius bend (vertical curve) immediately upstream of the manhole / access point, if any, at the change of grade.

  Note: by providing this vertical curve, it may be possible to avoid the need for a manhole / access point at the change of grade. Refer clause *6.7.4* for radius to centreline information.

- A dry manhole may be provided at the change of grade
- If a manhole / access point is essential at the change of grade, the flatter downstream sewer shall be checked for inlet control conditions (in addition to the requirements of clause 6.7.2). The larger of the two sizes (i.e. inlet control size and size, refer clause 6.7.3.1) shall be adopted for the downstream sewer.

Hydraulic Design

a The design of wastewater pipelines shall, for pipes flowing full, be based on either the:-

- Colebrook-White formula, using ks = 1.5mm, or
- Manning's formula, using n = 0.015

b Minimum full pipe flow velocity in pipelines shall normally be 0.65m/s (a gradient of 0.55% for 150mm pipes). Flatter gradients (full-pipe velocity at least 0.60m/s) for 150mm diameter pipes may be permitted in special cases where otherwise pumping would be required.

c A pipeline serving less than five dwelling units shall have a minimum gradient of 1%.

d Minimum gradient for polyethylene (PE) gravity sewers shall be 1%.

e e) Specific design is required for sewers laid at gradients in the range <1% to >=0.55% (minimum NB diameter 150mm) and such design shall be subject to the specific approval by the Council's Wastewater Network Operations Manager.

f Hydraulic design of trunk sewers requires the specific approval of the Council's Wastewater Network Operations Manager

6.7.3 Minimum Size, Cover and Radii of Bends

Minimum Size of Pipes

The minimum size of public sewers shall be as follows:

1	For Polyethylene (PE) pipes:	Mean Internal Diameter 140.6mm (This corresponds to OD160mm for SDR17 pipes) PE 180 SDR 17 shall be used where the upstream sewer is NB diameter 150mm.
1	For PVC pipes:	NB diameter 150mm (nominal internal diameter)

6.7.3.2 Desirable and Minimum Cover

a Pipes, must have at least:

- 900mm cover in private land and under footpaths;
- 1200mm cover in road carriageways.

b Where the minimum cover in private land and under footpaths cannot be provided, approved protective surrounds shall be provided to the satisfaction of Council (also refer Drawing WW205).

c Where pipes are located in the front yard of lots, the sewer system shall be designed with sufficient depth not to interfere with other utilities and any future driveway construction, particularly for lots with potential basement development.

d For PE pipes, the desirable cover is 1.5m since PE is more subject to expansion and contraction than other materials.

e Under carriage ways or in the Road Reserve, pipes shall be specifically designed to support an 8.2 tonne axle loading. The manufacurers' certification shall be required for all pipes installed under carriageways with less than 1200mm cover (also refer Drawing WW205).

6.7.4 Curved Sewers and Minimum Radii

6.7.4.1 Curved sewers

a Horizontal curvature of a sewer (primarily for green field developments) may be permitted (refer clause 6.7.4.2 for minimum radii of bends) provided that:

- The joint deflection is NOT utilised in achieving any curvature (the provision for joint deflection by the manufacturer provides only for protection the joint seal from possible pipe movements);
- The curvature is achieved using long radius bends of up to 22½° at appropriate points of the sewer;
- No more than four 22½° bends shall be utilised between any two manholes;
- ACCURATE AS-BUILT drawings are provided by the Contractor giving co-ordinates (x, y, z) tied to the national survey grid at every 3m of the sewer (submission of "as-builts" to be in accordance with NSCC's Asset Data Manual Requirements); and
- A detector tape is laid over the full length of the sewer within 300mm to 600mm from the ground surface.

b Vertical curvature of a sewer may be permitted (refer clause 6.7.4.14 for ninimum radii of bends provided that:

- The vertical curve(s) is between a upper manhole and lower manhole;
- The plan view of the vertically curved sewer is in a straight line;

- The joint deflection is NOT utilised in achieving any curvature (the provision for joint deflection by the manufacturer provides only for protection the joint seal from possible pipe movements);
- The curvature is achieved using long radius bends of up to 22½° at appropriate points of the sewer;
- There will be no more than four 22½° bends between any two manholes;
- The sewer upstream of the lower manhole enters the manhole at an appropriate angle (refer Drawing WW214); and
- ACCURATE AS-BUILT drawings are provided by the Contractor giving co-ordinates (x, y, z) tied to the national survey grid at every 3m of the sewer (submission of "as-builts" to be in accordance with NSCC's Asset Data Manual Requirements).

c. All curved sewers having a direction change greater than 22½° at any point requires the specific approval of the Council's Wastewater Network Operations Manager.

6.7.4.2 Minimum Radii of Bends

a Radius to centreline of the bend shall be not less than 4.5 x pipe ID for deviation 22½° or less, 8 x pipe ID for deviation over 22½° to 45°, and 12 x pipe ID for deviation over 45° to 90°.

b The minimum allowable bend radius for non-fabricated PE bends is 27 x Pipe OD.

6.7.4.3 Use of Bends Adjacent to Access Points

The use of bends adjacent to access points shall be minimised. Where unavoidable, such bends shall be long-radius bends with a radius to centreline of the bend not less than 4.5 x pipe ID for deviation 22½° or less, 8 x pipe ID for deviation over 22½° to 45°, and 12 x pipe ID for deviation over 45° to 90°. The use of bends greater than 22½° shall require the written approval from Council's Wastewater Network Operations Manager.

6.7.5 Pipe Materials

6.7.5.1 Preferred Pipe Materials for Gravity Sewers

Pipe types as listed in Table 6-7 may be used for gravity sewers provided they are manufactured to the current relevant standard, and fit for purpose. The Council's Wastewater Network Operations Manager's approval shall be obtained for using pipes manufactured from other materials, or where pipes are to be used other than from the preferred material for a given purpose and size range.

Table 6-7 : Preferred Pipe Materials for Gravity Sewers

Purpose	Size Range	Preferred Pipe Material
Gravity sewers with gradients 1% and steeper	As available	Black outer / white, brown or grey inner Polyethylene (PE) co-extruded jacket pipe. (refer clause 6.7.3.2(a))
Gravity sewers with gradients flatter than 1%	As available	PVC will be accepted for engineering approval, subject to a specific design (refer clauses 6.7.2(e) and 6.7.5.4) PE excluded
Gravity sewers	NB diameter 300mm and above	Corrugated black outer / smooth terracotta inner polypropylene (PP) pipes will be accepted for engineering approval, subject to specific design
Gravity sewers with gradients 1% and steeper, but in deep trenches or geotechnically difficult sites where welding cannot be at ground level, where it would be difficult to achieve sound electrofusion welds or butt welds	NB diameter 225mm and above	PVC will be accepted for engineering approval, subject to a specific design (refer clause 6.7.3.2(c))
Gravity sewers	NB diameter > 450mm	Reinforced Concrete (RC) will be accepted for engineering approval, subject to a specific design (refer clause 6.7.3.2(b))

Methods of sewer installation includes conventional trenching and tunnelling, and the following trenchless techniques:

- Directional drilling
- Guided boring
- Pipe jacking
- Micro-tunnelling
- On-line replacement

The terms “directional drilling” and “guided boring” are, for the purposes of this Code, interchangeable. The former term is frequently used to describe larger works. The techniques consist of drilling a pilot bore and then backreaming and pulling in the sewer pipeline.

“Pipe jacking” and “micro-tunnelling” are essentially from the same family on installation techniques. Frequently used components are: tunnelling machine at the forward face of the excavation, launch and reception pits, hydraulic jacks to push pipes, and alignment equipment.

6.7.5.2 Trenched Polyethylene (PE) Gravity Sewers

a Do not use PE pipes for sewers where a large temperature fluctuation is expected (greater than 10oC)

b Do not use PE pipes within tunnels that are not backfilled, unless the sewer is to be properly anchored against flotation and thermal movement

c Butt and electrofusion welded jointing shall be carried out only by experienced certified PE welders.

d The certifying organisation shall be acceptable to the Council’s Wastewater Network Operations Manager. In addition, welders may be required to carry out satisfactory test welds for each joint type. Stamp the welder’s number on each joint.

e Butt welds shall be, at least, 90% of the tensile strength of the parent pipe material, when tested in accordance with ISO 13953.

f All internal weld beads shall be removed, in an approved manner, to be smooth and flush with the pipe inner surface, without compromising the strength of the pipe joint. External beads shall be removed only if specifically requested by the Council’s Wastewater Network Operations Manager.

g Jointing by electrofusion welding: Couplers shall be of the same rating of the pipe or superior. Use manufacturer approved scraping tool to uniformly scrape the pipe ends all around the pipe barrel. Hand scraping is NOT PERMITTED. The welder shall mark witness marks on each end of the pipes to be jointed. The distance from the end of the pipe to the witness mark shall be half the length of the coupler. The pipe insertion to the coupler shall be achieved by manufacturer approved pulling and clamping equipment. Bending the pipes up for insertion into the coupler and then pushing back is NOT PERMITTED. Once the jointing is complete the witness marks should only be just visible.

h Wall thickness of PE sewers shall be determined as per AS/NZS 2566.1, subject to a minimum wall thickness of SDR 17. PE sewers shall be installed in accordance with AS/NZS2566.2 and AS/NZS2033.

i Stiffness rating of a SDR 17 pipe shall not be less than SN16.

j PE pipes and fittings shall conform to AS/NZS 5065.The colour of the inner core shall be suitable to provide an acceptable CCTV image as approved by NSCC. Currently natural (white), grey similar to DWV (as per AS/NZS 1260.) and brown (RAL8023 for PE80) have been approved.

k Temporary plastic end caps shall be provided to protect white inner core pipe ends from UV degradation. Refer clause 6.7.7.1 for acceptable storage requirements.

l The Wastewater Networks Operations Manager may require evidence of the inner core’s tensile strength to ISO6259-3 and ESCR to AS/NZS5065.

m Only if pipes meeting the above specification are not available for a required pipe size or wall thickness, black PE80C or superior compound pipes conforming to AS/NZS4130 shall be used.

n Any PE pipe supplied shall be suitable for jointing by electrofusion welding and butt fusion welding to other commercially available PE80 or jacket pipes.

o Minimum gradient as per clause 6.7.2.

p Maximum depth 8m

q Construction tolerances as per clauses 6.7.7.2 and 6.7.7.3.

r Refer clause 6.7.11 for trench depth/width requirements. Bedding and backfilling as per clause 6.7.8.

6.7.5.3 Trenched Reinforced Concrete (RC) Gravity Sewers

a Use only for pipes larger than NB diameter 450mm.

b RC pipes/sewers shall be subjected to special design against corrosion (e.g. PVC liner, HDPE liner). Liners shall be bonded into concrete by "T" locks or similar. Liner shall cover all areas that come into contact with sewage including inner surface of socket and outer surface of spigot. Details of the special design shall be submitted for the approval of the Council's Wastewater Network Operations Manager

c Only spun pipes are permitted

d Do not use RC pipes where there is a risk of hydrogen sulphide corrosion or external sulphates or aggressive groundwater. Carry out tests for groundwater and soil aggressiveness.

e Vertical working (service) loads shall be calculated in accordance with NZS/AS 3725: Loads on buried concrete pipes. The Class op pipe used shall be appropriate to loading and trench conditions, but not lower than Class 2.

f Minimum gradient as per clause 6.7.2.

g Maximum depth 8m

h Construction tolerances as per clauses 6.7.7.2 and 6.7.7.3.

i Jointing: Push-fit flexible spigot and socket joints using elastomeric ring seals (RRJ). Do not lubricate.

j Trench width: In accordance with AS/NZS 3725

k Bedding and backfilling as per clause 6.7.8.

Sewers Installed by Pipejacking & Micro-tunnelling

a Use only for PVC pipes NB diameter 375mm and smaller.

b Use of PVC pipes shall be at the discretion of Council. Design Engineers shall provide adequate reasons (not only cost considerations) to justify the choice of pipe material.

c Use SN16 to AS/NZS 1260 or PN9 to AS/NZS 1477 (formerly Class C) or PN12 to AS/NZS 1477 (formerly Class D) or stronger pipes only. Refer to Appendix 6C for SN Tables. The Council's Wastewater Network Operations Manager's specific approval is required for SN ratings of pipes used under conditions not covered in Appendix 6C.

d Use Type uPVC and mPVC only

e Specifically PVC pipes may be used for gravity (non-pressure) sewers under the following conditions:

- SN16 or equivalent or pipes as per Appendix 6C, whichever is stronger, for depths to invert less than 5m.
- SN40 or PN12 (formerly Class D) or equivalent or pipes as per Appendix 6C, whichever is stronger, for road crossings with cover less than 1.2m.

f The Council's preference is to use PVC pipes only for NB diameter 100mm and 150mm sewers in residential areas and for sewers with the majority of its sewage contributed from residential areas. Where PVC pipes are proposed for larger diameter sewers, or in industrial areas, Design Engineers shall provide adequate reasons (not only cost considerations) to justify the choice of pipe material

g Solvent weld joints are not permitted

h Minimum gradient as per clause 6.7.2.

i Maximum depth 5m

j Construction tolerances as per clauses 6.7.7.2 and 6.7.7.3.

k Jointing:

Push-fit polypropylene flexible coupling joints

Push-fit flexible spigot and socket joints using elastomeric ring seals

l Installation

Use witness marks and lubricant for spigot & socket and sleeved joints to ensure full penetration

If pipe is cut, use purpose made tool to bevel cut to ensure no damage to "O" ring

m Refer clause 6.7.11 for trench requirements. Bedding and backfilling as per clause 6.7.8.

n Sewers of NB diameter 150mm with a cover of more than 2m shall utilise a construction method to ensure uniform bearing pressure on the new sewer. The sewer shall be installed utilising a trenching bucket with a tongue of the correct dimension.

6.7.5.5 Trenched Polypropylene (PP) Structured Wall Gravity Sewers

a Use only for pipes of NB diameter 300mm and larger.

b PP pipes and fittings shall conform to AS/NZS 5065. PP pipes shall not be used within tunnels that are not backfilled unless the sewer is to be properly anchored against flotation and thermal movement.

c Pipes shall be class SN16 to AS/NZS5065, or better.

d The colour of the inner wall shall be suitable to provide an acceptable CCTV image as approved by NSCC. Currently brown (RAL8023) and grey (not lighter than RAL7035, and not darker than RAL 7042) have been approved.

e Minimum gradient as per clause 6.7.2 and maximum depth shall be determined as per AS/NZS 2566.1.

f Construction tolerances as per clauses 6.7.7.2 and 6.7.7.3.

g Jointing:

- Push-fit flexible spigot and socket joints using elastomeric ring seals (RRJ).
- Push-fit polyethylene coupling using RRJ.

h Installation:

- Witness marks (together with lubricant applied on outside of the rubber ring and inside of the socket) shall be used to ensure full penetration.
- If pipe is cut, the rubber ring shall be fitted in the pre-cleaned (no lubricant) second corrugation of the pipe.

i Trench widths shall be kept close to the following minimums in order to minimise loadings on the pipe:

- for DN225 inside diameter pipes, the minimum width is outer diameter of pipe barrel plus 300 mm.
- for DN300 and DN375 inside diameter pipes, the minimum width is outer diameter of pipe barrel plus 400 mm.
- for DN450 inside diameter and larger pipes, the minimum width is outer diameter of pipe barrel plus 600 mm.

j Bedding as per clause 6.7.8.

6.7.5.6 Polyethylene (PE) sewers installed by Guided Boring and Directional Drilling

a The following shall apply in addition to the requirements of clause 6.7.5.2 (except trench dimensions and bedding):

- Obtain specific approval of the Council's Wastewater Network Operations Manager
- Provide trace wire
- Determine required wall thickness to withstand the thrust, pullback forces and torque of the drilling machine and to suit the flexibility requirements, subject to a minimum wall thickness of SDR 17. Wall thickness shall also conform to AS/NZS 2566.
- Minimum design gradient shall be four times the minimum gradient as per clause 6.7.2 or 4% for directional drilling and guided boring which ever is steeper, or a gradient subject to the specific approval of the Council's Wastewater Network Operations Manager
- Maximum depth 8m
- Maximum length for directional drilling shall be 200m. Use intermediate drill pits for longer sewers and join the segments to form one continuous sewer. Do not provide manholes/access points at intermediate pits unless specifically necessary for the system performance.

b Construction tolerances: It is not practical to specify small construction tolerances for directional drilling and guided boring. Instead, the Contractor is required to demonstrate the following:

- Provide a good tracking system

- During installation, use the "walk over tracking and guidance system" to demonstrate that at all the surface guide pegs provided by the Contractor to the Council's Wastewater Network Operations Manager's approval, the sewer route is within a corridor of 1.5 x pipe diameter on either side of the design centreline
- On completion of the installation, allow water to flow through the line until the flow is observed for 10 minutes at the downstream end. Stop the flow and pull a CCTV camera through the line slowly minimising disturbance to puddles in dips, if any. There shall be no puddles that are deeper than 10% of the pipe bore
- Use an inclinometer on camera.

6.7.5.7 Polyethylene (PE) Sewers Installed by Pipejacking & Micro-tunnelling

The following shall apply in addition to the requirements of clause 6.7.5.2 (except trench dimensions and bedding):

- Do not use PE pipes for sewers where a large temperature fluctuation is expected (greater than 10oC)
- Use only purpose made white PE pipes. Determine required wall thickness to withstand the thrust and torque of the drilling machine, subject to a minimum wall thickness of SDR 17. Wall thickness shall also conform to AS/NZS 2566.
- Minimum design gradient shall be twice the minimum gradient as per clause 6.7.2 or 1% which ever is steeper
- Maximum depth 8m
- Construction tolerances as per clauses 6.7.7.2 and 6.7.7.3.

6.7.5.8 Reinforced Concrete (RC) installed by Pipejacking and Micro-tunnelling methods

a Use only for pipes larger than NB diameter 450mm.

b Only spun pipes are permitted.

c RC pipes/sewers shall be subjected to special design against corrosion (e.g. PVC liner, HDPE liner). Liners shall be bonded into concrete by "T" locks or similar. Liner shall cover all areas that come into contact with sewage. Details of the special design shall be submitted for the approval of the Council's Wastewater Network Operations Manager .

d Do not use RC pipes where there is a risk of hydrogen sulphide corrosion or external sulphates or aggressive groundwater. Carry out tests for groundwater and soil aggressiveness.

e The Council's preference is to use RC pipes only for NB diameter 300mm and larger sewers in residential areas and for sewers where the majority of sewage is contributed from residential areas. Where RC pipes are proposed for smaller diameter sewers or in industrial areas, Design Engineers shall provide adequate reasons (not only cost considerations) to justify the choice of pipe material.

f Use only the pipes specially produced, by the manufacturer for trenchless installation. Submit details for the Council's Wastewater Network Operations Manager's approval

g Minimum gradient shall be twice the minimum gradient as per clause 6.7.2.

h Maximum depth 8m

i Construction tolerances as per clauses 6.7.7.2 and 6.7.7.3.

j Jointing: Flush joints specially designed by the manufacturer for trenchless installation. Submit details for the Council's Wastewater Network Operations Manager's approval.

6.7.5.9 Polyethylene (PE) pipes used for On-Line Replacement (Pipe Bursting, etc)

The following shall apply in addition to the requirements of clause 6.7.5.2 (except trench dimensions and bedding):

- Specific approval of the Council's Wastewater Network Operations Manager is required
- Do not use PE pipes for sewers where a large temperature fluctuation is expected (greater than 100C)
- Do not use PE pipes for replacing existing sewers within tunnels that are not backfilled or where the existing sewer is not fully restrained against flotation and thermal movements
- Determine required wall thickness to withstand the pull, thrust, and torque of the on-line replacement machine, subject to a minimum wall thickness of SDR 17. Wall thickness shall also conform to AS/NZS 2566.
- Gradient depends on the gradient of the existing sewer. Check for future flows
- Maximum depth 8m
- Construction tolerances depends on the existing sewer
- Sizes: Generally, on-line replacement method is used for size-for-size replacement, but upsizing to certain extent is possible.

6.7.6 Visual Inspection of PE and PVC Pipes

All PE and PVC pipes and pipeline components will be subject to visual inspection (see Table 6-8) at any time and, if found unsatisfactory shall be rejected.

Table 6-8 : Visual Inspection Requirements for PE and PVC Pipes

Condition	Requirements
Ovality (Ellipticity)	± 1% on mean diameter
Eccentricity	Pipe wall thickness measured at any point must be such that the SDR calculated on that thickness is within the stipulated range.
Surface Finish	There shall be no crazing, flaking or indication of disintegration. There shall be no evidence of extrusion die-marks or 'spider-lines'. The interior surface shall be free of dust and other impurities.
Scratches	None on internal surface. External surfaces shall be free from longitudinal scratches and from circumferential scratches deeper than 10% of the pipe wall thickness for PE pipes and deeper than 5% of the pipe wall thickness for PVC pipes.
Cracks	All pipes shall be completely free from cracks.
Voids	No visible voids will be accepted.
Protuberances	Ridges or ripples shall not exceed 0.5mm in height.
Inclusions	There shall be no visible inclusions of extraneous matter.
Delamination	Not applicable.
Cuts	Bevel cut with purpose made tool to ensure no rough edges and no damage to “O” ring

6.7.7 Construction Requirements

6.7.7.1 General

Construction of sewers shall be in accordance with the relevant standards.

PE and PVC pipes, fittings, manholes, access chambers and other items shall not be stored in or exposed to direct sunlight for more than 30 days without the written consent of the Council. For such consent to be approved, Council may require that the above items be appropriately covered (i.e. by means of tarpaulin).

6.7.7.2 Tolerances for straight sewers

Unless otherwise specified in clause 6.7.5, the permissible tolerances for straight sewers in trench, pipejack, heading or tunnel shall be ±3mm in level and ±12mm from the centre line in line between manholes or changes in direction or gradient. In addition, where a gravity sewer is shown on the drawings, as being straight between manholes it will not be accepted unless a light can be sighted through the length concerned.

6.7.7.3 Tolerances for Curved Sewer

Unless otherwise specified in clause 6.7.5: Pipe Materials, the permissible tolerances for curved sewers in trench shall be ±3mm in level and ± 12mm from the design centre line shown on the drawings.

6.7.7.4 Impermeable Barriers

a Where required by geotechnical issues, impermeable cut-off barriers, designed to prevent groundwater flow along the trench, shall be provided.

b The frequency of barriers shall be increased, or other measures undertaken, in locations where the groundwater is known to be already highly mobile.

c Where pipes are laid with granular bedding or backfill a barrier shall be provided across the full width of the trench and for the complete depth of the granular bedding and fill at intervals not exceeding 50m and generally midway between manholes or access points.

d Barriers shall also be provided at any points where pipe trenches pass through or into impermeable strata or strata whose permeability is lower than that of the adjacent ground so as to form a restriction to the flow of groundwater.

e Barriers shall be constructed through the bedding at the ends of future connection sewers or to stub-pipes built out at manholes close to the capped end to facilitate future dewatering and excavation operations.

f The barriers shall consist of either:

- A 300mm long plug of clay, clayey soil or other approved impermeable soil consolidated in an approved manner
- A layer of plastic sheeting, minimum thickness 1mm, cut to fit around the pipe across the full width of the trench and laid on the granular bedding or fill material at the natural repose angle.

g Additional impermeable barriers are not required where anti-scour blocks are constructed as per the last paragraph of clause 6.7.8.1.

6.7.8 Bedding and Backfilling

6.7.8.1 General

a Pipes shall be installed in accordance with the requirements of AS/NZS 2566 Part 2 (*Buried flexible pipelines – Installation*). The pipe bedding selected shall meet the requirements of pipe type and class and of the design loading conditions.

b Some typical bedding details are shown on Drawings WW205 and WW206. For poor soils and special loading and trench conditions (depth and width), specific bedding and backfill designs are required (e.g. undercut & hardfill, piles, surrounds, etc.).

c AS/NZS 2566 Part 1 shall be used for the design of flexible sewers.

d For sewer gradients between 7.5% and 15%, or where ground conditions are unsuitable, the pipe shall be bedded in concrete. Sufficient cement shall be added to the bedding material to provide a weak concrete of, at least, 7.5 MPa strength. Where pipes are bedded in concrete a transverse expansion/movement joint shall be provided at each pipe joint. Use a compressible expansion joint filler shaped exactly to the shape of the pipe and the full extent of the concrete. The thickness of this expansion/movement joint shall be a minimum of 25mm except in the case of full concrete surrounds, where the minimum thickness shall be as follows:

- Pipes up to 300mm nominal diameter - 25mm
- Pipes 301 - 600mm nominal diameter - 50mm
- Pipes 601 - 1200mm nominal diameter - 75mm
- Pipes greater than 1200mm nominal diameter - 100mm or as otherwise specified

e For spigot and socket type pipes, the expansion joint in the concrete shall be aligned with the face of the socket, and for sleeve type joints, with the face of one end of the sleeve. For flexible detachable/sleeve type joints, the expansion joint filler material shall be positioned on one side of the coupling.

f For sewer gradients greater than 15%, the pipe shall be bedded in concrete. Anti-scour / anchor blocks constructed of ordinary grade 17.5 MPa cast in-situ concrete shall be placed at pipe-length spacing along the sewer. In the case of PE pipes, embed puddle / stub flanges in anti-scour / anchor blocks.

6.7.8.2 Granular Material for Bedding

When granular material is specified for bedding, this shall be, hard, clean, chemically stable crushed stone or crushed concrete. Acceptable gradings for the granular material are shown in Table 6-9. Design Engineers may submit alternative grading curves for the Council's Wastewater Network Operations Manager approval, along with written evidence to prove pipe manufacturers acceptance of such alternative gradings:

Table 6-9 : Granular Material Gradings for Pipe Bedding and Surround

Test Sieve	Percentage by Mass Passing	
	For Pipes of Diameter 600mm and below	For Pipes of Diameter 400mm and above
37.5mm	-	100
19mm	100	85 - 100
9.5mm	85 - 100	0 - 50
4.75mm	0 - 25	0 - 10
2.36mm	0 - 5	-

Notes:

1 For pipes 400mm to 600mm diameter, either grading is acceptable.

2 For thermoplastic pipes, only grading as per 'For pipes of diameter 600mm and below' is acceptable.

3 SAP7 or AP7 is acceptable for NB 250mm PVC or smaller

6.7.8.3 Bedding Material for Concrete Pipes

Bedding material for concrete pipes shall not contain more than 0.3 per cent sulphate, expressed as sulphur trioxide. Scoria bedding is not permitted.

6.7.8.4 Bedding for Thermoplastic Pipes (e.g. PVC, PP and PE)

For thermoplastic pipes (e.g. PVC, PP and PE) and those wrapped in polyethylene or polythene, care shall be exercised to exclude sharp objects. Embedment material shall be free of organic materials and of other materials that would be harmful to a pipe. For better compaction, the content of fines should not exceed 12% and preferably less than 5%.

6.7.8.5 Backfilling (over bedding and surround)

a Backfill shall be well compacted in layers not exceeding 200mm depth. The compaction standard shall conform to the Code of Practice for Working on the Road (Auckland Region).

b Provided the compaction standard can be met, backfilling material may be selected from the excavated material to exclude large lumpy objects (> 75mm), organic matter (peat, plant matter), and rubbish. If there is a shortfall of good quality material in the excavated material, suitable good quality soil shall be brought in from external borrow areas.

6.7.9 Construction

General

Where pipes are built into structures, all sewers (other than those constructed from PE) shall have two flexible joints adjacent to the structure located according to the sewer material and diameter (DN) as shown on Drawing WW207. The first joint shall be constructed as close to the face of the structure as is practicable. The term “structure” includes concrete surrounds and anchor blocks.

6.7.9.2 Requirements for PE, PP and PVC Sewers

a When passing through a concrete face

- The pipe shall be protected from stress concentration and possible fracture of the pipe at the concrete face as follows. A 10mm thick neoprene strip minimum 100mm wide shall be wrapped around and cemented to the pipe and embedded fully in the structure with one edge of the strip at the face.
- Care shall be taken to ensure that the neoprene strip is not displaced during concreting.

b When connecting to a manhole

- PE pipes shall be connected to manholes in accordance with Drawing WW209A.
- PVC pipes shall be connected to manholes in accordance with Drawing WW207. The joint between PVC pipe and the concrete manhole shall be made leakproof by roughening the embedded portion of the pipe barrel to ensure good bonding.
- PP Twin-wall pipes shall be connected to manholes using appropriate concrete manhole connectors in accordance with the current relevant standards and the pipe manufacturer’s recommendations.

6.7.10 Joints

6.7.10.1 General

a All pipes shall be provided with a complete flexible jointing system by the pipe manufacturer, complying with the current relevant standards (except where welding is the specified normal method of jointing, or where detachable mechanical couplings or flanged joints are specified).

b All components of the jointing system shall be mutually compatible, and shall be capable of providing a lasting watertight seal under the specified operating conditions, and under specified test conditions. The design and assembly of the joint shall be such that the stresses developed in the pipes, and joint components, do not in any way impair the functioning, strength, durability and watertightness of the joint.

c For gravity sewers all types of joints shall be designed to be watertight against both an excess external water pressure and an internal excess water pressure (surcharge) of 8m (80 kPa) head.

d A special design, to the approval of the Council's Wastewater Network Operations Manager, is required for gravity sewers laid in areas and at depths where the depth to the sewer invert from the maximum seasonal groundwater table is expected to exceed 8.0m. At all sections where the depth to the sewer invert from the finished ground surface is more than 8m, the Design Engineer shall carry out investigations and establish the maximum expected water table level. Evidence of this investigation, to the satisfaction of the Council's Wastewater Network Operations Manager, must be submitted to Council.

e Joints shall be watertight as described when subjected simultaneously to both the maximum angular deflection and shear load test requirements. Rubber sleeve joints with stainless steel wire ties or bands will be allowed only in special cases and with specific approval of Council. Jointing of PE pipes shall comply with the current relevant standard.

6.7.10.2 Flexible Joints - Sleeve and Integral Socket Types

Joints shall be capable of accepting the ranges of deflection and load conditions specified in Table 6-10, Table 6-11 and Table 6-12 without leakage, without direct contact between socket (or sleeve) and spigot other than via the sealing ring, and without inducing stresses or strains in the pipe that exceed safe working limits.

Table 6-10 : Angular Deflection: (all pipe materials)

Nominal Pipe Diameter (mm)	Minimum Angle (degrees)
Up to 200	3.0
201 to 500	1.5
501 to 1350	1.0
Greater than 1350	0.5

Table 6-11 : Axial Movement

Not less than 10mm or the following proportions of the length of the longest pipe or rigidly jointed pipeline unit at any joint:	
VC, RC, Steel, PRC and Ductile Iron	0.1%
Polyethylene (PE)	1.0%
uPVC and GRP	0.3%

Table 6-12 : Shear load

Joints for rigid pipes shall be capable of accepting a shear load equivalent to 20N/mm of pipe diameter.
Joints for flexible pipes shall be capable of accepting a shear load induced by a 5% elliptical deflection of the spigot end forming part of the joint.

Elastomeric Joint Sealing Rings

a The term “elastomeric joint sealing ring” shall be taken to encompass rings that are flat with convex face, finned type and circular or “D” shaped in cross section.

b All sealing rings shall be capable of withstanding internal and external differential water pressures specified in clause 6.7.12: Joints. (i.e. when the internal water pressure exceeds the external water pressure and when the external water pressure exceeds the internal water pressure by the specified amounts)

c All joints in rings where ends of straight sections are joined to form the ring shall be vulcanised. Joints made by glues or adhesives will not be permitted.

d Elastomeric sealing rings shall comply with AS 1646: *Elastomeric* Seals *for Waterworks purposes* and shall be of a type approved by the pipe manufacturer to use for the particular joint..

e Elastomeric sealing rings shall be manufactured from ethylene propylene rubber (EPDM or EPM) or Treated Natural Rubber treated to be immune from microbiologically induced corrosion.

f Sealing rings manufactured from styrene butadiene rubber (SBR) shall not be accepted.

g The design of the pipe joint assembly is such that, the sealing ring shall be located within a groove or otherwise restrained against “blowing-out” or “blowing-in” due to differential water pressures.

h All sealing rings shall have physical and chemical properties, including hardness (measured in International Rubber Hardness Degrees - IRHD), compatible with the pipe material.

i Sealing rings shall be stored in a clean, cool condition out of direct sunlight and without being deformed.

j Sealing rings for use with thermoplastic pipes shall contain no component that can react with the material of the pipes.

6.7.10.4 Lubricants for Joint Assembly

Lubricants for the assembly of sewer joints shall be inert so as not to damage the pipes or joint components. Lubricants other than those recommended by the pipe or joint supplier shall not be used.

6.7.10.5 PE to PVC Joints

In order to prevent the loss of joint seal due to PE creeping and pullout due to thermal movement, PE to PVC joint shall be made using an adaptor or an approved alternative system. The PE - PVC adaptor shall include an extra snaplock ring at PVC end to prevent pullout, an elastomeric ring seal for PVC end, a long insertion depth for PVC pipe, and a PE end suitable for electrofusion or butt-welding.

6.7.11 Trench requirements

6.7.11.1 Trench width

For trench depths 1.5m or less, the minimum width is 450mm or outer diameter of pipe barrel plus 300mm whichever is more. For trench depths greater than 1.5m the minimum width is as above from the base up to 300mm above the pipe crown and above that level the trench width shall be, at least 900mm.

6.7.11.2 Trench depth

The depth of trenches shall be sufficient to allow for the pipes to be bedded in accordance with Drawings WW203, WW204, WW205 and WW206 when installed to their required invert levels.

See subclauses of clause 6.7.3 for requirements regarding buried pipe depths (cover).

6.7.12 Trenchless Construction

6.7.12.1 General

a Trenchless construction should only be used where grades are adequate.

b Proposals for trenchless construction require the Council's Wastewater Network Operations Manager's specific approval based on detailed information and performance guarantees submitted by the Design Engineer.

c Only PE pipes with welded joints shall be used for trenchless technology where sewers cross public roads.

d Thorough surveys and site investigations which minimise the risk of encountering unforeseen problems in the course of the work, are essential to the success of trenchless construction.

e Work sequences, tolerances and possible errors shall be considered at the design stage, for example:

- which trenchless segments must be installed first where more than segment must be installed,
- entry points such as manholes to be used, and
- achievable construction tolerances (pipejacking can accommodate smaller tolerances compared to directional drilling).

6.7.12.2 Pipe Bursting and Pipe Splitting

a The Council's Wastewater Network Operations Manager's preference is to use the pipe bursting systems only for replacing sewers that are constructed of brittle pipe material such as cast iron, unreinforced concrete and vitrified clay. The method is not suitable for replacing RC pipes. Pipe splitting may be used to replace PVC sewers.

b Accurate information is necessary 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 in concrete.

c Particular consideration must be given to flow diversion requirements during the replacement period.

d Replacement shall take place from manhole to manhole. Intermediate connections shall be disconnected prior to the on-line replacement of the sewer and then subsequently reconnected to the new sewer. The number and frequency of connections may influence the economic viability of the technique.

6.7.12.3 Guided Boring and Directional Drilling

a Sewer installation using guided boring and directional drilling shall be restricted to instances where construction tolerances and steep gradients are allowable (refer clause 6.7.3.3).

b Maximum length for directional drilling shall be 200m. Use intermediate drill pits for longer sewers and join the segments to form one continuous sewer. Do not provide manholes/access points at intermediate pits unless specifically necessary for the system performance.

c Equipment used for guided boring and directional drilling shall incorporate a safety mechanism to prevent tensile failure of pipe. The safety mechanism shall fail prior to pipe failure thus safeguarding the pipe.

d The Design Engineer shall check the site conditions, consult with the affected property owners and make adequate space provisions in the design for:

- Drill pits, including working space
- Drill rigs (including access paths for drill rigs)
- Drilling angle (drill rig may need to be placed some distance away from the sewer starting point, depending on the angle)
- Placing an appropriate length of the joined sewer on ground for pulling through the preformed hole.
- Sediment and erosion control (e.g. settling ponds may be required for preventing slurry from getting into watercourses)

e Surface-launched drilling machines require larger construction and manoeuvring spaces compared to pit-launched drilling machines. The Design Engineer shall select a technique, in consultation with potential specialist contractors, suitable for the site conditions.

f Notwithstanding the indicative technique given in the design, the Contractor selected for the installation of the sewer shall be fully responsible for using appropriate equipment, guidance system and methodology for installing the sewer.

g Prior to commencement of the work, the Design Engineer shall satisfy him/herself as to the adequacy of the available survey/investigation information, carry out additional survey/investigation as necessary and guarantee that the sewer can be installed using the proposed technique. In the event it is impossible to install the sewer using the proposed technique due to unforeseen site conditions, the Design Engineer shall make alternative proposals for the Council's Wastewater Network Operations Manager's approval and complete the sewer accordingly.

h The Developer/Design Engineer shall be responsible for preparing, obtaining the Council's Wastewater Network Operations Manager approval and implementing a sediment and erosion control plan for the sewer installation works.

6.7.12.4 Pipe jacking and Micro tunnelling

a The Council's Wastewater Network Operations Manager's preference is to use pipe jacking or micro-tunnelling techniques for the installation of gravity sewers only:

- Requiring trenchless construction while having limited construction tolerances.
- With large diameter (>300mm).

b The Design Engineer shall check the site conditions, consult with the affected property owners and make adequate space provisions in the design for:

- Drill and reception pits, including working space
- Access paths to drill and reception pits
- Sediment and erosion control (e.g. settling ponds may be required for preventing slurry from getting into watercourses)

c Notwithstanding the indicative technique given in the design, the Contractor selected for the installation of the sewer shall be fully responsible for using appropriate equipment, guidance system and methodology for installing the sewer.

d Adequate ground investigation is paramount to the success of any pipe jacking or micro-tunnelling project, particularly with respect to the choice of cutting head.

e Prior to commencement of the work, the Design Engineer shall satisfy him/herself as to the adequacy of the available survey/investigation information, carry out additional survey/investigation as necessary and guarantee that the sewer can be installed using the proposed technique. In the event it is impossible to install the sewer using the proposed technique due to unforeseen site conditions, the Design Engineer shall make alternative proposals for the Council's Wastewater Network Operations Manager's approval and complete the sewer accordingly.

f The Developer/Design Engineer shall be responsible for preparing, obtaining the Council's Wastewater Network Operations Manager's approval and implementing a sediment and erosion control plan for the sewer installation works.

Private Connections

6.8.1 General

a All new connections, or any work related thereto on existing sewers, shall at the cost of the applicant, be performed by a North Shore City Council Approved Drainage Contractor (ADC). Application forms for connections and the current list of Approved Drainage Contractors (ADCs) are available from Council offices. The applicant must obtain prior approval from Council for all such work.

b Private pumping stations shall not discharge directly to the public sewer, but shall discharge to an boundary access chamber with a gravity connection to the public sewer.

c Any private sanitary drain shall have a NB diameter of not less than 100mm. The point of connection provided shall be capable of taking the spigot end of a 100mm pipe.

6.8.2 Provision

a All lots in new subdivisions shall be provided with a gravity wastewater connection. At the time of the subdivision, there shall be at least 900mm fall from the anticipated lowest finished ground level within the building site (or more if considered necessary) to the service connection invert to adequately service the lot by gravity.

b Any new connection shall terminate a minimum of 1m within the lot boundary. Where the public sewer is outside the lot to be served, a NB diameter 150mm drain shall be extended to at least 1 metre inside the lot boundary to a boundary access chamber, and the lot connection shall terminate with a factory sealed stopper (refer drawings WW215 or WW216).

c Where a private drain is required to cross a boundary with another private property, the prior approval of the affected landowners shall be required.

6.8.3 Boundary Access Chamber

All new or replaced connections shall be provided with a boundary access chamber as shown on drawings WW215 or WW216 at the developer's/property owner's cost.

Where a private drain or lateral will become a public sewer (refer Drawings WW224 and WW225), an access chamber or other approved access point shall be provided just inside the lot, close to the boundary of the lot and the public (road) reserve. For all other cases, an access chamber/shaft shall be provided and be located within the lot in the best practicable location in terms of the accessibility for maintenance and inspection.

6.8.4 Construction

a Direct connections of private drains to sewers or manholes on sewers larger than NB diameter 225mm shall not be permitted.

b Access chambers providing lot connections shall wherever possible not be positioned online on the public sewer, but rather be located offline and then connect by means of factory manufactured "Y" junctions to the public sewer (refer Drawings WW224 and WW225). An acceptable solution for connecting to a public sewer located within a private property is shown in Drawing WW216A. A 17.5 MPa concrete bedding shall be provided for the "Y" junction as shown on Drawings WW215 or WW216.

c A private drain or lateral may connected to the public sewer by means of a manhole stub pipe.

d Saddle connections shall not be used, unless:

- for PE pipelines, the connection is electrofusion welded and the connection hole on the pipeline is cut by a method approved by Council's Wastewater Network Operations Manager.
- a connection is required to a rehabilitated sewer (e.g. CIPP, Fold & Form, Ribloc) and provided the new connection has been approved by the Council's Wastewater Network Operations Manager on a case by case basis. The rehabilitated sewer shall not be cut and the invert shall be left intact.

e Lot connections shall terminate and be completely and securely sealed with removable sealed caps no deeper than 1.25m below ground level.

f Where an existing or proposed sewer is more than 5m deep to the top of the pipe, connections shall not be made directly to it, but a new shallower branch sewer shall be laid from a manhole on the deep sewer and connections provided to the lots to be served. A ramped drop or an internal drop shall be provided on the inlet side of the manhole on the deeper sewer, as appropriate.

Connections to New Manholes

a Where private drains or laterals directly connect to a manhole, the connection shall be constructed in accordance with the requirements of clause 6.9.2.9.

b Internal drop connections shall be provided for deep manholes. For more than two drop connections, a larger diameter manhole shaft will be required. Open cascade will not be permitted. Internal drops shall discharge at the invert of the channel if the main channel NB is equal to or less than 300mm, or at springing level if the main channel NB is greater than 300mm. Discharging on to the benching is not permitted.

6.8.6 Connections to Existing Manholes

a Where a private drain or lateral is to be connected an existing manhole, the connection shall be made at the base of existing manholes, or by means of an internal drop.

b All necessary holes shall be drilled (cored), new pipes installed, gaps sealed and surfaces/protective coatings reinstated in accordance with the requirements of clause 6.9. All gaps shall be sealed by means of an approved epoxy mortar. Plastering shall not be permitted.

c Existing benching shall be carefully removed to avoid damage to the manhole structure and other pipes. Any damaged items shall be reinstated to original or better condition. Benching, conforming to clause 6.9, shall be reconstructed as necessary to accommodate the new inlet or drop. The chamber shall be made watertight with an approved epoxy mortar around all openings.

d After construction of the new inlet, the manhole shall be tested, remedied and retested until it satisfies the requirements of clause 6.9.

6.8.7 Markers

a Each lot connection shall be marked by a 50mm square timber stake (H4 or equivalent treated pine or better) embedded, at least, 600mm in ground and extending 600mm above finished ground level with the top painted red. The lower end of the timber marker shall be adjacent to, but not touching the connection point.

b In addition, two measurements shall be taken from the access chamber to two permanent features and shown on the “as-built” drawings of the sewer. These “as built” drawings shall clearly indicate the position of the sewer, the access chamber and the private connection points.

c The Council’s Wastewater Network Operations Manager may approve alternative methods of marking connection junctions.

6.9 Manholes And Access Points

6.9.1 Layout

6.9.1.1 Provision in general

a Manholes and access points are essential to the proper functioning of a sewer network. They provide access for inspection and maintenance.

b Experience has shown that manholes (man entry access points) could be a weak point in a sewer network in terms of watertightness and work safety. The Council, therefore, prefers that the need for manholes be minimised through appropriate sewer network design and layout. This objective has an added advantage in terms of lower cost, as manholes are relatively costly items. Design Engineers are encouraged to propose innovative methods to minimise the number of manholes that would be needed. Any such innovative proposals shall be subject to the Council's Wastewater Network Operations Manager's approval.

c Some measures for minimising the number of manholes include the following:

- The provision of factory manufactured access points where appropriate.
- Curved sewers subject to the provisions of clause 6.7.4.

d All of the above must permit introduction of inspection (Pan-and-tilt CCTV cameras) and cleaning equipment (rods, root cutters, water blasters etc.).

e Drawing WW201 shows permissible maximum spacing of manholes and access points and Drawing WW202 shows minimum clearances from edge of foundations.

6.9.1.2 Inspection and testing

All manholes shall be inspected visually. Those with visible defects or one manhole in 10, whichever is more, shall be tested for water-tightness as follows. After a 24-hour period of soaking to allow for absorption, etc., the manhole shall be completely filled with water so that the surface is level with the top surface of the roof slab. The rate of water loss shall not exceed 5 litres per hour. If any of the tested manholes fail, then more manholes shall be tested as directed by the Council.

6.9.1.3 Preferred Types and Materials

The preferred types and materials for manholes and access points for the function as listed in column 1, is specified in Table 6-13. The approval of the Council's Wastewater Network Operations Manager is required for the use of a different type or material other than the preferred type or material for a given purpose.

Table 6-13 : Preferred Types and Materials for Manholes and Access Points

Function	*Preferred Type*	*Preferred Material*
To provide access primarily for inspection purposes on sewers up to and including diameter NB 225mm, where man-entry is not required.	Access Points such as Access Shafts/Chambers and Rodding Eyes.	PE on PE pipe networks and PVC on PVC pipe networks, or at ends of the PE pipe networks to provide for lot connections in not-trafficked areas.
To provide access maintenance and inspection purposes on shallow sewers (depth to invert level less than 1.2m) where man-entry is not required.	Mini-Manholes where access points would not be appropriate.	Precast Concrete. In non-trafficked areas where the depth to the sewer invert is 3m or less and provided the sewer outlet diameter are NB 225mm or less, manhole structures manufactured from plastics material or GRP (Type F – refer table 6.14) may be used subject to the approval of the Wastewater Network Operations Manager.
To provide access for maintenance and inspection purposes on sewers up to and including diameter NB 225mm, where man-entry is required.	Manholes (man entry points)	

Notes:

a) The need for manholes should be minimised through appropriate design.

b) Manholes to be provided for maintenance and inspection purposes of sewers larger than 225mm NB diameter.

c) Manholes required at the junctions of main sewers and branch sewers where any branch is servicing more than 10 lots (refer Drawing no. WW201).

d) Manhole required at the junction of main sewer and a branch, when the branch is crossing a road (refer Drawing no WW201)

e) Manholes required at any change in sewer size.

f) The approval of the Council’s Wastewater Network Operations Manager is required where types of material other than the preferred type for a given purpose are used.

6.9.1.4 Layout Rules

Refer clause 6.5.2.

6.9.2 Manholes

6.9.2.1 Standard Types of Manholes

Table 6-14 : Standard Types of Manholes

Standard Types of Manholes	
Type	Description
Type A	Manholes up to 1.8m deep from lid to invert of the outlet and with nominal internal diameter (NID) 1050mm: Type A1: Precast base with vitrified clay / reinforced concrete (VC/RC) connections; Type A2: In-situ base with PE sewer connections; Refer drawings WW208, WW209 and WW209A and their Tables for riser diameters
Type B	Manholes with depth from lid to invert of the outlet from 1.8m up to 3.0m and with nominal internal diameter (NID) from 1200mm to 2100mm: Type B1: Precast base with VC/RC connections; Type B2: In-situ base with PE sewer connections Refer drawings WW210 and WW211 and their Tables for riser diameters Note: Larger diameter manholes shall be provided depending on the number and size of branches, change of direction and the need for adequate benching.
Type C	Manholes with a nominal internal diameter of 1350mm to 2100mm for depths from lid to invert of the outlet exceeding 3.0m Refer drawing WW212
Type D	Drop manholes for Type B and C manholes with an internal drop on a NB diameter 150mm sewer. Internal drop shall be fixed firmly and durably to the manhole wall using stainless steel straps and fasteners, one at top, one at base and in between at 1m intervals. Refer drawing WW213 for internal drop details
Type E	Drop manholes for Type B and C manholes with an external ramp Refer drawing WW214 Note: Type E is the preferred type of drop manhole, over Type D
Type F	Manholes manufactured from Polyethylene (PE) / Polypropylene (PP) having a nominal internal diameter of not less than 1000mm may be used where: **a** sewer outlet sizes are diameter NB 225mm, or less; **b** the depth of the sewer is no more than 3.0m from the lid to invert of the outlet;

Standard Types of Manholes	
Type	Description
	c the manhole is not located in trafficked areas; **d** the Design Engineer provide evidence to prove that the approved manufacturer of the manholes allows this intended use (together with the Manufacturer's drawings); and provided it's use is approved by the Wastewater Network Operations Manager.
Type G	Dry manholes (sealed channel manholes) Refer clause 6.9.2.7 and drawing WW217

6.9.2.2 Manholes Deeper Than 3m

All manholes deeper than 3m shall be provided with a bolted stainless steel grid beneath the manhole cover (refer Drawing WW212A) unless the manhole cover is of the hinged type fitted with an approved lockable device. A warning sign shall be provided on the stainless steel grid or the back of the manhole cover, as appropriate.

6.9.2.3 Non-standard Manholes

Table 6-14 contains a list of NSCC approved standard types of manholes. The use of non-standard manholes shall be kept to a minimum. However, where their use is unavoidable they shall be to a special design and to the approval of the Council.

6.9.2.4 Changes in Direction

(a) For sewers up to and including NB diameter 300mm:

Changes in direction through a manhole shall be limited to 90°at grade. The change in direction shall be accommodated in a long radius curve in the manhole channel. The centreline radius of the curve shall not be less than 2.5 times pipe diameter.

A change of direction greater than 90° can be accommodated, provided that:

- There is a drop on the incoming line that requires the change of direction
- This drop can be located in such a way that its channel has a direction change less than 90^0

(b) For sewers over NB diameter 300mm dia and up to NB diameter 750mm:

Changes of direction through a manhole shall not be greater than 22.5°.

For larger deflections, a 22.5° change of direction shall be taken up within the manhole, and the balance change in direction shall be by a curved sewer outside the manhole. The curved sewer shall have a radius of curvature not less than 15m. The maximum change of direction provided by a curved sewer shall not exceed 22.5° between any two consecutive manholes.

(c) For sewers larger than NB diameter 750mm:

Changes of direction through a manhole shall not be greater than 11.25°.

For larger deflections, a 11.25° change of direction shall be taken up within the manhole, and the balance change in direction shall be by a curved sewer outside the manhole. The curved sewer shall have a radius of curvature not less than 15m. The maximum change of direction provided by a curved sewer shall not exceed 11.25° between any two consecutive manholes.

6.9.2.5 Gradient through Manhole

Where there is no change in the pipe size and where there are branches and/or change of directions, the gradient of the channel in the manhole chamber shall be the gradient of outgoing sewer plus a minimum drop of 15mm through the chamber (e.g. incoming gradient 1.0%, outgoing gradient 1.2%, channel fall will be 1.2% across the chamber plus 15mm).

Where there is no change in the pipe size and where there are no branches and/or change of directions, the gradient of the channel in the manhole chamber shall be the gradient of outgoing sewer (e.g. incoming gradient 1.0%, outgoing gradient 1.2%, channel fall will be 1.2%).

If the difference between the incoming and outgoing gradients is greater than 5%, then the manhole channel shall incorporate a vertical curve so that the channel gradient matches the incoming and outgoing gradients at either end.

The manhole channel top level shall be 200mm above the pipe soffit, where the incoming gradient exceeds the outgoing gradient by more than 5%, notwithstanding the 100mm specified in the standard drawings.

When there is a change of pipe size from smaller to larger (usual situation), the gradient of the channel shall be such that the soffit of the inlet pipes shall not be lower than soffit of the outlet pipe.

When there is a change of pipe size from larger to smaller (e.g. siphons), the gradient of the channel shall be the steeper of the gradients of incoming and outgoing sewers.

6.9.2.6 Drop Manholes and Ramps

(a) General

When a grading requirement necessitates a drop greater than 600mm at a manhole a drop manhole or an external ramp shall be provided as detailed below. Where possible, however, sewers shall be laid as steep as permitted by this manual, avoiding the need for a drop manhole or a ramp. Where a drop manhole or a ramp is proposed, the Design Engineer shall provide adequate reasons to justify why a drop in the grade cannot be avoided.

When a grading requirement necessitates a drop 600mm or less, then it shall be taken up by a drop in the grade of the incoming sewer.

All drop manholes shall be designed to maximise streamlining of flow, and to minimise turbulence and gas release.

(b) Internal Drop Manholes

Internal drop manholes shall be provided only for NB diameter 100mm laterals and NB diameter 150mm incoming branch sewers, or main sewer (refer Type D of Table 6-14 and Drawing WW213). Under unavoidable circumstances, the Council's Wastewater Network Operations Manager may approve internal drops for larger sewers.

The drop pipe from the external flexible joint nearest to the manhole wall down to and including the bend at the channel at the manhole base shall be of PE or stainless steel construction of Grade 316. A factory manufactured approved adaptor shall be used to connect the incoming sewer to the PE or stainless steel pipe.

The installation of the PE or stainless steel pipe through the manhole wall shall ensure watertight joint. The annular gap between the pipe and the wall shall be sealed with an approved epoxy mortar.

An approved factory manufactured London or “Y” junction at the top end and a factory manufactured 87.5^{0} or 90^{0} bend at the bottom end of the drop pipe shall be provided, both in PE or stainless steel. The internal end of the junction (rodding eye) shall not be capped.

The wall thickness of all stainless steel components shall not be less than 2mm. SDR value of PE pipe shall not be greater than 17 and the material quality shall be PE80 or better.

(c) External Ramp Drops

External ramp drops shall conform to the following rules and may be provided on incoming branch sewers or main sewer of any diameter and material (refer Type E of Table 6-14 and Drawing WW214):

- The vertical distance between the top and bottom ends of the ramp shall not exceed 2.5m.
- The vertical angles of deviation at the top and bottom ends shall be as given in Table 6-15:

Table 6-15 : Vertical Angles of Ramped Drops

Pipe Diameter (NB) mm	Maximum Angle of Deviation
150 and larger	45^0

- The vertical bend at the bottom end shall be immediately adjacent to a manhole.
- Ramp drops shall not be provided adjacent to an access point.

Grade 17.5 MPa concrete surround shall be provided in accordance with the drawing WW214 along the full length of the ramp including the bends, down to the foundation level of excavation and integral with or supported by the manhole base.

Approved adaptors shall be used to connect the top and bottom bends to the sewers.

The installation of the bottom bend/adaptor through the manhole wall shall ensure watertight joint. The annular gap between the bottom bend/adaptor and the wall shall be sealed with an approved epoxy mortar.

6.9.2.7 Dry Manholes (Sealed Channel Manholes)

Dry manholes (also known as sealed channel manholes) shall have access pipes or access junctions instead of open channels through the chamber (refer Drawing WW217). These access pipes or access junctions shall be internally sealed using corrosion resistant lids and frames. Material for this internal lid and frame shall be selected depending on the expected maintenance and hydraulic loading conditions (e.g. polyethylene, aluminium alloy, stainless steel, polypropylene, GRP). As a minimum, the internal lid and the frame shall be able to withstand a point load of 150kg mass at its centre.

Dry manholes shall be used only when specifically required to meet the conditions described below, subject to specific approval by the Council's Wastewater Network Operations Manager:

- Manholes that are likely to surcharge, e.g. shallow manholes at the base of steep grades. Manholes less than 1.5m deep at the bottom of grades steeper than 7% are likely to have surcharge risks
- Manholes located in overland flow paths due to unavoidable circumstances. In this case, the sealed channel will serve as an additional defence against stormwater ingress. In addition, the manhole shall have a sealed cover (refer clause 6.9.1.3).
- Manholes likely to have odour problems in sensitive areas

6.9.2.8 Construction

a Experience shows that poor joints at the pipe connections to manholes contribute significantly to infiltration and exfiltration problems associated with existing manholes. Therefore, particular care shall be exercised to make pipe/manhole joints watertight. The recommended methods are as follows:

• Where the manhole base is precast, the pipe/manhole connections shall be made using factory manufactured vitrified clay (VC) pipe shorts. Factory manufactured reinforced concrete (RC) pipe shorts are permitted only in residential areas and in areas where majority of sewage is from residential areas. Joints between manhole walls and pipe shorts shall be sealed using epoxy mortar (refer clause 6.9.2.11: Epoxy Mortar).

• Where flexible pipes (PVC, PE) are used for connections, the manhole base and wall starter shall be cast in-situ with 20 MPa concrete. This is to prevent flexible pipes from deforming due to loads transferred through manhole walls and hard backfill, causing deformed pipe joints and loss of watertightness.

b All inlet and outlet pipes shall be fully assembled, along with the base reinforcement, before pouring 20 MPa concrete. The wall starter shall be built up to 300mm above the crown of all inlet and outlet pipes. The rest of the manhole shall not be built-up until the in-situ concrete achieves sufficient strength to prevent pipe deformation.

c All sewers (other than those constructed from PE) shall have two flexible joints as specified in clause 6.7.11.

d All flexible pipes (e.g. PVC, PE, GRP) shall be protected from stress concentration and possible fracture of the pipe at the concrete face as follows. A 10mm thick neoprene strip minimum 100mm wide shall be wrapped around and cemented to the pipe and embedded fully in the manhole wall/concrete surround with the outer edge of the strip at the outer surface of the concrete. There shall be sufficient concrete thickness between the inner edge of the strip and inner surface of the manhole to ensure watertightness (refer Drawings WW209, WW209A and WW211). Care shall be taken to ensure that the neoprene strip is not displaced during concreting.

e Cast in-situ manholes shall be constructed of Ordinary Grade concrete (20 MPa) compacted to maximum density and of watertight construction. Refer Drawings WW209 and WW211.

f Precast manholes shall consist of centrifugally spun concrete pipes to Class 'S' standard.

g The frame of the manhole cover shall be fixed to the concrete lid/throat using epoxy mortar. Concrete (17.5 MPa) haunching shall be provided around the frame.

h Two measurements shall be taken from the manhole cover to two permanent features and shown on the “as-built” drawings of the sewer. These “as-built” drawings shall clearly indicate the position of the sewer and the manhole.

i The manhole bases shall be benched and haunched with concrete, formed and vibrated to a smooth finish to accommodate the inlet and outlet sewers. The concrete shall be 17.5 MPa or 1:2:4 mix (cement: sand: AP20 aggregate, all to NZS 3108). Plastering of benching to achieve a smooth finish shall not be permitted. Severely honeycombed benching shall be rejected and shall be replaced fully. Any minor defects shall be made good using epoxy mortar.

j Branches and changes in direction shall be accommodated in long radius curves in manhole channels merging smoothly into the outlet channel. The centreline radius of the curve shall not be less than 2.5 times pipe diameter. The channel cross-sections shall be as shown on Detail 1 of WW208.

k The height of the manhole throat shall not be greater than 300mm. The throat and any subsequent extensions to the throat shall be cast in-situ using 17.5 MPa compacted watertight concrete to a smooth finish. Plastering of the throat to achieve a smooth finish shall not be permitted. Severely honeycombed throats shall be rejected and shall be replaced fully. Any minor defects shall be made good using epoxy mortar. Pre-cast throats shall not be permitted. Watertight bonding shall be provided between the throat and the lid, and between the existing part of the throat and subsequent extension.

l The throat and the lid shall be painted bright red. Paint manufacturer shall certify that the paint used is suitable for painting manhole lids, usually having a previous bituminous coating. Paint manufacturer shall guarantee the paint life to be at least 2 years. Paint shall be applied strictly in accordance with the manufacturer's instructions. Acrylic paint systems are not permitted.

m Experience shows that, in many existing precast manholes, the joint between the lid and the riser top is not watertight. This is because the riser top is easily damaged by lifting chains during handling on site. To prevent this from happening, the Contractor shall use the lifting systems recommended by the manufacturers of risers (e.g. chains with spreader bars). Any minor damages in riser tops shall be made good by caulking an approved epoxy mortar to completely fill the voids ensuring a watertight joint between the riser and the lid. Any badly damaged risers shall be rejected.

n The need for repairs to manholes shall be minimised by careful handling and high quality construction. However, when repairs are necessary, all epoxy repairs to manholes shall extend through the full depth of the wall, by coring out and cleaning the problem location. Superficial surface application of epoxy is not permitted.

6.9.2.9 Joints and Connections

a All construction joints of manholes, including risers, inlet/outlet pipe shorts, lids, rungs and cover frames, shall be joined using an approved epoxy mortar. Clean all work surfaces thoroughly before applying. Remove all laitance and grease from the surfaces. Apply a 10mm layer of epoxy mortar evenly over the full contact surface. Carefully press down the joining section and secure in correct position.

b Caulk the rebates fully with epoxy mortar. All bonding shall be achieved by gluing the components to each other with epoxy mortar.

c Riser joints shall be minimised by using long risers. For manholes up to 1.8m depths only one riser length shall be used. For deeper manholes, the length of the bottom riser shall not be less than 1.5m.

d Reuse of old risers with holes in their walls is not permitted.

e Any holes required in precast manholes shall be made using either drills or power saws. Breaking of holes by impacting shall not be permitted. All holes so drilled or cut shall not exceed a diameter 50mm greater than the outside diameter of the sewer being joined. All annular gaps shall be sealed by caulking an approved epoxy mortar to completely fill the gaps and to form haunches on all sides.

f Box-outs shall not be permitted in the case of cast-in-situ manholes. All connections and rodding eyes built through cast-in-situ manhole walls shall be constructed by drilling through the completed wall and subsequently sealing the annular gap using an approved moisture compatible epoxy mortar.

g The pipe shall project a minimum of 25mm and a maximum of 50mm past the inside face of the manhole, or where a liner is provided, past the internal manhole protection lining system. The protection lining system shall be connected to the projecting pipe in accordance with approved details.

6.9.2.10 Manhole Rungs and Ladders

a Normally, all manholes shall be provided with rungs. Manholes without rungs shall be installed only where specifically required by the Council's Wastewater Network Operations Manager. Recessed steps are not permitted.

b Manhole rungs shall be steel, hot dipped galvanized after fabrication to BS 729, as a minimum. All rungs shall be knurled to provide a non-slip stepping surface. External recesses for rungs on manhole risers shall be fully caulked using an approved epoxy mortar (refer Drawing WW218).

c Fixed ladders instead of separate rungs are acceptable subject to approval of the Council's Wastewater Network Operations Manager. Ladders shall be of corrosion resistant material (e.g. stainless steel, aluminium - refer Drawing WW219).

6.9.2.11 Epoxy Mortar

a Epoxy mortar shall be used to seal pipe/manhole joints and joints between manhole components. All constituents of the epoxy mortar (silica sand filler, resin and hardener) supplied shall be of a brand and specification approved by the Council's Wastewater Network Operations Manager.

b Epoxy mortar shall be certified by the manufacturer as follows:

- Suitable for permanent immersion in sewage
- Suitable for curing to full strength under waterlogged conditions
- Has a service life of 100 years
- No water permeation through thin (10mm) sections
- Suitable for adhering firmly to concrete and VC surfaces to form durable watertight joints
- Suitable for bonding to wet concrete

c Manufacturer's instructions shall be followed strictly in storing, mixing, applying and curing. After mixing, the mortar shall be used within the time period specified by the manufacturer. All pre-hardened mortar shall be disposed off-site.

d Do not use water and additional sand to mix.

e Clean all work surfaces thoroughly before applying. Remove all laitance, free moisture and grease from the surfaces. Avoid air entrapment by building up successive thin layers. Do not apply in lumps.

6.9.2.12 Manhole Covers and Frames

Manhole covers and frames shall be provided as per the requirements of Table 6.16 below. Manhole covers and frames, manufactured and tested to BS EN 124 or AS 3996, shall be preferably be from ductile iron, alternatively be from cast iron (cast iron is to be phased out).

Table 6-16 : Manhole Cover and Frame Requirements

Type	Condition	Cover size and type	Cover Grade
Type A	Access shafts	Ordinary CI type, 545mm diameter r(refer drawing WW221)	Light Duty (BS EN 124 – Pedestrian Loading or 75kg at its centre)
Type B	Mini Manholes (non man-entry) or manholes not in trafficked areas	Approved DI types (clear opening not less than 600mm diam)	AS 3996 Class B or better – Test load of 80 kN at its centre
Type C	Mini Manholes or Manholes in trafficked areas	Approved DI types (clear opening not less than 600mm diam)	AS 3996 Class D or better – Test load of 210 kN at its centre
Type D	Manholes deeper than 3m (irrespective of the location)	Approved DI types fitted with an appropriate locking device (clear opening not less than 600mm diam)	AS 3996 Class D or better – Test load of 210 kN at its centre
Type E	All manholes where air or water tightness# is required (irrespective of the location)	Approved DI types that can withstand a positive or negative pressure of not less than 1 Bar	AS 3996 Class D or better – Test load of 210 kN at its centre
Type F	Special/high loading conditions	Specific design to the approval of the Council's Wastewater Network Operations Manager	Specific design to the approval of the Council's Wastewater Network Operations Manager
# Manholes in low-lying areas and flood plains, or in sensitive areas where odours could be a problem.			

6.9.2.13 Manholes from Thermoplastics

a The Council permits the use of manholes from thermoplastics in non-trafficed areas, unless approved otherwise, in place of concrete manholes. The use of manholes from thermoplastics should minimise water ingress and sewage exfiltration due to factory manufactured jointing systems. Manholes from thermoplastics are more resistant to corrosion and may be used, subject to the following conditions:

- The ground is firm and stable
- The sewer size is small (i.e. sewers up to and including diameter NB 225mm)
- A manhole from thermoplastics shall consist of a factory manufactured benched base, a vertical riser(s), a suitable transition, as necessary, from the base to the riser (eg an adaptor), a cover slab, a throat, as necessary, from the cover slab to the lid at ground level, a frame and a cover. The components must be easy to assemble on site to form a watertight construction.
- Manholes from thermoplastics shall have a safety factor of at least 2 against flotation after backfilling (eg weight of backfill over horizontal ring fins and cover slab).
- All components of the manhole shall be designed by the manufacturer for the expected site loading. A manufacture's certificate shall be provided to this effect.
- Depth to the invert of the outlet from the lid shall not exceed 3.0m

b The Council permits the use of thermoplastics manholes manufactured from PVC, polyethylene (PE), polypropylene (PP) and glass reinforced plastics (GRP). The cover and frame shall be ductile iron (DI) as per clause 6.9.2.12.

c The components inlet pipe short, outlet pipe short, benching, base, transition, risers and throat up to the lid level shall be either:

- Manufactured as one single unit, or
- Designed to be joined using seamless EPDM ring seals. The ring seals shall be in grooves so as not to move (blow out or in) under differential water pressure or during handling.

d A PE or PP inverted cap shall be provided under the lid. The cap shall be easily removable for maintenance access, but shall have a durable watertight seal when in place.

e Where the plastic wall of the riser(s) is sufficiently thick and strong, stainless steel or aluminium rungs fixed through the wall may be used. Alternatively a stainless steel or aluminium ladder bolted to the base and cover slab shall be provided. Rungs and ladder bolts shall have back nuts and washers to ensure watertight construction.

f Pipe shorts for internal drops shall be factory manufactured with a curved flange for fixing to the wall. The curvature of the flange shall fit snugly to the curvature of the wall. The flange shall be fixed to the wall with an EPDM gasket using stainless steel bolts and nuts with EPDM washers ensuring a watertight joint. The down pipe of the drop shall be fixed to the wall using approved strong stainless steel pipe brackets, stainless steel bolts and EPDM washers. All other details of the drop shall conform to the relevant requirements of clause 6.9.2.6: Drop Manholes and Ramps (Drop manholes).

g A 17.5 MPa concrete surround shall be provided to secure the frame of the cover.

h Sewers shall be joined to the inlet and outlet using elastomeric ring seal joints.

i Manholes from thermoplastics shall be bedded on 17.5MPa concrete to spring line and backfilled with granular bedding material, passing 19mm sieve as per Table 6-9, to provide a complete surround of at least 250mm. The backfilling shall be carried out as follows:

• Backfill material shall be well compacted, but the compaction loads shall not exceed the loads recommended by the manufacturer.
• Backfilling shall be brought-up uniformly on all sides, ensuring that differential loads are not exerted on the manhole.

j Under normal circumstances, manholes from thermoplastics shall not be used in trafficked areas. Specific approval of the Council's Wastewater Network Operations Manager is required, if manholes from thermoplastics are to be located in trafficked areas under a special circumstance. In trafficked areas, bedding and the 250mm minimum backfill surround shall be of 17.5 MPa concrete.

6.9.3 Access Points (in lieu of manholes)

6.9.3.1 General

Access points are non-man-entry devices, which allow operators to work from the surface to carry out maintenance and inspection of sewers using commonly available maintenance and inspection equipment (including rods, water blasters, root cutter and pan-and-tilt CCTV cameras). Access points do not permit persons to enter the sewer, and consequently are not safety hazards.

Access points include:

- Access Shafts/Chambers
- Rodding Points
- Mini-manholes

6.9.3.2 Access Shafts/Chambers

a Access Shafts/Chambers are non man-entry access points and Council permits the use of such units manufactured from PVC, polyethylene (PE) and polypropylene (PP). However, as they are not suitable for use in public carriageways, trafficked areas or in kerbside footpaths, they shall under normal circumstances not be used in these areas. Specific approval of the Council's Wastewater Network Operations Manager is required when they are to be located in the above areas.

b Access Shafts/Chambers shall be bedded and backfilled in granular bedding material, passing 19mm sieve as per Table 6-9 to provide a complete surround of at least 250mm. The backfilling shall be carried out as follows:

i) Backfill material shall be well compacted, but the compaction loads shall not exceed the loads recommended by the manufacturer.

ii) Backfilling shall be brought-up uniformly on all sides, ensuring that differential loads are not exerted on the access shaft.

iii) Where a PE pipe is connected to a PVC base, a 17.5 mPa concrete bedding up to the spring line shall be provided as shown on drawings WW215 to WW216A.

c Access shafts/chambers may be used subject to the following conditions:

i) The ground is firm and stable

ii) The sewer size is small (up to and including NB diameter 225mm)

iii) The distance between a manhole and an Access Shaft/Chamber does not exceed 180m, and/or where the distance between two Access Shafts/Chambers does not exceed 120m for sewer diameters up to and including diameter NB 225mm.

iv) All components of the Access Shaft/Chamber shall be designed by the manufacturer for the expected site loading conditions and they shall have a safety factor of at least 2 against flotation after backfilling. A manufacture's certificate shall be provided to this effect.

v) Access Shafts/Chambers shall not be located in depressions and overland flow paths. Their location shall be selected so as to have its rim a minimum of 150mm above the potential maximum stormwater level in the adjacent area.

vi) In PE piped networks, Access Shafts/Chambers shall be only from PE. Provided that units from PVC may be used at the ends of the PE pipe network to provide for lot connections.

vii) At the top of the Access Shaft/Chamber riser, an appropriate watertight access cover cap shall be provided. The cap shall be easily removable for maintenance access, but shall have a durable watertight seamless ring seal when in place. The ring seal shall be retained so as not to fall into the sewer when the access cover cap is removed.

viii) Plastic access cover caps shall be protected by means of a manhole cover and frame as shown on WW221 (designed and tested according to AS 3996 for 80 kN (8t) loading capacity), unless approved otherwise in writing. The frame shall be supported on a concrete pad that is structurally separated from the Access shaft/Chamber riser so that the traffic loads are not transferred to the Access Shaft/Chamber riser (as shown on Drawings WW215 and WW216). A 17.5MPa concrete surround shall be provided to secure the frame of the cover.

ix) The Access Shaft/Chamber riser shall be vertical or within a 2% angle to vertical.

x) In case where two materials to be joined are not the same (e.g. PVC to PE), pipes shall be joined by means of a PE / PVC adaptor having elastomeric ring seal joints as specified on drawings WW215 to WW216A. The ring stiffness at all points of the adaptor shall not be less than SN16, once the PVC pipe is fully inserted into the adaptor.

d For access shafts/chambers manufactured from PVC, the following shall apply:

i) The access shaft or chamber riser shall be connected to the base using flexible "O" ring joints (spigot/socket or polypropylene coupler). The design of the "O" ring/gasket joints shall be so as to prevent any displacement of the ring/gasket due to external/internal water pressure or during installation. Seals shall not move (blow out or in) under differential water pressure or during handling.

ii) The access shaft/chamber shall be a manufactured unit incorporating a benched base, standard pipe joints for connection, a suitable transition from the base to a riser (eg conical shape) and a vertical riser. The main channel in the base of the unit shall have a gradient not less than 1%. All the components of the manufactured unit shall be easy to assemble on site to form a watertight unit.

iii) The inlet and outlet pipes shall be connected to the access shaft/chamber by means of flexible “O” ring joints (spigot/socket or polypropylene coupler).

iv) Access shafts/chambers with straight through bases (i.e. one inlet and outlet), shall have a shaft/riser with a NB diameter of not less than 300mm for ND 150mm sewers and/or NB diameter 100mm laterals. Chambers with five inlet/outlets, or with a double junction base (i.e. three inlets and outlet), shall have a riser NB diameter of at least 450mm.

v) Access shafts/chambers with one inlet, the depth to the invert of the outlet from the manhole lid shall not exceed 3.0m while for access shafts/chambers with three inlets at base level, the depth to the invert of the outlet from the manhole lid shall not exceed 1.25m.

vi) For sewers steeper than 2% gradient, purpose made long radius bends may be used immediately upstream and downstream of the access shaft/chamber to make the access shaft or chamber riser at 2% to vertical (i.e. 2% channel gradient).

vii) The use of bends in laterals to achieve a change in direction adjacent to access shafts/chambers, shall be minimised. Where unavoidable, such bends shall be long-radius bends (radius to the centreline not less than 4.5 times the diameter (NB)) up to 22½º adjacent to and on one or either side(s) of the chamber (eg a 450 direction change may be achieved by using two 22½º long radius bends one on each side of the chamber). Refer drawing WW216, for an example of a 3-inlet chamber. The use of bends greater than 22½º shall require the written approval from Council’s Wastewater Network Operations Manager.

e For access chambers with a globular base manufactured from PE, the following shall apply.

i) The chamber shall consist of a factory manufactured benched base or a globular base of at least 550mm nominal inside diameter, standard pipe joints for connections, vertical riser and suitable transition from the base to the riser (eg conical shape).

ii) The NB diameter of the riser shall not be less than 225mm.

iii) The depth to the invert of the outlet from the manhole coverlid shall not exceed 3.0m.

iv) The components inlet, outlet, benching, base, transition, and riser up to the lid level shall be either manufactured as one single unit, or designed to be joined using seamless ring seals.

v) Any change in direction and branches shall be achieved by welding the inlets at the required angles at the factory. Welding of components to the access shaft shall utilize injection-welding techniques, and staff shall be trained to PMBWELD-309A as recommended by Plastics Industry Pipe Association of Australia Ltd (PIPA). A manufacture’s certificate shall be provided to this effect.

vi) Although house connections are normally made at the base, Council may permit one house connection to the riser, based on evidence submitted to prove that the lateral will have adequate alternative access for maintenance and inspection. The connection shall be made using a tee connector incorporated into the riser and tested at the factory.

vii) PE pipes shall be joined to the inlet and outlet using butt or electrofusion welding.

6.9.3.3 Rodding Points

Rodding points (Terminal Maintenance Shafts (TMSs)) conforming to Drawing WW223 could be provided at the head of sewers and laterals, subject to the following conditions:

a Rodding points shall be of the same size as the sewer or the lateral, or larger.

b All components of the rodding point shall be designed by the manufacturer, for the expected site loading. A manufacture's certificate shall be provided to this effect.

c The components must be easy to assemble on site to form a watertight construction. The riser shall have a ring stiffness of SN8 (min).

d All PVC to PVC joints used for the rodding point shall be elastomeric ring seal joints or shall be welded and tested at the factory.

e The connection to the riser shall be made using a tee connector incorporated into the riser and tested at the factory, if appropriate.

f A PE / PVC adaptor as specified on Drawings WW215 to WW216A shall be used if the two joining materials are not the same. The ring stiffness at all points of the adaptor shall not be less than SN16, once the PVC pipe is fully inserted into the adaptor. When a PE pipe is connected to a PVC rodding point, 17.5MPa concrete bedding up to the spring line shall be provided as shown on Drawings WW215 to WW216A.

g All PE to PE joints shall be by butt or electrofusion welding.

h Connections to the base shall be achieved by welding the inlets at the required angles at the factory. Welding of components to the rodding point shall utilize injection-welding techniques, and staff shall be trained to PMBWELD-309A as recommended by Plastics Industry Pipe Association of Australia Ltd (PIPA). A manufacture's certificate shall be provided to this effect.

i At the top of the rodding point, an appropriate watertight access cover cap shall be provided. The cap shall be easily removable for maintenance access, but shall have a durable watertight seamless ring seal when in place. The ring seal shall be retained so as not to fall into the sewer when the access cover cap is removed.

j Plastic access cover caps shall be protected by means of a manhole cover and frame as shown on Drawing WW221 (designed and tested according to AS 3996 for 80 kN (8t) loading capacity), unless approved otherwise in writing. The frame shall be supported on a concrete pad that is structurally separated from the Access shaft/Chamber riser so that the traffic loads are not transferred to the Access Shaft/Chamber riser (as shown on Drawings WW215 and WW216). A 17.5MPa concrete surround shall be provided to secure the frame of the cover.

6.9.3.4 Mini Manholes

Mini manholes are generally shallower than manholes and can be used in lieu of access shafts/chambers. Maximum depth shall be 1.25 m measured from top of manhole cover lid to the invert of the sewer. They shall have an internal diameter of not less than 600mm and may be constructed from concrete, or be a manufactured unit from thermoplastics material. Technical details for concrete mini manholes shall be generally as per technical details for concrete manholes.

6.10 Local Wastewater Pumping Stations

Design of pumping stations should be carried out by person/s qualified and experienced in this field of expertise. While general requirements are covered in this manual, designers will need to consult the Council's Wastewater Network Operations Manager as early as practicable.

6.10.1 General Requirements

This Manual does not cover the requirements of Trunk Sewer Pumping Stations, which are covered by the NSCC Standards for Trunk Sewer Pumping Stations available for reference from the Wastewater Network Projects Manager.

Pumping stations will be only considered and approved by the Council when all other options are impracticable. Where required pumping stations shall be provided at the entire expense of the developer. If properly designed and constructed to the Council's approval, the Council will take over their future operation and maintenance after they have been commissioned.

Pumping stations shall be provided with:

a A freestanding low height weatherproof control cabinet shall be provided to house electrical equipment.

b Where the station serves more than 50 households, an architecturally designed control building shall be provided to house electrical equipment, to allow servicing in all weather conditions.

c All-weather vehicle access, including an adequate turning area near the station structure.

d Suitable (swing-arm type davit or similar) equipment for lifting pumps and heavy equipment, or adequate access for mobile lifting plant.

e Stack to disperse exhaust ventilation air. This may be combined with the lifting davit.

f Provision for installation of odour control facilities

g Metered water supply (minimum service line diameter of 32mm) for wash-down purposes. Backflow prevention shall be provided for the station's water supply using a 25mm backflow prevention device. See G12/AS1 of the Building Code, for the methods and devices required to comply with the Council's requirements.

h Underground mains power supply.

i Building doors, switchboards, control cabinets and chamber cover-plates able to be securely locked and vandal proof.

6.10.2 Station Site

The Council will require that the station have its own dedicated lot, provided exclusively for the purpose of housing the station and all related structures and equipment.

It will however be permissible for the access right-of-way to the station lot to be shared with other lots. The Council may also require the lot to be designated as a utility reserve or similar.

6.10.3 General Design Standards of Local Wastewater Pumping Stations

Pumping station design standards shall be the standards contained in *Sewage Pumping Station Code of Australia, WSA 04-2001,* published by Water Services Association of Australia (WSAA), except as amended in clause 6.10.4 below.

Should there be any discrepancy between this Manual and WSA 04-2001, the requirements of this manual shall take precedence.

Particular Design Standards of Local Wastewater Pumping Stations

For the purpose of this Manual, the requirements of WSA 04-2001 shall be amended as per Table 6-17.

Table 6-17 : Amendments to WSA 04-2001

WSA 04-2001 Clause Number	Amendment
1.3 Referenced Documents	Add: NZS 4203 General structural design and design loadings for buildings
2.1 Concept Design Plan	Substitute: “EPA” with “ARC (Auckland Regional Council) and NSCC”
2.3 Due Diligence Requirements: Standards	Add: New Zealand Standards
3.4.3 Emergency Structures	Add: Comply with the North Shore City Standards for Storage Volumes (refer 6.10.5) Comply with the North Shore City Standards for Storage Tanks (refer 6.12)
4.2 1 Pumping System, General	Substitute: “WSA 02” with “NSCC IDSM (this standard)” “Water agency's” with “NSCC Water Services'”
4.2.3.4 Junction Boxes	Delete
4.2.5 Starters and Variable Speed Drives	Delete (refer clause 6.10.47 of this standard)
4.3 Power System	Delete
4.5.2 Wet Well Design	Add: All interior walls of the wet well structure shall be coated. The coating system (such as an epoxy-based system) shall be approved by the Council's Wastewater Network Operations Manager.

WSA 04-2001 Clause Number	Amendment
4.5.5.1 Emergency Storage	Add: Comply with the North Shore City Standards for Storage Volumes (refer 6.10.5) Comply with the North Shore City Standards for Storage Tanks (refer 6.12)
4.5.7 Wet Well Access Covers	Add: Covers over chamber openings shall be made of suitable aluminium alloy plate and frame of such size and thickness that the separate units weigh less than 20 kg.
4.6.4 to 4.6.6 Pressure Mains, Valves and Pressure Main Structural Design	Delete (refer this Manual's clause 6.11 Rising (Pressure) Mains for Local Stations)
4.6.7.1 Odour Control	Delete (refer this Standard's clause 6.11.13 Odour and Septicity Control)
4.6.7.2 Septicity Control	Add: The Council may require a contribution towards the operation and maintenance of remedial measures such as air / oxygen / chemical injection.
4.7.7 Buildings	Substitute: “Building Code of Australia” with “New Zealand Building Code”
4.8.1.1 Water	Delete (refer this Standard's clause 6.10.1 General Requirements)
4.8.1.4.1 Lifting Equipment	Delete (refer this Standard's clause 6.10.1 General Requirements)
4.9.2 Operation and Maintenance Requirements	Substitute: “Appendix D of WSA 101” with “Appendix 6E of NSCC IDSM (Standard)”

WSA 04-2001 Clause Number	Amendment
4.9.6 Detailed Design Drawings	Add: All electrical and mechanical equipment shall be coded as per Appendix 6F of NSCC IDSM (this Standard)

6.10.5 Storage Volume

Storage volume shall be provided according to the following criteria:

- For population equivalent of up to 200 - minimum of 6 hours at ADWF (ADWF up to 0.5 litres/sec), with a minimum volume of 1 cubic metre.
- For a population equivalent 200 to 5000 persons - minimum of 4 hours at ADWF (ADWF from 0.5 to 12.5 litres/sec).
- For stations with an ADWF greater than 12.5 litres/sec, storage or other measures to avoid or contain overflows shall be specifically designed.

6.10.6.1 General

a This standard provides the requirements for the design, fabrication, supply, installation, testing, commissioning and handover to North Shore City Council of small sewage pump station switchboards and associated pump station control and security systems for use in the North Shore City Council (NSCC) area for pump motor sizes up to and including 15.0 kW.

b All requirements stated in this standard shall be complied with unless written approval has been received from North Shore City Council to vary particular features.

c Outdoor switchboards shall consist of a pad mounted sheet metal enclosure in which is mounted powder coated aluminium multibox enclosures housing pump motor starters and telemetry units.

d Indoor switchboards housing pump motor starters and telemetry units shall consist of wall mounted powder coated aluminium multibox enclosures.

e All switchboards shall have provision for the connection of a remote generator to provide backup electric power. For some installations, that do not have suitable vehicle access, a remote generator connection switchboard shall be provided.

f Some areas of the installation may be classified under AS2430 as a flammable gas or flammable vapour hazard. Confirm the Hazardous Area Classification with the NSCC Wastewater Project Engineer. Equipment, cables and accessories installed in Hazardous Areas shall comply with AS 2380.

g The Works includes the design, supply and installation, testing and commissioning and all material and labour required for all electrical equipment, services controls, telemetry and security systems as specified herein and as shown on the drawings, including all accessories reasonably necessary to ensure the proper and safe functioning of all items.

6.10.6.2 Design Requirements

a The following sewage pump switchboard types are described in this standard:

- Two pump switchboard with ‘Direct on Line’ starters.
- Two pump switchboard with electronic ‘Soft’ starters.

b Generally, unless otherwise required by the Power Authority or NSCC, all pump stations with pump motor sizes less than 3 kW shall be designed for Direct on Line starting. Otherwise, all switchboards shall include soft starters for all pumps.

c Actual sizes for pumps, starters and enclosures are to be determined at the time of enquiry. Written approval of motor starter equipment type and enclosure sizes is to be obtained prior to switchboard construction.

d North Shore City may require the Contractor to used standard equipment or component types and sizes, even if this requirement increases the cost of the Works. These requirements are detailed in this specification and shown on the drawings. This does not relieve the Contractor of any design responsibilities. North Shore City is under no obligation to reimburse the Contractor for any additional costs in relation to this requirement.

6.10.6.3 Pump Station Control

The primary control of the pump start/stop shall consist of a wet well level sensor, normally connected to a pump level controller located in the controls multibox within the switchboard. The present sites use a ten-stage Multitrode level sensor and a Multitrode MT2PC Duplex pump controller. This level sensing and level control arrangement is to be used for any new sites.

The Contractor shall design and configure the switchboard and control system equipment to meet the requirements of the pump station. The Multitrode controller shall be configured to operate on level control with a duty and a standby pump operating in alternating pump mode.

Particular care is required for the selection of the pump and the wet well size to ensure that:

- wet well overflows do not occur,
- each pump is selected to provide sufficient capacity to meet the peak wet weather flow,
- pump run cycle times are within the limits specified by the pump manufacturer. In no case shall the installation exceed 15 pump starts per hour during the design maximum wet weather flow.

Each wet well shall also be provided with an ultrasonic level transmitter with 4 - 20 mA output connected to the telemetry analogue input. The ultrasonic level sensor shall be rated IP68. The transmitter shall be mounted in the switchboard enclosure and be supplied from a suitable 24 VDC battery backed source.

In addition to the primary pump station controls describe above, the telemetry system has the facility to allow remote control of the pumps and a wet well spray washer. The telemetry system also monitors various conditions within the pump station and the switchboard. This specification includes details of the supply, installation and commissioning of these devices and of the telemetry equipment.

The following level switches shall be provided:

- A float level switch (LSH1) shall be installed in the wet well to detect excessive wet well water level. This level switch shall be connected to the telemetry input “Wet Well Level High”.
- A float level switch (LSHH) shall be installed in the wet well to detect impending overflow. This level switch shall be installed to switch at a wet well level rising 50 mm below the overflow invert. Connect to the telemetry input “Wet Well Overflow”.
- For pump stations with dry wells, a separate float level switch shall be installed to detect excessive dry well water level. This level switch (LSH2) shall be connected to the telemetry input “Dry Well High Level”.

Instrument devices and level switches etc shall be identified, both on site and on the drawings, using the tag numbering conventions described in the drawings.

6.10.6.4 Design and Construction

The pump station switchboard and electrical works design shall conform to the requirements of this North Shore City Council standard specification.

The materials used in the construction of the Works shall be new, of high quality and shall meet the required duties. Workmanship and general finish shall be of high trade quality. The Contractor shall ensure that the completed switchboard is vermin and insect proof and is constructed to minimise corrosion.

The Contractor shall be responsible to ensure that any design completed by him is safe, suitable for the purpose intended and in accordance with the relevant Regulations, Codes and Standards. Acceptance of the completed works by the NSCC shall in no way relieve the Contractor from such responsibility. Such responsibility shall also apply to the Contractor if inferior materials are used in place of the specified grades without the written approval of the NSCC.

The design and workshop drawings shall be submitted to NSCC for approval before work proceeds.

For indoor switchboards, design and supply switchboard mounts as specified herein. For all outdoor switchboards and remote generator connection switchboards, design, supply and install the switchboard concrete base and cable access ducts within the concrete base as shown on the general arrangement drawings. The design of this base shall be submitted for NSCC approval before the work proceeds.

The switchboard fixings, to walls or to concrete bases, shall be 316 stainless steel bolts 12mm minimum diameter and shall also comply with the seismic design requirements.

Refer to the General Arrangement drawing for the typical layout of small pump station multi-box switchboards and for remote generator connection switchboards. The multi-box switchboard panel layout may change according to actual site locations of pumps and mains cable entry etc. Final panel layout and the location of the generator connection plugs shall be approved by NSCC before assembly of the switchboard commences.

6.10.6.5 Typical drawings and Bill of Materials

Cabinet and door equipment layouts are also dependent on the equipment selected and the equipment clearances required by the manufacturers. The Contractor shall provide workshop drawings to NSCC for approval prior to switchboard fabrication.

Note that the type of control system, motor starter types and pump sizes are to be approved by North Shore City prior to design detailing.

Typical drawings are included with this specification as follows:

- Switchboard layouts,
- Power single line diagram for remote and local generator connection switchboards,
- DOL starter motor schematic diagram,
- Soft starter motor schematic diagram,
- Level control circuit schematic diagram,
- Kingfisher Telemetry connection diagram,
- Wet well spray washer,
- Concrete plinth arrangement.

A Bill of Materials is provided in Appendix A, listing equipment reference, type and supplier.

6.10.6.6 Codes and Standards

Unless another Standard is specifically mentioned in the Contract, the Works shall be designed, manufactured and tested in accordance with current editions of the relevant New Zealand and Australian Standards. Standards issued by the International Electrotechnical Commission are also applicable.

For example:

AS 3439-1 *Low-voltage switchgear and controlgear*

IEC 60158 *Low-voltage controlgear*;

IEC 60185 *Current Transformers*;

IEC 60947-4 *Low-voltage switchgear and controlgear: Contactors and Motor starters*;

BS 60947-2 *Circuit Breakers*

IEC 60529 *Classification of degrees of protection provided by enclosures*;

BS 88 *Cartridge fuses for voltages up to and including 1000 V AC and 1500 V DC (± IEC 60269);*

BS 89 *Specification for direct acting indicating electrical measuring instruments and their accessories;(± IEC 51);*

BS 142 *Electrical Relays*

BS 5419 *Specification for air-break switches, air-break disconnectors, air-break switch disconnectors and fuse-combination units for voltages up to and including 1000 VAC and 1200V DC; (±IEC 60408)*

BS 5424 *Specification for controlgear for voltages up to and including 1000 V AC and 1200 V DC; (± IEC 60158-1)*

BS 5486 *Low-voltage switchgear and controlgear assemblies; (± IEC 60439)*

6.10.6.7 Earthquake Strength

The Works shall be designed to ensure that the installation and its component parts will withstand a horizontal force, acting through the appropriate centre of gravity to 0.4 times the relevant component weight without suffering deformation or breakage that will interfere with its operation. All plug-in units shall be adequately restrained.

6.10.6.8 Equipment Identification and Labelling

North Shore City Council has adopted an equipment coding system for identification of major equipment items such as pumps, valves, switchboards, control panels etc. These equipment items are to be labelled with purpose made stainless steel labels in accordance with the NSCC Coding System standard.

The Contractor shall supply all nameplates, caution plates and labels needed for the safe and effective operation of the Works.

Panel mounted components shall be labelled with a function description. All apparatus within enclosures shall be labelled with either a brief description of the function or a non-ambiguous code relating to the schematic diagrams.

Danger and warning notices shall be displayed where the removal of covers exposes any parts live at a voltage exceeding extra low voltage. Danger labels shall be red lettering on white background. They shall be of adequate size and be easily readable.

Stainless steel screws, monel metal or nylon rivets shall permanently attach labels on multi-box exteriors. Nylon rivets or stainless steel screws shall be used for engraved label attachment inside the multi-box enclosures. Self-adhesive labels shall not be used.

Labels shall be made of corrosion resistant material, such as laminated plastic. Stainless steel may be used where plastic is unsuitable. Plastic labels shall be engraved with black lettering on a white background unless otherwise stated; stainless steel labels shall be engraved.

Labelling on the outside of enclosures shall be engraved stainless steel fixed with stainless steel threaded nuts and bolts, silicone sealant shall be applied between the label and the outside surface to give a complete weatherproof seal.

The label inscription shall be either a description of the function of the item or an unambiguous code relating to the drawings. The Contractor shall provide a switchboard label schedule at the time the electrical drawings are submitted to NSCC.

6.10.6.9 Electrical Regulations

The Contractor shall comply with all statutory and other requirements applicable to the Works including the Electricity Regulations 1997, the New Zealand Electrical Codes of Practice and all relevant New Zealand and other national and international standards declared as suitable for the purposes of the Wiring Regulations by the Secretary of Energy.

All electrical work using voltages of 415 VAC and lower shall comply with the New Zealand Electrical Codes of Practice and AS/NZS3000.

6.10.6.10 Environmental Conditions

Materials and equipment shall be suitable for operation in outdoor ambient temperature from - 5 °C to 30°C and an indoor maximum air temperature of 40 °C.

Allowance shall be made for the effects of solar heating on the cabinets and on the ratings of cables exposed to sunlight.

Due regard shall be given to the increase in ambient temperature in any room or enclosure due to heat generated by equipment within or adjacent to that enclosure.

6.10.6.11 Materials and Components

All materials and components used shall be new and of the high quality and class fully suitable for the duty they will be required to perform and shall comply with the latest issue and amendments of the relevant NZS, AS, IEC or BS standards.

Sewage generates H_2S gas, which is heavier than air. This gas forms a corrosive acid when wet and is especially aggressive to silver and copper and their alloys. Specific precautions shall be taken to avoid corrosion by H_2S. All copper work shall be tinned. Silver contacts shall be gold flashed or gold plated. Extra low voltage contacts for switches and relays shall be selected specifically for the voltage and current conditions applicable to the circuit in which they are connected.

Protection against corrosion, deterioration, absorption of moisture and the like shall be provided for all materials, and all materials and equipment shall be finished in approved colours and qualities of finish.

All fixings, both inside the switchboard compartments and throughout the installation shall be stainless steel. This requirement also includes conduit saddle fixings and the like.

During manufacture, no repairs of damaged or defective parts will be permitted without written approval from the North Shore City.

6.10.6.12 Mains Cables and Pump Motor Cables

Mains cables shall be sized for a maximum 1% volt drop calculated with one pump running and the other starting. Pump motor cables shall be sized for a maximum running volt drop of 1.5%.

Unless otherwise shown on the drawings, the distances, measured between the cables, specified below shall separate cables run along the same route from other cables:

a	400/230V and 24 Vdc cables	50mm
b	400/230V cables and communication cables	250mm
c	400/230V cables and instrument cables	150mm
d	11kV cables and 400/230V, instrument or communications cables	1,000mm

Where the 1,000mm separation cannot be maintained a continuous vertical 300mm high concrete tile barrier shall separate LV and MV cables. This also applies to dual 11kV supplies of 1,000mm separation with vertical 300mm concrete tiles installed between these cables.

Cables shall be run not less than 300mm clear of other services whether running parallel to or transversely to the cable route.

The Contractor shall provide all cable boxes, gland plates and the like as required for terminating cables at transformers, switchboards, motors and other equipment. The Contractor shall provide all jointing materials, glands and accessories necessary for the correct connection of cables to the equipment.

Cables insulated with PVC, XLPE or elastomeric compounds shall be terminated through correctly sized compression glands. Glands for armoured or screened cables shall be provided with properly designed clamping devices for the armour or screen wires. Cable glands shall be manufactured by CMP Glands Ltd. Glands shall be threaded ISO metric. The Contractor shall drill and tap all necessary holes in gland plates for the fitting of cable glands. All unused openings shall be plugged with screwed plugs.

All electrical terminations shall be shrouded to IP20 (finger touch proof) or better.

6.10.6.13 Underground Cables

All underground cables shall be installed in rigid UPVC cable ducts. Cable ducts shall be laid at the depths as specified by NZS/AS3000. Power cables shall also be separated by at least 300mm from any low voltage or instrument cabling.

Ducts shall be clean and free from obstructions before cable installation commences. Installation of cables in ducts shall be carried out by hand; winches shall not be used. The ends of ducts shall be sealed after the installation of cables with "Denso Mastic" applied in accordance with the Manufacturer's instructions.

Cover cable ducts with a layer of 150 mm of sand or selected soil, which shall extend 75mm on either side of the cable. Place concrete cover tiles or Magslab or protective timbers of 25mm thick rough sawn tanalised pine of H4 treatment over the entire length of the cable providing 75mm overlay on each side. Place a continuous proprietary orange plastic warning strip 200mm above the tiles/Magslab/timber.

Backfilling shall be carried out in 200mm thick layers, each layer being individually compacted. Reinstate trench surfaces to match surrounding surfaces to original condition as practicable. Make due allowance for settlement including overfilling trench and temporary reinstatement prior to contract completion or by stabilising backfill.

Make all necessary arrangements for removal, suitable storage and the replacement of plants and pay all associated costs.

6.10.6.14 Instrument Cables

Instrument cables shall be those screened cables connected to the switchboard and field instruments for the purpose of sequential or process control excluding communications cables. Cables runs shall be vertical or horizontal and parallel or perpendicular to the principal axis of the building. Cables shall be run between fittings, accessories or equipment enclosures without joints.

Conductors shall be terminated with tinned pre-insulated compression bootlace pins. A maximum of two cable cores shall be connected to any equipment terminal

Instrument cable shall conform to the Belden industrial instrumentation series cable specification for screened multicore cables. All cores shall use tinned copper stranded conductors. Cable cores shall be in white and black pairs for loop powered or active instruments, or red, white and black for RTD's or DC powered instruments.

Single paired or single triple conductors shall have a cross sectional area of approximately 1.5mm^2, Belden catalogue number 1030B and 1031B respectively.

Multicored paired conductors shall have a cross sectional area of approximately 0.55 mm^2, 2 pair and 4 pair overall screened, Belden catalogue number 3016B and 1056B respectively.

6.10.6.15 Security System Cables

Security system cables shall be those cables connected to the security panel and remote switchboards for the purpose status or analogue monitoring. Cables runs shall be segregated from power cables by a minimum distance of 300 mm. Cables shall be run between fittings, accessories or equipment enclosures without joints.

Cable from the generator switchboard to the pump station switchboard shall be General Cables B5504ES/CS 1.5 mm^2 4 pair individual screened and overall screened PVC. Install the cable in a 25 mm UPVC buried conduit.

6.10.7 Outdoor Switchboard Enclosures

6.10.7.1 Construction

The Outdoor Enclosure shall house a Multibox Switchboard. The enclosure shall be free standing, front access, manufactured from heavy duty fully welded aluminium sheet on a self supporting channel section framework, suitable for direct mounting onto a concrete plinth. In areas where salt water/spray corrosion is possible, 316L stainless steel shall be used for all cabinet metalwork. With all doors closed the complete assembly shall have a degree of protection to IP55 in accordance with IEC60529, unless otherwise specified.

Outdoor Enclosures shall be to standard modular size. Double and triple module sized enclosures shall be used as required by constructing a single enclosure with multiple doors. Right hand doors are to be hinged on the right hand side. The overall height of the switchboard cabinet, including the base shall not exceed 1,500 mm.

The roof of the outdoor enclosures shall slope away from the front (doors) of the enclosure to lessen rainwater run-off when the doors are open. The roof slope ratio shall be 400mm horizontal 20mm vertical.

A ventilated (multi-louvered) cable base shall be provided. Underground cables will enter the ventilated base and their ducts shall be sealed at grade with the base. Cables will then enter the enclosure via a 6mm full depth split aluminium gland plate. See the general arrangement drawing for concept.

Where a remote generator connection switchboard is required, the outdoor enclosure shall be manufactured to the same standards and concepts as the enclosure that houses the pump station switchboard, except that the maximum size shall be 1,000 mm wide and 1,250 mm high.

The housing will have two top-hat sections welded horizontally onto the inside back of the enclosure. One top hat section at the top of the board and the other at the bottom in line with the top and bottom of the multiboxes.

Two 50mm x 6mm bars shall be fixed to the respective top hat sections with two M10 stainless steel studs per bar. The four M10 studs are to be accessible at each end of the multibox assembly. The multibox assembly will be bolted to the 50mm x 6mm bars with a minimum of two M6 stainless steel bolt per multibox to form a rigid structure. The two 50mm x 6mm bar shall have tapped M6 holes for the multibox fixing bolts. Each multibox will be bolted to its neighbour multibox with M6 stainless steel bolts.

A single 50mm long M10 stainless steel earthing stud shall be welded to the LHS base plate.

6.10.7.2 Outdoor Enclosure Doors

The metal sheets forming the enclosure doors shall be of minimum 2 mm thick if stainless steel, or a minimum of 3 mm thick if aluminium. Doors are to be finished semi-flush with the enclosure and fitted with three substantial stainless steel hinges. Hinges shall be fitted with stainless steel screw fixings, inaccessible when the doors are closed. Hinge pins shall be fixed and have pins that cannot be driven out.

Single door enclosures and the left hand door of two door enclosures are to be fitted with handles with rod latches top and bottom. The handle shall incorporate a staple suitable for the North Shore City standard padlock. Lock handles shall be *Selectrix 1107SS* or approved equal.

For the right hand door of two door enclosures, the locking shall be by way of substantial stainless steel internal padbolts fitted top and bottom. No external fixings are to be visible.

Door seals formed in the enclosure shall consist of a double return channel and drip catcher of minimum size 22 x 16 x 8mm, all round. The door edges shall be of double return construction, bearing on the neoprene enclosure seal. All doors shall be hung true and square, with sealing and locking verified prior to acceptance.

Doors shall be constructed to open at least 120 degrees and fitted with substantial stops or stays to prevent damage due to over opening.

6.10.7.3 Surface Finish

The enclosure and doors shall have all welds cleaned and polished, and all external welds polished to match the 2B buff external finish. All edges shall be deburred.

Stainless steel cabinets generally shall not be coated, however all aluminium enclosures shall be powder coated. For some specific areas, as instructed by NSCC, the stainless steel outdoor enclosures shall be powder coated to make the enclosure less conspicuous. Powder coat colour shall be Deep Brunswick Green, (Orica 959/81879), and rated for at least a 15 year outdoor life.

6.10.7.4 Enclosure Cable Base and Anchoring

The base shall be constructed to maximise the space for cable access. Each end of the enclosure base (End-base) shall be constructed as an open U shape, 200mm high x 450mm deep x 220mm long on the front and back dimensions, with 50mm returns top and bottom and ends.

Each End-base shall be fabricated and welded from 2mm thick stainless steel.

A full size doubler plate of 2mm stainless steel shall be spot welded to the inside of each face (three doubler plates for each End-base) to provide stiffening for each End-base.

A 25mm x 25mm x 6mm stainless steel angle shall be welded to each End-base, front and back at grade, to which the four stainless steel ventilated (louvered) base covers attach. Two central supports, one front and back, consisting of a 25mm x 25mm x 6mm RHS shall be welded to the 25mm x 25mm x 6mm stainless steel angle to provide central support for switchboard and to provide a attachment points for the ends of the four ventilated base covers.

For anchoring the board to the concrete base a 450mm long, 50mm x 50mm x 6mm angle shall be bolted to the end of each End-base. This angle shall be bolted to the each End-base by three M12 stainless steel bolts, with the bolt heads to the outside of the board.

Fixings through the 50mm x 50mm angle into the concrete base shall be 3 x M12mm stainless steel Dynabolts at each end of the switchboard, with at least 50mm embedment into the concrete plinth and at least 100mm from the concrete edge.

The arrangement of the anchoring and attachment stainless steel bolts holes in the 50mm x 50mm angle shall be a minimum offset such the six bolt/nuts do not clash. The switchboard builder shall drill the 50mm x 50mm angle holes for the anchoring bolts, offset as noted above.

6.10.8 Multibox Switchboard assemblies

6.10.8.1 Multibox assemblies and enclosures

The designations within Australian Standard NZS/AS3439.1 Low-voltage switchgear and control gear for the switchboards detailed in this Standard are multi-box assemblies

A NZS/AS3439.1 defines multi-box assemblies as a combination of boxes mechanically joined together with or without a common supporting frame, the electrical connections passing between two adjacent boxes through openings in the adjoining faces. For outdoor use, multi-box assemblies shall be installed in appropriate enclosures.

To achieve adequate dust, moisture and insect protection for the multi-box enclosures, the cable entries into all enclosures within these pump station switchboards shall use cable glands. The multiboxes shall also be installed to achieve an IP54 rating to IEC 60529.

All multi-box enclosures installed in either pump station buildings or outdoor stainless steel enclosures shall be manufactured from 3mm aluminium, continuously welded and finished with powder coating. The powder coat shall be applied to each multi-box at the factory after fabrication. The powder coating shall be 'light straw' colour, applied on the inside and outside of all faces and shall have a minimum life of 10 years.

The multi-box enclosures shall be fitted with dust seals for all doors and penetrations to obtain as as-installed rating of IP54 or better. Multi-box hinges and latches/locks shall be stainless steel. Doors shall not foul enclosure supports or other equipment.

Multi-box enclosures containing power dissipating equipment shall each be fitted with two self-draining side louvers or vents fitted with 1 mm aperture stainless steel mesh.

When the multi-box switchboards are installed in outdoor enclosures, the multibox enclosures and shall be bolted to sections welded to the main enclosure. For indoor use i.e., inside pump station buildings, the multi-box switchboard shall be mounted with stainless steel fixing brackets to the pump station wall.

Each multibox shall be fitted with a 6mm aluminium gear plate and a full depth gland plate. The gear and gland plate edges and corners shall be rounded so it has no sharp edges. Cable entry for outdoor multibox switchboards shall be bottom entry only.

The switchboard shall be segregated into separate multi-boxes as follows (refer also to the typical switchboard general layout drawings):

- Main Incomer
- Power supply Metering
- Generator-Mains selector switch
- Power Distribution - MCB distribution
- Motor Starters - direct-on-line or soft starters
- Kingfisher Telemetry system
- Field device marshalling cabinet and aux controls
- Control power supplies, including batteries and control relay interface
- Access security - with keypad.

6.10.9 Cable Entry

All cables shall be selected with a circular outer sheath for gland sealing. Flat TPS cables shall not be used. Cables entering multibox enclosures shall be glanded through the multibox gland plates. All penetrations between the multiboxes shall be effectively sealed by the switchboard manufacturer apart from a single proprietary insect proof air vent/moisture drain installed at the bottom of each multibox.

Motor cables shall be terminated directly into the motor starter multiboxes. Field cables from the Multitrode level sensor, wet well level switches, proximity switches and the like shall be terminated into rail mounted terminals in the 'Field device marshalling cabinet and aux controls' multibox.

6.10.9.1 Segregation and shielding of wiring and sensitive equipment

All wiring and equipment both inside and outside the switchboard shall have the necessary segregation, screening, and filtering to prevent malfunction of the equipment.

6.10.10 Power Supplies

The switchboard shall have two incoming power supplies: one from the 3 phase and neutral 400/230 VAC street distribution system and the other, via a plug/inlet from a three phase 400/230 VAC portable generator. Ensure that the cable terminations are correctly sized for the power supply cable conductors and for the system fault current.

Telemetry, instrument and radio power supplies shall be battery backed 24 V DC.

Wet well level switches and other wet well equipment shall only be supplied at extra low voltage.

6.10.11 Front Panel Controls and Indications

Provide all control and monitoring equipment shown on the drawings. All indicators and selector switches shall be visible when the outer enclosure doors are open.

6.10.12 Tariff Metering

Take delivery of and mount and wire the Electricity Supply Company tariff meter, (and current transformers, test blocks and the like) to the requirements of the Supply Company. Fit transparent polycarbonate windows in sealed auto-rubber mouldings to provide adequate viewing of the kWh reading without the need to open any doors.

Make provision for fitting of Supply Authority seals to meter panel and potential fuses.

6.10.13 Isolation Switches

Provide a Terasaki 125A Moulded Case Circuit Breaker for the switchboard main switch and a motor isolation switch for each pump. Provide a generator/off/mains changeover switch, 126 Amp rated K & N.

Where a remote generator panel is provided, the main switch in the generator panel shall be a Terasaki 125A Moulded Case Circuit Breaker. The main switch for the Pump Station switchboard shall be a 125 Amp non-auto MCCB rated for AC3 operation.

All main switches, pump isolating switches and three position mains changeover switches shall:

- be fitted with rotary handle with a padlock facility. Switches and handles shall fully comply with IEC 60947-3 for use as isolation switches and be rated for 600 Vac AC3 operation,
- have IP20 rated terminal shrouds fitted to both line and load side connections.

All MCBs and switches shall be padlockable and have a hole for an Isolation tag to be fitted once switched off.

6.10.14 400/230 VAC Equipment

The 400/230 VAC three phase power supplies, terminations and connections shall be shrouded to achieve an IP20 rating to IEC 60529.

The following 400/230 VAC equipment shall be mounted in the enclosure and shall be segregated from the low voltage control equipment:

a) three phase, 400VAC, BS88 HRC fuses for indicators and monitoring instruments,

b) miniature circuit breakers for the Motor starters, enclosure anti condensation heater, cabinet light and combined wet well, area and cabinet light switch, 10 Amp single phase power outlet, RCD's and other equipment as required,

c) three phase 400 VAC lockable motor isolator to IEC 60947-3 for each motor,

d) neutral bar,

e) earth bars,

f) motor starters as shown,

g) power factor correction contactors, capacitors and current limiting air cored chokes,

h) cable terminations,

i) fluorescent panel light,

j) time delayed off lighting control switch.

6.10.15 Generator Connection and Pump Plugs/Sockets

Provide and install a 63 Amp 5 pin, surface mounting, polycarbonate, Gewiss IEC 60309 generator inlet receptacle. The generator inlet receptacle shall be mounted under a weatherproof padlockable shroud as shown on the general arrangement drawings. The actual side location of the generator receptacle i.e., LHS or RHS of the switchboard shall be agreed with NSCC during the switchboard design stage.

6.10.16 Station Telemetry

The Contractor shall provide all telemetry equipment, data radio, aerial, mounting equipment, power supplies, relays and cabling including the field or control devices shown on the drawings.

The Kingfisher telemetry and radio shall be purchased from W Arthur Fisher to the standard NSCC design. Mount and wire the telemetry system in a multibox of the switchboard.

Provide power supply, batteries, antenna and antenna mounting to the standard NSCC design. Provide, install and connect a six element vertically polarised UHF Yagi antenna for the telemetry unit. The antenna and accessories are available from Marsa Consultants ph 815 3274 Mark Flower.

All telemetry module inputs and outputs will be wired to rail mounted terminals within the telemetry cabinet. Refer W Arthur Fisher “CP10 - Telemetry Baseplate Layout” drawing number 02007 sheet 1, and “CP10 - Telemetry Cross section” drawing number 02007 sheet 2, for typical telemetry mounting details.

Input and output devices and connection details are shown in the W Arthur Fisher schedule “Kingfisher PC1 for 2 pump, Sewage Pump Stations”. Ensure that adequate wetting current is used for the Flygt level switches to ensure reliable switching. To achieve this, it may be necessary to connect additional resistors to each telemetry input.

Power supplies and battery capacity shall be selected to provide a backup duration of 12 hours for all telemetry and instruments.

Configuration of the telemetry software will be by Marsa Consultants as a subcontractor to the Contractor. Test and commission the complete telemetry system in conjunction with NSCC Water Services engineer.

6.10.17 Station Security System

The NSCC pump station security system consists of a keypad/controller, backup battery, door switches, various sensors and output items supplied by Instrumentation Systems Ltd. Ph 021 293 7608. This equipment shall be installed and wired by the Contractor. Configuration of the security system software will be by Instrumentation Systems Ltd as subcontractor to the Contractor.

The Security controller space allowance is 300mm wide, 300mm high and 100mm deep. It shall be installed in a multibox in the switchboard for outdoor pump station switchboards, or wall mounted in pump station buildings. For pump station buildings, allow space and provide mounting brackets and mount the Controller/keypad enclosure on the inside of the first-opening door.

Allow installing the Security system in the switchboard multibox before dispatch to site, i.e. Keypad, controller, and door proximity switches that connect back to the controller enclosure.

6.10.18 Power Factor Correction Capacitors

Confirm requirements for power factor correction capacitors (PFCs) with the Power Authority and NSCC Water Services Engineer. If required, PFCs shall be installed in the switchboard for each pump. The PFCs size shall be selected, based on the pump manufacturers data sheets, to correct the full load power factor to the value specified by the Power Authority to avoid any reactive power charges (normally no less than 0.96PF).

Capacitors 2kVAr and above shall have an overpressure disconnect system for use in the event of internal faults. The capacitors shall be manufactured and tested to comply with IEC 60831-1/2.

The connection of power factor connection capacitors shall be switched by a contactor connected to the line (upstream) side of the motor starter protection and CT modules.

Fit air cored inductors to each capacitor phase to limit capacitor inrush current. Capacitor contactors shall be rated for capacitor switching. Rating of the capacitor contactor(s) is to be verified by the designer.

Power factor correction capacitors shall be installed outside the switchboard multi-boxes as follows:

- Indoor pump-stations - in stainless steel enclosures mounted on the wall away from the multi-box switchboard.
- Outdoor pump-stations - in the ventilated cable base of the outdoor enclosure. The capacitors shall be installed in stainless steel containers.
- Power factor capacitors 2kVAr (at 400V) and above shall be 440 Volt rated Vishay-Estaprop brand mounted in stainless steel enclosure with air chokes and cable terminations - Supplier, Lees Technology.
- Power factor capacitors below 2kVAr (at 400V) shall be 440 Volt rated epoxy-cased capacitors mounted in stainless steel enclosure with air chokes and cable terminations - Supplier, Metalect Industries.

6.10.19 Anti-Condensation Heaters

Each multibox containing switchgear or control equipment shall be provided with an anti-condensation heating operating at 230V AC.

Heaters of black heat type shall be continuously energised and shall be designed to maintain the enclosure temperature at 3°C above ambient temperature at all times.

Thermostatic temperature control shall not be used. The heater circuit shall have its own anti-condensation heater circuit-isolating switch and neon indicating light. Heaters that have operating surface temperatures exceeding 60 °C shall be fitted with expanded metal mesh protective screens to prevent personnel contact with the hot surfaces.

The preferred heating arrangement is for a 10 Watt aluminium body, TS35 rail mount, Rittal SK3105.000 heater located at the bottom of each multibox. This heater is supplied with a 300 mm connection cable.

For larger enclosures, the 20 Watt SK3106.000, or the 30 watt SK3115.000, may be more appropriate, depending on the heat load from the equipment.

6.10.20 Enclosure Power Outlets

Each switchboard shall be provided with one, single phase 230 VAC switched 10 amp socket outlet, complying with AS/NZS 3112 for general purpose use. The outlet shall be mounted vertically and protected by A Class, 30mA Residual Current Devices (RCD) located in an IP66 enclosure. In addition, non-RCD protected outlets shall be provided for dedicated power supplies to equipment.

6.10.21 Enclosure Earthing

All enclosure metal work including multiboxes shall be electrically bonded to a single enclosure earth stud. All non-current carrying metalwork installed and the metalwork of the structure, plumbing pipes, fittings and the like, shall be effectively earthed.

All earth wiring within enclosures shall be covered and coloured green or green/yellow. The earth cable to the earth electrodes shall be green PVC insulated stranded copper conductor.

6.10.22 Power Wiring

Wiring size between 400/230 V terminals, fuses and MCBs shall be selected for accommodate the maximum fault rating from the upstream circuit protection device. Circular sheathed cabling only shall be used.

6.10.23 Secondary and Control Wiring

All secondary and control wiring shall use flexible, tinned copper conductors with flame retardant insulation. Wiring shall be adequately sized for the circuit load but not less than 1.0 mm^2.

All current transformer, voltage transformer, and AC supply wiring shall be appropriately sized for the duty and of the appropriate phase colour.

Every wire shall be numbered at each end with Grafoplast TRASP or equal slip-on ferrule crimped pins with labels reading from left to right or top to bottom. The ferrule shall be readily visible without any disconnecting or dismantling, and be firmly attached to the wire.

All flexible control wiring shall be terminated in tinned copper insulated crimp pins of the appropriate size to match the wire size. Suitable ratchet operated crimp tools are to be used for the crimp pins.

Low voltage enclosure wiring shall generally be contained in PVC fire retardant slotted trunking. Trunking shall be adequately sized to contain all low voltage enclosure wiring and external field wiring. On completion, trunking shall be no more than 50% filled. Internal wiring shall not be run in trunking intended for field wiring. A minimum of 40mm space shall be allowed between slotted trunking and the adjacent terminals.

Wire looms may be secured with plastic buckle ties or Nylon spiral wrap. Self adhesive tie bases shall not be used. A wiring loom between moving parts shall not exceed 12 wires.

All wiring between multibox enclosures shall be via glanded circular PVC/PVC cables. Glass fibre-filled Nylon IP65 glands of the appropriate size are suitable for this duty.

Control Wiring Colours:

400/230 V Phase conductors	RED, YELLOW, BLUE
230 V ac active control circuits	ORANGE
400/230 V ac neutral	BLACK
ELV dc Telemetry Digital outputs	PURPLE
ELV dc Telemetry Input circuits	WHITE
ELV common	GREY

6.10.24 Terminals

Terminal blocks for all low voltage wiring shall be TS35 rail mounted modular terminals complying with the following standards:

VDE 0611 Part 1 : *Terminal blocks for connection and* joining of *copper conductors up to 1000VAC and 1200VDC. (Feed through terminals up to 230mm*^{2})

VDE 0110 *Creepage and clearance dimensions*

VDE 0609 *Clamped screw connections for connection of copper conductors up to 230mm*^{2}.

Mounting rails shall be extruded with a TS35 profile in accordance with DIN 46277/EN. All terminals shall be individually labelled with an unambiguous code relating to the schematic diagrams. All enclosure wiring shall be terminated on the same side of a given terminal block.

Twenty five percent spare terminals of each type shall be provided with the enclosures to allow for additions and revisions to the wiring during commissioning and subsequent changes.

The terminal rails in the Enclosures shall have terminals segregated into the following groups:

a) Instrumentation
b) 24 VDC Control Inputs
c) 24 VDC Control Outputs
d) 230 VAC Control/Indication
e) 400/230 VAC Power

The terminal block requirements for particular types of circuit shall be as follows:

Control

Terminals for interconnections between internal and external control circuits shall be capable of accepting 2 x 1.5mm2 crimp pins. Purpose made bridging accessories are to be used when additional bridged terminals are required. Adequate terminals plus 20% spare (with a minimum of 5) shall be provided for each terminal block group. Terminals shall be Klippon WDU 2.5 with all necessary accessories or approved equal. Diode terminals are to be WTR 2.5D or approved equal, with 1N4007 diodes fitted.

Instrumentation

Terminals shall be Klippon WDU 2.5 with all necessary accessories. All outgoing instrumentation circuits shall have dedicated terminals. Loops between outgoing instrumentation circuits shall be provided on the enclosure side. Where a single analogue loop is to be connected to more than one field device, dedicated terminals shall be provided for each loop. A matching instrument earth terminal for the cable screen shall be provided for each outgoing circuit.

400/230 V Power Circuits

The distribution board MCBs shall be supplied from a NHP Din-T fully insulated coloured Red, White, Blue, 3 phase 415V copper bus bar chassis rated at 250A with a fault withstand rating of 25 kA for 0.2 second.

Terminals used for the connection of power circuits shall be sized for a conductor with a current rating at least 150% the full load current of the supply. All AC mains terminals shall be fully shrouded, marked with a red label indicating the highest voltage present, and segregated from control terminal blocks. Terminals shall be Klippon with minimum rating of WDU 2.5 complete with all accessories.

6.10.25 Auxiliary and Control Relays

Control relays, contactors and auxiliary contacts shall be as specified in the drawings and schedules. All control equipment shall be mounted on TS35 rails. Control relays shall incorporate a three-pole changeover contact set in a sealed relay housing. Only gold flashed or gold plated contacts shall be used. Provide front-wired 11 pin base and hold down clips.

6.10.26 Electrical Measuring Transducers

All transducers shall provide an isolated 4 to 20 mA output and accuracy over the specified operating range shall be ± 1 % or better. The output signal for each transducer shall be wired via rail mounted terminals as described above. Transducers shall be as specified on the drawings.

6.10.27 Indication Lamps

Indicating lamps shall be IP66 rated 22.5mm diameter, multi LED high intensity BA9S type. Lamp lenses shall be prismatic and have a minimum diameter of 22mm. Lamps shall be sufficiently bright to be clearly visible in shaded sunlight. Klockner RMQ 22 LED series or similar.

Unless shown on the drawings, lamps shall be coloured as follows:

- Green Energised or operative condition
- Red Overload/Unenergised or inoperative condition
- Amber Status indication

6.10.28 Control Switches, Push Buttons and Emergency Stop Button

Control switches shall be IP66 22.5 mm diameter industrial lever switches of the "add on" contact block type. Where switches have an "Auto" position, they shall be oriented so that the lever points in a vertical position with "Auto" selected.

Push buttons shall be of the 22.5mm diameter industrial "add on" contact block type.

An Emergency Stop pushbutton shall be latching, 40mm or 50mm Ø mushroom head type, coloured red. It shall be equipped with at least one normally open and three normally closed contacts and connected to stop both pumps i.e. denergise the motor line-contactor for both DOL and Soft-starters. A contact from the E-Stop button shall be connected to the telemetry digital input.

Control switches and pushbuttons shall be readily accessible for maintenance. Contacts shall be suitable for the required 230 VAC or 24 VDC duty. Gold plated or gold flashed contacts shall be used for 24 VDC or extra low voltage service.

6.10.29 Indicating Instruments

Unless individually specified, all indicating panel instruments shall comply with IEC 51 with dimensions to DIN Specification 43700. Instruments shall be of flush pattern with a 72mm square bezel and 90° scale unless otherwise stated.

Motor ammeter scales shall be selected so that the motor full load current reads between 60% and 80% of scale length. Motor ammeters shall be overscaled to 2 times nominal current. Multi turn phase conductors through the CT is an acceptable method for scaling ammeter primary current. Each pump motor ammeter shall have a self-adhesive red line indicating the normal maximum running current.

6.10.30 Low Voltage Fuses, Circuit Breakers and Co ordination

Fuses

Unless otherwise stated, all fuses shall be of the high rupturing capacity cartridge type conforming to BS 88. Each fuse carrier shall be labelled with its circuit function and current rating. Fuses in direct current circuits shall be in both positive and negative poles and located in individual holders. Fuses and links shall be provided as required to ensure adequate protection for equipment and to provide isolation of control and protection circuits.

Miniature Circuit Breakers

Miniature circuit breakers shall be fitted with magnetic and thermal trip devices. Miniature circuit breakers shall only be used in applications requiring a rating of less than 63A. They shall have provision and accessories necessary for padlocking the mechanism in the open position. The minimum short circuit breaking capacity of miniature circuit breakers shall be 15kA Ultimate breaking capacity (Icu). Small 1A MCBs that supply indicating instruments etc shall be backed up by a 2A HRC fuse. Where the prospective short circuit rating of the miniature circuit breaker is less than 15kA Icu then the miniature circuit breaker will be supplied via a HRC fuse of an equivalent rating. MCBs shall be Terasaki fault-current limiting breakers.

Moulded Case Circuit Breakers

Low voltage circuit breakers of rating 63A and above shall be of the moulded case type with clear indication of the open, closed or tripped positions. They shall be fitted with magnetic and adjustable thermal trip devices. They shall have a normally open auxiliary contact and shall include provision, and accessories necessary for padlocking the mechanism in the open position. As a minimum all moulded case circuit breakers shall have a short circuit breaking capacity of 30kA Service Breaking Capacity (Ics). Prior to purchase of moulded case circuit breakers the local power supply authority shall be asked for prospective short circuit levels for the area. Where the prospective short circuit level is within 20% of the 35kA rating, 50kA Ics breakers shall be used. MCCBs shall be Terasaki fault-current limiting type.

Protection Device Tripping and Co ordination

The designer shall select and size fuses and circuit breakers to achieve coordination between protection devices. The object is to allow down-stream faults and overloads to effect only that circuit, eg for a pump motor short circuit or arcing fault only that pump's circuit breaker will trip and not any upstream protection. The designer shall produce protection device curves and a protection setting schedule that show co-ordination has been achieved. If complete co ordination cannot be achieved the curves and setting schedule will show what coordination level has been achieved. These curves, breaker types, fuses sizes and breaker setting schedule shall be submitted to NSCC for approval prior to purchase of the protection devices. The prospective short circuit level for the installation shall also be shown on the coordination curves.

6.10.31 Contactors

Contactors shall be of the block, air-break, electromagnetic type having inherent under-voltage release characteristics and provision for replacement of fixed and moving contacts and operating coils. Contactors shall be suitable for Class 0.1 duties, utilisation category AC3 (IEC 60158-1) with a minimum rated electrical life at full load current of 1 million operations. Contactors shall be equipped with at least one normally open auxiliary contact wired to the telemetry as shown. Contactors shall be Telemecanique brand.

6.10.32 Motor Thermal Overload Protection

For Direct on Line starters, three-element thermal overload protection with unbalanced phase tripping shall be used. There shall be no permanent distortion of the operating element as a result of over current conditions. Thermal overload relays shall be of the hand and remote reset type and shall be equipped with at least one normally open auxiliary contact. Protection co-ordination shall be to Type 2 to IEC 60947-4. Fuse sizes shall be selected to match the motor full load current and IEC 60947-4 type 2 requirements. All Thermal overload relays shall be fitted with 230 V ac electric reset solenoids connected to a blue RESET pushbutton within the multibox. Thermal overloads are to have a manually tripable overload contact for testing the alarm function. Thermal overload units shall be Telemecanique brand.

6.10.33 Electronic Motor Starters

Where required, electronic motor starters shall be provided in addition to the motor contactors. All electronic motor starters shall be provided with line side overvoltage protection. Pump applications will require both soft starting and soft stopping. To ensure adequate cooling, enclosure clearances shall be provided for these motor starters as recommended by the equipment manufacturer.

Aucom IMS series IP42 rated soft starters shall be used. The minimum starter size shall be IMS20018.

Soft starters are to be sized as follows unless NSCC or the Pump Vendor advises otherwise:

a) Current to be limited to 3.5 times full load current.

b) Soft-start time as short as possible to limit heat dissipation in enclosure, typical 2.5 seconds.

c) Soft-stop - not generally required, but allow for 3.0 seconds for minor water-hammer reduction in higher head applications. Again, to minimise heat dissipation in the starter enclosure.

d) Duty Cycle 1: 10 starts per hour for 3 hours twice per 12hr daylight day. Run time 3 minutes, Rest time 3 minutes.

e) Duty Cycle 2: 15 starts per hour for 1 hour twice per 12hr daylight day. Run time 3 minutes 20 seconds, Rest time 40 seconds.

The Line switching contactor shall be controlled from the soft starter Main Contactor auxiliary contact. Bypass and power factor capacitor switching contactors shall be provided and controlled from the soft starter RUN auxiliary contacts.

Configure the soft starter to utilise the following features:

- Line contactor,
- Bypass/capacitor contactor,
- Soft start,
- Soft stop,
- Phase sequence trip (fault output),
- Underload trip (fault output),
- Thermal trip (fault output),
- Motor analogue output to the telemetry input.

6.10.34 Submersible Pump Motor Protection

All pump motors shall be provided with thermal sensors, either in the form of thermistors or a thermal switch in each winding. Thermal protection shall be connected to the soft starter thermistor input or a thermistor relay and configured to trip the starter on over temperature.

Where a thermistor relay is connected to motor thermal switches, a 1 watt 100 ohm resistor shall be connected in series with the sensor wiring, at the switchboard terminal rail, to prevent false tripping.

Thermal switches shall be either connected to the digital input of the soft starter or connected to a proprietary control relay located in the motor starter multibox. These shall be configured to trip the starter on over temperature. Water-in-oil sensors can also be connected to the thermal protection relay or to a Flygt MiniCASS on Flygt pumps.

An NHP earth fault relay shall be installed to provide earth fault protection for each pump starter. Earth fault relays shall be configured to be normally energised. Refer drawings for details.

6.10.35 Voltmeter, Ammeter, Hour meter and Generator Phase Rotation Indicator

Provide a switched voltmeter scaled 0 - 500 V, connected to the load side of the switchboard's incoming 400 V ac mains supply switch. Provide and connect a phase failure relay, with time delayed relay output, to the mains supply. Both the voltmeter and phase failure relay shall be supplied via 2 Amp HRC fuses and a local 1 Amp 3 pole MCB.

Provide an ammeter for each motor starter and mount it so it can be clearly read through the polycarbonate window in the pump motor starter multibox. Connect in the Yellow phase line side.

Provide an hour run meter for each motor starter and mount it so it can also be read through the polycarbonate window in the pump motor starter multibox. The hour meter shall be non resetable and shall be at least five digit (0-99,999 hours) and shall operate at 230VAC.

Provide a Crompton 243-12PG phase rotation indicator marked with the correct phase rotation. The phase rotation indicator shall be connected to the line side of the generator incomer isolator. Three 2 amp HRC fuses and a local 3 pole 1A MCB shall be provided to protect the phase rotation indicator supply.

Provide and connect a Crompton 252-PVR phase failure relay as shown.

Three LED indicator lamps RED, WHITE, BLUE shall be fitted below the Main-switch incomer switch handle. The indicator lamps shall be labelled: Mains Available. Each indicator light will be connected as follows - R to N, W to N, B to N. The three Mains Supply Present LED indicator lights shall be Klockner type: RMQ 22-ML R/W/B 240V 50Hz. For site with remote generator connection switchboards, the Mains Supply Present Indicator lamps will be installed in the Remote Generator Connection switchboard.

6.10.36 Site Installation

6.10.36.1 Overview

In addition to installing the switchboard(s) and plinth(s), the works shall include the provision and installation of field instruments, level switches, pump plug sockets, cables, conduit, ducting, security system switches, lighting and all other items necessary to complete the works.

6.10.36.2 Project management meetings

The Contractor shall prepare and submit, to NSCC Water Services Engineer, a detailed programme of works in Gantt chart form that includes all tasks prior to and during installation and commissioning. The Gantt chart shall be updated regularly by the Contractor showing the percentage completion of all tasks.

At the request of the NSCC, during the installation and commissioning phases of each pump station the Contractor's representative shall attend a weekly coordination meeting with NSCC and Techscape at the Techscape offices in Albany.

At the meeting the Contractor shall present an updated Gantt chart and a written report on progress, problems and the work proposed for the following week.

Testing and commissioning dates shall be agreed to suit all parties.

6.10.36.3 Permit and Fees

The Contractor shall obtain all necessary permits in connection with the works unless otherwise specified.

The Contractor shall pay all fees and other charges in connection with the works unless otherwise specified.

6.10.36.4 Setting Out

Drawings provided show the general arrangement of plant and equipment with principal dimensions.

The Contractor shall set out the Works in detail having regard to all the circumstances pertaining at the time of commencing work, including the coordination with the civil works, the running of other services, the provision of conduits and ducting, spare space for future services and proposed methods of construction and installation.

6.10.36.5 Installation of Switchboards, Pumps, Telemetry, Controls and Security system

The Contractor shall coordinate delivery and installation of all switchboards, control, telemetry and security equipment in a timely manner and in accordance with the agreed programme of planned work. Coordinate with all other suppliers, contractors and NSCC to provide a programme of work for the completion of this installation.

For all outdoor switchboards and remote generator connection switchboards, design, supply and install the switchboard concrete base and cable ducts within the concrete base as shown on the general arrangement drawings.

All locations of the cable ducts in the concrete switchboard foundation shall be designed so that that no cables crossovers occur in either the ventilated switchboard base or in the outdoor enclosure for the multibox switchboard. Any proposed cross-overs, either in the ventilated base or within the outdoor enclosure shall be fully discussed before construction of the concrete foundation starts. The same design and NSCC approval process shall apply to cable conduits or ducts and cables entering pump station buildings to switchboards and control panels.

All underground cable ducts and cableways from the wet well into the ventilated base of the outdoor enclosure shall be sealed after construction to be gas and water tight. A suitable seal would consist of a 50mm plug of non-hardening, flame retardant compound, Flame-safe FSP1000 Firestop putty available from Electropar Limited, or Fyreflex sealant available from Grinnell Supply Sales (Tyco).

The switchboard fixings, to walls or to concrete bases, shall be 316 stainless steel metric bolts, 12mm minimum diameter and shall also comply with the seismic design requirements.

All cables entering the ventilated switchboard base shall have circular outer sheaths for gland sealing. Flat TPS cables shall not be used. All cables entering multibox enclosures shall be glanded through the multi-box gland plates. These glands shall provide an IP55 seal on the outer-sheath of the cables.

Gland all cables between the ventilated base aluminium gland plate and the internal space of the outdoor enclosure to provide an IP55 degree seal on the outer sheath of the cable.

6.10.36.6 Pump Plug sockets

For pump motors with separate thermistor cable and a full load current of less than 16 amps, provide a PDL unswitched socket outlet, IP66, 500 V, minimum size 56SOx20 for the motor cable. Provide a separate 56SOx20 plug socket for the thermistor cable.

For pumps with a full load current greater than 16A, plug sockets shall be interlocked such that the plug cannot be withdrawn with the switch in the "on" position. Marechal DSN IP67 type to suit pump (Pins 3P+E+2C) are suitable, supplied by Cutler Hammer.

The sockets shall be mounted well above flood level in the wet well at a location that is accessible from the wet well access hatch. Route the pump cables to allow either pump to be removed from service without disturbing the other pump. NSCC Water Services is to approve locations and cable routes before installation commences.

Provide angled matching plugs for the pump cables and matching plugs for the thermal sensor cables. The motor and thermistor plug sockets may be incorporated in a single multipin plug socket for each pump. Prior approval by NSCC is required before purchasing plugs and mountings to ensure compatibility with existing installations.

6.10.36.7 Security System Cabling

For sites that include a remote generator switchboard, install a General Cables B5504ESCS 1.5 mm^2 4 pair individual screened and overall screened PVC cable from the generator switchboard to the pump station switchboard. Install the cable in a 25 mm UPVC buried conduit maintaining at least 300 mm separation from power cables and other services.

Install IP68 proximity type door switches on the first of any of the opening doors, to detect the opening of the following:

- Outdoor switchboard doors
- Generator switchboard door
- Pump station building doors
- Wet well access covers
- Valve chamber access covers.

Each proximity switch shall be wired to the security controller and each switch shall activate when the respective door is between 60 mm and 200 mm open.

6.10.36.8 Switchboard Earthing

A minimum of two 1.5m driven 16mm diameter copper coated steel earth rods spaced at 2 metres and associated earth cable shall be provided and installed to comply with the NZ Wiring Regulations.

Two electrodes shall be installed at each switchboard location. For remote generator connection sites, two electrodes shall be installed at the remote generator switchboard and two electrodes shall be installed at the pump station switchboard.

Earth cables from the switchboard to the electrodes shall be green PVC sheathed stranded copper conductor. A separate earth cable shall be run from the switchboard earth to each electrode.

Inspection toby boxes shall be provided and installed at grade to access the switchboard earth electrodes. The toby boxes shall be concreted in with a 150mm surround of concrete. Protect the earth rod earthing cable with UPVC conduit/fittings buried at least 300mm below finished ground level. Corrugated conduit shall not be used.

6.10.36.9 Site Lighting

Provide and erect a single, 50mm diameter galvanised pipe, with pole mounted 160 W self ballasted narrow beam luminaire mounted 3m above finished ground level. The luminaire shall be located so that it provides light in the wet well to allow inspection and maintenance. Erect the lighting pole in a poured concrete base at a location agreed with the North Shore City representative. Protect the lighting cable with UPVC conduit buried at least 600mm below finished ground level. Connect the luminaire to the time off-delay manual light switch, set to 5 minutes.

The light fitting shall be an Iwasaki Lighting (EYE), KO lampholder with cast metal guard and 160 W PAR38 Self Ballasted MV Lamp and F7 flanged base. Bolt the F7 base to a 50mm Galvanised screwed flange on top of the 50mm galvanised pole. All fastenings shall be 316 Stainless steel, including the bolts, nuts and locknuts for the KO lampholder hinge and the guard clamp ring.

6.10.36.10 Telemetry Antenna

Provide and erect a single, 40mm diameter galvanised pipe, with pole mounted six element vertically polarised UHF Yagi antenna mounted 4m above finished ground level. The pipe shall be attached to the switchboard enclosure with galvanised clamps and stainless steel fasteners. The bottom of the pole is to rest on the concrete plinth. Routing of the antenna coax to the Telemetry unit shall be down the inside of the pipe and be vandal resistant. A drainage hole shall be provided at the base of the pipe.

6.10.36.11 Level switch cabling

Wet Well level switch cables shall be selected to:

- allow adjustment over the full range of wet well water level;
- be adjustable from the wet well access hatch without having to enter the wet well;
- have no cable joints.

6.10.36.12 Wet well washer

Provide a 230V/24V isolation transformer with earthed screen, AUTO/OFF/MANUAL control switch, auxiliary relay, indicating light and other items as shown on the drawings. Provide field cabling and conduit to a wet well spray washer solenoid valve. The cable shall be 3 core tinned copper 2.5mm^2 600/1000V PVC/PVC of circular construction.

If the washer system is installed, connect the cable to the solenoid valve coil using an IP68 connection. Connect the other end of the cable as shown on the drawings.

If the wet well wash is not installed at the time of switchboard commissioning, install sufficient cable to reach the location of the wet well washer solenoid valve and leave the cable neatly coiled and tied inside the switchboard ventilated base.

6.10.37 Testing and Commissioning

This clause includes testing, commissioning and acceptance of all items and switchboard(s) supplied.

This clause of the Works also includes level controller configuration, setting the position of the wet well level switches and the like.

Configuration of the Kingfisher telemetry system and the security system will be by the respective Subcontractors.

After construction work has been completed, the entire installation shall be in a clean and tidy condition ready for testing and commissioning.

6.10.37.1 Switchboard Inspection and Testing

The switchboard shall be completely assembled at the manufacturer's works for testing.

Tests and inspections shall be undertaken by the Contractor on completion of manufacture as agreed between the North Shore City Council and the Contractor. The North Shore City Council representative may witness all tests and inspections.

Tests on the complete switchboard shall be carried out at the manufacturer's premises in accordance with Section 8.3 AS3439-1 Routine Tests and the results recorded on works test certificates.

In addition to AS3439.1 Routine Tests, the Contractor shall perform the following tests:

- checking of equipment type, layout, and connections against the approved drawings,
- check labels, lens colours, physical size against the approved drawings,
- visual inspection of installation standard,
- check that all electrical terminations are rated IP20 (finger touch proof) or better,
- point to point visual and electrical wire checking against the approved drawings,
- insulation tests and checks,
- functional check and operation using simulated field connections,
- check foundation drawings against actual fixing dimensions.

6.10.37.2 Site Testing

Following installation of the switchboard, pumps, field equipment and earthing system the whole of the equipment provided under this specification shall be available for a programme of inspections and tests. Advise NSCC Water Services Engineer at least 7 days prior to testing. Coordinate testing so that NSCC representatives may inspect the installation and witness the tests.

The complete installation shall be tested by the Contractor to ensure compliance with AS/NZS3000. Carry out the inspections and tests listed in Section 6 of AS/NZS3000. Record all tests and test results in a schedule. Include a signed copy of the test schedule in the manuals.

6.10.38 Commissioning and Handover

The Contractor shall commission the works. Allow for checking that all equipment and functions conform to the requirements of the drawings and this specification and that the installation is in a safe and fully operational condition. Record all commissioning settings and configuration details.

Operating training shall be provided by the Contractor to North Shore City Council operations, maintenance staff and contractors during and after commissioning.

Once the pump station is fully operational, both in manual and automatic operation, the pump station shall be offered for acceptance to North Shore City Council by the Contractor with full supporting documentation and manuals, which include copies of all test results and as-built drawings. The installation and equipment shall be handed over complete and in perfect working order and condition.

6.10.39 Operation and Maintenance Manuals

The works are not complete until three bound copies of the operation and maintenance manuals are delivered to and approved by the North Shore City Water Services Engineer.

The spine of the Manual shall be identified by the Contract number, Site name and Installation date (month and year). The site name is to be agreed with the North Shore City and shown on the title block of all drawings, diagrams, Bill of Materials and other documents. 'Two hole' or 'three hole' punched pages will not be accepted.

All drawings shall also be provided in AutoCAD format to a numbering system approved by the Water Services Engineer.

The Operation and Maintenance manual shall include the following documentation, in logical sections:

- An index
- As-built scaled drawings of the switchboard enclosure(s).
- As-built scaled drawings of the panel layouts, internal equipment and trunking, with all equipment identified.
- As-built electrical schematic diagrams showing all equipment identification, labels, wiring interconnections, terminal numbers, wire numbers, wiring cross section area and wiring colour codes.
- The Switchboard Works test certificates.
- The Installers name, address and contact details.
- The Installers Electrical Work Certificate of Compliance.
- As-built bill of materials for all equipment and electrical components showing equipment manufacturer, model numbers and supplier name for all equipment.
- Equipment data sheets for all equipment supplied, with all non-applicable information deleted or clearly crossed out.
- A record of pump motor start currents and the duration of starting and stopping.
- A record of pump motor running currents.
- Record confirmation of motor overload settings. NB thermal overloads to be set to the motor full load current.
- Records of all soft-starter, level transmitter and level controller configuration settings.
- Soft and hard copy records of as-built pump station telemetry system configuration.
- A copy of the site inspection and test schedules.
- Verification that the generator phase rotation meter is correctly indicated
- As-built, scaled, underground cable drawing showing all cables and routes.
- Earth Electrode test results.
- Manufacturers operation and maintenance requirements for all equipment.
- Hazardous Areas document dossier (if applicable to the particular site), shall comply with AS 2380.

6.11 Rising (Pressure) Mains For Local Stations

6.11.1 Hydraulic Design

The design of rising mains shall be carried out on the basis of pipes flowing full.

The frictional resistance of the sewer shall be based on the Colebrook-White formula using a k_s = 1.5mm.

Maximum velocity in rising (pressure) mains shall be 2m/s. Preferred minimum velocity in a rising main shall be 1.2m/s (absolute minimum of 0.9m/s). The minimum flow velocity shall be calculated for the pump flow expected at the beginning of the sewer's service life.

If development is staged and long retention times are expected, consideration may need to be given to duplicate mains.

The main shall be designed to meet standards essentially similar to those for principal water supply mains.

The selection of pipe class and diameter shall be matched with pump, motor and flow characteristics.

The sewer shall be designed to withstand:

- The specified test pressure
- The working head (i.e. static, H_s, and friction heads, H_f, of long duration)
- Surge pressures of short duration, but cyclic in nature

The test pressure (P_t in metres) shall be:

$$P_t = 2 (H_s + H_f)$$

The long-duration working pressure (P_w in metres) shall be:

$$P_w = H_s + H_f$$

The short duration and cyclic surge pressures (P_h in metres) shall be the higher of:

$$P_h = 1.5 (H_s + H_f)$$

$$P_h = H_s + \Delta H$$

where

H_s = static head (m)

H_f = friction head (m)

H = C (V/g)

C = $(\rho (1/K + d/Et))^{-0.5}$

= liquid density (kg/m^3)

K = liquid bulk modulus (Pa)

d = internal pipe diameter (mm)

t = pipe wall thickness (mm)

E = modulus of elasticity of pipe material (Pa)

V = change in liquid velocity (m/s)

g = acceleration due to gravity (m/s^2)

Surge pressure cases to be considered shall be as follows:

- Normal cyclic surge due to pump starting and stopping
- Abnormal non-cyclic surge due to a check valve stuck open, then closed after full reverse flow has been established

6.11.2 Minimum Size

The minimum internal diameter of a rising main shall be 100mm (80mm may be permitted by special approval of the Council's Wastewater Network Operations Manager).

6.11.3 Layout

The main shall, wherever possible, rise continuously from the station, and terminate with a manhole at the upper end (downstream end). The manhole shall be provided with a ventilation stack, and where necessary, an odour control device.

In some instances it may not be practical to have a main rising continuously from the station up to the receiving manhole. Then the main shall be designed to have alternative rising and falling gradients. At each peak a sewage type double orifice air valve shall be provided inside a chamber with a ventilation stack, and where necessary, an odour control device.

At each trough a scour valve shall be provided inside a chamber with facilities for discharging into a sewer or for emptying by a sucker truck.

Minimise the peaks and troughs by maximising, as far as practicable, the lengths of the rising and falling sections.

The opening of the ventilation stack shall be, at least, 50m away from any building. If the manhole/chamber is within 50m of a building then the vent pipeline shall be laid underground up to a suitable location and rise up vertically to form the vent stack. The vent pipeline shall rise continuously from the manhole/chamber to the vertical vent stack. Where necessary for aesthetic reasons, vent stacks shall be suitably disguised as a lamp post or a road sign or the like.

6.11.4 Location

Wherever possible, public rising mains shall not be located within private properties. Specific approval of the Council's Wastewater Network Operations Manager is required for locating a public rising main within private properties.

6.11.5 Pipe Materials

Rising main pipe types as listed may be used provided they are manufactured to the current relevant New Zealand standard, and suitable for their purpose.

6.11.5.1 Summary

A summary of the preferred pipe material for rising mains is given in Table 6-18. The Council's Wastewater Network Operations Manager's approval shall be obtained for using different materials other than the preferred material for a given purpose and size range.

Table 6-18 : Preferred Pipe Materials for Rising Mains

Purpose	Size Range	Preferred Pipe Material
Trenched or trenchless rising mains	As available	Polyethylene (PE) (refer 6.11.5.2)

6.11.5.2 Pipe Material Details

Polyethylene (PE) Rising (Pressure) Mains

Do not use PE pipes for sewers where a large temperature fluctuation is expected (greater than 10 °C)

PE pipes shall not be used for pipe bridges and within tunnels that are not backfilled unless the pipe is adequately anchored against flotation and thermal movement

Butt and electrofusion welded jointing shall be carried out only by experienced certified PE welders.

The certifying organisation shall be acceptable to the Council's Wastewater Network Operations Manager. In addition, welders may be required to carry out satisfactory test welds for each joint type. Stamp the welder's number on each joint

Butt welds shall be, at least, 90% of the tensile strength of the parent pipe material, when tested in accordance with ISO 13953.

All internal weld beads shall be removed, in an approved manner, to be smooth and flush with the pipe inner surface, without compromising the strength of the pipe joint. External beads shall be removed only if specifically requested by the Council's Wastewater Network Operations Manager.

Jointing by electrofusion welding: Couplers shall be of the same rating of the pipe or superior. Use manufacturer approved scraping tool to uniformly scrape the pipe ends all around the pipe barrel. Hand scraping is NOT PERMITTED. The welder shall mark witness marks on each end of the pipes to be jointed. The distance from the end of the pipe to the witness mark shall be half the length of the coupler. The pipe insertion to the coupler shall be achieved by manufacturer approved pulling and clamping equipment. Bending the pipes up for insertion into the coupler and then pushing back is NOT PERMITTED. Once the jointing is complete, the witness marks should only be just visible.

Refer clause 6.7.9.1 for acceptable storage requirements.

Wall thickness of PE sewers shall be determined as per AS/NZS 2566.1, subject to a minimum wall thickness of SDR 17. PE sewers shall be installed in accordance with AS/NZS2566.2 and AS/NZS2033.

Stiffness rating of a SDR 17 pipe shall not be less than SN16.

The inner colour of pipe shall be suitable to provide an acceptable CCTV image as approved by NSCC. Currently natural (white), brown and grey (DWV grey as per AS/NZ 1260) have been approved.

Only PE80 or PE100 pipes conforming to AS/NZS4130 subject to a minimum wall thickness of SDR17 shall be used. The required wall thickness shall be the greater than:

- Wall thickness calculated as per AS/NZS 2566; or of
- Wall thickness calculated using the following equation:

$T_{min}=(PxD_m)/(2xHDS+P)$

Where:

T_{min} = Minimum wall thickness

P = Nominal working pressure

D_m = Mean outside pipe dia as per AS/NZS 4130

HDS = Hydrostatic design stress

HDS = MRS/F

MRS is the Minimum Required Strength certified by the pipe manufacturer for a 100yr service life taking into account derating due to operating temperature and derating due to 10^7 cycles of cyclic water hammer load causing pressure swings from 1.5P to 0.5P

F = Safety factor which shall not be less than 1.25

The tolerance in the wall thickness variation shall not exceed the following:

$T_{max} = 1.10T_{min} + 0.1$

Where:

T_{max} = Maximum wall thickness (mm)

T_{min} = Minimum wall thickness (mm)

PE fittings fabricated from pipes shall be derated due to stress concentrations in the fabricated fittings. Manufacturer's recommendations shall be strictly followed with regard to the extent of derating required for each type of fabricated fitting

Maximum depth 8m

Construction tolerances as per clause 6.7.9.2 and clause 6.7.9.3.

Sizes: Refer clause 6.11.2 for minimum size.

Trench width: For trench depths 1.5m or less, the minimum width is outer diameter of pipe barrel plus 300mm. For trench depths greater than 1.5m the minimum width is as above from the base up to 300mm above the pipe crown and above that level the trench width shall be, at least 900mm.

Bedding as per clause 6.7.10.

6.11.6 Pipe Materials - Special Provisions

SP1: Subject to the approval of the Council's Wastewater Network Operations Manager, Ductile Iron (DI) pipes may be required on potentially unstable ground.

SP2: PVC pipes shall be used only with the approval of the Council's Wastewater Network Operations Manager, and with attention to anchoring valves and bends against movement.

SP3: RC pipes shall not be used for rising mains.

SP4: Council may permit other pipe materials subject to specific approval.

6.11.7 Joints

Joints shall conform to clause 6.7.12: Joints except that the joint shall be capable of withstanding the test pressure, the long-term working pressure and the short-term water hammer pressures specified in clause 6.11.1: Hydraulic Design.

6.11.8 Bedding and backfilling

Pipe bedding and backfilling shall conform to clause 6.7.10.

6.11.9 Fittings

Fittings such as tees, tapers, blank caps, plugs and bends of various degrees, made of ductile iron or cast iron, and the pipeline material, shall be as a minimum either spun concrete or epoxy lined, with approved external protective coating and PE sleeving to AS 3680 / 3681. Where PVC or PE pipes are used, their respective purpose made fittings shall be used.

Flanges shall be to Table 9 of AS/NZS 4331.2 (and BS 10). Fittings laid adjacent to other fittings shall have flanges.

All bolts, nuts and washers shall be grade 316 stainless steel to AS 1449. EPDM gaskets shall be used.

Where dissimilar metals are used purpose made approved thermoplastic inserts shall be installed in the flanges to prevent electrolytic action.

6.11.10 Valves

The designer shall detail the locations and types of isolating, air release, non-return (check) and scour (washout) valves on the rising main.

Intermediate Isolating Valves outside the pumping station shall only be fitted on excessively long rising mains, where it is necessary to isolate sections for effective maintenance. Such valves shall be capable of being locked in the open and closed positions. It shall be possible to fully drain out each section separated by intermediate isolating valves. The section adjacent to the pump station shall be drained to the wetwell and the volume within this section shall not exceed half the volume of the wetwell. Other sections shall be provided with washouts as per drawings WW227 or WW228. Each section shall be provided with at least one air valve at a high point as per drawing WW226 to allow air in during draining.

In order to facilitate maintenance and inspection, isolating valves shall be of the same internal (bore) size as the rising main.

The depth of the rising main shall be sufficient to accommodate the height of valve chambers / boxes.

Isolating valves shall be resilient seated sluice (gate) valves.

Scour (washout) valves shall discharge to a gravity sewer or be able to be connected to a sucker truck, without causing sewage to overflow (refer drawing WW227).

The accumulation of gas could severely restrict the pumping capacity, and therefore the need for air release valves shall be investigated for all high points of the rising main. It shall be possible to isolate air release valves (refer drawing WW226) when required for maintenance.

6.11.11 Plastic Pressure Pipes Encased in Concrete

Where plastic (including GRP) pressure pipes are encased in concrete, for instance where they pass through anchor or thrust blocks, they shall be wrapped with an approved compressible material such as building felt of minimum thickness 2mm. Where the pipe passes from the concrete encasement, the requirements as shown in drawing WW207 shall apply.

6.11.12 Anchor and Thrust Blocks

Cast in-situ concrete anchor blocks shall be provided at all points where there may be an unbalanced thrust.

Anchor blocks shall be designed using the bearing value of the site soil conditions, subject to a maximum soil bearing value used of 75 kPa. The inner face of the block shall not be of lesser thickness than the diameter of the fittings, and shall be constructed so as to allow access to the bolts on the fittings.

Concrete shall have a minimum compressive strength of 17.5 MPa at 28 days.

6.11.13 Odour and Septicity Control

The developer's proposal shall include measures, acceptable to the Council's Wastewater Network Operations Manager, to minimise potential odour problems that may result from excessively long detention time within a rising main. During the initial stages of a pumping station (i.e. when the actual pumping rate is much less than the ultimate design capacity), the detention time within a rising main designed for the ultimate capacity could be high. Measures to minimise potential odour problems may include the following:

- Where the actual pumping rate is expected to increase quickly due to rapid development, chemical-dosing facilities may be provided until the detention time falls to an acceptable level. The Council may require a contribution towards the operation, maintenance and decommissioning of such temporary facilities.
- Design and construct duplicate rising mains, with one commissioned immediately and the other to be commissioned at a suitable future time, as required.
- Other more complex measures such as injection of air / oxygen / oxidising agents may be considered only if all other options are not possible. The Council may require a contribution towards the operation and maintenance of such complex facilities.

6.12 Storage Tanks

Storage tanks shall be designed and constructed in accordance with the North Shore City Standards for Storage Tanks. This is a document that is updated regularly. The current version is available for reference from the Wastewater Network Projects Manager.

6.13 Tunnels

This Standard does not cover the requirements of Tunnels.

Tunnels will be considered by the Council on a case-by-case basis with due regard to consenting, technical, access, maintenance and economic considerations. At an early stage, developers shall discuss any potential tunnel proposals with the Council's Network Operations Manager to find out whether it will be an option acceptable to the Council. If the tunnel option is acceptable, standards for the tunnel will be stipulated by the Council on a case-by-case basis.

6.14 Pipe Bridges

6.14.1 General

Above ground sewers or pipe bridges shall be constructed in preference to inverted siphons, for crossing low lying land or gullies, or where excavation through unstable land may induce instability, or damage vegetation or bush areas protected by the NSCC District Plan or the ARC Regional Plan or any other statutory requirement.

Pipe bridges shall be constructed at grade, and shall have provision for draining-down for maintenance purposes. The scour valve arrangement for draining-down the sewer shall discharge to a sewer manhole or to a chamber for trucking away of the drained contents, as per drawings WW227 or WW228.

For rising (pressure) mains, it is theoretically possible to use arched pipelines to increase the length of unsupported span. However, arched sewers shall not be permitted due to issues associated with providing air valves at the crowns and washouts at the low points.

A building consent is required for any pipe bridge, whether private or public.

6.14.2 Aesthetics

Where a pipe bridge is to be located in a place where it causes a visual impact (eg residential areas, parks), the pipe bridge shall be designed in an aesthetically acceptable form. The exterior protection system, pipe joints and the form of the piers, abutments and the deck shall be selected to the Council's Wastewater Network Operations Manager's approval, with due regard for aesthetic considerations.

6.14.3 Pipe Material

When the sewer is to be laid above ground or as a pipe bridge, the pipe and support structure material shall be selected with respect to the particular conditions and shall be subject to the Council's Wastewater Network Operations Manager approval.

Pipe material shall be:

- UV resistant
- Impact resistant
- Vandal proof
- Fire proof

Above ground sewers and pipe bridges shall be of steel Pipes in accordance with NZS 4442, or Ductile Iron Pipes in accordance with AS/NZS 2280, or of stainless steel. Stainless steel pipes conforming to Table 6-2 shall be used for pipe bridges located in marine environment and bush areas of difficult access. The wall thickness of all stainless steel components shall not be less than 2mm, and the Design Engineers shall provide calculations to support the selection of wall thickness.

Where other pipe materials are proposed for above ground sewers and pipe bridges, the Design Engineers shall provide adequate reasons (not only cost considerations) to justify the choice of pipe material and this choice of material shall require the specific approval of Council's Wastewater Network Operation Manager.

6.14.4 Corrosive Sewage

Where above ground sewers and pipe bridges are required to carry corrosive sewage (e.g. sewage from a predominantly industrial area), then cement mortar internal lining shall not be used. The proposed internal lining system shall comply with the following requirements

- For the internal lining system, the Design Engineer shall submit calculations and copies of references for the Council's Wastewater Network Operations Manager's approval. The calculations shall relate projected life of the interior lining system to such parameters as the dry film thickness (dft) or the application rate, number of coatings, and the anticipated ambient conditions throughout the service life of the pipe bridge. The calculations shall prove a projected life of 100 years for the internal lining system, or the calculations shall recommend a replacement interval and maintenance requirements for the interior lining system, and provide a lifecycle cost of the lining system for a 100 year life of the pipe bridge.

  Along with the calculations, evidence shall be submitted to show that the material proposed for lining the pipes and fittings have a minimum 20 year successful history of protecting sewers in corrosive sewage environment similar to the proposed use (e.g. sewage from a predominantly industrial area).

  The material shall be a high build, multi-component, amine cured approved epoxy lining. It shall be solvent free on curing and capable of application by electrostatic charging of particles and stoving or by airless spray. It shall contain at least 20% by volume of ceramic quartz pigment.

  The use of polyurethane as the lining material, including 100% solids polyurethane, non-extended material without fillers, shall not be permitted.
- The minimum overall dry film thickness (dft) to pipe barrels and fitting waterways shall be as recommended by the coating system manufacturer, but not less than 1mm (1000 microns) over the peaks of the prepared metal surface.
- The number of coating layers and time between layers to achieve the minimum overall thickness to optimise in-service performance shall be based on recommendations by the coating system manufacturer and as approved by the Council's Wastewater Network Operations Manager.
- The coating system supplier shall supply laboratory evidence of corrosion and abrasion resistance of the proposed coating system prior to approval. Any manufacturing company test data shall be backed up by certified, independent approved laboratory test data.
- The protective coating system shall extend into the sockets and over the spigot ends of pipes so that no part of a completed joint assembly is exposed to direct corrosive attack. Minimum average thickness in sockets up to the shoulder of the gasket groove shall be 1mm (1000 microns) and on spigots and in gasket grooves shall be 250 microns with an absolute minimum thickness at any individual point of 200 microns. Lining of the spigots and gasket grooves shall be carried out after application of the pipe barrel and socket lining.
- The protective coating system shall provide resistance to abrasion and, therefore, fillers other than the ceramic quartz pigment shall not be permitted.
- The protective coating system shall be applied at the pipe manufacturers works or an approved specialist applicator firm's premises. The specialist applicator firm shall be competent with a minimum 10-year successful history of applying linings to the interior of ductile iron and steel pipes and fittings.
- Wherever flange fittings are to be utilised the lining shall not be applied to the face of the flanges. Full face, EPDM, 3.2mm thick, gaskets shall be used to protect the ends of the pipe.

- Holiday Detection Testing: The factory applied lining shall be subjected to a holiday detection testing at the manufacturer's/applicator's works. Site applied linings and areas of factory applied linings which have been completed or repaired on Site or which may, in the opinion of the Council's Wastewater Network Operations Manager, have suffered damage or have deteriorated in any way which warrants a retest shall be tested on site. The operating voltage of the equipment shall be selected to suit the type and thickness of the coating to be tested and the dielectric breakdown voltage per millimetre of coating thickness quoted by the manufacturer.
- Pipe manufacturer shall supply a guarantee warranting the in-service performance of the protective coating for a minimum period of ten years from the date of the Defects Liability Certificate. The guarantee shall also include a certificate from the coating manufacturer attesting to the fact that the material used was properly manufactured and comply with this Manual, and a certificate from the coating applicator attesting to the fact that the surfaces were properly prepared to receive the material and that the material was correctly mixed and applied under acceptable ambient conditions.

6.14.5 Design

6.14.5.1 Loading

Design loadings shall include those from dead and live loads, earthquake forces, wind forces, construction loading and other applicable forces, and conform to NZS 4203.

6.14.5.2 Design

The design shall be based on a site-specific geotechnical investigation. The design requires the specific approval of the Council's Wastewater Network Operations Manager. A Professional Engineer who is experienced in pipe bridge design and chartered under the Chartered Professional Engineers of New Zealand Act 2002 and who has professional indemnity insurance shall prepare the design.

6.14.5.3 Geotechnical Investigations

All geotechnical investigations shall be prepared by a Professional Engineer who is experienced in the practice of soils engineering and chartered under the Chartered Professional Engineers of New Zealand Act 2002 and who has professional indemnity insurance.

Investigations shall include, but not be limited to, a combination of the following:

- Machine Drill holes
- CPT testing
- Investigation Pits
- Hand Augering
- Laboratory testing

The Developer shall co-ordinate with all relevant utility providers so that existing services are not damaged due to geotechnical investigations. The Developer shall give sufficient prior notice as required, but not less than 2 weeks, to the Council and relevant utility providers regarding the commencement of geotechnical investigations.

6.14.5.4 Sewer Gradient

Design of the sewer gradient shall take into account the potential maximum settlement of the piers estimated using site geotechnical data. The gradient, calculated on the basis of projected maximum settlement of the piers, shall not be less than the required gradient as per Cl 6.7.1.

6.14.5.5 Differential Settlement

Flexible joints shall be provided at both ends of the above ground sewer or the pipe bridge in accordance with the requirements of Standard Drawing WW207. In addition, flexible joints shall be provided to cater for projected differential settlement, if any, of the piers. Such flexible joints shall be adequately supported or appropriately located to prevent sagging of the sewer.

Use Gibault joints, as required, for connecting different pipe materials at both ends of the bridge.

6.14.5.6 Dismantling Piece(s)

Using Gibault joints, a dismantling piece or pieces shall be provided, as required, to facilitate maintenance. Such dismantling piece or pieces shall be adequately supported or appropriately located to prevent sagging of the sewer.

6.14.5.7 Thermal Movement

The design shall take into account the projected cyclic thermal movements during the service life of the above ground sewer or the pipe bridge. Expansion/contraction joints shall be provided as necessary. Such expansion/contraction joints shall be adequately supported or appropriately located to prevent sagging of the sewer.

6.14.5.8 Safety / Vandal-proofing

Strong, durable, corrosion resistant barricades shall be fixed at either end of the pipe bridge to prevent public access on to the sewer, as per drawing WW230.

6.14.5.9 Walkways

Walkways shall not be provided on the pipe bridges unless specifically required by the Council's Wastewater Network Operations Manager who will discuss the proposed pipe bridge with Council's Parks Department and others as required. Where the pipe bridge piers are to be used to support a walkway, as per a Council request, the walkway shall not be placed directly above the sewer. The walkway shall be placed on one side of the sewer. Handrails shall be provided on the side opposite to the sewer, and guardrails shall be provided on the sewer side to prevent public access on to the sewer. Walkways shall be designed to NZS/AS 1657, as a minimum, plus additional specific requirements of the Council's Wastewater Network Operations Manager.

6.14.6 Construction

6.14.6.1 Steel Sewers

Welded joints in steel pipes shall be either butt joints, with an external welding band, or spigot and socket joints, or as otherwise approved by the Council's Wastewater Network Operations Manager. All welds shall be fillet welds of 7mm or larger, applied in the field. Where butt jointed pipes are used the ends shall be neatly butted where possible with a seal weld applied from the outside before the welding band is affixed.

The entire pipeline shall be hydrostatically tested as per clause 6.15.7 to ensure that the joints are adequately sealed. Any faulty welds shall be cut out and rewelded. On no account are leaks to be sealed by caulking. In addition to weld defects noted in NZ 4442, clause 111.1.1, if one leak in a welded seam length of 1.5m, or leakage over 75mm of seam or over more than 2 percent of seam, is apparent then the whole seam may be required to be cut out completely and rewelded. After repairs, the pipeline shall be retested hydrostatically. Continued failure of a repaired seam to pass the test will be grounds for the complete rejection of the section in which it is located.

After welding and testing as required, all unprotected metal inside and outside shall be thoroughly cleaned by appropriate methods. The internal and external exposed steel shall be protected promptly and damaged protective coatings repaired to original condition.

Field installed flanges shall also be thoroughly cleaned and protected by the application of an approved treatment system.

All protection systems shall conform to the following requirements:

- The complete protection system shall be manufactured by a manufacturer reputed in the industry and widely recognised as making state-of-the-art protective systems
- The exterior protection system shall conform to AS/NZS 2312 (exterior protection of above ground iron and steel). Where required by the Council's Wastewater Network Operations Manager, full gloss epoxy (2 pack) coatings shall be applied to AS/NZS 3750 Part 10.
- The application of the system shall be carried out by trained personnel certified by the manufacturer of the system
- For the exterior protection system, the Design Engineer shall submit calculations and copies of references for the Council's Wastewater Network Operations Manager's approval. The calculations shall relate projected life of the exterior protection system to such parameters as the dry film thickness (dft) or the application rate, number of coatings, rust inhibiting properties of the coatings, UV resistant properties of the coatings and the anticipated ambient conditions throughout the service life of the pipe bridge. The calculations shall recommend a replacement interval and maintenance requirements for the exterior protection system, and provide a lifecycle cost of the protection system for a 100 year life of the pipe bridge.
- A guarantee from the manufacturer shall be provided against UV degradation of the protection system and rusting of the exterior surface of the sewer for a period not less than the projected life of the protection system as per the Design Engineer's calculations (refer preceding paragraph). The manufacturer's guarantee shall further certify that the protection system is fully compatible with the material of the sewer, gaskets, flanges, brackets, valves and all other material that will be in contact with the exterior protection system during its service life.
- Testing of the external pipe protection system, and external joint protection system and its continuity with the pipe protection system shall be carried out strictly in accordance with the requirements of the manufacturer guaranteeing the performance of the protection systems.

- The internal protection system for the pipes shall be equivalent to or superior to the spun cement mortar lining specified in NZS 4442, subject to the following requirement on service life. The internal pipe protection system, and internal joint protection system and its continuity with the pipe protection system shall ensure a sewer service life of not less than 100 years. The Design Engineer shall submit calculations and copies of references for the Council's Wastewater Network Operations Managers approval, to demonstrate that the projected service life of, at least, 100 years can be achieved.
- Where the pipes are spun cement mortar lined to NZS 4442, Joints shall be internally protected with an epoxy mortar lining to give a smooth and even internal bore. Materials for the mortar shall comply with the requirements of the manufacturer guaranteeing the performance of the protection system. The application shall be carried out using a lining machine by trained personnel strictly in accordance with the manufacturer's methodology. Epoxy mortar consistency shall be such that to prevent the mortar from sagging or dropping out. An approved admixture may assist. The surface finish shall be further improved by pulling a conical trowel behind the lining machine. All in-situ mortared joints shall be checked over the full circumference by CCTV survey, and all cracked joints or joints with mortar protruding into the bore shall be replaced.

6.14.6.2 Ductile Iron Sewers

DI pipes shall be either spun concrete or epoxy lined, with approved external protective coating and PE sleeving to AS 3680 / 3681.

Appropriate approved protection systems shall be used for DI pipes in industrial areas and if hydrogen sulphide corrosion or external corrosion is likely. The developer shall carry out tests for external aggressiveness, to assist the selection of an appropriate protection system.

Based on the design wall thickness required for the sewer, Class K9 or K12 shall be used.

DI pipes shall be jointed using either flanged joints or flexible joints (Gibault or approved rubber ring joints, refer clause 6.7.12.3). Gibault joints shall have stainless steel bolts (grade as per Table 6-2).

6.15 Testing And Acceptance

6.15.1 General

Prior to placing them into service, completed works shall be tested by the Developer / Design Engineer, at their own cost, to the satisfaction of the Council's Wastewater Network Operations Manager / representative. This shall include the submission and approval of as-built plans, testing of works, defects liability periods, consents issued by other parties, financial considerations and checking against conditions of approval issued for the works originally.

As-built data shall conform to the Council's requirements, as specified in the Asset Data Standards Manual (ADSM).

Testing shall be carried out at two stages. The first test shall be carried out on completion of the works at the sub-division stage and the second test on completion of the connections at the development stage.

6.15.2 Reinstatement Works

Areas where works have taken place shall be reinstated to a condition not worse than before the works have taken place. The Developer shall obtain written approval of the owners affected by the works indicating their satisfaction of the reinstatement works.

6.15.3 Documentation

Documentation of testing and certification of works shall be in accordance with NSCC Quality Assurance Manual for inspection and release of subdivision development projects.

6.15.4 Pipelines

Straight pipelines shall be visually sighted to ensure a full bore can be seen in each section.

All pipelines shall be inspected internally with CCTV, preferably after a rain event, and recorded on videotape. Inclinometer surveys shall be carried out with all CCTV inspections. The cost of the inspection shall be borne by the Consent Holder.

Pressure or leakage testing as specified in the current relevant standards shall be carried out on all pipelines (or on a selected sample) as directed by the Council's Wastewater Network Operations Manager. Pipelines shall be tested for acceptance with at least 500mm of cover.

The pipeline testing should be carried out in the following order:

1. Infiltration test: This would be the first test to be carried out if the groundwater level is above the buried pipeline.
2. Low-pressure air test.
3. Water test: Water test would only be carried out if the pipeline fails the air test.

Make sure that plugs have remote deflation device and are secured to rungs of manhole, or other approved means, to avoid being washed through pipeline upon deflation.

Dispose all collected sewage to the next downstream sewer manhole and leave the site in a clean and sanitary condition.

6.15.5 Infiltration Test

The pipeline under test should be effectively plugged as for the water test, particular care being taken to fix plugs against washing down the line (refer clause 6.15.4).

The upstream ends should be plugged first. The pipeline should be allowed to drain for 15 minutes and the downstream ends should be plugged on the outlet side of the observation manhole. All remaining water in the observation manhole should be pumped out to the next downstream sewer manhole for a maximum of 15 minutes.

Pump out the inflow to the observation manhole into a graduated 200 litre drum for 30 minutes or note the time to fill the drum, whichever takes lesser time. This data would be used to calculate the infiltration rate (Q_t) into the pipeline and the observation manhole.

Isolate the observation manhole by plugging all inlets and outlets. Pump out the infiltration to the observation manhole into a graduated 200 litre drum for 30 minutes or note the time to fill the drum, whichever takes lesser time. This data would be used to calculate the infiltration rate (Q_m) into the observation manhole.

Infiltration rate to the pipeline would be calculated by subtracting Q_m from Q_t. The infiltration rate should not be more than 0.3ml per hour per mm diameter of pipe per metre length.

Dispose all collected water to the downstream sanitary sewer manhole and leave the site in a clean and sanitary condition.

6.15.6 Low Pressure Air Test

The pipeline under test should be effectively plugged as for the water test, particular care being taken to fix plugs against movement, and air introduced by suitable means (such as hand pumps) until a pressure of 300mm of water is indicated by a suitable manometer (such as a U-tube) connected to the system. Chains shall be used to tie the plugs to sturdy rungs or similar (refer clause 6.15.4).

After the air has attained a uniform temperature, as indicated by the pressure becoming steady, the source of air supply shall be physically disconnected and the pressure drop measured after a test period of 5 minutes.

The acceptance limit shall be a pressure drop not exceeding 50mm in 5 minutes.

Under conditions of high groundwater, a gain in pressure may indicate that a pipeline is unsatisfactory.

6.15.7 Water Test

The pipeline under test shall be subjected where practicable to a minimum internal pressure of 1.5m head of water above the top of the pipe at the high end, but not more than 6m at the low end. Pipelines laid to steep gradients should be tested in stages to avoid exceeding the maximum pressure indicated above.

The test line should be sealed by fixing suitably strutted plugs at both ends and into side connections, if necessary, and filled with water, care being taken to expel all air. Chains shall be used to tie the plugs to sturdy rungs or similar (refer clause 6.15.4). The line should be maintained filled with water for an absorption period of at least 30 minutes.

The acceptance limit shall be a water loss not exceeding 0.3mL per hour per mm of internal diameter per metre of pipeline length.

Where a buried pipeline is below groundwater level, the minimum test head of 1.5m shall be measured above the level of the groundwater.

6.15.8 Rising Mains

Before joints are covered, the entire rising main shall be tested in the presence of the Council's Wastewater Network Operations Manager / representative. A test pressure, equal to twice the maximum working pressure shall be applied to the main for a period of 15 minutes. During this period the leakage shall not exceed 0.1mL per hour per mm diameter per metre length.

The Engineer may require the same test to be repeated after backfilling is completed.

CHAPTER 2

Appendices

In This Chapter

Appendix 6A: Bill of Electrical Materials: NSCC Small Pump Stations

Two Pump Station, Electronic Soft Starter or DOL starters.

Revised 19 July 2005

The Contractor shall supply the following equipment types. All dimensions are to be confirmed by Contractor on receipt of the equipment and prior to switchboard construction:

Reference	Quantity	Description	Supplier
Outdoor Enclosure	1	Stainless steel or powder coated aluminium IP54 enclosure for mounting all control cabinets (confirm powder coat requirements with NSCC)	
Enclosure light	1	Versalux AD240/13 slimline Fluorescent	Versalux Lighting
Multibox Enclosures	As required	3mm Aluminium fully welded IP54 powder coat enclosures for mounting all electrical equipment. Colour light straw.	
DB1	1	NHP Din-T fully insulated 3 phase 415V copper bus bar chassis rated at 250A	NHP
MCCB1	1	Terasaki XS125NJ for incomer main switch	NHP
Generator Changeover Switch	1	3 pole three position 126 A Kraus & Naimer lockable rotary handle. Type KG126-E Gen/Off/Mains	N Z Solenoid
MCB1 …	As required	Terasaki Fault current limiting distribution MCBs Type DTC B15	NHP
V1	1	Voltmeter, 0-500V AC 72 mm square	Carrel & Carrel
PFR	1	Phase Failure Relay; Crompton 252-PVR	Electrade
PRI	1	Phase Rotation Indicator; Crompton 232-12PG	Electrade
VS1	1	4-position AC voltmeter Selector Switch CG8-A007	N Z Solenoid
A1, A2	2	Motor Ammeter, moving iron 72 mm square overscaled to 2x. Direct reading or multi turn through 60/5 CT	Carrel & Carrel
CT1, CT2	2	60/5A 5VA type 1.0B Current Transformers for ammeter (if required)	Carrel & Carrel

Reference	Quantity	Description	Supplier
C1A - C2C	4 or 6	Contactor, 3 pole, 240VAC coil, Telemecanique LC1-D series selected for the required switching duty	Schneider
IT1, IT2	For DOL starters only	Loop powered CT Current Transmitter. Carrel & Carrel T-ILC Range selected for motor FLC.	Carrel & Carrel
THOL1, 2	For DOL starters only	Motor Thermal Overload relay, 3 pole, Telemecanique LRD series to suit full load current	Schneider
HS1, 2, 4	2	2 pole 3 position 230VAC/24V DC, 10A Control Switch, Kraus and Naimer CA4-1/FS	NZ Solenoid
HS3	1	2 pole 2 position 230VAC/24V DC, 10A Control Switch, Kraus and Naimer CA4-1/FS	NZ Solenoid
F1 etc	as required	BS88 HRC, 32A Fuse holders 400/230 VAC	
HR1, 2	2	Hour run meter 240 V 50Hz, 5 digit non-resetable, Panel mount	Carrel & Carrel
Reference	Quantity	Description	Supplier
IS1, IS2	2	3-Pole 63A lockable main isolator, 1 NO Auxiliary, KG series with lockable rotary handle	NZ Solenoid
L1 etc housings	as required	Indicator housings, 22mm, Klochner RQM22-ML LED, voltage and colour as specified	Bremca
L1 etc lamps	as required	24 V BA9S Multi LED lamps, colour as specified	Bremca
M1	1	3 Phase 80A max Revenue Meter	Electricity Supplier
ES	1	4 pole Latching Push button 22 Ø mount, Mushroom head, Klockner	Bremca
PB1, 2, 3	3	Push button 22 Ø shrouded, contacts and colour as required, Klockner	Bremca
PFC1, 2	2	3 phase Power Factor Correction Capacitors	Refer spec 2.5.12
EFR1, 2	2	Terasaki TSZ AD 120240 earth fault relay with TZS 15 or 24 CT Current Transformer, 15 or 24 mm hole to suit cable size	NHP

Reference	Quantity	Description	Supplier
SS1, 2	For Soft Starter version only	Aucom IMS2 Series IP42 soft starters	Danfoss
Relays R1 …	as required	Finder 60.13.x.xxx.52540 240 VAC or 24 VDC coil, bifurcated gold plated contacts with rail mount front wired 90.12 base	Electrade or NHP
Telemetry RTU	1	Kingfisher RTU enclosure, radio, power supplies, with mounting hardware and connections	W A Fisher
Power Supplies, Antenna	As required	Power supplies, UHF antenna with mounting pole, hardware and cables	Marsa Consultants
T1	1	Wet Well Washer 240V/24VAC 30VA Isolating Transformer with earthed screen	Transformer Specialties Ltd
S1	1	1 phase RCD IP66 Switched socket outlet, 3-pin 10 A 30 mA	PDL56C310E LCB
Terminals	as required	Weidmuller WDU 2.5 with all accessories	Cuthbert Stewart
THERM	DOL starters only	Manual reset Thermistor relay with two output contact sets	Schneider or Rockwell Automation
Heaters	one per multibox	Rittal SK3105.000 rail mounted 10 Watt 230 VAC anticondensation heater,	Rittal
MT2PC	1	Multitrode MT2PC pump controller	Applied Instruments
Level Probe	1	Multitrode Ten sensor probe (length to be determined by wet well pump start/stop levels)	Applied Instruments
Security system	1	Station Security controller with remote keypad for flush fitting on multibox door	Instrumentation Systems Ltd. Ph 021 293 7608.
Generator connection	1	Gewiss IEC 60309 generator inlet receptacle 5 pin 63 amp	Ideal Electrical
Pump Plugs and sockets (hazardous)	2	Marechal DSN type to suit pump motor and thermistor (Pins 3P+E+2C)	Bremca. ChCh

Reference	Quantity	Description	Supplier
Pump Plugs and sockets (non-hazardous)	2	PDL 56 Series type to suit pump motor and thermistor (Pins 3P+E+2C)	Schneider
Reference	Quantity	Description	Supplier
Door switches	as required	P & F IP68 Inductive proximity switch for enclosure doors and wet well and valve chamber covers	Unilink
Float switches	as required	Flygt ENM-10, SG 0.95 - 1.1, cable length as required to reach switchboard	Trimate Industries
Wet Well washer solenoid valve	1	IP68 24 VAC solenoid valve coil for potable water spray washer	TBA
Wet Well Area lighting	1	EYE 160 Watt 240 V self ballasted MV PAR38 lamp, with cast guard and F7 flanged base on 50 mm galvanised pole.	EYE Lighting

Appendix 6B: Glossary

Item	*Definition*
ABS	Acrylonitrile Butadiene Styrene
Access point	Access points are non-man-entry devices, which allow operators to work from the surface to carry out maintenance and inspection of sewers using commonly available maintenance and inspection equipment. Access points are provided in-lieu-of manholes.
ADWF	Average Dry Weather Flow
Air Valve	A valve used to release air automatically from a rising (pressure) main. There are two types; single orifice and double orifice.
Air Valve Chamber	A chamber housing an underground air valve. Air valve chambers should be vented, and if required, provided with odour management devices.
Allotment	Refer lot
Anti-siphon	See inverted siphon.
AP	All Passing: This is a grading specification for a granular material (eg granular bedding material). The term AP implies a more stringent grading specification than GAP or SAP (see below). The term AP is used by Transit NZ in the specifications for road basecourse (eg AP40 means a granular material all passing through a 40mm sieve and having a specified grading curve).
ADC	A qualified and experienced drainage contractor approved by the North Shore City Council as an Approved Drainage Contractor to carry out wastewater works in accordance with this manual. The list of current ADCs is available from the Council's area offices.
Backflow Preventer	A check valve arrangement used to prevent reverse flow of liquid.
Backfill	The soil material placed back in the trench after the pipe is laid, at the sides of a pipe and above the pipe. It influences the supporting strength of the pipe by exerting lateral pressure against the sides i.e. by resisting the pipe being “squashed” oval by the vertical load on it. It adds to the crushing load on the pipe from its weight on top of the barrel.
Benching	The sloped floor of a manhole on both sides of and above the channel, on which a person can stand. Located at the sides of the channel(s) in a manhole, typically (desirably) providing a standing place above the level of the top of the pipe. Typically sloped towards the channel so as to be self-draining.
BP	Refer City Blueprint
Branch Sewer	A sewer serving a relatively small area that joins another similar or larger sewer.

Item	*Definition*
Cast-in-situ Manhole	A manhole constructed in-situ using concrete poured into formwork.
Catchment Area	The area draining to a given point. Sometimes termed a 'catchment basin', or 'catchment'.
Channel	The open water way from inlet to outlet in the manhole base. The channel is “U” shaped with the bottom semi-circle having diameters smoothly varying from the inlet diameter to outlet diameter. The top of the “U” should be above the soffits of the inlet and outlet pipes. When manholes have branches or flow direction changes, the channels should be formed as smooth curves. At the point of merging, a branch flow should not be in an opposing direction to the main flow.
Check Valve	A valve that is opened by the flow and closed by gravity or backpressure when the flow stops, thereby preventing reversal of flow. Also termed a non-return valve, or reflux valve.
City Blueprint	The City Blueprint sets a framework for managing growth and change in the city over the next 20 years, while protecting the natural environment
Coarse Screen	A screen used for removing gross solids from domestic or industrial wastewater, with spaces between the bars typically 20mm wide or more.
Conceptual Reticulation Plans	Conceptual wastewater reticulation plans developed by the Council which are based on the most up to date ultimate growth information
Connection	** to be defined through consultation*
Cumec.	Cubic metre per second
Customer's wastewater drain	The wastewater pipe and drain from the customer's property to the point of connection with the Water Services' drain, or through to the boundary with the legal road (whichever is nearer), is entirely the owner's responsibility. These are sometimes referred to as “private sewers” or “private drains” or “laterals”.
Detailed Catchment Model	Wastewater catchment models developed by NSCC which provides details such as system capacity, on a mini-catchment level
DI	Ductile Iron
Discharge	The rate of flow through a pipe or channel, typically expressed in litres per second or cubic metres per day.
District Plan	The District Plan is a legal document that the City is required to prepare under the Resource Management Act (RMA) 1991. It identifies the City's objectives for looking after and improving the environment, and the policies and rules for achieving them. The District Plan contains rules on building, subdividing or undertaking a new type of activity and identifies resource consent requirements.
DN	See ND
DP	Refer District Plan

Item	*Definition*
Drop Manholes	If an incoming sewer is considerably higher than the outgoing, a drop manhole should be used (refer Drawings for internal and external drops)
Dry Weather Flow (DWF)	The rate of flow during normal dry weather; typically expressed as cubic metres per day or litres per second.
Dry Well	A dry chamber housing non-submersible pumps below the operating water level, located adjacent to the wet well.
Easement	A right acquired legally to make use of another's property, such as a right of way over their land.
Environmental Services Development Engineer	NSCC Environmental Services Development Engineer who acts as a representative of the Wastewater Network Operations Manager and the Wastewater Planning Manager, for the purpose of approvals and provision of information as defined in the Infrastructure Design Standards.
Equivalent Population (EP)	Equivalent population is the population in an area plus the calculated population which produce a wastewater flow equal to the area's non-residential wastewater flow when calculated on the basis of daily flows.
Exfiltration	Leaking out of sewage into soil and groundwater through faulty joints, damaged pipes, at manholes and the like. Exfiltration causes environmental pollution.
External Drop	The short vertical pipeline that connects a higher-level sewer to the channel at the base of a manhole is referred to as a Drop. It has a Y at the top end and a bend at the bottom end. When the drop is located outside the manhole it is called an External Drop (refer Drawing). At the moment, the Council does not allow external drops.
Flexible Joint	A coupling between pipes that can accommodate rotational movement between the two without loosing its ability to provide a leak tight seal. Typically involving rubber rings. Common types are spigot and socket joints, and gibaults.
Force Main	See rising main.
Foul water	See sewage.
FRP	See GRP
GAP	General All Passing: This is a grading specification for general granular material (eg granular bedding material). The term GAP implies a less stringent grading specification than AP (see above). If a tighter specification is required it should be stated (eg GAP40 with no fines smaller than 2.36mm).
Gravity Sewer	A sewer with sewage flowing under gravity only.
Groundwater	Water contained in the soil. Usually meant as below the water table but also includes capillary water etc in unsaturated soil above the water table.
GRP	Glass Reinforced Plastics (Glass-fibre Reinforced Polyester) or (Glass-fibre Reinforced Thermosetting Resin) or (Reinforced Thermosetting Plastic)

Item	*Definition*
GRTR	See GRP
Gully	A small chamber that receives wastewater discharges from washbasins, sinks and baths. A gully is usually fixed to ground or floor, has a grating as the cover and discharges to a sanitary sewer through a water trap formed by an "S" or "U" bend in the outlet pipe. Due to these traps, a gully is also referred to as a *Gully Trap*. If gully is located in a low spot of the ground or in a flow path, copious amounts of surface water can enter the sewer through the gully. The Council requires that the top of the rim round a gully should be well above the maximum expected surface water level at the location of the gully.
Infiltration	Ingress of groundwater into the sewer system through faulty joints, damaged pipes, at manholes and the like. Infiltration increases sewage volume and flow rate, makes the sewer and treatment systems more costly and causes environmental pollution due to sewage overflows. The Council requires the infiltration to be minimised through proper design, construction, operation and maintenance of private and public sewerage systems.
Inflow	Ingress of surface water into the sewer system through faulty gullies, damaged manhole covers and the like. Inflow increases sewage volume and flow rate, makes the sewer and treatment systems more costly and causes environmental pollution due to sewage overflows. The Council requires the inflow to be minimised through proper design, construction, operation and maintenance of private and public sewerage systems.
Inlet	An opening through which an incoming sewer enters a manhole or a pump station.
Non-entry Chamber	A chamber provided over a sewer or lateral for inspection and maintenance access purposes.
Interceptor Sewer	See trunk sewer.
Internal Drop	The short vertical pipeline that connects a higher-level sewer to the channel at the base of a manhole is referred to as a Drop. It has a Y at the top end and a bend at the bottom end. When the drop is located inside the manhole it is called an Internal Drop (refer Drawing).
Invert	The surface of the bore of a pipe or of a channel at the bottom centreline of its cross section.
Inverted Siphon	A section of gravity pipeline that dips below the general gradient such that it (the section) flows full, and in which the flow is driven by the difference in level between its upstream and downstream ends.
Junction	Refer Y Junction.
Lateral	Customer's Wastewater Drains are sometimes referred to as "laterals". Also, where a Customer's Wastewater Drain enters the road reserve or a reserve, the drain section within the reserve will be taken over by the Council as a public drain and is referred to as a lateral.
Local Sewer	See reticulation sewer.

Item	*Definition*
Long Radius Bend	Bends used for forming curved sewers and in ramped drops and the like. These bends have long radii (not less than 4 times the diameter (NB)) to allow maintenance and inspection equipment to pass through them. Long radius beds are also used at locations where minimal headloss is desired for hydraulic reasons
Lot	A piece of land having specific boundaries. The word "lot" is the shorten form of the word "allotment" which is defined in the Building Act 1991 and in the Resource Management Act 1991. A lot is sometimes referred to as a "property"
Manhole	A chamber built on a sewer pipe or conduit usually large enough for a person to enter to provide access from ground level for the purposes of inspection, clearing of obstructions, or repair.
NB (Nominal Bore)	Nominal internal diameter of a pipe. The exact internal diameter corresponding to a NB is specified in the relevant standards, subject to a tolerance limit.
ND (Nominal Diameter)	Nominal external diameter of a pipe. The exact external diameter corresponding to a ND is specified in the relevant standards, subject to a tolerance limit.
NID	Nominal internal diameter of a pipe or a manhole. The exact internal diameter corresponding to a NID is specified in the relevant standards, subject to a tolerance limit. Also refer NB.
Outlet	Exit of flow from manhole.
Overflow (accidental)	An accidental sewage overflow could occur due to system malfunction, but proper design and operation of a system should eliminate such overflows.
Overflow (designed)	Specially designed overflow facilities are provided in sewage pump stations to prevent accidental uncontrolled overflows in the event of pump system malfunction.
PB	Polybutylene
PE	Polyethylene
PWWF	Peak Wet Weather Flow (4 times average dry weather flow, ADWF)
Pipeline	A long line of pipes forming a continuous conduit, typically constructed in a trench or tunnel.
PN (Nominal Pressure Rating)	The pressure rating of a pipe, usually expressed in bars (1 bar is approximately 10m head of water or 100 kPa)
Polymer Concrete	See PRC
Potable water	Water that is suitable for drinking.
PP	Polypropylene
PRC	Polyester Resin Concrete

Item	*Definition*
Pre-cast Manhole	A manhole constructed using pre-cast concrete components.
Private Drain	Refer customer's wastewater drain.
Private Pumping Station	A private pumping station is operated and maintained by a private party. A pumping station, normally automatically controlled and monitored, pumps sewage form a low point to a high point of the sewer system.
Private Sewer	Refer customer's wastewater drain.
Property	Refer lot
Public Drain	Refer Water Service 's wastewater drain.
Public Sewer	Refer Water Service 's wastewater drain
Pumping Station	A pumping station, normally automatically controlled and centrally monitored via telemetry, pumps sewage form a low point to a high point of the sewer system.
PVC	Polyvinyl Chloride
Ramped Riser	Where a junction is deeper than 1.5m below ground level, an inclined short pipeline, referred to as a ramped riser is constructed to bring the point of connection to within 1.2m of ground level.
RC	Reinforced Concrete
Relief Sewer	A secondary sewer installed to carry flows in excess of the capacity of i.e. to relieve the hydraulic load on, the primary sewer.
Representative	The term “Representative” (when used to define a person) means the Council's Wastewater Network Operations Manager's nominated representative, including a NSCC Water Services Engineer or NSCC Environmental Services Development Engineer
Resource Management Act (RMA)	Resource Management Act including all its amendments
Reticulation Sewer	A relatively smaller sewer, up to NB 300mm diameter, serving a mini-catchment. It is also referred to as a “local sewer”.
Rising Main	A pipeline through which a liquid is pumped to a higher level. Such a pipeline always flows full (and under pressure) as distinct from a gravity sewer.
Rodding Point	An access point for maintaining sewers, which is constructed using a “Y” branch or a 45^0 bend, short inclined pipe and a removable sealing cap.
Sanitary Sewer	A sewer conveying domestic, industrial, commercial and institutional wastewater.
SAP	Scoria All Passing: This is a grading specification for scoria granular material (eg granular bedding material). The term SAP implies a less stringent grading specification than AP (see above). If a tighter specification is required it should be

Item	*Definition*
	stated (eg SAP40 with no fines smaller than 2.36mm).
Scour valve	A gate valve on the washout of a sewer. A scour valve is opened only when it is necessary to empty or flush a sewer.
Screen	A device for removing gross solids from sewage.
SDR	Standard Dimension Ratio (Diameter/Wall Thickness)
Sewer	See sanitary sewer.
Sewage	The water borne waste of a community, which consists of foul water and trade effluent. Ingress of surface and ground water into the sewers and manholes increases the volume and rate of sewage flow.
Sewerage	A system of pipes and appurtenances for the collection and transportation of domestic and industrial wastewater.
Soffit or Crown	The surface of the bore of a pipe at the top dead centre of its cross section.
Springing line or Spring line	Mid section of pipeline.
ST	Steel
Surface Water	The run-off of natural water from the ground surface, including paved areas, roofs, and unpaved land. Also includes ponds, streams etc.
Surge	A high-pressure wave that travels along a rising (pressure) main. Surges are created due to sudden changes of flow conditions (eg sudden closure of a valve). Surges could cause pipe bursts and equipment damage.
Surge Tank	A tank designed to dampen surges to protect pipelines and equipment.
Thermoplastics	Plastics made up of non-cross linked chain molecules. These plastics melt when heated (eg PVC, PE, PP, PB, ABS)
Thermoset	Plastics made up of cross-linked chain molecules. When heated, these plastics disintegrate before melting (eg GRP)
Throat	Manhole throat is located between the buried lid of the manhole and the cover at the surface level. Access to the manhole is through the throat, which is of a smaller size than the chamber of the manhole.
Trade Waste	Wastewater of industries. Unlike domestic wastewater, different trade wastes could have a wide range of physical and chemical characteristics.
Trunk Sewer	Trunk sewer is a public sewer that has a nominal inside diameter of its pipe barrel equal to or greater than 300mm. It is a relatively large sewer, serving several reticulation sewers. Trunk sewers are sometimes referred to as “trunk pipelines”.
VC	Vitrified Clay

Item	*Definition*
Verticals	Vertical or near vertical pipe structure used in lieu of drop manholes, where a sudden change in sewer invert level is necessary.
Washout	Washouts are provided at suitable low points of long rising mains, and are used at times to empty and flush rising mains for maintenance purposes.
Wastewater Network Operations Manager	The Council's Wastewater Network Operations Manager or nominated representative (also refer Representative)
Water Hammer	See surge.
Water Services' Wastewater Drain.	What is considered a Water Services' drain depends upon a number of factors. A Water Services' drain is normally: ▪ a wastewater drain that serves more than one lot, or, ▪ a wastewater drain when it enters the legal road reserve or other reserve from the boundary, or, ▪ a wastewater drain declared by the council to be a Water Services' drain. These are sometimes referred to as “public sewers” or “public drains.” Refer WW224 and WW225
Water table	The surface below which the ground is saturated with water, except where that surface is impermeable.
Wet Weather Flow (WWF)	The rate of sewage flow during wet weather; typically expressed as cubic metres per day or litres per second. Wet weather flow is higher than the dry weather flow due to inflow and infiltration. Systems should be designed and constructed so as to minimise flow increase due to wet weather.
Wet Well	In a pumping station, the chamber that collects sewage for pumping is called a wet well. Some types of pumping stations have dry wells adjacent to wet wells, to house non-submersible pumps. In some types of pumping stations, wet wells house submersible pumps.
Y Junction	A point at which a sewer is connected direct to another sewer. A “Y” is used to make the junction, hence the term Y junction.

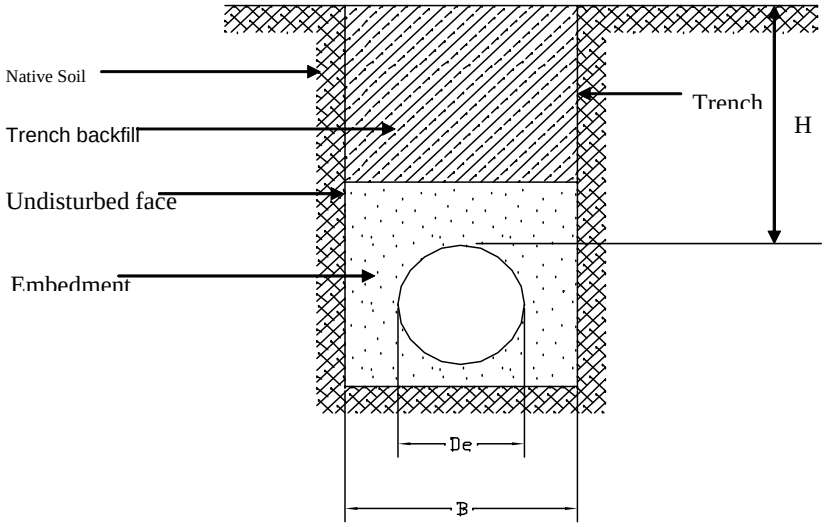
Appendix 6C: SN Tables for PVC Pipes

PVC PIPES TO AS/NZS 1260:1999 FOR DRAIN, WASTE AND VENT (DWV) APPLICATIONS

PIPE CLASS FOR STRUCTURAL PERFORMANCE - SELECTION CHART

Based on AS/NZS 2566.1: 1998: Buried flexible pipelines, Structural Design

Definitions



B = Width of trench at the springline

D_e = Outside diameter (OD)

H = Cover, vertical distance between the top of the pipe (external) and the finished surface

H_w = Height of water surface above the top of the pipe

DN = Nominal size (internal)

R_D = Dry density ratio of compacted backfill determined in accordance with AS 1289 (refer AS/NZS 2566.1, Cl 3.3.2.2(b))

Assumptions:

1) HW = 2m This is a reasonable assumption, but during wet weather periods some sites can have high water table levels.

2) It is assumed that RD reflects the quality of workmanship approximately as follows:

R_D	Workmanship
85%	Poor
95%	Good

3) It is assumed that the native soil is; fine grained soil (liquid limit < 50%) with medium to no plasticity and containing more than 25% coarse-grained particles (AS1726 classification CL, ML, mixtures ML-CL and ML-MH). The following soil moduli are assumed:

SPT Value Range	Soil Moduli E'n
5 to 14	1
15 to 24	3
25 and more	5

Note: Different types of soil and SPT values below 5 need specific design.

4) B = De + 300mm (as per clause clause 6.7.5.4(c))

5) Unit weight of trench fill (G) = 20 kN/m3

6) Superimposed live load (w_q) at the trench surface is taken as Austroads T44 truck loading with multiple lanes (refer Figure 4.1 of AS/NZS 2566.1: 1998 which includes impact factor).

7) It is essential that the pipeline should be protected from loading during construction stage. It may be necessary to provide temporary cover locally to reduce the construction loads, in case loading is unavoidable. It is assumed that, as a minimum, a cover of 1.0m including embedment will be provided before any loading occurs. The following construction loading is assumed:

Construction equipment assumed to load the pipeline	Vibrating roller
Assumed total load (AS/NZS 2566.1 Supp1: 1998 Cl C4.7.3)	350 kN
With 1.0m cover, assumed distributed area (3.55m x 1.45m)	5.1m^2
Design load on pipeline during construction	68 kPa

8) This analysis does not include accidental construction loading including accidental impact loading. These must be avoided by providing adequate cover.

Chart 1 - DN 150mm

THIS CHART SHALL BE READ IN CONJUNCTION WITH DEFINITIONS AND ASSUMPTIONS SPECIFIED EARLIER IN THIS APPENDIX AND THIS PAGE.

Native Soil SPT Values (Refer (3), Pg 1-1)	Embedment	Cover Depth (m)	Workmanship	
			Poor	Good
25 and more (E'_n = 5)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	SN16	SN16
		10	**PN12**	SN16
		12	**PN12**	SN16
25 and more (E'_n = 5)	SAP7 or AP7	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	**PN12**	SN16
		12	-	**PN12**
15 to 24 (E'_n = 3)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	**PN12**	SN16
		12	**PN12**	**PN12**
15 to 24 (E'_n = 3)	SAP7 or AP7	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	**PN12**	**PN12**
		12	-	**PN12**
5 to 14 (E'_n = 1)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	**PN12**	**PN12**
		8	**PN12**	**PN12**
		10	-	-
		12	-	-
5 to 14 (E'_n = 1)	SAP7 or AP7	2	SN16	SN16
		4	**PN12**	**PN12**
		6	**PN12**	**PN12**
		8	**PN12**	**PN12**
		10	-	-
		12	-	-

Disclaimer:

This chart provides indicative information only. Its validity for individual jobs are not guaranteed.

This chart does not cover job specific pipe quality, site conditions, standard of construction and level of supervision.

This chart shall not in any way be interpreted as relieving the responsibility of designers for a job specific pipeline design.

Assumptions:

If site conditions and workmanship differ from any of the following assumptions and those described in this Table and Assumptions detailed in previous pages, then a job specific pipeline design must be carried out by the developer's design engineer and approved by the Council's Wastewater Network Operations Manager.

The assumptions are:

Maximum design loading at the top of the cover during construction: 350kN over 2.1m length

Minimum cover for the construction loading: 1m

Maximum water table level over top of pipe: 2m

NOTE: When there will be PVC pipes under a road, these must be **PN12**.

Chart 2 - DN 175mm

THIS CHART SHALL BE READ IN CONJUNCTION WITH DEFINITIONS AND ASSUMPTIONS SPECIFIED EARLIER IN THIS APPENDIX AND THIS PAGE.

Native Soil SPT Values (Refer (3), Pg 1-1)	Embedment	Cover Depth (m)	Workmanship	
			Poor	Good
25 and more ($E'_n = 5$)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	SN16	SN16
		10	**PN12**	SN16
		12	**PN12**	SN16
25 and more ($E'_n = 5$)	SAP7 or AP7	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	**PN12**	SN16
		12	-	**PN12**
15 to 24 ($E'_n = 3$)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	**PN12**	**PN12**
		12	-	**PN12**
15 to 24 ($E'_n = 3$)	SAP7 or AP7	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	-	**PN12**
		12	-	**PN12**
5 to 14 ($E'_n = 1$)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	**PN12**	**PN12**
		8	-	-
		10	-	-
		12	-	-
5 to 14 ($E'_n = 1$)	SAP7 or AP7	2	SN16	SN16
		4	**PN12**	**PN12**
		6	**PN12**	**PN12**
		8	-	-
		10	-	-
		12	-	-

Disclaimer:

This chart provides indicative information only. Its validity for individual jobs are not guaranteed.

This chart does not cover job specific pipe quality, site conditions, standard of construction and level of supervision.

This chart shall not in any way be interpreted as relieving the responsibility of designers for a job specific pipeline design.

Assumptions:

If site conditions and workmanship differ from any of the following assumptions and those described in this Table and Assumptions detailed in previous pages, then a job specific pipeline design must be carried out by the developer's design engineer and approved by the Council's Wastewater Network Operations Manager.

The assumptions are:

Maximum design loading at the top of the cover during construction: 350kN over 2.1m length

Minimum cover for the construction loading: 1m

Maximum water table level over top of

NOTE: When there will be PVC pipes under a road, these must be **PN12**.

Chart 3 - DN 225mm

THIS CHART SHALL BE READ IN CONJUNCTION WITH DEFINITIONS AND ASSUMPTIONS SPECIFIED EARLIER IN THIS APPENDIX AND THIS PAGE.

Native Soil SPT Values (Refer (3), Pg 1-1)	Embedment	Cover Depth (m)	Workmanship Poor	Workmanship Good
25 and more (E'_n = 5)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	SN16	SN16
		10	**PN12**	SN16
		12	**PN12**	SN16
25 and more (E'_n = 5)	SAP7 or AP7	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	**PN12**	SN16
		12	-	**PN12**
15 to 24 (E'_n = 3)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	**PN12**	**PN12**
		12	-	**PN12**
15 to 24 (E'_n = 3)	SAP7 or AP7	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	-	**PN12**
		12	-	-
5 to 14 (E'_n = 1)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	**PN12**
		10	-	-
		12	-	-
5 to 14 (E'_n = 1)	SAP7 or AP7	2	SN16	SN16
		4	**PN12**	**PN12**
		6	**PN12**	**PN12**
		8	-	-
		10	-	-
		12	-	-

Disclaimer:

This chart provides indicative information only. Its validity for individual jobs are not guaranteed.

This chart does not cover job specific pipe quality, site conditions, standard of construction and level of supervision.

This chart shall not in any way be interpreted as relieving the responsibility of designers for a job specific pipeline design.

Assumptions:

If site conditions and workmanship differ from any of the following assumptions and those described in this Table and Assumptions detailed in previous pages, then a job specific pipeline design must be carried out by the developer's design engineer and approved by the Council's Wastewater Network Operations Manager.

The assumptions are:

Maximum design loading at the top of the cover during construction: 350kN over 2.1m length

Minimum cover for the construction loading: 1m

Maximum water table level over top of pipe: 2m

NOTE: When there will be PVC pipes under a road, these must be **PN12**.

Chart 4 - DN 300mm

THIS CHART SHALL BE READ IN CONJUNCTION WITH DEFINITIONS AND ASSUMPTIONS SPECIFIED EARLIER IN THIS APPENDIX AND THIS PAGE.

Native Soil SPT Values (Refer (3), Pg 1-1)	Embedment	Cover Depth (m)	Workmanship Poor	Workmanship Good
25 and more (E'_n = 5)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	SN16	SN16
		10	**PN12**	SN16
		12	**PN12**	SN16
25 and more (E'_n = 5)	SAP7 or AP7	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	**PN12**	SN16
		12	-	**PN12**
15 to 24 (E'_n = 3)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	**PN12**	SN16
		12	-	-
15 to 24 (E'_n = 3)	SAP7 or AP7	2	SN16	SN16
		4	SN16	SN16
		6	SN16	SN16
		8	**PN12**	SN16
		10	-	**PN12**
		12	-	-
5 to 14 (E'_n = 1)	Graded gravel	2	SN16	SN16
		4	SN16	SN16
		6	**PN12**	**PN12**
		8	-	-
		10	-	-
		12	-	-
5 to 14 (E'_n = 1)	SAP7 or AP7	2	SN16	SN16
		4	**PN12**	**PN12**
		6	**PN12**	**PN12**
		8	-	-
		10	-	-
		12	-	-

Disclaimer:

This chart provides indicative information only. Its validity for individual jobs are not guaranteed.

This chart does not cover job specific pipe quality, site conditions, standard of construction and level of supervision.

This chart shall not in any way be interpreted as relieving the responsibility of designers for a job specific pipeline design.

Assumptions:

If site conditions and workmanship differ from any of the following assumptions and those described in this Table and Assumptions detailed in previous pages, then a job specific pipeline design must be carried out by the developer's design engineer and approved by the Council's Wastewater Network Operations Manager.

The assumptions are:

Maximum design loading at the top of the cover during construction: 350kN over 2.1m length

Minimum cover for the construction loading: 1m

Maximum water table level over top of pipe: 2m

NOTE: Pipes under roads must be **PN12**.

Appendix 6D: Sewage Pumping Station Operation and Maintenance Manual, Example Table of Contents

North Shore City Council

Sewage Pumping Station Operation and Maintenance Manual

EXAMPLE TABLE OF CONTENTS

Photo 8 Sump and Pumps (Give Item Code)

Photo 9 Pump No.1

Photo 10 Pump No.3. Inset: Seal water inlet rotameter

Photo 11 Pump and MCC Ventilation System

Photo 12 Booster Pump

Photo 13 Wet well Emergency Lighting

Photo 14 Incomer 3. External Generator Connection

Photo 15 Ultrasonic Level Indicator

Appendix 6E: Sewage Pumping Station, Coding System for Item Identification

CODING SYSTEM FOR ITEM IDENTIFICATION

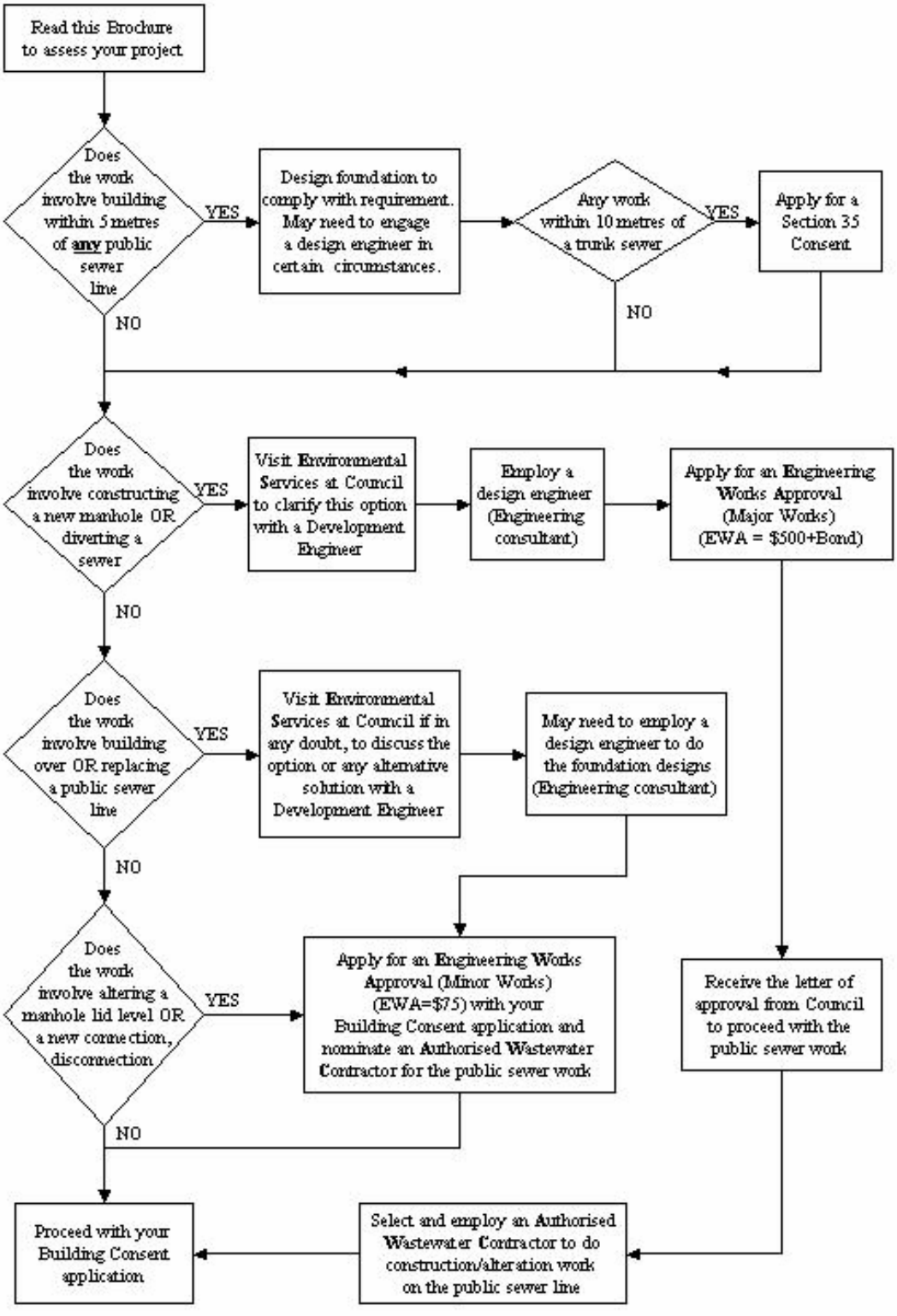
Pumping Station Code			Equipment Item Code			
Item	Code	Number	Equipment Group		Equipment Subgroup	
			Item	Code	Item	Code
Sewage Pumping Station	PS	001 to 199	Aeration/Odour Control	A	Fan	F
Water Pumping Station	PW	201 to 399			Ducting	D
Other Pumping Station	PO	401 - 599			Vent	V
Storage Tank	ST	001 to 199			Treatment Unit	T
Overflow Point	OF	001 to 199			Other	O
Note: - Storage Tank and Overflow point numbers relate back to Pumping			Building Structures	B	Main Building	M
					Dry Well	D
					Wet Well	W

Station Number			Storage Tank/well	S
			Valve Chamber	V
			Other	O
	Control / Indicators	C	Flow	F
			Level	L
			Temperature	T
			Other	O
	Electrical Installation	E	Alarm Panel	A
			Switchboard	S
			Distribution Board	D
			Control Board	C
			Telemetry	T
			Generator	G
			Power Factor	P
			Other	O
	Pipeline	L	Plumbing (service water)	P
			Water	W
			Sewage	S
			Other	O
	Pump	P	Impeller	I
			Set (imm/subm. Pumps)	S
			Casing (Dry pumps)	C
			Motor (Dry pumps)	M
			Other	O
	Valve	V	Air release/surge valve	A
Examples			Inlet Main	I
			Rising Main	M

PS056VD02	Sewage pumping Station 056, Delivery valve for pump 02			Suction valve	S
				Delivery valve	D
				Wetwell valve	W
				Check/non-return	C
PW213OG01	Water Pumping Station 213, Gantry			Backflow Preventer	B
				Regulating valve	R
				Other	O
		Other	O	Gantry/Rail & Trolley	G
				Hoist	H
				Strainer/Screen	S
				Tank	T

Appendix 6F: Consent Process for Building near Public Sewers

Process for Building near Public Sewers



Appendix 6G: Peak Inflow and Infiltration Flow (PIIF) for Detailed Mini-Catchments

Mini - Catchment Number	PIIF for aged sewer systems (L/s/net site ha)
C001 BROWNS BAY SOUTH	0.71
C00101 Anzac Road	2.06
C00102 Argyle Road	0.66
C00103 Nigel Road	0.54
C00104 Glencoe Road	0.89
C00105 Crestview Place	0.52
C00106 Bayside Drive	0.43
C00107 Helvetia Drive	0.39
C00108 King Richard Place	0.86
C00109 John Downs Drive	0.56
C00110 Mistletoe Place	1.01
C00111 Celina Place	0.55
C00112 Oaktree Avenue	0.68
C004 ROTHESAY BAY	0.60
C00401 Browns Bay Road	0.63
C00402 Rothesay Bay Road	0.44
C00403 Sandown Road	0.58
C00404 Masterton Road	0.63
C00405 Buelah Road	0.51
C00406 Churchill Road	0.91
C00407 Lyons Avenue	0.42
C00408 Saddleback Rise	0.41
C00409 Rossmore Terrace	0.63

Mini - Catchment Number	PIIF for aged sewer systems (L/s/net site ha)
C00410 Murrays Bay	0.53
C00411 Sunrise Avenue	0.76
C00412 Hyde Road	Use catchment PIIF 0.60
C00413 Masterton Road	Use catchment PIIF 0.60
C009 GLENFIELD NORTH SUNNYNOOK	
C00901 Wairau Road	0.46
C00902 Bond Crescent	1.80
C00903 Becroft Park	2.69
C00904 Link Drive	2.07
C00905 Sunnynook Road	0.43
C00906 Blakeborough Road	2.67
C00907 Sycamore Drive	1.96
C00908 Heather Place	098
C00909 Erica Road	1.82
C00910 Kapiti Place	0.93
C00911 Trias Road	3.16
C00912 Ellis Road	1.83
C00913 Wairau Park	1.19
C00914 Hillside Road	2.09
C00915 Dianna Drive	2.27
C00916 Ashfield Road	1.48
C00917 Croftfield Lane	0.42

Mini - Catchment Number	PIIF for aged sewer systems (L/s/net site ha)
C013 BIRKDALE WEST	0.53
C01301 Lancaster Rd	1.99
C01302 Hellyers Street	1.28
C01303 Tiri Tiri Road	0.75
C01304 Fordham St	0.88
C01305 Birkdale Road	0.34
C01306 Taurus Crescent	0.50
C01307 Island Bay Road	0.27
C01308 Valkyria Drive	0.27
C014 BIRKDALE	0.57
C01401 Beach Haven Road	3.28
C01402 Valley View Road	0.20
C01403 Parkhill Road	0.82
C01404 Verran Road	1.40
C01405 Eskdale Road	1.45
C01406 Verbena Road	0.46
C01407 Roseberry Avenue	0.46
C01408 Recreation Drive	0.70
C01409 Lauderdale Road	0.52
C01411 Domain Road	0.47

Mini - Catchment Number	PIIF for aged sewer systems (L/s/net site ha)
C017 MILFORD TAKAPUNA	2.42
C01701 Stratford Avenue	1.05
C01702 Ihumata Road	0.80
C01703 Worsley Avenue	1.33
C01704 Margery	0.75
C01705 Seaview Road	1.77
C01706 Omana Road	1.09
C01707 Milford Beach	0.57
C01708 Muratai Road	0.48
C01709 Takapuna Beach	1.15
C01710 The Promenade	0.97
C01711 Sanders Avenue	0.45
C01712 Rarere Road	3.01
C01713 Inga Road	0.91
C01714 Black Rock	2.46

Mini - Catchment Number	PIIF for aged sewer systems (L/s/net site ha)
C020 HILLCREST	1.06
C02001 Northcote Road	1.12
C02002 Hillcrest Avenue	0.90
C02003 Sylvia Road	0.51
C02004 Linley Place	1.00
C02005 Orion Place	0.72
C02006 Compton Street	0.50
C02007 Moore Street	0.68
C02008 Havenwood Place	0.56
C02009 Ocean View Road	2.18
C02010 Lynden Avenue	1.14
C021 OLD NORTHCOTE	0.38
C02101 Sulphur Beach Road	1.10
C02102 Alfred Street	2.40
C02103 Alfred Pump Station	1.76
C02104 Stafford Road	2.43
C02105 Queen Street	2.35
C02106 Denby Lane	0.96
C02107 Belle Vue Avenue	0.73
C02108 Tarahanga Street	0.36
C02109 Sylvan Avenue	0.52
C02110 Exmouth Road	0.45

Mini - Catchment Number	PIIF for aged sewer systems (L/s/net site ha)
C24A HAURAKI BELMONT	2.00
C24A01	1.69
C24A02	0.96
C24A03	1.60
C24A04	1.12
C24A05 Philomel Reserve	1.10
C026 DEVONPORT	0.55
C02601 Queens Parade	1.17
C02602 King Edwards Parade	1.20
C02603 Cheltenham Road	1.73
C02604 Tainui Road	2.82
C02605 Patuone Avenue	4.37
C02606 Cautley Street	1.67
C02607 Stanley Point Road	Use catchment PIIF 0.55
C02608 Victoria Road	2.63

Based on Non Rehabilitated WWF for 2 year ARI event

Appendix 6H: Bill of Materials: NSCC Small Pump Stations

APPENDIX 6H
DESIGN FLOWS CALCULATION FLOW CHART

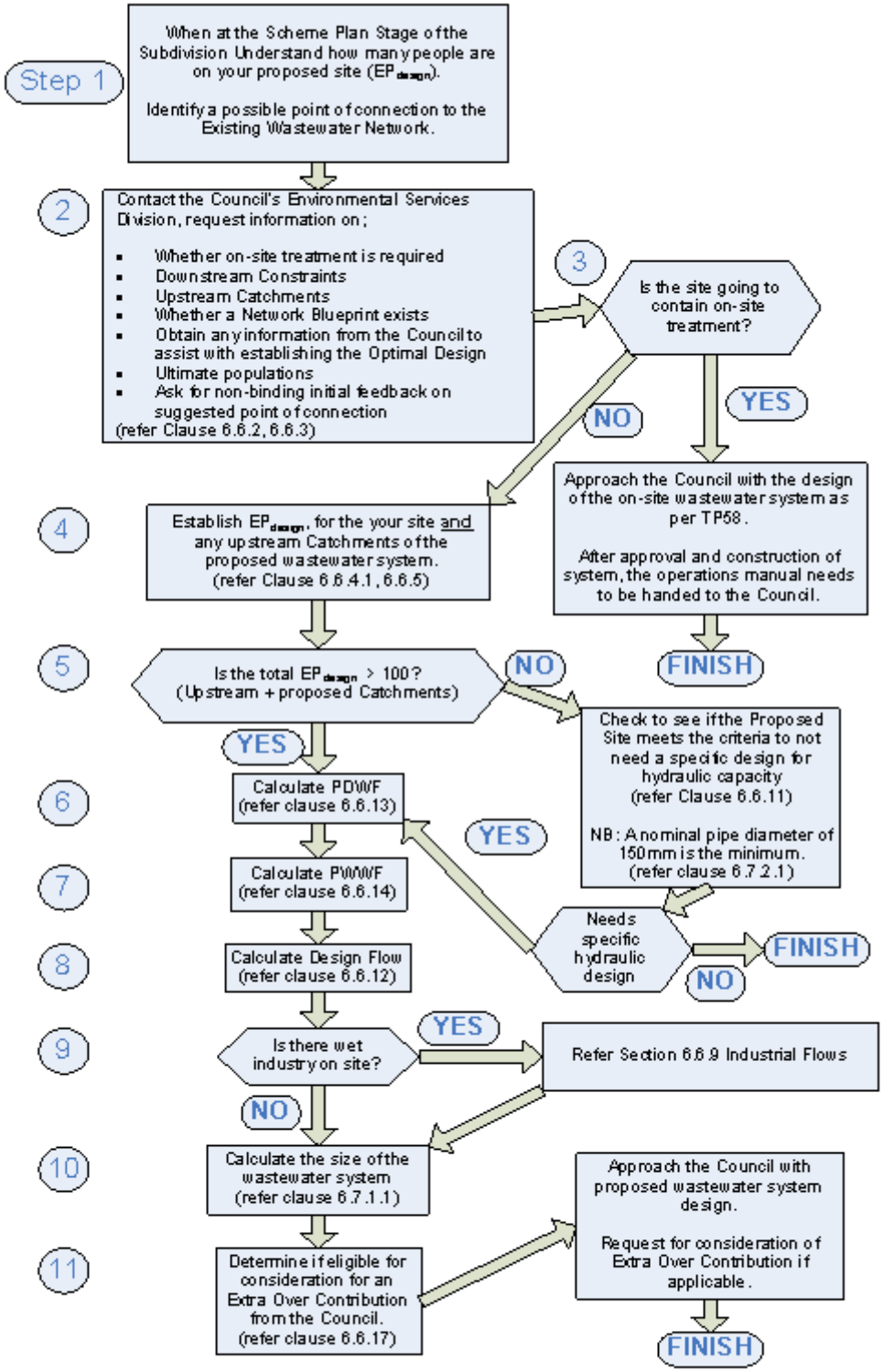
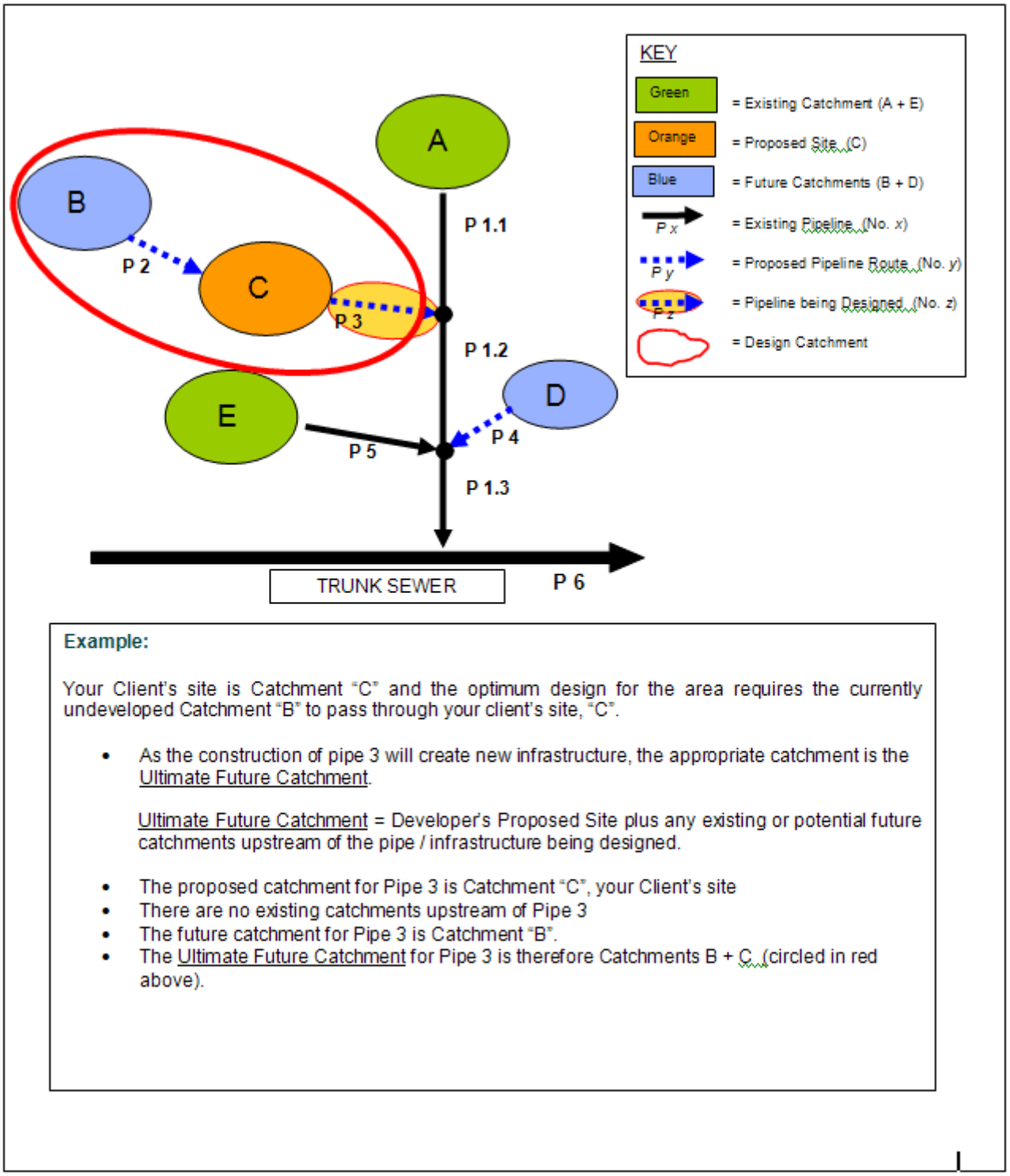


Figure 1 : Flow chart process for calculating design flows

Appendix 6I: Design Flow Catchment Examples

Example A1 : Ultimate Future Catchment (for Sizing New Infrastructure)



Example:

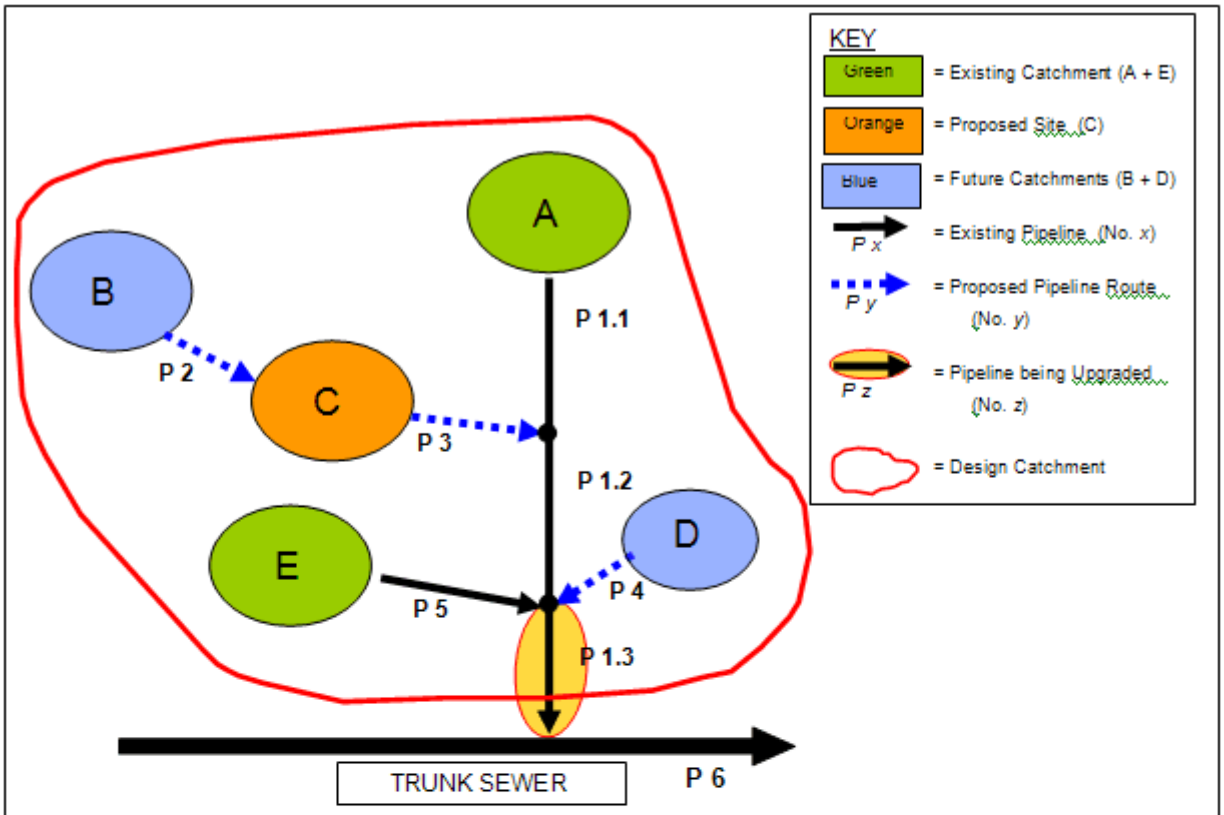
Your Client's site is Catchment "C" and the optimum design for the area requires the currently undeveloped Catchment "B" to pass through your client's site, "C".

- As the construction of pipe 3 will create new infrastructure, the appropriate catchment is the Ultimate Future Catchment.

  Ultimate Future Catchment = Developer's Proposed Site plus any existing or potential future catchments upstream of the pipe / infrastructure being designed.

- The proposed catchment for Pipe 3 is Catchment "C", your Client's site
- There are no existing catchments upstream of Pipe 3
- The future catchment for Pipe 3 is Catchment "B".
- The Ultimate Future Catchment for Pipe 3 is therefore Catchments B + C (circled in red above).

Example A2 : Ultimate Future Catchment (for Sizing New Infrastructure)



Example:

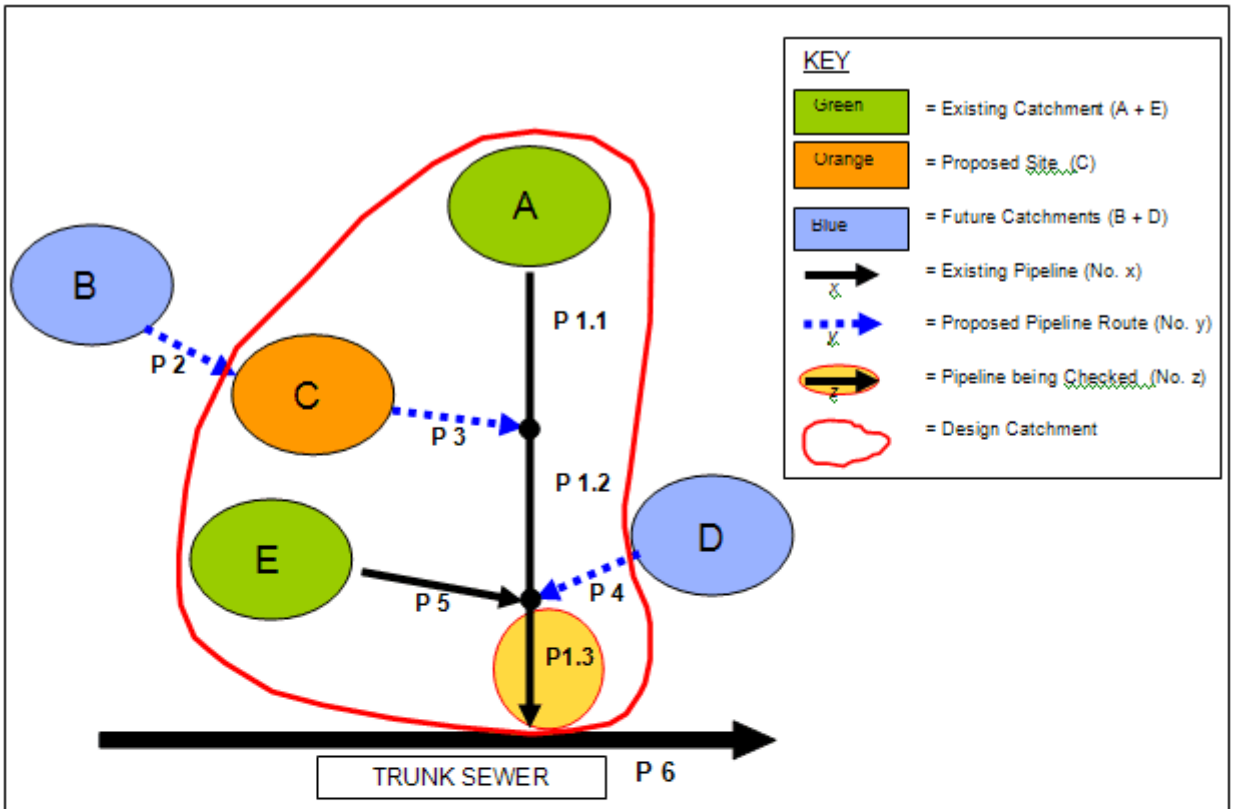
The Developer's engineer has identified that his client's proposed development, Catchment "C", will exceed the capacity of pipe P1.3. The Council's Asset Consents Engineer has assessed the information provided by the developer's engineer, and has advised that the Council will accept the Developer's application for a Wastewater Connection if pipe P1.3 is upgraded.

- The Developer's is required to identify and incorporate downstream improvements required as a result of the proposed works (Clause 6.4.1)
- As the upgrade to pipe P 1.3 will create new infrastructure, the appropriate catchment is the Ultimate Future Catchment.

  Ultimate Future Catchment = Developer's Proposed Site plus any existing or potential future catchments upstream of the pipe / infrastructure being designed.

- The existing catchments for pipe P 1.3 are Catchments A & E.
- The future catchments for pipe P 1.3 are Catchments B & D.
- The proposed catchment for pipe P 1.3 is Catchment C.
- The Ultimate Future Catchment is therefore Catchments A + B + C + D + E (circled in red above).

Example A3: Proposed Catchment (for Assessing the Capacity of Existing Infrastructure)



Example:

The Council has asked the Developer of Catchment "C" to assess if there is sufficient capacity in the existing network (Pipe 1.3) for the proposed development (Catchment C).

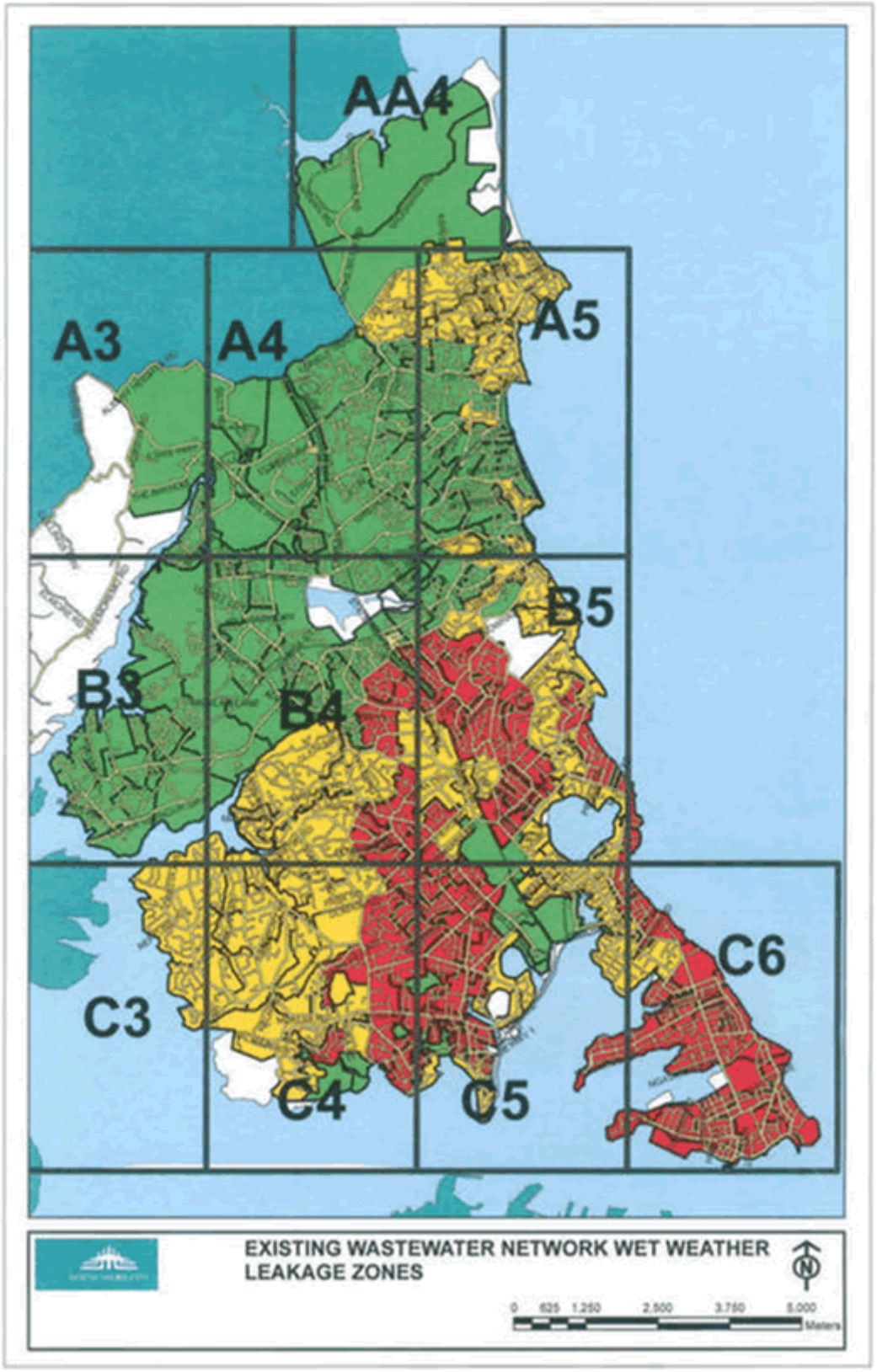
- As this is an assessment of the capacity of existing infrastructure, the catchment that is relevant is the Proposed Catchment

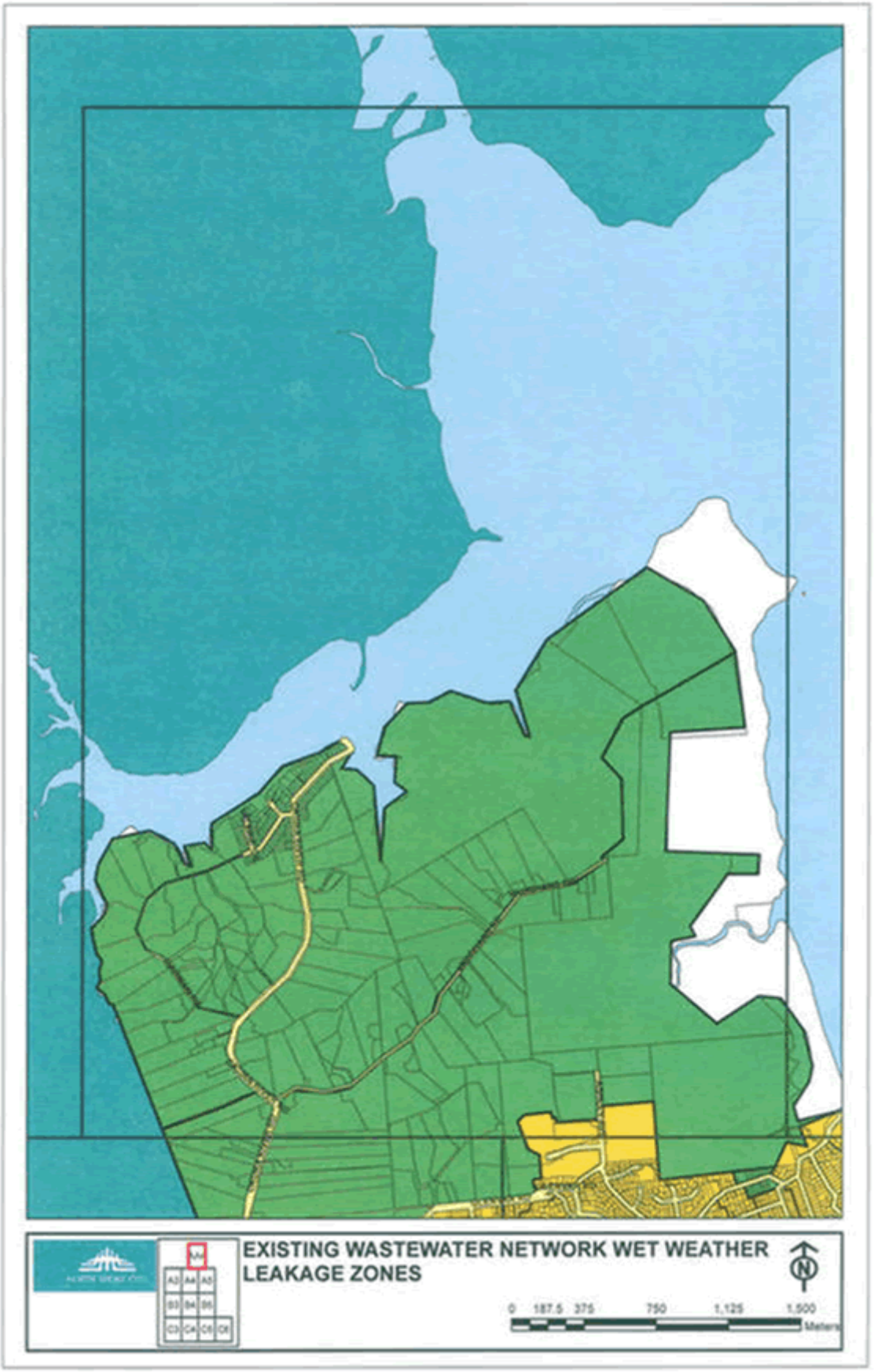
  Proposed Catchment = existing catchment upstream of the pipe being designed + the full extent of the developer's proposed site and/or catchment.

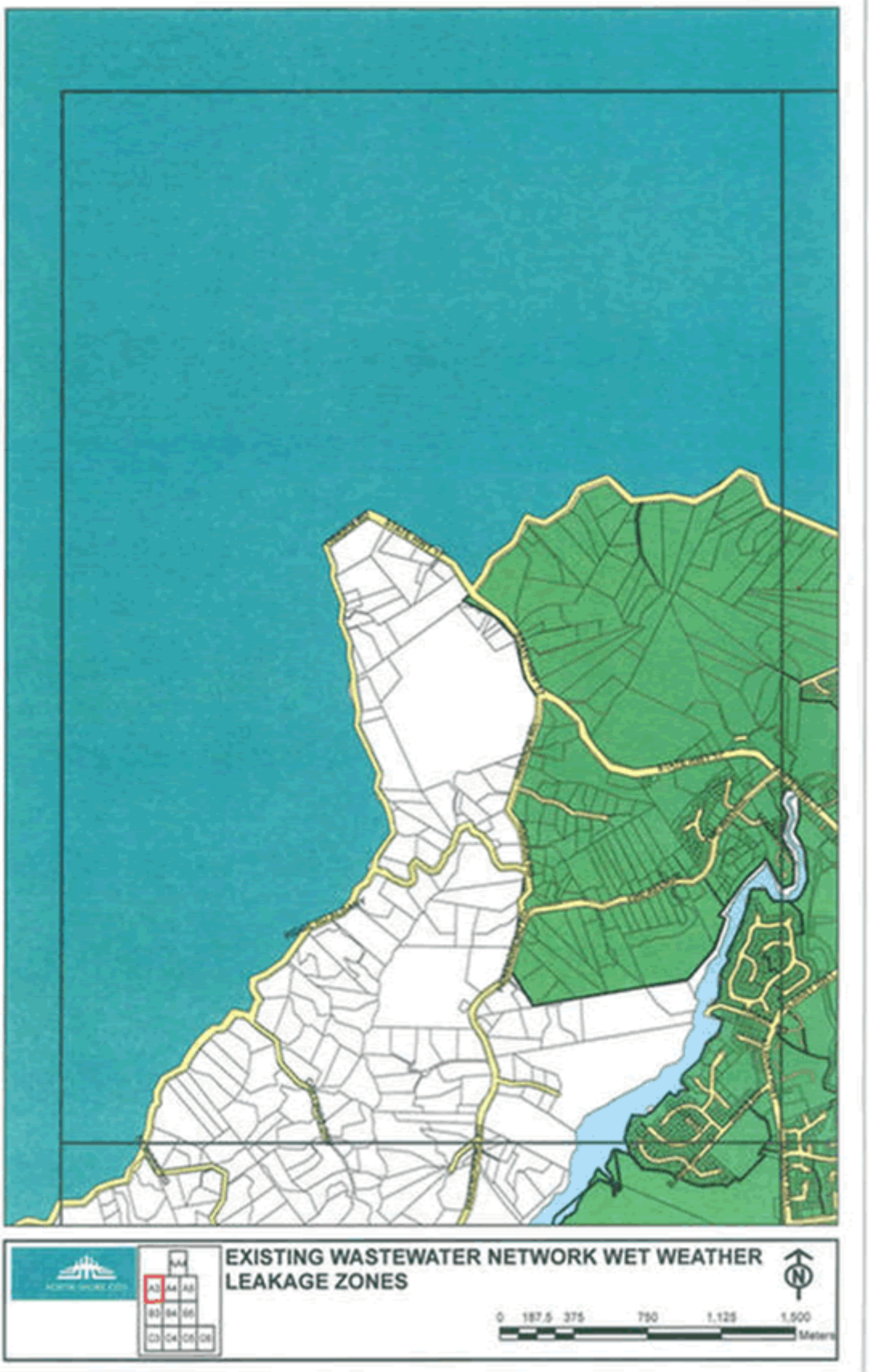
- The existing catchments for Pipe 1.3 are Catchments A & E.
- The proposed catchment for Pipe 1.3 is Catchment C.
- The Proposed Catchment is therefore Catchments A + C + E (circled in red above).

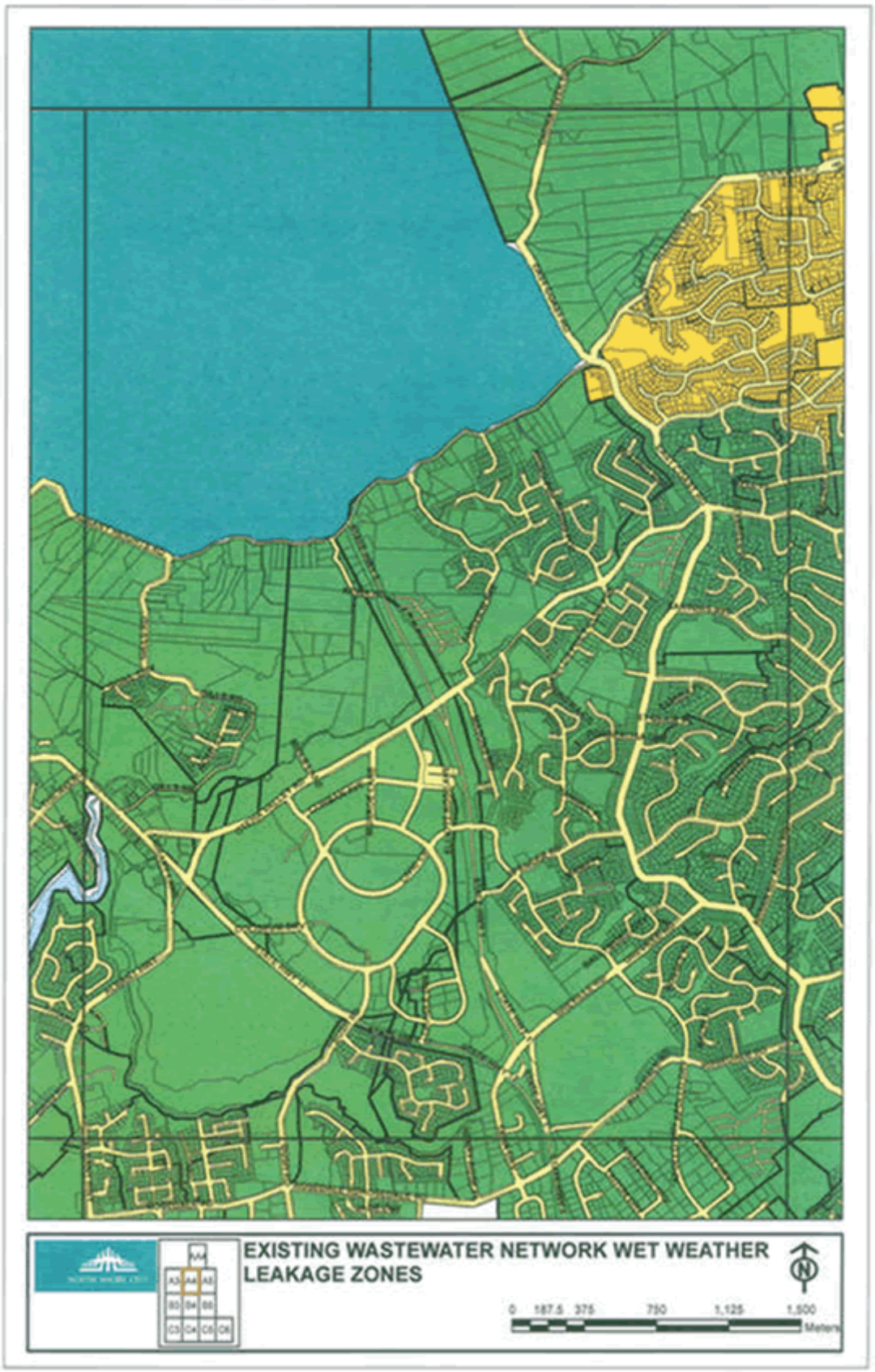
Note: Separate assessments will be made for Catchment B & D when their land owners / developers approach the Council.

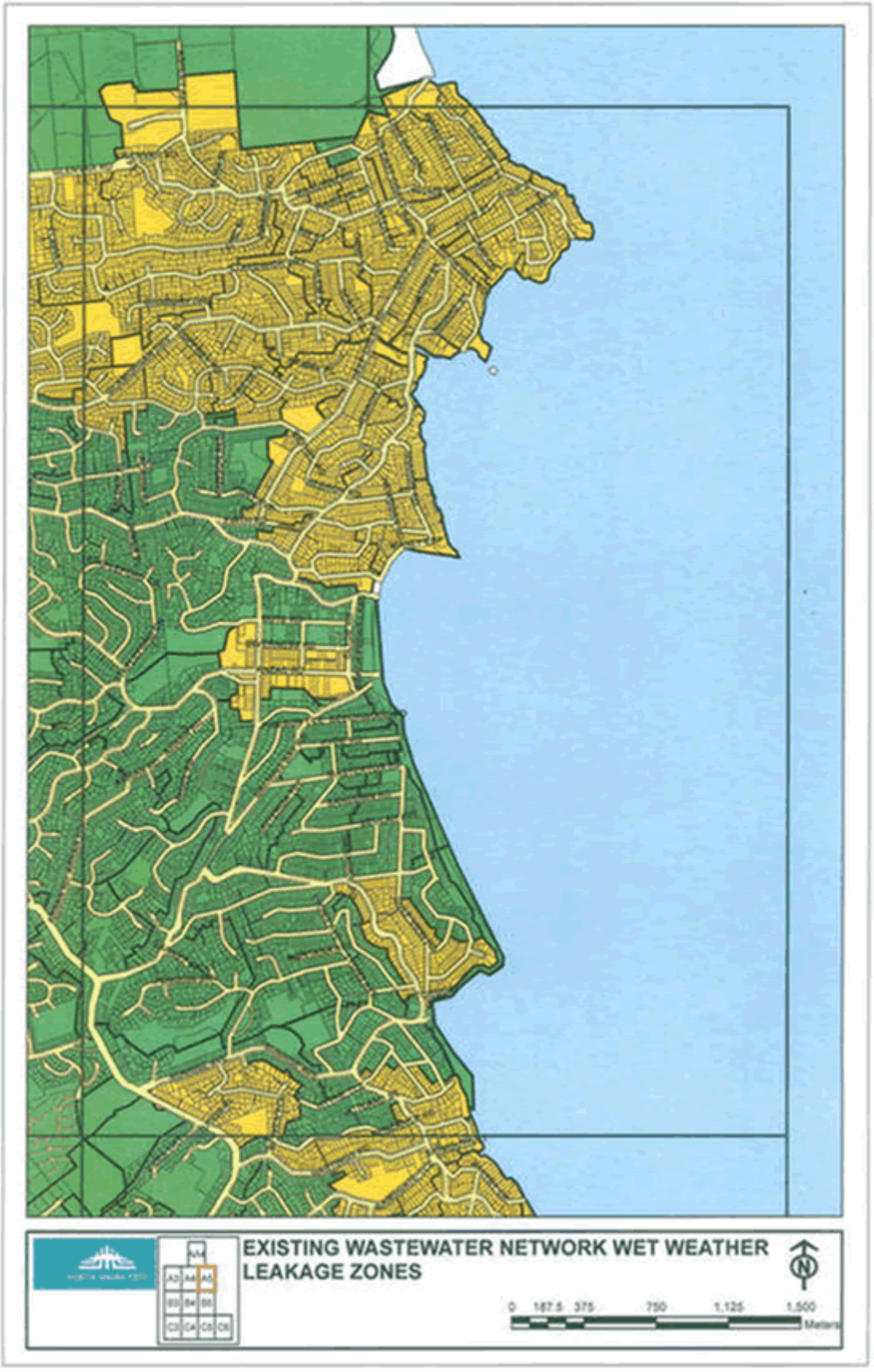
Appendix 6J: Wet Weather Leakage Zones

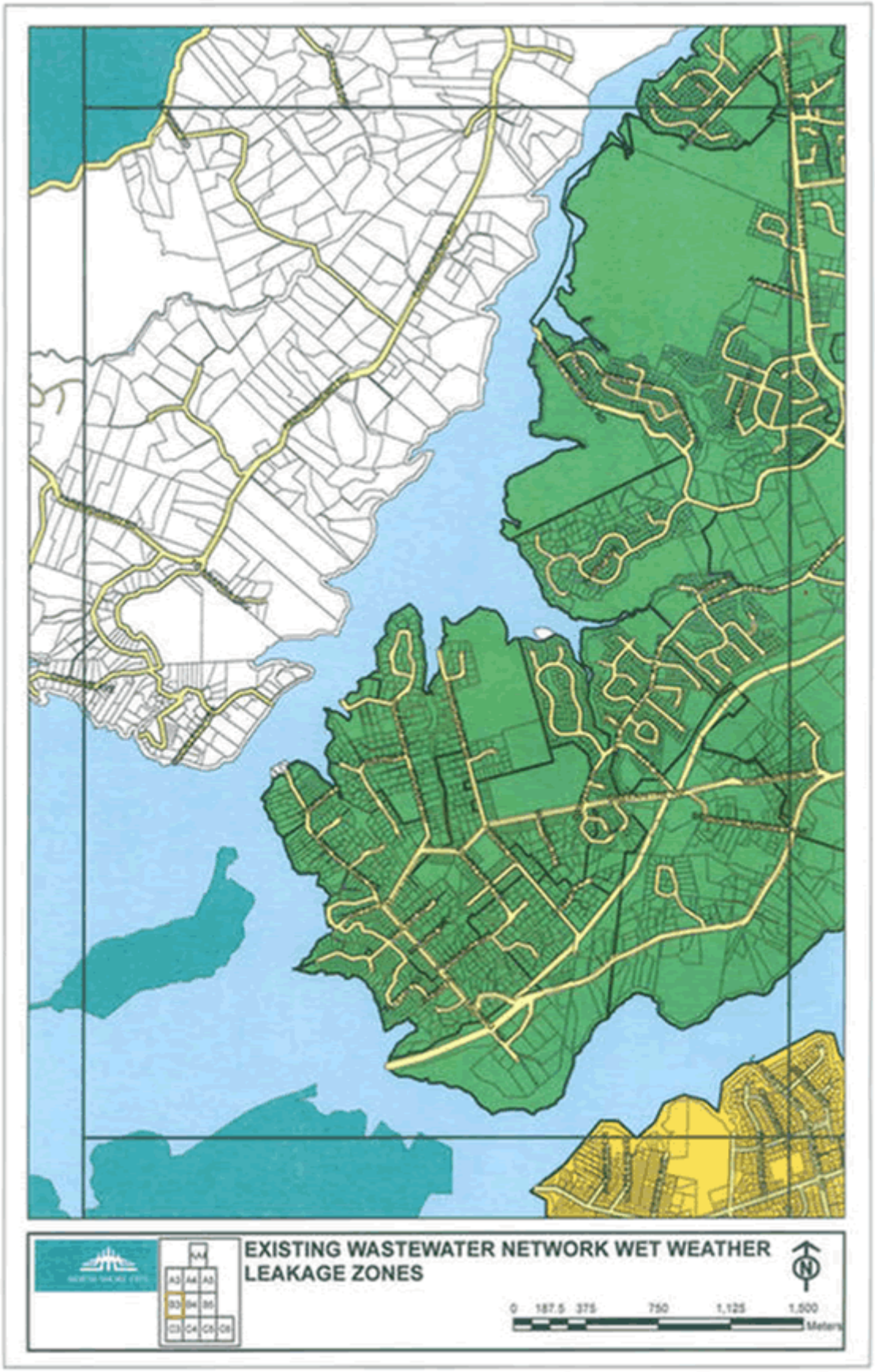


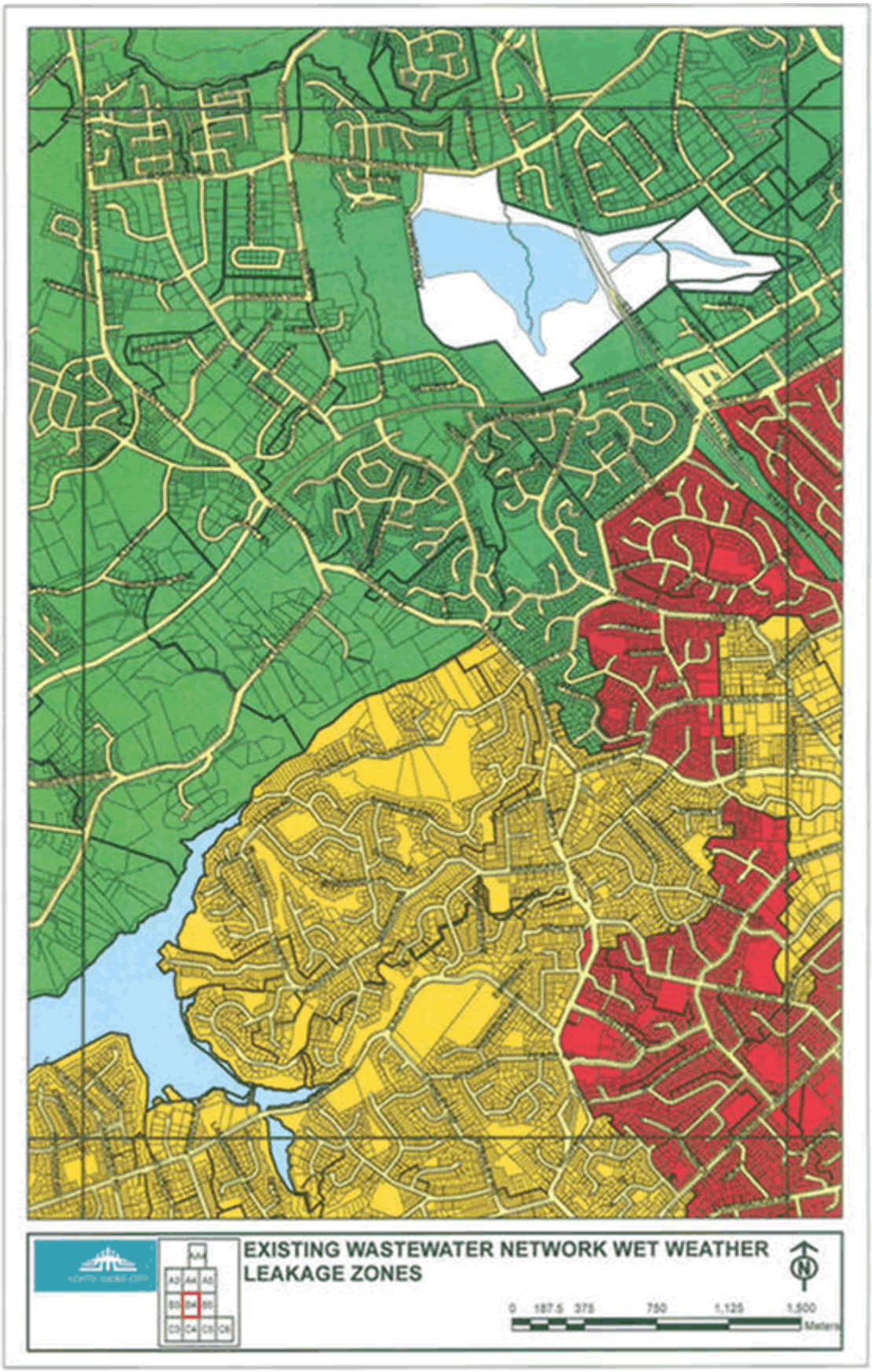

EXISTING WASTEWATER NETWORK WET WEATHER LEAKAGE ZONES
0 187.5 375 750 1,125 1,500
Meters

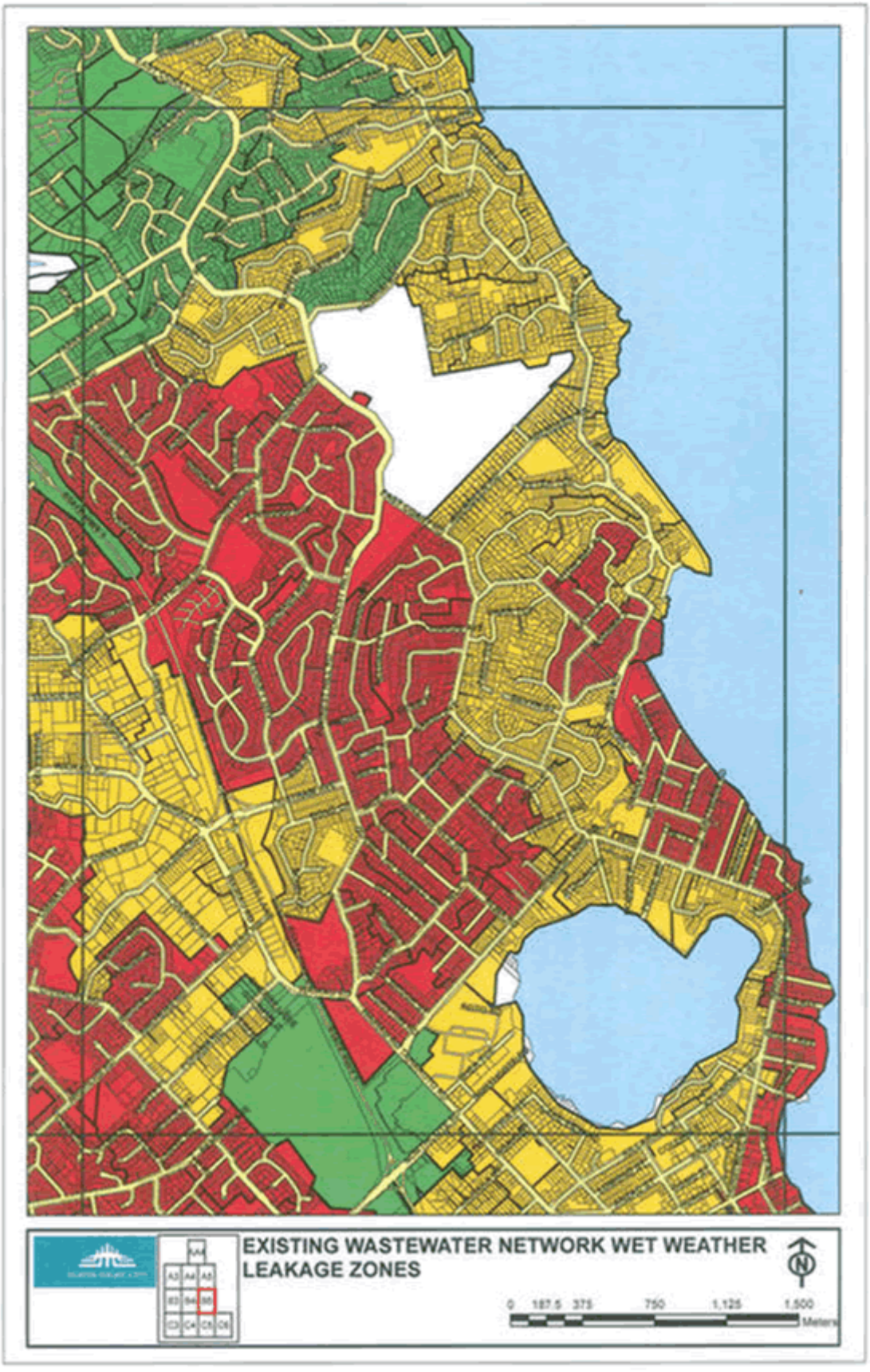

EXISTING WASTEWATER NETWORK WET WEATHER LEAKAGE ZONES
A2
A3
A4
A5
B3
B4
B5
C3
C4
C5
C6
0
187.5
375
750
1,125
1,500
Meters


EXISTING WASTEWATER NETWORK WET WEATHER
LEAKAGE ZONES
A3
A4
A5
B3
B4
B5
C3
C4
C5
C6
0
187.5
375
750
1,125
1,500
Meters

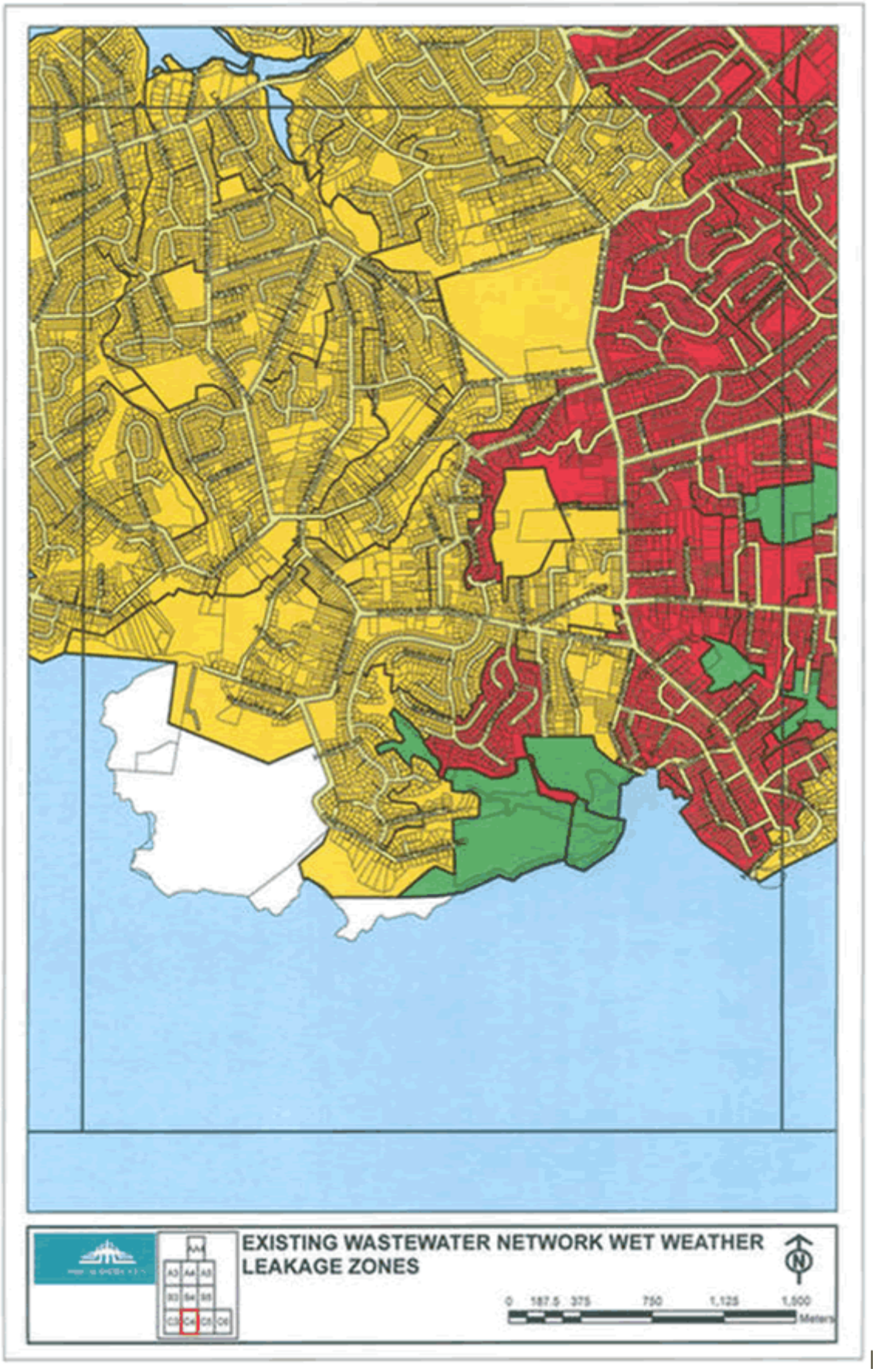

EXISTING WASTEWATER NETWORK WET WEATHER
LEAKAGE ZONES
A3
A4
A5
B3
B4
B5
C3
C4
C5
C6
0
187.5
375
750
1,125
1,500
Meters


EXISTING WASTEWATER NETWORK WET WEATHER
LEAKAGE ZONES
0 187.5 375 750 1,125 1,500
Meters


EXISTING WASTEWATER NETWORK WET WEATHER
LEAKAGE ZONES
0 187.5 375 750 1,125 1,500
Meters


EXISTING WASTEWATER NETWORK WET WEATHER
LEAKAGE ZONES
A3
A4
A5
B3
B4
B5
C3
C4
C5
C6
0
187.5
375
750
1,125
1,500
Meters


EXISTING WASTEWATER NETWORK WET WEATHER LEAKAGE ZONES
0 187.5 375 750 1,125 1,500
Meters


EXISTING WASTEWATER NETWORK WET WEATHER LEAKAGE ZONES
A4
A3 A4 A5
B3 B4 B5
C3 C4 C5 C6
0 187.5 375 750 1,125 1,500
Meters


EXISTING WASTEWATER NETWORK WET WEATHER
LEAKAGE ZONES
A2
A3
A4
A5
B3
B4
B5
C3
C4
C5
C6
N
0
187.5
375
750
1,125
1,500
Meters

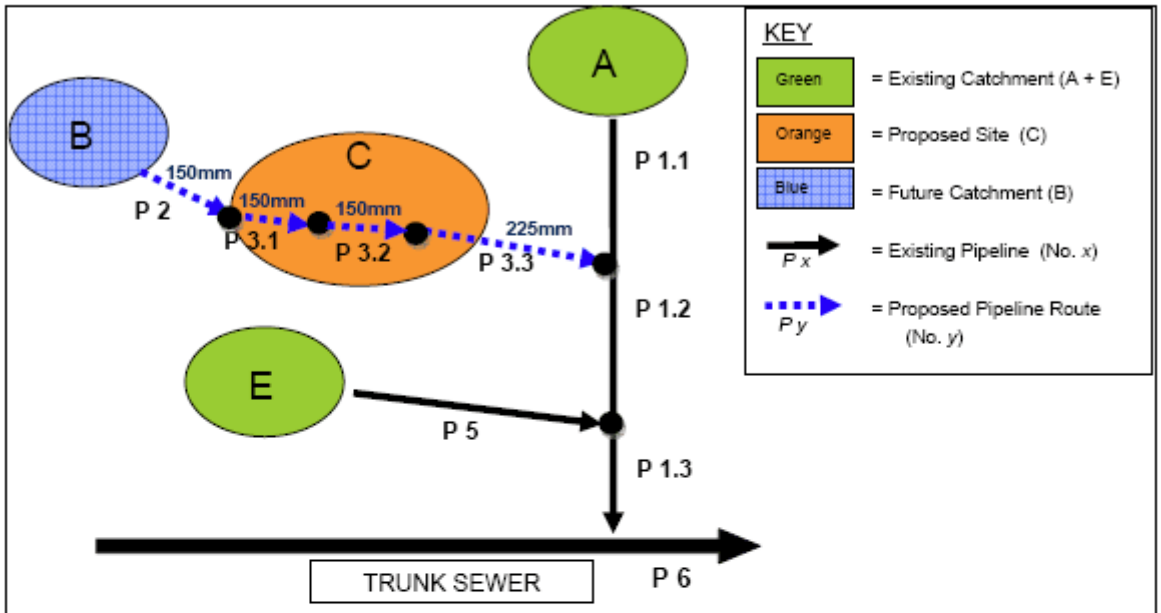
EXISTING WASTEWATER NETWORK WET WEATHER LEAKAGE ZONES

0 187.5 375 750 1,125 1,500
Meters

Appendix 6K: Extra Over Contribution Examples

Example A4 - Assessment of eligibility for Extra Over Contributions for Upstream Catchments

The Developer is required to extend the network to the upstream boundary (P3.1). The upstream development requires only the minimum sized sewer, and the pipes constructed by the developer in order to service his/her/its development do not need to increase in size in order to convey the flows from the upstream development. No pipes have been upsized beyond the minimum size requirements due to other developments.



Upstream Catchment 150mm

Pipe Layout:

- A Developer needs to install new local sewer (Pipes 3.2, and 3.3) for his Site (Catchment C).
- Pipe 3.1 is not needed for the Developer's proposed development, however it needs to be built to service the upstream catchment.
- Pipe 2 is not the responsibility the Developer as it is outside of the property boundary.

Design Flow Scenario:

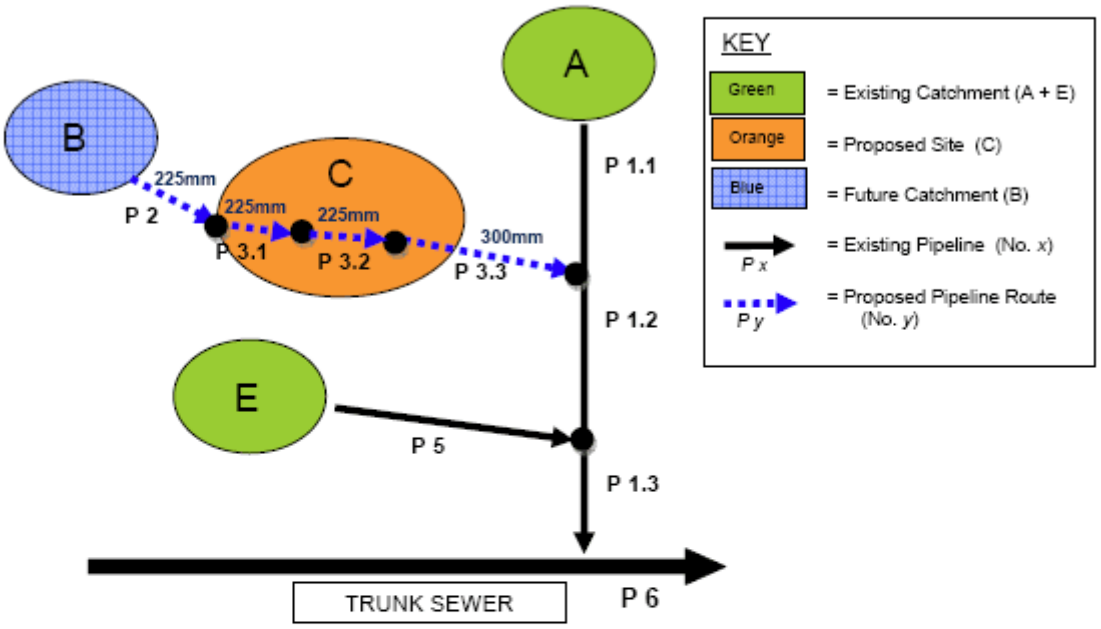
The Developer's proposed development requires a 225mm nominal pipe to service the full catchment (P 3.3)

- Catchment B does not cause Pipe 3.3 to be increased in size beyond that required to Convey the Design Flow from the Developer's Site (Catchment C).
- Pipe 3.2 for the proposed development requires a 150mm pipe and the flows from Catchment B do not require Pipe 3.2 to be upsized.
- Pipe 3.1 requires only a 150mm sewer to convey the Design Flow for the Ultimate Future Development Scenario from the upstream catchment (Catchment B)

The Developer cannot apply for an Extra Over Contribution because the upstream catchment(s) require only the minimum sized sewer.

Example A5 - Assessment of eligibility for Extra Over Contributions for Upstream Catchments

The Developer is required to extend the network to the upstream boundary (P3.1). The upstream development requires a 225mm sewer. However, in the absence of the upstream development, the Developer's proposed development also requires a 225mm pipe (P3.2) and a 300mm pipe (P3.3). The addition of the upstream catchment does not require pipes P3.2 and P3.3 to be increased in size. The extension of the wastewater network to the upstream boundary requires a 225mm pipe, which is over and above the minimum size requirements.



Upstream Catchment requires a pipe > 150mm, but does not impact on the pipe sizes required for the Proposed Development Downstream

Pipe Layout

- A Developer needs to install new local sewer (Pipes 3.2, and 3.3) for his Site (Catchment C).
- Pipe 3.1 is not needed for the Developer's proposed development, however it needs to be built to service the upstream catchment.
- Pipe 2 is not the responsibility the Developer as it is outside of the property boundary.

Design Flow Scenario

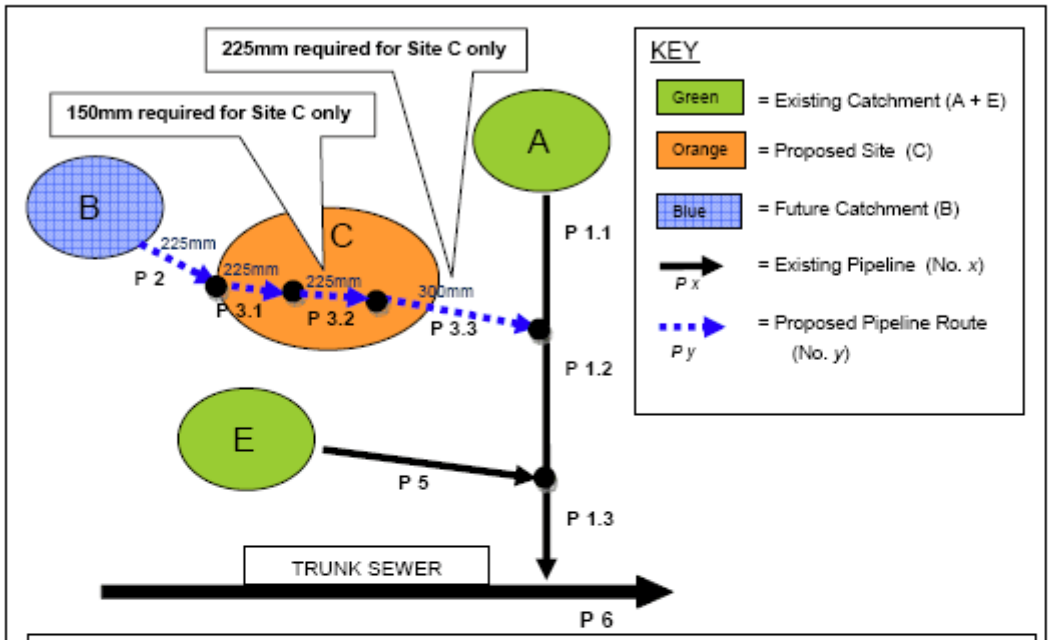
- The Developer's proposed development requires P3.3 to be a 300mm nominal pipe to service its development (Catchment C).
- Pipe 3.2 for the proposed development requires a 225mm pipe.
- Catchment B does not cause Pipes 3.2 and 3.3 to be increased in size beyond that required to convey the Design Flow from the Developer's Site (Catchment C).
- Pipe 3.1 requires a 225mm sewer to convey the Design Flow for the Ultimate Future Development Scenario from the upstream catchment (Catchment B)

The Developer can apply for an extra over contribution for:

- Pipe 3.1. The marginal cost of constructing a 225mm pipe over that of a 150mm pipe.

Example A6 – Assessment of eligibility for Extra Over Contributions for Upstream Catchments

The Developer is required to extend the network to the upstream boundary. The upstream developme requires a 225mm sewer. In the absence of the upstream development, the Developer's propose development requires a 150mm pipe through the development (P3.2) and a 225mm pipe downstream of th development (P3.3). The addition of the upstream catchment requires pipe P3.2 to be increased fro 150mm to 225mm and pipe P3.3 to be increased in size from 225mm to 300mm.



Upstream Catchment requires a pipe > 150mm, and causes pipes to be upsized downstream

Pipe Layout

- A Developer needs to install new local sewer (Pipes 3.2, and 3.3) for his Site (Catchment C).
- Pipe 3.1 is not needed for the Developer's proposed development, however it needs to be built to service the upstream catchment.
- Pipe 2 is not the responsibility the Developer as it is outside of the property boundary.

Design Flow Scenario

- The Developer's proposed development, Catchment C, requires a 225mm nominal pipe, but a 300mm must be constructed in order to convey the Ultimate Design Flow, which includes the flow from Catchment B + C (P 3.3)
- Pipe 3.2 for the proposed development (Catchment C) requires a 150mm pipe to service P3.2's share of the flow from Catchment C; but a 225mm must be constructed in order to convey the Ultimate Design Flow, which includes the flow from Catchment B + C (P 3.3)
- Pipe 3.1 requires a 225mm sewer to convey the Design Flow for the Ultimate Future Development Scenario from the upstream catchment (Catchment B)

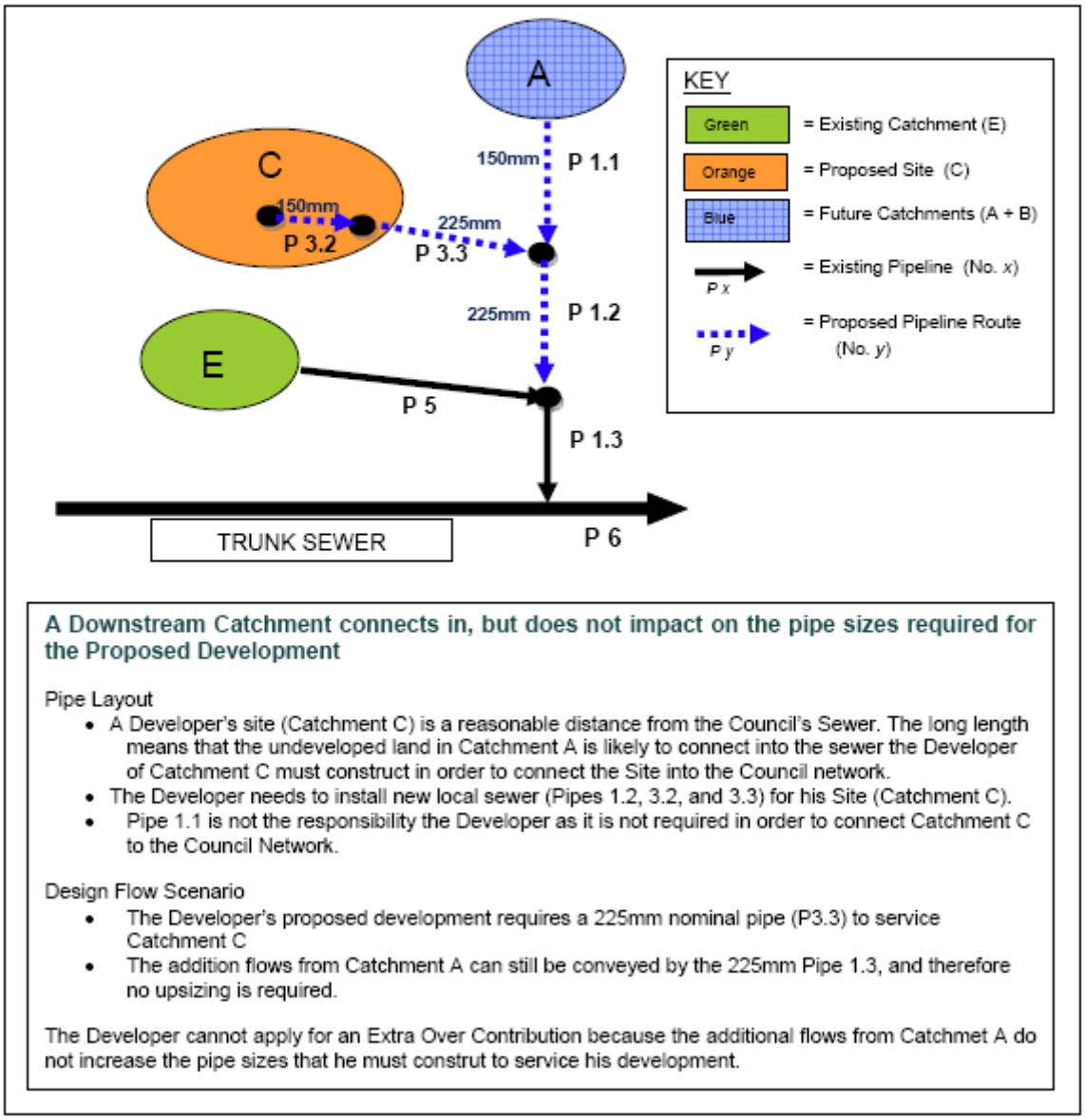
The Developer can apply for an extra over contribution for:

- P3.1 the marginal cost of constructing a 225mm pipe over a 150mm
- P3.2 the marginal cost of constructing a 225mm pipe over a 150mm
- P3.3 the marginal cost of constructing a 300mm pipe over a 225mm

Example A7 – Assessment of eligibility for Extra Over Contributions for Downstream Catchments

The Developer's site (Catchment C) is a reasonable distance from the Council's nearest available sewer. The Developer is required to connect the development into the Council's nearest available sewer (in black, Pipe 1.3). A 225mm sewer is required to convey the wastewater from Catchment C (the developer's site).

Catchment A has been identified by the Council's Asset Consents Engineer as a catchment likely to connect at some time in the future into the new sewer. The flow from Catchment A will still be capable of being conveyed by the 225mm sewer (Pipe 1.2). The additional flows from Catchment A do not require the pipes to be upsized.



A Downstream Catchment connects in, but does not impact on the pipe sizes required for the Proposed Development

Pipe Layout

- A Developer's site (Catchment C) is a reasonable distance from the Council's Sewer. The long length means that the undeveloped land in Catchment A is likely to connect into the sewer the Developer of Catchment C must construct in order to connect the Site into the Council network.
- The Developer needs to install new local sewer (Pipes 1.2, 3.2, and 3.3) for his Site (Catchment C).
- Pipe 1.1 is not the responsibility the Developer as it is not required in order to connect Catchment C to the Council Network.

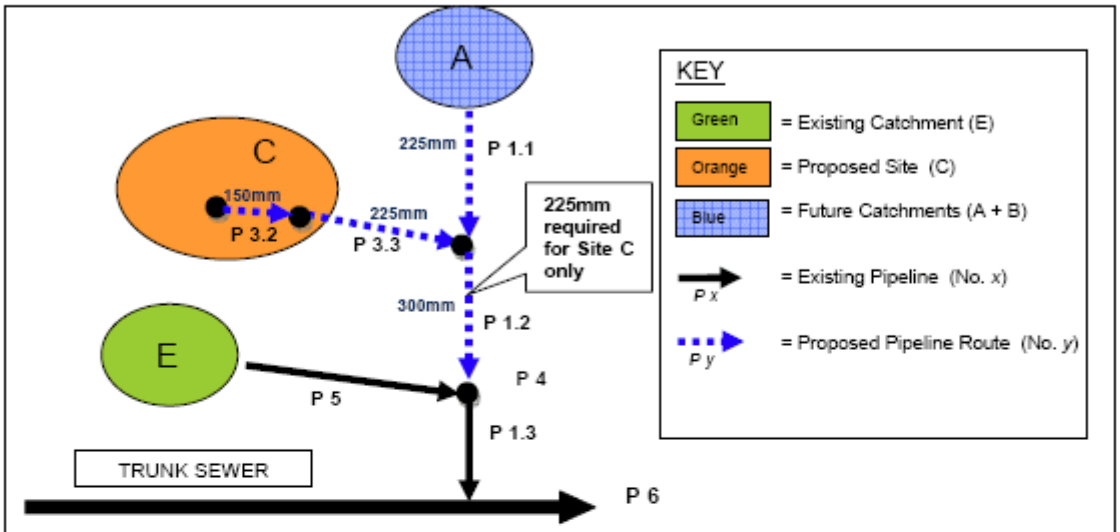
Design Flow Scenario

- The Developer's proposed development requires a 225mm nominal pipe (P3.3) to service Catchment C
- The addition flows from Catchment A can still be conveyed by the 225mm Pipe 1.3, and therefore no upsizing is required.

The Developer cannot apply for an Extra Over Contribution because the additional flows from Catchmet A do not increase the pipe sizes that he must construt to service his development.

Example A8 – Assessment of eligibility for Extra Over Contributions for Downstream Catchments

The Developer's site is a reasonable distance from the Council's nearest available sewer. The Developer is required to connect the development into the Council's nearest available sewer at cost. A 225mm sewer is required to convey the wastewater from the proposed development. Catchment A has been identified by the Developer's Design Engineer as a catchment likely to connect at some time in the future into the sewer constructed by the Developer in order to connect his/her/its development to the Council's existing sewer. The sewer constructed by the Developer needs to upsized in order to convey the future flows from Catchment A (Pipe 1.2 need to be increased from a 225mm to a 300mm).



Downstream Catchment connects in, and causes the Pipe required for the Proposed Development to increase

Pipe Layout

- A Developer's site (Catchment C) is a long way from the Council's Sewer. The long length means that the undeveloped land in Catchment A is likely to connect into the sewer connecting Catchment C into the Council network at some time in the future.
- The Developer needs to install new local sewer (Pipes 1.2, 3.2, and 3.3) for his Site (Catchment C).
- Pipe 1.1 is not the responsibility the Developer as it is not required in order to connect Catchment C to the Council Network.

Design Flow Scenario

- The Developer's proposed development requires a 225mm nominal pipe (P3.3) to service Catchment C
- Pipe 1.2 also requires requires a 225mm pipe to convey the flows from the Developer's proposed development in Catchment C, but the future addition of flows from Catchment A will require Pipe 1.2 to be upsized to a 300mm in order to cope with the Ultimate Development Scenario.

The Developer can apply for an extra over contribution for:

- Pipe 1.2 the marginal cost of constructing a 300mm pipe over a 225mm

Index

6