Document Control

Purpose

- To provide minimum standards for the design and construction of stormwater systems for all scales of land development and subdivision
- Should the minimum standards not be achievable, developers shall discuss alternative approaches to development and ownership with the council

| Document name | Code of Practice for Land Development and Subdivision: Chapter 4 – Stormwater |

Version History

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Approval for Version 2.0

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Acknowledgements

Thanks to the Stormwater Code of Practice working group:
Omar Al Sheibani, Greg Hall, Konrad Heinemann, Mark Iszard, Doug Johnston, Craig Mountjoy, Ken Schmidt, Sarah Sinclair, Branko Veljanovski.

We also gratefully acknowledge the significant feedback from industry groups.

Thanks are also extended to Auckland Council staff, both past and present, who contributed to the development of the Stormwater Code of Practice.

Feedback

There is a feedback form available to download along with this document. Please send all feedback to SWCoP@aucklandcouncil.govt.nz.
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4. Stormwater

4.1. Scope

The Stormwater Code of Practice (SWCoP) is Chapter 4 of Auckland Council’s Code of Practice for Land Development and Subdivision. This November 2015 revision of the SWCoP supersedes the October 2013 edition.

The word ‘shall’ refers to practices which are mandatory for compliance with the SWCoP. The words ‘should’ or ‘may’ indicate a recommended practice. Any guidance given in the SWCoP, including references to technical publications and guideline documents, is provided to assist with meeting these minimum standards.

4.1.1 Purpose

The purpose of the SWCoP is to provide minimum standards for the design and construction of new public stormwater assets and of new assets which are to be vested in council ownership. In the event that these minimum standards are not achievable, developers shall discuss alternative approaches to development and ownership with the council. Auckland Council requires that any vested assets are safe to maintain, operate and decommission. The council also needs to ensure that its assets perform consistently throughout their design life without onerous maintenance risks or costs. Detailed design advice is available in a range of Auckland Council technical publications and other relevant industry best practice guidelines, rather than within this document.

4.1.2 Document Context

Former councils within the Auckland region had their own documents which addressed compliance with development rules. The first version of the SWCoP was published in October 2013, creating a single set of stormwater minimum standards for Auckland and superseding the stormwater sections from previous council standards. The Water and Wastewater Code of Practice for Land Development and Subdivision (Watercare CoP) addresses water and wastewater infrastructure and the Auckland Transport Code of Practice (ATCOP) addresses transport infrastructure.

The Auckland Plan (2012) sets the vision of Auckland becoming the ‘world’s most liveable city’. This places an emphasis on sustainable urban development to accommodate population growth, while ensuring that communities are safe and healthy environments to work, live and play. The significant issues for stormwater management are the protection of people, property, infrastructure, and the receiving environment. Auckland Council’s approach to supporting the vision of the Auckland Plan includes encouraging the use of Water Sensitive Design, an inter-
A Auckland Council – Stormwater

disciplinary approach which promotes balancing land development with the ecosystem services necessary to support it.

The SWCoP is to be used in conjunction with Auckland Council guideline document GD2015/004 (Water Sensitive Design for Stormwater) and Auckland Regional Council technical publications TP10 (Stormwater Management Devices: Design Guidelines Manual) and TP108 (Guidelines for Stormwater Runoff Modelling in the Auckland Region) which together provide best practice guidance for stormwater design. Auckland Council plans to update TP10 and TP108 with new guideline documents to bring them up to date with current technologies and best practice. Once these new guideline documents are published, they will supersede all references to TP10 and TP108 throughout the SWCoP.

Auckland Council will develop a Code of Practice chapter on Water Sensitive Design and landscaping, starting in 2016.

4.1.3 Future Revisions

The SWCoP will be updated again once the Proposed Auckland Unitary Plan becomes fully operative. Auckland Council intends to provide future revisions to the SWCoP periodically in response to changes in legislation, policies, technologies and national standards, and feedback from industry.

In developing this SWCoP, a collaborative approach has been taken with industry. After the October 2013 publication of the SWCoP there was a series of roadshows to present information on the document and to allow feedback and discussion. The council also consulted with key internal stakeholders and industry, and requested additional written feedback via email. The responses from this process have been collated and considered for this version of the SWCoP. It is expected that ongoing industry input will continue for future revisions.

There is a feedback form available to download along with this document. Please send all feedback to SWCoP@aucklandcouncil.govt.nz.
4.2. General

4.2.1. Objectives

The primary objective of a stormwater system is to manage stormwater runoff to minimise flood damage and adverse effects on both the built and natural environments.

Design of the stormwater system shall include provision for:

- Meeting all standards of Auckland Council
- Minimising adverse environmental and community impacts
- Protection of aquatic ecosystems from potential adverse effects
- Compliance with environmental requirements
- Adequate system capacity to service the fully developed catchment
- Long service life with consideration of maintenance and whole of life cost
- Application of Water Sensitive Design solutions
- Minimisation of flood risk to life and property
- Safety in design – refer to Section 4.2.5.4.

4.2.2. Legislation and Policy

The legislation and policy framework that controls the planning, design, construction, operation and maintenance of the council’s stormwater system includes the following documents.

4.2.2.1. National Legislation, Approved Codes of Practice, and Standards

- Resource Management Act 1991 (RMA)
- Public Works Act 1981
- NZ Dam Safety Guideline 2000
- Plumbers, Gasfitters, and Drain Layers Act 2006
- Civil Defence Emergency Management Act 2002
- Health and Safety in Employment Act 1992
- Health and Safety Reform Bill 2013
- Health and Safety in Employment (Mining Operations and Quarrying Operations) Regulations 2013
- Approved Code of Practice for Temporary Traffic Management (Version 4)
- Australian Standard (AS) 2865 : 2009 – Confined Spaces
- Hauraki Gulf Marine Park Act 2000

4.2.2.2. National Policy

- National Policy Statement for Freshwater Management 2014
- National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011.

4.2.2.3. Auckland Council Policy

- Auckland Council Proposed Auckland Unitary Plan (PAUP)
- Auckland Council Bylaws
- Auckland Council Minimum Health and Safety Requirements for Physical Works (HS262).

4.2.3. Auckland Council Technical Publications and Guidance Documents

Auckland Council publishes numerous technical publications and guidance documents that are relevant to stormwater design. These can be found on the council website.

The SWCoP refers to existing guidance documents and technical publications. However, many of these publications are in the process of being revised and re-published. It is the responsibility of developers and designers to ensure that they are using a current version of all publications. A list of many of the potentially relevant documents can be found in Appendix A.

4.2.4. Auckland Council Requirements

4.2.4.1. Engineering Approval

Engineering Approval is required for works that are to be vested in Auckland Council ownership. Infrastructure that does not meet the minimum engineering standards within this CoP and/or does not comply with conditions of consent and/or Network Discharge Consents will require specific Engineering Approval to confirm acceptance.

Where there is a conflict between the requirements of the CoP and any other infrastructure requirements or conditions this shall be discussed and resolved with the council. In general the most stringent requirement will prevail.

Auckland Council aims to streamline the approval process for developments that can comply
with our vested asset requirements, so that each application does not need to go through an individual design review. Minimum standards may not always be achievable, in which case the Engineering Approval process enables non-compliance to be addressed.

The recommended first step in the Engineering Approval process is a **pre-application meeting** with the council. The purpose of this meeting is to identify potential non-compliance with the SWCoP and to explore possible alternative solutions. Early discussion around alternative solutions will help the council indicate which, if any, would be unacceptable.

### 4.2.4.2. Regional Policy Statement, Regional and District Plans

Development shall comply with the requirements of Auckland Council’s Auckland Regional Policy Statement, Regional Plans and District Plans under the Resource Management Act 1991 (RMA), including obtaining a resource consent as required under regional and district plans. Relevant policy statements and plans include:

- Proposed Auckland Unitary Plan (PAUP), notified on 30 September 2013
- Auckland Regional Policy Statement
- Auckland Regional Plan: Air, Land and Water
- Auckland Regional Plan: Coastal
- Auckland Regional Plan: Sediment control
- Auckland City (including Central, Hauraki Gulf Island and Isthmus), Manukau City, North Shore City, Waitakere City, Rodney, Franklin and Papakura District Plans.

Generally, provisions within the PAUP will take effect once decisions on submissions have been made (RMA, s.86B). However, some parts of the PAUP take effect at notification date (e.g. certain provisions which protect or relate to water, air, soil (for soil conservation), significant indigenous vegetation, and significant habitats of indigenous fauna or historic heritage) and will gain weight as the submission and decision process progresses. Many of the PAUP rules relevant to the SWCoP have legal effect from 30 September 2013. Refer to Chapter A, Section 4.3 of the PAUP for further information on the status of rules.

Under the Housing Accords and Special Housing Areas Act 2013, rules in the PAUP have operative effect from the date of notification for qualifying developments in Special Housing Areas, and that other operative regional and district plans will have no further effect.

The regional and district plans above set out the requirements for every stage of development in order to promote sustainable management under the RMA through managing adverse effects on the environment, including:

- Setting the Rural-Urban Boundary
- Requirements for planning and plan changes for greenfield and brownfield
development, including structure planning and framework planning requirements

- Controls on land use, subdivision and development (RMA, s9), including for the purpose of sediment control, and managing flood risk and stormwater flow and quality
- Restrictions on use of the Coastal Marine Area (RMA, s12)
- Restrictions on the use of beds of lakes and rivers (RMA, s13), including placement and use of structures
- Restrictions on the use, damming and diversion of water (RMA, s14)
- Restrictions on discharges to the environment (RMA, s15), including discharge of stormwater.

The requirements of this CoP shall be taken into consideration at early planning stages of development as part of integrated land and water management planning. This is to ensure that stormwater assets to be vested in the council meet the council’s requirements as a stormwater network owner and operator. However, the requirement to meet network infrastructure operator requirements, including complying with the CoP, is specified in subdivision and development sections of the PAUP as this is the time that detailed infrastructure planning occurs. Any activities involving connection to, modification of, or creation of new public stormwater network shall be approved by the network operator (Auckland Council) prior to approval of survey plans under the RMA s224(c). Note that these requirements vary across legacy district plans, which are effectively superseded by the enactment of the Stormwater Bylaw (see Section 4.2.4.3).

Auckland Council’s Stormwater Unit holds Network Discharge Consents (NDCs) for parts of its network and at the time of publication is in the process of preparing a single, Auckland-wide NDC application. NDC and growth planning processes shall be aligned wherever possible to deliver integrated land and stormwater management, including Water Sensitive Design. Developments that discharge into the public stormwater network shall comply with Auckland Council’s NDC requirements and any catchment planning analyses approved under that NDC. Discharges direct to the environment may be covered by an individual NDC, if the NDC provides for this and its conditions are met.

### 4.2.4.3. Stormwater Bylaw

Auckland Council has developed a new Auckland-wide bylaw for stormwater management which will be operational from 1 November 2015. The key purpose of the bylaw is to provide a consistent regulatory approach for stormwater management across Auckland.
The bylaw will:

- Ensure that the public stormwater network and private stormwater systems are of a consistently high standard throughout Auckland
- Require on-site stormwater devices on private land to be well maintained, as they form part of the wider stormwater network
- Manage activities on private property that have adverse impacts on the public stormwater network
- Enable the council to develop stormwater controls for specific areas and specific local issues.

All design decisions for stormwater shall be in accordance with the Stormwater Bylaw.

4.2.5. Health and Safety – Access to Auckland Council’s SW Network

Stormwater assets represent a number of risks to the person. For example, confined spaces may include the inherent dangers of entrapment, engulfment and asphyxiation. As such, Auckland Council acknowledges that under the Health and Safety Reform Bill as a PCBU (Person Conducting a Business or Undertaking) that they may have overlapping duties for any persons wishing to access that asset. In discharging those duties, the council shall make every effort to advise the public through the Engineering Approval or Asset Owner Approval process based on a known application. In doing so, the council requires the applicant to submit for review a safe work methodology with supporting training evidence and an applied risk assessment relating to the intended work.

Based on that review, the council may seek to monitor the work or may request that the applicant provides evidence to demonstrate that the work has been monitored and inspected to meet the intent of the safe work methodology. This includes ensuring that all workers participate in carrying out the safe work methodology, that workers are ultimately free from the potential of harm, and that all identified safety improvements are implemented at that time.

In addition, any confined spaces within the public stormwater network shall only be accessed by an authorised and trained person. Access to combined networks is managed by Watercare and shall comply with Watercare’s requirements, including health and safety.

4.2.5.1. Access Granted by Engineering Approval

Prior to commencing any physical works on the public stormwater network involving physical access, all contractors shall meet the council’s minimum health and safety requirements for physical works (HS262), have a current, Site-Specific Safety Plan (or safe work methodology) for the particular project, and have gained Engineering Approval if required. Where the council is aware of an existing site-specific hazard, they will notify the contractor of it.
Examples of works to be undertaken under Engineering Approval are:

- New connection to a pipeline
- Maintenance/repair of existing stormwater pipelines
- Construction of a new stormwater asset to be vested in the council.

4.2.5.2. Access Granted by Asset Owner Approval

Contractors requiring access to the public stormwater network for purposes other than physical works shall undertake such works under approval from Auckland Council.

Access to services within the road reserve also requires a Corridor Access Request (CAR) approval from Auckland Transport. The contractor shall also obtain all necessary land owner approvals for access.

Examples of works for which approval is required from Auckland Council as the asset owner are:

- CCTV inspection
- Jetting and other cleaning
- Visual inspection requiring physical entry to network
- Any other physical access to the network not involving physical works.

4.2.5.3. Non-Man Entry Inspection

Opening of covers for short durations (for example, to check depths) not involving physical access to the system is permitted, providing the contractor uses the appropriate tools and complies with Auckland Council’s minimum health and safety requirements for physical works (HS262), and obtains all necessary approvals (for example for land access, working in the road (CAR approval), etc.).

4.2.5.4. Safety in Design

Design of all stormwater assets shall consider health and safety risk throughout the life of the asset and shall help to promote the safety of Auckland Council employees, contractors, the public, property, and operating personnel. As PCBUs (Persons Conducting a Business or Undertaking), designers, architects, engineers, manufacturers, and suppliers or installers of structures such as stormwater pipes hold a duty of care under the Health and Safety Reform Bill. PCBUs are required to consider all aspects of risk during all phases of the asset life, including design, construction, operation and decommissioning. Operational risks shall be considered during both normal use and in extreme storm events.

Operation and maintenance activities often involve personnel working within live networks. Design engineers shall ensure that all practicable measures are included in the design to facilitate
safe working conditions in and around the asset.

As these assets will generally be developed in urban areas, careful consideration is also needed in design and construction with respect to how the public may interact with the asset, to ensure public safety.

4.2.6. Catchment Planning

Auckland Council will undertake stormwater management planning on a catchment-wide basis for urban areas. Rural catchments may not have specific management plans developed. Where a proposed development is in an area covered by an Auckland Council catchment management plan, designers shall comply with that plan. Access to these documents will be made available via request to Auckland Council Development Engineers.

If there is no catchment management plan for the area of the proposed development, designs shall utilise the Best Practicable Option that will meet the provisions of relevant plans as required by the council.

The implications of future development on adjoining land shall be assessed to ensure the mitigation of negative hydrological effects both during and post-development. Effects to be assessed include those due to higher flow rates and volumes of stormwater discharge and peak flood levels. Refer to Section 4.3.5.6 for secondary flow path design requirements.

Any catchment management planning issues, including non-compliance with the catchment management plan, shall be discussed with the council.

4.2.6.1. Network Consents

Auckland Council is applying for a single Auckland-wide Network Discharge Consent (NDC). Designers shall either comply with the NDC or make a private application for stormwater discharge/diversion consent. Compliance with the NDC will be assessed against relevant criteria, objectives and outcomes within the NDC, and will require network utility operator certification. If designers make a private application, the private NDC will not be approved by the council and will remain with the consent holder. Any assets relevant to the private NDC will not be vested into council ownership.

4.2.7. System Components

The stormwater system conveys storm surface runoff and shallow groundwater from the point of interception to soakage areas, attenuation areas, or the point of discharge to receiving waters.
The stormwater system consists of:

- Natural systems such as:
  - Streams (ephemeral, intermittent and permanent)
  - Ground aquifers
  - Overland flow paths.

- Built assets such as:
  - Roadside channels
  - Swales
  - Catchpits
  - Piped network
  - Manholes
  - Inlets and outlets
  - Constructed channels
  - Stormwater quality improvement devices (such as wetlands, ponds, rain gardens, etc.)
  - Diversion devices
  - Control structures.

Acceptable design solutions of different system components are set out on standard construction drawings contained in Appendix B. The drawings and guidelines can be used by anyone in accordance with Creative Commons licences and NZ Government Open Access and Licensing framework.

4.2.8. Catchment and Off-Site Effects

Proposed stormwater systems shall cater for stormwater runoff from within the land being developed together with any runoff received from upstream catchments. The upstream catchment shall be considered for the Maximum Probable Development (MPD) scenario, meaning that it allows for development within a catchment that takes into account the maximum impervious surface limits of the current zone or, if the land is zoned Future Urban in the Proposed Auckland Unitary Plan, the probable level of development arising from zone changes. If the upstream catchment includes areas outside the Rural Urban Boundary then the MPD shall be agreed with the council. In order for a system to be considered for vesting in council ownership, or for stormwater discharges to be authorised under the council’s Network Discharge Consent (see Section 4.2.6.1), the system must be designed to cater for the MPD scenario as defined in this section.
For a proposed land development (including projects involving changes in land use or coverage) the design of the stormwater system shall include the evaluation of the effects on both upstream and downstream properties. This evaluation will be required at the resource consent stage and may be linked to a requirement to achieve alteration of the hydrological regime to the benefit of the wider catchment.

The council will endeavour to provide guidance at an early stage in the resource consent application process as to whether a catchment-wide solution will be required.

Downstream effects could include (but are not limited to) changes in peak flows and patterns, flood water levels, contamination levels and erosion or silting effects, and effects on the existing stormwater system. Developers shall allow for any specific mitigation requirements for the area being developed. If the proposed development area is not covered by a specific catchment management plan, and the proposed development includes effects that are assessed by the council as being more than minor, mitigation measures such as peak flow attenuation and volume control will be required. Where a proposal details effects that are assessed by the council as being less than minor, the developer may or may not be required to implement mitigation measures as directed by the council, in particular where the cumulative effects of similar development within the catchment are considered.

Where modification of a watercourse is required, fish passage shall be maintained. Refer to relevant consent requirements and Auckland Council technical publication TP131 (*Fish Passage Guidelines for the Auckland Region*) for further detail. Auckland Council will look for opportunities to enable fish passages in watercourses where these have been obstructed by ‘man-made’ structures. In circumstances where the developer can demonstrate that fish passage would provide no nett benefit, the above criteria may be exempted at the council’s discretion.

### 4.2.9. Water Quality

A resource consent may be required for the diversion and discharge of stormwater. The attenuation and treatment of stormwater discharge may also be required in order to comply with permitted activity rules or as a condition of consent. Consent may be required for a discharge even when it is not a direct discharge to land or receiving water, such as where the discharge is to an existing network.

Stormwater devices may be required to avoid any potential adverse water quality effects on receiving land or waters. The type of contaminants that could become entrained in the stormwater shall be identified during the stormwater system design phase and then a suitable treatment device(s) shall be considered to address the particular issues.

Guidance and criteria for the design of stormwater devices is provided in the Auckland Regional Council technical publication TP10 (*Stormwater Management Devices: Design Guidelines Manual*)
which is based on the requirements of the Auckland Council Regional Plan: Air, Land and Water rather than on those of the Proposed Auckland Unitary Plan (PAUP). The volume-based design methodology in TP10 is equivalent to treating the runoff from 90% of the annual rainfall. Flow-based devices treat an equivalent proportion of the annual runoff by sizing to a design rainfall intensity of 10mm/hr, as detailed in Auckland Council technical report TR2013/035 (Unitary Plan Stormwater Management Provisions: Technical Basis of Contaminant and Volume Management Requirements).

4.2.10. Climate Change

Climate change is expected to alter the intensity and frequency of significant rainfall events. In general, an increase of peak flow is expected. Hydrological calculations shall be carried out in accordance with Auckland Regional Council technical publication TP108 (Guidelines for Stormwater Runoff Modelling in the Auckland Region) with allowances for climate change effects in accordance with Table 5.2 of Climate Change Effects and Impact Assessment: A Guidance Manual for Local Government in New Zealand (Ministry for the Environment, 2008), using a temperature increase of 2.1 degrees by 2090. This includes an increase to the 24-hour rainfall depth, as well as a change to the dimensionless TP108 rainfall profile as shown in Table 4.1 and Table 4.2.
### Table 4.1: Percentage Increase in 24-hour Design Rainfall Depth

<table>
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<th>Percentage Increase in 24-Hour Design Rainfall Depth Due to Future Climate Change*</th>
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<tr>
<td>2%</td>
<td>16.8%</td>
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<tr>
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*assuming 2.1°C increase in temperature

### Table 4.2: TP108 Normalised 24-hour Temporal Rainfall Intensity Profile

<table>
<thead>
<tr>
<th>Time (hrs:mins)</th>
<th>Time Interval (min)</th>
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*assuming 2.1°C increase in temperature
The performance of stormwater systems in coastal areas shall take into account expected future sea levels. Refer to Section 4.3.5.8 below.

**4.2.11. Access to Relevant Information**

A range of information including a GIS viewer, planning documentation and property information can be accessed at [www.aucklandcouncil.govt.nz](http://www.aucklandcouncil.govt.nz).

Developers are also advised to visit the Auckland Design Manual website at [www.aucklanddesignmanual.co.nz](http://www.aucklanddesignmanual.co.nz).
4.3.  Design

4.3.1.  Durability

Designers shall provide whole of life costs including capital, maintenance and rehabilitation costs using a life cycle of 100 years. It is recognised that the durability of individual components may vary, and this should be accounted for in the whole of life cost.

4.3.2.  Future Development

Any proposed development shall make provision for stormwater services to cater for the upstream catchment and shall extend to the boundary with the adjacent upstream property. See Section 4.3.11 for details of pipeline ownership.

4.3.3.  Water Sensitive Design

The Water Sensitive Design (WSD) approach aims to rely on natural components such as vegetation and soil media to cater for stormwater quality as well as enhancing urban environments. The main principles of WSD are to:

- Promote inter-disciplinary planning and design
- Protect and enhance the values and functions of natural ecosystems
- Address stormwater effects as close to source as possible
- Mimic natural systems and processes for stormwater management.

The benefits of WSD include protecting and enhancing natural waterways by limiting discharges of silt, suspended solids, and other pollutants into receiving waters.

As far as practicable, all future development in Auckland should apply the principles of WSD to minimise stormwater runoff volumes and peak flow rates and to improve the quality of stormwater runoff entering the receiving environment.

WSD principles shall be considered during the initial planning stage, developed during design and implemented at the construction stage of the project. Good planning and design early in the development process maximises the cost effectiveness of WSD.

Guidance on the implementation of WSD is available in the following documents:

- Auckland Council guideline document GD2015/004 (Water Sensitive Design for Stormwater) – commonly known as GD04
The requirements of this Code of Practice take precedence over any guidance provided by the above documents.

4.3.4. Stormwater System Design Approach

Sections 4.3.4 and 4.3.5 aim to provide designers with a clear understanding of the approach Auckland Council requires for the design of stormwater systems. The council’s preferred approach is to minimise any impact upon the receiving environment. All development should, in the first instance, be in accordance with the Water Sensitive Design principles detailed in Section 4.3.3 above and in Auckland Council guideline document GD2015/004 (Water Sensitive Design for Stormwater). The information provided in the following two sections primarily focuses on the minimum standards required for the design of both primary and secondary systems.

The stormwater system shall be designed for the Maximum Probable Development (see Section 4.2.8) of the entire upstream catchment and in accordance with Auckland Regional Council technical publication TP108 (Guidelines for Stormwater Runoff Modelling in the Auckland Region) with allowances for climate change as described in Section 4.2.10 above. Effects on downstream systems shall be shown to be acceptable. The system shall be designed to collect surface water from all areas, including lots, roads, rights-of-way and reserves.

4.3.4.1. Primary Stormwater System

Primary stormwater systems include both open and closed conduits and shall be designed to cater for the flows generated by the event specified in the design standards in Section 4.3.5.2 below. The location of primary systems should be aligned with natural flow paths as far as possible.

4.3.4.2. Secondary Stormwater System

A secondary stormwater system consists of ponding areas and overland flow paths with sufficient capacity to transfer the flows generated by the event specified in the design standards in Section 4.3.5.2 below. The location of secondary systems should be aligned with natural flow paths as far as possible. The existing constructed or natural flow paths shall be retained as far as practical. Any alteration of the existing stormwater system shall result in no detrimental impacts to either upstream or downstream properties.

Secondary systems shall be located on public land where possible. However, creation of an overland flow path is not to be considered as justification for the land it passes through to be vested in the council. Overland flow paths on private property for flows in excess of 100L/s for the 1% Annual Exceedance Probability (AEP) event shall be protected by registered easements in favour of Auckland Council or by other encumbrances prohibiting earthworks, fences and other structures, as appropriate.
4.3.5. Design Criteria

When the design process requires hydrological or hydraulic modelling, a design report will be necessary. The design report shall include all underlying assumptions such as runoff coefficients, time of concentration, catchment areas, roughness coefficients and losses. These assumptions shall be clearly presented so that an appropriate check of all calculations is possible. A copy of the model or calculations will be required by Auckland Council for review and/or record keeping. Models developed in proprietary software need to be submitted with temporary licenses.

The designer shall undertake the required design and prepare design drawings compatible with Auckland Council's design and performance parameters. Designers shall ensure the following aspects have been considered and included in the design where appropriate:

a) The size of pipes, ponds, swales, wetlands and other devices in the proposed stormwater management system

b) How the roading stormwater design is integrated into the overall stormwater system (please refer to Auckland Transport Code of Practice (ATCOP)). For works within the road reserve, liaison with Auckland Transport is required to confirm design parameters. Where these are different to those of Auckland Council, the most stringent parameters shall apply.

c) The type and class of materials proposed to be used

d) System layouts and alignments including:
   • Route selection
   • Topographical and environmental aspects (see Watercare's Water and Wastewater CoP)
   • Easements
   • Clearances from underground services and structures (see Watercare's Water and Wastewater CoP)
   • Provision for future extensions
   • Location of overland flow paths, and checks against depth and flow criteria (see Section 4.3.5.6)

e) Hydraulic adequacy (see Section 4.3.5.3)

f) Property service connection locations and sizes (see Sections 4.3.9.5 and 4.3.11)

g) Accessway, including vehicle access for future operation and maintenance activities

h) Cost, including whole of life cost

i) Other specific requirements such as specific geotechnical conditions, fish passage, debris
loading/blockage as necessary.

Where necessary, the designer shall liaise with Auckland Council prior to commencement of design, to ensure that sufficient prerequisite information is available to undertake a robust design.

4.3.5.1. Hydrological Design of Stormwater Systems

For most catchments, estimation of surface water runoff shall be derived using Auckland Regional Council technical publication TP108 (Guidelines for Stormwater Runoff Modelling in the Auckland Region), adjusted for climate change as stated in Section 4.2.10. For larger catchments, or where significant storage elements (such as ponds) are incorporated, surface water runoff shall be determined using an appropriate hydrological and/or hydraulic model to the approval of Auckland Council.

Runoff factors are to be based on the underlying geology, as defined on the geological map for the Auckland Region and confirmed by site inspections. Runoff factors will also be influenced by land use.

4.3.5.2. Design Standard

All new public stormwater systems shall be designed to cater for design storms of at least the Annual Exceedance Probability (AEP) set out in Table 4.3 (adjusted for climate change – see Section 4.2.10) unless specific approval has been obtained from Auckland Council.

<table>
<thead>
<tr>
<th>Function</th>
<th>Annual Exceedance Probability (AEP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary systems</td>
<td>10% AEP</td>
</tr>
<tr>
<td>Secondary systems</td>
<td>1% AEP</td>
</tr>
</tbody>
</table>

Development is generally not permitted in areas with no secondary flow path.

Secondary systems shall be designed to accommodate the 1% AEP design storm event assuming the conditions listed in Section 4.3.5.6.

4.3.5.3. Hydraulic Design of Stormwater Systems

The primary piped system shall be designed to cater for the peak design flow, without surcharge, determined by the water surface profile throughout the piped system. Secondary stormwater systems shall be designed as open channel flow.

The hydraulic design of stormwater pipelines shall be based on either the Colebrook-White
formula or the Manning formula. System capacity shall be determined from the Colebrook-White or Manning coefficient. The Colebrook-White and Manning formulae can be found in *Metrication: Hydraulic data and formulae* (Lamont, n.d.). The roughness coefficient used when determining the system capacity shall consider the aged condition of the new and the existing stormwater network. Manufacturers’ specifications shall also be referred to.

Examples of appropriate ranges for Manning’s roughness values for materials are provided in Table 4.4.

Table 4.4: Manning’s Roughness Values for Closed Conduits and Overland Flow Path (Chow, 1959)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Manning’s Roughness Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal (coated, uncoated, galvanised)</td>
<td>0.010 – 0.017</td>
</tr>
<tr>
<td>Plastic</td>
<td>0.010 – 0.012</td>
</tr>
<tr>
<td>Corrugated metal</td>
<td>0.017 – 0.030</td>
</tr>
<tr>
<td>Concrete (finished)</td>
<td>0.011 – 0.014</td>
</tr>
<tr>
<td>Concrete (unfinished)</td>
<td>0.012 – 0.020</td>
</tr>
<tr>
<td>Overland flow paths along roadways</td>
<td>0.02 – 0.03</td>
</tr>
<tr>
<td>Overland flow paths through properties/parcels</td>
<td>0.10 – 0.20</td>
</tr>
</tbody>
</table>

Any obstruction to flow in a pipeline, such as fish passage, will require specific design to the council’s approval.

Hydraulic design of precast concrete stormwater culverts shall be in accordance with CPAA Design Manual *Hydraulics of Precast Concrete Conduits (Pipes and Box Culverts).* For other materials use *Guide to Road Design: Part 5B – Open Channels, Culverts and Floodways* (Austroads, 2013). Also see Section 4.3.9.8.
4.3.5.4. Energy Loss through Structures

Energy head loss (also known as head loss) in a pipeline or an access chamber typically consists of entrance, exit and bend losses.

Energy loss is expressed as velocity head:

\[ \text{Energy loss } H_e = K \frac{V^2}{2g} \text{ (m)} \]

where:

- \( K \) is the empirical entrance loss coefficient
- \( V \) is velocity (m/s)
- \( g \) is gravitational acceleration (m²/s).

The entrance loss coefficient table (Table 4) and energy loss coefficient graph (Figure 12) in New Zealand Building Code (NZBC) clause E1/VM1 (Compliance Document for New Zealand Building Code: Clause E1 Surface Water (Department of Building and Housing, 2011)) provide appropriate \( K \) values for flow through inlets and access chambers respectively. Figure 4.1 below shows coefficients for energy loss due to bends through manholes.

The exit loss coefficient has a range of values from 0 to 1. A free discharge exit has a \( K \) value of 0 while an exit submerged in a pond has a \( K \) value of 1.

When modelling catchpits, either of the following scenarios may be used:

- Where catchpit grating losses are allowed for, water levels at design flow shall not exceed kerb level at catchpit positions.
- Where catchpit grating losses are neglected, design water level shall not allow standing water above the catchpit grating.
4.3.5.5. Determination of Water Surface Profiles

Stormwater systems with a subcritical flow shall be designed by calculating backwater profiles along the pipe starting from an appropriate outfall water level. Computer modelling shall be utilised where the system is complex. On steep gradients with supercritical flows, both inlet control and hydraulic grade line analyses shall be used and the more severe relevant condition adopted for design purposes. At manholes and inlets, the water levels computed from the design...
flow shall be low enough to prevent overflow and to allow existing and future connections to function satisfactorily.

Request shall be made to the council to provide outfall levels from the relevant hydraulic model when the discharge is to an existing stormwater network. If the discharge is to a river or other body of water, the council shall be consulted for relevant hydraulic model information; however, in the event that this information is unavailable, the outfall water level shall be determined using the tailwater depth calculation in E1/VM1 (Compliance Document for New Zealand Building Code: Clause E1 Surface Water (Department of Building and Housing, 2011)). For areas with tidal outfalls (including tidal rivers) designs will need careful consideration in terms of the nominated receiving body water level which will be used for the backwater curve calculations. Each situation will need to be individually assessed by the council.

In principle, each step in the determination of a water surface profile involves calculating a water level upstream i.e. reduced level of water surface (h_2) for a given value of discharge and a given start water surface level downstream (h_1).

This can be represented as:

\[ h_2 + \frac{V_2^2}{2g} = h_1 + \frac{V_1^2}{2g} + H_f + H_e \]

where:
- \( V \) is velocity (m/s)
- \( g \) is gravitational acceleration (m²/s)
- \( h_1 \) is downstream water level
- \( h_2 \) is upstream water level
- \( H_f \) is head loss (in metres) due to boundary resistance within the reach (for pipes, unit head loss is read from Manning’s flow charts, for example)
- \( H_e \) is head loss (in metres) within the reach due to changes in cross section and alignment (see Figure 4.1 for loss coefficients for bends through manholes).

### 4.3.5.6. Secondary Flow Paths

Secondary overland flow paths shall be designed with sufficient capacity to accommodate the 1% AEP storm event assuming the following conditions:

- For pipelines up to and including 600mm diameter, assume that the pipeline is 100% blocked.
- For pipelines between 600mm and 1050mm diameter, assume that the pipeline’s capacity has been reduced by 50%.
• For pipelines in excess of 1050mm diameter, assume that the pipeline’s capacity has been reduced by 10%.

The following matters need to be taken into account when considering the design of all secondary flow paths:

a) Secondary flow paths shall not be obstructed in any way. Buildings or structures, including fences and retaining walls, shall not be built within a secondary flow path or form an obstruction to any part of a secondary flow path. This includes works which do not require a building consent.

b) Any property owner is legally required to accept stormwater runoff that would naturally flow onto their property. The plotted secondary flow path entry point on the upstream boundary and the exit point on the downstream boundary shall not be altered by site development. However, it may be possible to relocate the flow path entry and/or exit point by mutual agreement with neighbouring properties.

c) Where modification to a secondary flow path is required by a development, applicants shall submit a detailed design of the overland flow path when the catchment exceeds 4000m² and for smaller catchments at the council’s discretion.

d) Where the road reserve is to be used as the secondary flow path, Auckland Transport shall be consulted at an early point in the design on a number of issues such as road and reserve width, road profile, lifelines access, and health and safety.

e) Where flow paths traverse pedestrian or vehicular accessways or public carriageways, the guidelines are that the expected flow has both:

   • A maximum of 200mm depth
   • A maximum velocity for pedestrian safety of:
     ○ 0.6m/s where there is no obvious danger
     ○ 0.4m/s where there is obvious danger.

f) Secondary systems shall be designed to avoid land instability and to reduce the significance of erosion during significant events. The design shall incorporate erosion protection measures as appropriate.

g) Careful management of stormwater on the site (for example landscaping, placement of driveways) can sometimes be used to convey secondary flows. All applications potentially affecting secondary flow shall include design details showing the layout of the secondary flow path across the site including flow depth and velocity at critical locations.

h) All modifications to secondary flow paths shall be documented on as-built plans.
4.3.5.7. Freeboard

Floor level requirements in relation to floodplains are set through rules in the Proposed Auckland Unitary Plan (PAUP) and operative district plans. Refer directly to these plans to be certain of requirements. Examples of relevant permitted activity thresholds for floor levels are in Chapter H of the PAUP under Section 4.11 (natural hazards) and Section 4.12 (flooding). Where more than one requirement applies, the most stringent will be used.

The minimum freeboard for overland flow paths shall be as per Section 4.3.1 of E1/VM1 (Compliance Document for New Zealand Building Code: Clause E1 Surface Water (Department of Building and Housing, 2011)), using the flow generated by the 1% AEP flood event, except where the flow is in excess of 2m³/s. Table 4.5 shows freeboard requirements for different situations.

Table 4.5: Freeboard Requirements for the 1% AEP Event

<table>
<thead>
<tr>
<th>Freeboard</th>
<th>Minimum height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vulnerable Activities*</td>
<td>500mm</td>
</tr>
<tr>
<td>Less Vulnerable Activities*</td>
<td>300mm</td>
</tr>
</tbody>
</table>
| Overland flow paths where flow is less than 2m³/s | • 500mm where surface water has a depth of 100mm or more and extends from the building directly to a road or car park, other than a car park for a single dwelling  
• 150mm for all other cases |
| Overland flow paths, where flow is equal to or in excess of 2m³/s | • 500mm for Vulnerable Activities*  
• 300mm for Less Vulnerable Activities* |

* As defined in the PAUP

Alternative specific designs for freeboard within overland flow paths may be considered for approval at the council’s discretion.

Freeboard shall be measured from the top water level to the finished floor level.

4.3.5.8. Coastal Areas

In coastal areas, design criteria shall be discussed with Auckland Council at an early stage. Coastal processes including storm surge, tsunami hazards, climate change, sea level rise and coastal vulnerability need to be taken into account in accordance with the following guidance documents:

- Coastal Inundation by Storm Tides and Waves in the Auckland Region (Stephens et al., 2013)
• Coastal Storm Tide Levels in the Auckland Region (Stephens et al, 2011)
• Coastal Hazards and Climate Change: A Guidance Manual for Local Government in New Zealand (Ministry for the Environment, 2008)
• Assessment of Potential Sea Levels Due to Storms and Climate Change Along Rodney’s East Coast (Rodney District Council, 2005)
• North Shore City Sea Inundation Study (North Shore City Council, 2004)
• Kaipara Harbour Hydrodynamic Modelling (DHI Water & Environment, 2006).

The worst case from any of the above documents shall be considered, where relevant.

4.3.6. Stormwater Quality and Quantity Control

Development can generate increased runoff rates and contaminants, with corresponding negative effects on receiving environments. Stormwater devices can be used to reduce the effects of changes in stormwater quality and quantity.

Refer to relevant planning provisions for stormwater quality and quantity requirements that need to be met for new developments. Auckland Regional Council technical publication TP10 (Design Guideline Manual for Stormwater Treatment Devices) provides guidance for stormwater device design using a Best Practicable Option approach.

4.3.6.1. Stormwater Devices

There is a wide range of stormwater devices available for managing the quality and quantity of stormwater. Each of these devices may be appropriate for varying sites with different land use types and other constraints. Readers should refer to Auckland Regional Council technical publication TP10 (Stormwater Management Devices: Design Guideliness Manual) for guidance on the appropriate selection and design of stormwater devices. Final selection of any devices to be vested is to be approved by the council.

In addition to the devices outlined in TP10, proprietary devices may also be considered in re-development or ‘brownfield’ development areas where spatial constraints and practicality require their use. In these instances, only devices that have been approved by Auckland Council may be used. In general, the use of proprietary devices in ‘greenfield’ development areas shall not be permitted for vesting in council ownership. A cost-benefit analysis of all devices is required before vesting.
4.3.6.2. General Design Approach for Stormwater Devices

The success and cost effectiveness of stormwater devices is enhanced by considering them in the very early stages of planning and design of a development. The developer shall enter into discussions with the council regarding the selection of these devices as early as practicable in the development’s design prior to sign-off by the council. The following key items shall be considered:

a) **Primary objective.** Having a clear understanding of the statutory requirements regarding water quality and quantity is crucial in identifying appropriate stormwater devices. The devices chosen need to match the water quality and quantity objectives.

b) **Secondary objective.** Stormwater devices offer many opportunities to deliver multiple benefits in addition to their stormwater functionality.

c) **Integrated approach.** An integrated approach considers several aspects of stormwater design including the following:
   - Consideration of stormwater management requirements in the early stages of a project
   - Integration of stormwater devices with other infrastructure such as parks, reserves, wastewater, water supply and buildings as part of the Water Sensitive Design of the development. For example, a green roof may function as a quality device, roof and open space.
   - Maintenance of stormwater devices shall be considered early in the design process. This will assist in the identification of features that will facilitate the ease and efficiency of on-going operation and maintenance of devices. All maintenance requirements shall consider current resource consent requirements.

d) **Device selection.** The proper design and position of a device within the stormwater catchment is critical. Several devices are often used in series, in what is called a “treatment train”. The respective position of the various components in the treatment train is an important consideration in ensuring effectiveness of the system throughout its lifecycle. Treatment trains are needed where a single device does not meet all of the water quality and quantity objectives. Refer to Auckland Regional Council technical publication TP10 (*Stormwater Management Devices: Design Guidelines Manual*) for further guidance on the treatment train approach. The whole of life cost of devices, including maintenance costs, shall be considered.

e) **Device location.** Any stormwater device shall be located in a readily accessible location, preferably on public land or land to be vested in the council. In cases where this is not possible and the device is located in private land, easements are to be provided for maintenance and access purposes. Generally, the location of stormwater devices in trafficked locations is not acceptable. Deviations from this approach may be considered
by the council, for example where the device is in a very low traffic volume location,
access is on the berm rather than the carriageway, and there is sufficient area. Device
location, type, size and maintenance requirements are subject to the council’s approval.
Refer to Section 4.3.6.4 for access requirements.
Devices located in high amenity open space areas require additional consideration to
achieve a sympathetic and unobtrusive design to the council’s approval. Reference should
be made to the Auckland Design Manual (www.aucklanddesignmanual.co.nz) for
guidance with respect to design in high-amenity open space.

f) **Device quantity.** Applicants shall optimise the number of devices proposed in relation to
the treatment effects and whole of life costs. There are situations where fewer and larger
facilities are preferable to many smaller ones; there are also situations where the
opposite applies.

g) **Device replacement parts.** Applicants shall demonstrate that any spare parts
anticipated being required for routine maintenance activities are commonly available on
the open market and are not subject to any licences or other restrictions that would bind
the council to purchase such items from a single supplier.

h) **Design for safety.** Ensuring that the device is safe both for the public and for operational
and maintenance staff is of critical importance. Devices involving open water storage such
as wet ponds and wetlands require particular attention to water safety, including inlet
and outlet location and levels. Pond fencing requirements will be subject to careful risk
assessment which shall demonstrate to the council’s approval that risks to public safety,
in particular falls from height and drowning, have been appropriately addressed.

i) **Other issues.** Additional items that may need considering include aesthetics,
biodiversity, site topography, underground devices and future decommissioning of the
device.

### 4.3.6.3. Maintenance of Stormwater Devices

The design and construction of any stormwater device shall take into consideration the future
ownership, access and maintenance requirements, and whole of life costs, and shall ensure that
maintenance can be carried out with little or no disturbance to the surroundings or neighbouring
properties.

Elements to consider in the design for the maintenance and operation of the device include the
following:

a) Safety in design to enable safe operation and maintenance

b) Access arrangements for operation and maintenance purposes shall be in accordance
with Section 4.3.6.4.
c) Procedures for the removal and disposal of sediment, including the required frequency. This shall include any consenting issues that are considered likely to occur in the future associated with the removal and disposal of silt.

d) Obtaining consent(s) for any maintenance activities for assets to be vested in the council

e) Where necessary, an appropriately sized and located drying/storage area shall be provided for litter/silt/media etc. that is removed from the device.

f) Wherever practical, it should be possible to drain the device and forebay by gravity flow.

g) Maintenance requirements of mechanical parts

h) Vegetation maintenance requirements. Weeds shall be controlled and removed in accordance with the Auckland Council Plant and Pest Management Strategy. Plant maintenance for vegetation shall be included in the maintenance plan.

An operation and maintenance manual for all stormwater devices, public or private, shall be submitted to the council and approved, prior to issue of certificates such as the Code Compliance Certificate (CCC) or Resource Management Act (RMA) s224(c) Certificate for subdivision consent. This manual shall include a detailed technical data sheet and shall state the methodology for the ongoing and long-term maintenance of the device, including:

- Inspections required and frequency
- Maintenance needs and frequency
- Recommended ongoing control methodology to eradicate established pests and invasive weeds from both terrestrial and aquatic areas.

Additional operation and maintenance information that is needed for detention ponds and wetlands (and their surrounding drainage reserve) are:

- Details for permanently wet areas
- Details for the surrounding planted area
- De-watering methodology for the main pond and the forebay
- De-silting methodology for the main pond and the forebay
- Consent(s) for operation and maintenance.

4.3.6.4. Access Requirements for Maintenance of Devices

The following minimum criteria shall be met in order to allow anticipated future maintenance works for treatment devices:

a) The minimum accessway width shall be 3.0m.

b) The maximum gradient of the accessway should be 1:10.
c) The minimum track specification including the design, construction and choice of surfacing for access tracks shall be discussed with the council. Requirements will vary according to device type and the use of the area in which the device is located.

d) A turning circle or equivalent shall be provided, of sufficient size to accommodate the intended vehicles for all maintenance activities.

e) Where necessary, provide a suitable platform for an excavator to undertake any maintenance work as required.

f) The approved access shall remain available at all times in perpetuity or until the council confirms in writing that the access is no longer required.

g) If the device is located in a trafficked location, sufficient area shall be allowed to establish all necessary traffic management controls, or any other requirements of the traffic management plan.

The suitability of the access and all other requirements listed above shall be demonstrated in the device’s design and in the operation and maintenance plan.

4.3.6.5. Stormwater Device Ownership

New stormwater devices may be vested in the council’s ownership if it can be demonstrated that a significant flow from the public stormwater network discharges to that treatment system. The council may at its discretion approve public treatment systems where there is considerable public benefit, that is, treatment is available for stormwater runoff from public land or from properties outside of the immediate development site. Prior to vesting such assets, a comprehensive Net Present Value (NPV) analysis shall be submitted to the council. Stormwater devices shall otherwise remain in private ownership.

Stormwater devices either created by the council or by a developer then vested in the council’s ownership shall satisfy a number of criteria, including the following:

- Public stormwater devices shall be located on Auckland Council-owned land.
- The stormwater discharge consent and any operation and maintenance consent, if issued to the developer, shall be transferred to the council at the same time as the land and assets are vested in council ownership.
- The developer shall enter into an agreement on vested assets with the council prior to resource or building consents being issued. Granting consent is conditional on signing the vested assets agreement.

The ownership and maintenance responsibility of stormwater devices (e.g. rain gardens) installed as part of a road project lies with Auckland Transport, and should comply with Auckland Transport Code of Practice (ATCOP) requirements.
Catchpits and associated pipe systems located on private land will remain private assets and will not be maintained by the council.

4.3.7. Watercourses, Natural and Constructed Waterways

Watercourses are an important part of the stormwater system. Discharges to watercourses shall be designed so as to minimise erosion, water quality impacts and flood risk. Watercourse maintenance is the responsibility of the owners of the land through which they pass. In some situations the council has control over the watercourse via covenants or easements. Where daylighting of existing piped watercourses occurs, the resulting watercourse shall be maintained by the landowner. In isolated instances where watercourses are vested in the council or in the council’s control, they shall be protected by an easement-in-gross in favour of Auckland Council.

Enhancement of watercourses is to be considered as part of a development, where appropriate. Enhancement may include, but is not limited to, the following:

- **Watercourse Rehabilitation:**
  - Providing riparian margins and landscaping that takes into account ecological values as well as flood risk issues
  - Protection against scour and erosion of the watercourse
  - Removing obstacles for free fish passage
  - Restoring ripples and runs to provide habitat and mimic natural conditions
  - Weed removal.

- **Watercourse Day-Lighting:** In some situations the council may decide to remove an existing culvert or pipe and restore a watercourse to its pre-development status. These will be determined on case-by-case basis.

4.3.8. Stormwater Pumping

All modifications or extensions to the public network shall be designed as gravity systems. There shall be no stormwater pumping within the public network without explicit permission from the council. All private stormwater rising mains, backflow prevention devices and other fittings shall be owned by the lot that the rising main serves. This applies for the full length of the rising main, ending at the public discharge chamber.
4.3.9. Pipelines and Culverts

4.3.9.1. Alignment of Pipelines

The expectation is that the pipe will be located within the overland flow path. Stormwater pipes shall be located, where practicable, within the road reserve (preferably in the berm) or other public land. Only where this is not possible shall the location of stormwater pipes within private property be considered. In such cases the pipe shall be located so as not to reduce the building area available on the lot (i.e. located as close as possible to a boundary) or where it can be shown that a satisfactory house location site is available clear of the pipe, and that access points have been allowed for, suitably placed so that access will be available post-development. Where stormwater pipes are installed adjacent to wastewater pipes within the berm or under the footpath, they shall preferably be installed on the carriageway side of the wastewater pipe.

The order of preference for the location of stormwater pipes is summarised as follows:

1. Within overland flow path
2. Road reserve and other public land
3. Shared accessway
4. As close to the property boundary as is practicable, and parallel to the boundary.

Pipelines adjacent to boundaries, structures and foundations shall be located at least a distance equal to the depth to invert away from such boundaries and the edge of such structures and foundations with an absolute minimum clearance of 1m in all cases (Refer to drawing SW22 in Appendix B).

The stormwater network layout shall ensure the following:

a) Access to all parts of the reticulation shall remain available for inspection and maintenance. Adequate spacing of manholes, access points and access chambers shall be provided for regular maintenance and inspections including CCTV inspection, water jetting, root cutting and grouting.

b) The proposed pipe system shall comply with the design, construction and maintenance aspects of AS/NZS 2865:2001 (Safe Working in a Confined Space).

c) The potential for infiltration and exfiltration shall be minimised, for example by optimising the number of manholes and access points.

d) Siphons and inverted siphons are generally not permitted, however the council will exercise its discretion on a case by case basis. These will require specific design and approval.

e) In general, pipelines between access points shall be straight with manholes at a change in
direction or grade. Horizontally or vertically curved pipelines will require specific design and approval by the council. Pipelines with both horizontal and vertical curvature will not be permitted.

4.3.9.2. Other Services

For normal trenching and trenchless technology installation, clearance from other service utility assets shall generally be in accordance with those established in Watercare’s *Chapter 5 – Water and Wastewater CoP*.

Service crossings of open stormwater channels or watercourses shall be installed beneath the channel or watercourse. In the event that it is impractical to install the service beneath the channel, specific design approval is required from the council.

4.3.9.3. Design for Installation

All pipes shall be designed to support all existing and any predicted future dead loads. Design live loads shall be HN-HO-72 for motorways and arterial roads, HN for local streets and driveways, and 20kN wheel load for non-trafficable areas. Reinforced concrete pipe installation design shall be in accordance with AS/NZS 3725:2007 and CPAA Engineering Guideline *Selecting Materials for Bedding Steel Reinforced Concrete Pipe*. The minimum acceptable support type shall be H2 as shown in drawing SW03 in Appendix B. The use of higher support types to reduce pipe class shall be subject to specific design and council approval.

All reinforced concrete pipes shall be designed to AS/NZS 4058 and AS/NZS 3725.

All flexible pipes shall be designed and constructed to AS/NZS 2566 parts 1 and 2.

Installation of reinforced concrete pipe in road reserve shall require specific design to demonstrate that any possible heavy compaction of trench fill to achieve road subgrade and pavement stability requirements will not cause excessive cracking of pipes. The use of free flowing granular materials for pipe embedment as shown in drawings SW02 and SW03 in Appendix B is recommended to reduce compaction stresses on pipes.

In areas with a high water table, it shall be demonstrated to the council’s satisfaction that all pipelines are designed against flotation.

4.3.9.4. Materials

The pipe types listed in Table 4.6 below may be used for stormwater drainage work when appropriate, provided they are designed, manufactured and installed to the current New Zealand or Australian standards.
Wherever it may be reasonably anticipated that concentrations of chlorides, sulphates and acids may be elevated, and in industrial areas, the pipe material and grade shall be selected to resist attack from any chemicals that are identified through a suitable testing regime. In all cases where elevated chemical concentrations may exist, including in peat soils and the marine environment, the soil, groundwater, and stormwater shall be tested and results provided with the design report.

### Table 4.6: Pipe Materials

<table>
<thead>
<tr>
<th>Pipe Type</th>
<th>Standard</th>
<th>Conditions of Use*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reinforced concrete (RC)</td>
<td>AS/NZS 4058 and AS/NZS 3725</td>
<td>All stormwater applications</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC)</td>
<td>AS/NZS 1254 or AS/NZS 1260 – Minimum SN16</td>
<td>Generally for up to 375mm diameter</td>
</tr>
<tr>
<td>Polyethylene (PE)</td>
<td>AS/NZS 4130 and 5065 – Minimum PE100 or base resin from which PE100 is compounded, with Standard Dimension Ratio (SDR) of 17 or superior including for thrust and drilled lines that are grouted</td>
<td>Generally confined to trenchless applications or trenched applications where required by specific site conditions. Will be approved for use following demonstration of satisfactory specific design.</td>
</tr>
<tr>
<td>Polypropylene (PP) twin-walled pipe</td>
<td>AS/NZS 5065 – Minimum SN16</td>
<td>Will be approved for specific applications following demonstration of satisfactory specific design</td>
</tr>
</tbody>
</table>

* Refer also to Section 4.3.9.4.

All other pipe materials are excluded from use without specific approval from the council.

### 4.3.9.5. Minimum Pipe Sizes

#### Public Mains

All public mains shall have a minimum internal diameter of 225mm. The upstream point of a public main shall start at a manhole, non-access chamber or catchpit, and shall terminate at a manhole or outlet. The pipe shall be sized in accordance with Section 4.3.5. In this context, a public main is a pipeline which meets all of the following criteria:

- Has been vested or is in the process of being vested in the council
• Is designed to convey at least the Maximum Probable Development (see Section 4.2.8) 10% AEP storm for the sub-catchment it services

• Is (or could be in the future) connected to a public catchpit.

Branch Lines

All branch lines shall have a nominal diameter of minimum 150mm (or minimum 100mm if serving up to two lots) and maximum 225mm. If a capacity assessment indicates that 225mm is too small, the pipeline shall be a public main instead of a branch line. Branch lines shall be sized in accordance with Section 4.3.5. In this context, a branch line is a pipeline which meets all of the following criteria:

• Has been vested or is in the process of being vested in the council

• Is generally the connection between the lot or lots that it serves and the public main

• Shall be no greater than 25m in length

• Connects to the public main via a manhole when connecting more than three dwellings to the public system, or where more than three dwellings may be connected in the future

Where the point of connection to the public system is not at a chamber, appropriate access for CCTV inspection shall be provided on the private section of the line (as per drawing SW04 in Appendix B).

Refer to drawing SW24 in Appendix B for examples of public/private boundaries for stormwater connections.

For further information regarding connections to the public system refer to Section 4.3.11, and for information regarding connection to public mains refer to Section 4.3.12.

4.3.9.6. Minimum Cover

All pipelines shall be specifically designed to support all likely loadings, in relation to the minimum cover to the top of pipe to be provided in accordance with the relevant standards. The cover shall be not less than 600mm (including during the development of the site).

In the road reserve the cover shall be not less than 1000mm.

Where the reticulation pipelines are laid in the front yard of lots and the lots are elevated above the carriageway, the minimum cover on the pipelines within the lot area shall be 600mm below the adjacent road level. This is to avoid damage when the lot is subsequently levelled out to make way for building platforms and/or driveways are subsequently excavated.
The requirements for minimum cover on pipelines are summarised in Table 4.7.

<table>
<thead>
<tr>
<th>Pipeline Location</th>
<th>Min. Cover (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location where specific design shows no additional cover is required</td>
<td>600</td>
</tr>
<tr>
<td>Front yard of lot where the lot is elevated above the carriageway</td>
<td>600 below finished surface level of carriageway</td>
</tr>
<tr>
<td>Road reserve</td>
<td>1000</td>
</tr>
</tbody>
</table>

For special cases and with agreement from Auckland Council, cover can be reduced by using higher class pipe, special bedding, concrete protection or a combination of these. Reference shall be made as noted in the clause above to AS/NZS 3725:2007 (*Design for Installation of Buried Concrete Pipes*) or similar standards for pipes of other materials.

Reference shall also be made to AS/NZS 3725:2007, AS/NZS 2566.2:2002 (*Buried Flexible Pipelines Part 2: Installation*), or to similar standards for pipes of other materials. The key issue is that pipes shall not be installed in situations where their design load capability is exceeded during construction or subsequent operation.

### 4.3.9.7. Minimum Gradients and Flow Velocities

#### Pipe Velocity Limits

The velocity of stormwater in pipes and box sections shall be maintained within acceptable limits to both ensure self-cleaning of the pipe or box section and to avoid scouring and erosion of the conduit.

The acceptable minimum flow velocities for all pipes of all materials for the 50% Annual Exceedance Probability (AEP) design storm are an absolute minimum of 0.6m/s and desired minimum of 1.0m/s.

The acceptable maximum flow velocity for all pipes for the 10% AEP design storm is 4.0m/s.

Notwithstanding the above velocity limits, hydraulic considerations may well require the velocity to be controlled to well below the stated maximum velocity and/or the pipe size increased to minimise structure losses and the slope of the hydraulic grade line.

#### Pipe Grade Limits

Pipeline gradients shall be designed to allow for the maximum and minimum velocities stated...
above. Within these limits, the maximum gradient shall not exceed 25% (1 in 4), and the minimum gradient shall not be less than 0.1% (1 in 1000) for all pipes. Gradients outside these limits shall be at the council’s discretion.

In addition, designers shall consider the peak velocity in the pipe against the maximum design velocity provided by manufacturers and suppliers.

### 4.3.9.8. Culverts

For the purposes of this document, a culvert is defined as any conduit that transfers the flows of a watercourse or waterway across a road or embankment. The design of culverts shall comply with *Auckland Transport Code of Practice* (ATCOP) and the following criteria:

a) The culvert shall be designed to cater for the flows and water levels generated by the 1% AEP event without affecting upstream or downstream property.

b) The headwater pond created by the culvert during the 1% AEP event shall have a depth not exceeding 3.0m above the invert of the pipe and shall provide 500mm freeboard to the edge of the seal of the road (or similar feature) at the top of the embankment. For cases where the approach velocity is greater than 2m/s, the freeboard shall be at least 1.5 times the velocity head at the entrance. The headwater pond created by the 10% AEP event shall not be higher than the soffit of the pipe.

c) Culverts shall be designed such that the maximum velocity within the culvert generated by the 1% AEP event does not exceed 6.0m/s. Higher velocities in culverts require approval from the council. High outlet velocities are likely to cause scour and erosion of natural channels and reference shall be made to Auckland Council technical report TR2013/018 (*Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices*) for design guidance for energy dissipation. Note that energy dissipation will be required at far lower velocities than the maximum allowed within the conduit stated above.

d) Culverts shall be designed such that an absolute minimum velocity of 0.6m/s and desired minimum of 1.0m/s is achieved. Minimum flow velocities apply to the 50% AEP design storm.

e) Culverts shall have a minimum internal diameter of 375mm (for vehicle crossing standards refer to ATCOP).

f) A suitable transition structure is required at both the inlet and outlet to the proposed culvert which shall ensure that there is no scour or erosion in the watercourse, private property and/or the road formation. Refer to ATCOP for special requirements adjacent to roads.

g) A secondary flow path shall be kept unobstructed at all times. The secondary flow path
design shall assume the total blockage of the culvert in cases where it is less than
1500mm in diameter, and 50% blockage of the culvert where it is greater than or equal to
1500mm in diameter.

h) Allowance for 100% blockage of pipes greater than 1500mm in diameter may be
necessary in some circumstances. The risk of blockage resulting from the contributing
catchment shall be assessed on a case-by-case basis (this includes situations where a
safety grille or trash screen is used) to determine if specific culvert design (including
consideration of a secondary inlet) is required.

i) No obtrusive brand names on proprietary devices and other visible components of the
stormwater system shall be visible once constructed.

j) For culverts whose inlets may be difficult to locate if submerged, green retro reflective
raised pavement markers shall be required to mark the presence of the culvert under the
roadway. For all culverts to be maintained by Auckland Transport, markings shall be in
accordance with ATCOP requirements.

k) Provision of safety measures may be required, for example a barrier along the culvert
headwall. Refer to ATCOP for special requirements adjacent to roads.

l) Culverts under road fencing or barriers are to be designed to Auckland Transport
approval.

m) Adequate provision shall be made for maintenance. This shall include, but not be limited
to: access to inlet and outlet for inspection, debris removal and scour protection
maintenance, and any other activities stated in the operation and maintenance manual.

n) Fish passage shall be provided in accordance with Section 4.2.8.

o) The need for debris screens will be subject to specific design, taking into account the
likelihood of debris flowing from the upstream catchment and potential impact on the
culvert.

p) Culverts will be single-barrelled unless specific design is approved by the council.

Culverts of watercourses and roadside drains are owned and maintained by the property
owner(s) served by that crossing, except all culverts transferring flow across the road reserve
which are owned and maintained by Auckland Transport or NZ Transport Agency. Note that
culverts for private vehicle crossings (i.e. serving a private property) within the road reserve will
be owned and maintained by the property owner.

4.3.9.9. Inlets and Outlets

Where a pipeline discharges into a natural or constructed waterway, or vice versa, consideration
shall be given to energy dissipation or losses, erosion control, and land instability. This is often
achieved by an appropriately designed headwall structure and rock armour.

For outlets, the design shall ensure non-scouring velocities at the point of discharge. Acceptable outlet velocities will depend on soil conditions, and reference shall be made to Auckland Council technical report TR2013/018 (Hydraulic Energy Management: Inlet and Outlet Design for Treatment Devices) for the maximum velocities allowable prior to the requirement for specific provision for energy dissipation and velocity reduction.

Where inlets or outlets are located on or near natural waterways, their appearance in the riparian landscape and likely effect on in-stream values shall be considered. Methods to reduce such impacts may include:

- Cutting off the pipe end at an oblique angle to match soil slope
- Constructing a headwall from local materials such as rock or boulders
- Planting close to the structure
- Locating outlets well back from the water's edge.

Design of inlet and outlet structures in high-amenity open space areas requires additional consideration to achieve a sympathetic and unobtrusive design. Auckland Council Community Services Department is to be consulted when the outlet is located in public reserve land.

Direct discharge to a waterway or the sea may require a discharge permit from the council unless authorised by a Network Discharge Consent held by the council, or a permitted activity under the relevant plan(s).

An example standard design drawing for an inlet/outlet headwall is provided in drawing SW19 in Appendix B. Energy dissipation and erosion control is likely to be required in addition to the headwall structure, and shall be specifically designed using guidance from Auckland Regional Council technical publications TP10 (Stormwater Management Devices: Design Guidelines Manual), and TP131 (Fish Passage Guidelines for the Auckland Region) if fish passage is required. For further technical guidance on the design of stormwater device outlets, see TR2013/018.

Inlet/outlet structures for pipe culverts shall be either a standard precast wingwall supplied by a certified precast manufacturer, or a specifically designed structure as approved by Auckland Council. Inlet/outlet structures require specific design and will be subject to Auckland Council approval in the following situations:

- Pipe culverts larger than 600mm
- Duplicate pipe culverts
- Culverts at complicated natural soil locations
- Where special appearance and/or energy dissipaters are required.
Inlets and outlets adjacent to roads may require additional road user safety considerations. Refer to Auckland Transport Code of Practice (ATCOP).

With respect to health and safety, all inlets to the stormwater network greater than 375mm diameter shall be fitted with a safety grille. The inlet grille shall be specifically designed and requires Auckland Council approval. The grille shall have a clear opening of 100mm between bars. Note that grilles are not required on manholes or, generally, at the inlet to a culvert.

Culvert inlets are not generally screened for safety reasons. When designing inlets to culverts, debris screening may be required as discussed in Section 4.3.9.8 above. However, a risk assessment shall be undertaken on each culvert (and the surrounding catchment) to ascertain if a grille is required to prevent accidental entry to the culvert. If a grille is required, provision shall be made for the effects of debris build-up against that grille. There shall also be suitable access for maintenance personnel and for any mechanical plant required to remove debris build-up from the grille.

Fencing around inlet/outlet structures is required unless it can be demonstrated that human access to the inlet/outlet structure is unlikely and/or the height of the structure is less than 1.2m. A standard detail for a safety fence for inlet/outlet structures is provided in drawing SW20 in Appendix B.

4.3.9.10. Outfall Water Levels

Backwater profiles shall be considered such that the design is fully informed with respect to any likely adverse effects.

Similarly, for tidal outfalls, peak flow may or may not coincide with extreme high tide levels. A full dynamic analysis and probability assessment may be required. In circumstances where a flap valve or flood gate is necessary, specific design and approval from the council is required.

Sea level rise shall be taken into account in design (see Section 4.3.5.8).

4.3.9.11. Subsoil Drains

All subsoil drains to provide land stability are considered to be private and should be self-contained within the individual lot.

Where private subsoil drains are installed behind a retaining wall, subsoil drains shall discharge into a silt trap before connecting into the public drainage system via the private connection pipe. Retaining walls shall be positioned to ensure that subsoil drainage will be capable of connecting into the drainage system at the public connection point.

All other subsoil drains shall also be connected to a settling chamber or catchpit before
connecting to the public line via the private connection pipe.

### 4.3.9.12. Anchor Blocks and Waterstops

#### Steep Gradients and Anchor Blocks

Where gradients of pipes are between 10% and 20%, pipelines shall be laid from downstream to upstream with sockets facing upstream and shall be bedded in low strength concrete (7MPa). Where gradients of pipes are in excess of 20%, anchoring will be required to prevent movement. Anchor blocks also help to prevent:

- Bedding scour
- Migration of fine granular particles
- Separation of joints
- Transfer of groundwater through the backfill material surrounding the pipe.

In situations where anchor blocks are to be implemented, pipelines shall be laid from downstream to upstream with sockets facing upstream. A protective/compressible membrane shall be wrapped around the pipeline for the length of the anchor block at the concrete interface. Spacings between anchor blocks shall not exceed 6m, measured centre to centre. See drawing SW23 in Appendix B.

Manholes with flanged bases adequately installed against a trimmed excavation may be considered as an anchor block.

Specific anchor block design and arrangement is required for pipelines where:

- The gradient is greater than 30%, or
- High groundwater table or unstable ground conditions are apparent.

#### Waterstops

Where a pipeline is to be installed between an area with a high water table and an area with a lower water table or in tidally affected areas, transfer of groundwater through the backfill material in the reinstated trench is likely to occur. Transfer of groundwater through backfill materials may also occur due to the gradient of the pipeline/trench and the geotechnical conditions of the native soil. A waterstop shall be used to prevent transfer of groundwater where required. For pipelines up to 750mm diameter, an anchor block as shown in drawing SW23 in Appendix B shall be used to provide a waterstop at a maximum spacing of 10m. Waterstops for pipelines in excess of 750mm diameter are subject to specific design and approval, including spacing.
4.3.9.13. Trenchless Technology

In general, open-cut trenching is the default stormwater pipe installation method. However trenchless technologies may be preferable or required by Auckland Council and should be assessed for practicality for deep installations or alignments passing through or under:

- Environmentally sensitive areas
- Built-up or congested areas
- Railway and road crossings
- Significant vegetation.

Trenchless installation may include:

- Horizontal directional drilling
- Uncased auger boring/pilot bore microtunnelling/guided boring
- Microtunnelling
- Pipe jacking
- Pipe ramming.

Trenchless pipe rehabilitation/renovation may include:

- Slip lining/grouting
- Closefit slip lining
- Static pipe bursting
- Reaming/pipe eating/inline removal
- Soil displacement/impact moling
- Cured in place pipe
- Spiral wound pipe.

Any trenchless technology and installation methodology shall be chosen to be compatible with achieving the required gravity pipe gradients.

For trenchless solutions, the following details shall be submitted to Auckland Council for information/approval:

- Clearances from services and obstructions
- A plan and long section identifying surface levels, pipe invert levels, depths to invert and chainages
- Proposed pipe support
- Proposed pipe material and pipe class including supporting design calculations
Factual and interpretative geotechnical reports
• How pipes will be protected from damage during construction
• Any assessed risk to services, surfaces and structures
• Location of pipe welding and laydown area
• Pipe pulling route
• Location of access pits, shafts and working spaces
• Specific proposals for risk mitigation when working close to or under watercourses
• Identification of high risk areas for “frac-outs”
• Methodology for controlling “frac-outs”
• Anticipated settlement due to overcut, groundwater drawdown and excavation support deflection including supporting calculations.

**Materials and Gradient**

The two types of pipe approved for trenchless installation are polyethylene and reinforced concrete. Reinforced concrete pipes shall be specifically manufactured for jacking operations. Pipe classes for each type are subject to specific design. The joints for all pipes are subject to specific approval by the council. The methodology used shall ensure that the design gradients are met along with hydraulic efficiency of the pipeline. Microtunnelling is recommended where gradients are less than 1.5%. For fusion welded polyethylene pipe, removal of internal weld beads (de-beading) is generally not required.

**Acceptance**

Where trenchless methods of construction are used, the resulting pipeline will not be accepted if it contains sags or crests in the vertical plane which will retain flow and consequently lead to siltation in the pipeline. Horizontal deviation from alignment is acceptable without loss of vertical alignment provided that the maximum horizontal deviation is not more than one pipe diameter. Clear line or laser profiling shall be undertaken to meet the requirements of Table 5.6 of AS/NZS 2566. Profiling shall be undertaken 30 days after installation of the trenchless section. Note that where the annulus is grouted, this profiling shall be undertaken 30 days after grouting.

**4.3.9.14. Pipeline and Culvert Ownership**

The ownership rules in the SWCoP apply to assets vested after the publication date of the SWCoP. Assets vested prior to the first publication of the SWCoP (1 October 2013) will remain public or private in accordance with legacy rules (codes of practice or infrastructure design manuals).

Where a pipe that is not on the council’s asset register is discovered on a property, the pipe shall be deemed to be private unless the land owner can provide documentation of a completed
vesting process that proves beyond doubt that the asset belongs to the council. See Section 4.3.16 for information on cross-boundary ownership.

Where approval has been gained for a watercourse in private land to be piped by private land owners, ownership and maintenance responsibility remains with the landowner. Where approval has been granted for a watercourse in private land to be piped and for the constructed pipe to be vested in the council, the pipe shall be deemed to be a public asset. In all other instances, whether the watercourse was piped through a consenting process or not, the pipe shall be considered to be private and is the responsibility of the owner(s) of the land through which it passes.

4.3.10. Manholes

Manholes or non-access chambers shall be provided at all changes of direction, gradient and pipe size, and at branching lines and terminations. Other suitable specifically designed structures may be used subject to Auckland Council approval. Manholes shall be provided at a distance apart not exceeding:

- 90m for pipelines with diameter less than 750mm
- 150m apart for pipelines with diameter of 750mm and above.

Manholes shall be easily accessible and shall be located at least 1.0m clear of any structure or boundary. All public mains shall terminate with a manhole, non-access chamber or catchpit at the upstream end.

Table 4.8 shows the types of manholes that shall be used and their reference drawing numbers. Drawings are in Appendix B.

<table>
<thead>
<tr>
<th>Type</th>
<th>Outlet Pipe Diameter Range</th>
<th>Depth Range*</th>
<th>Drawing No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard manhole</td>
<td>≤1050mm</td>
<td>&lt;4.0m</td>
<td>SW05</td>
</tr>
<tr>
<td>Non-access chamber</td>
<td>≤225mm</td>
<td>&lt;1.0m</td>
<td>SW06</td>
</tr>
<tr>
<td>Manhole with in situ base</td>
<td>500 - 1200mm</td>
<td>&lt;5.0m</td>
<td>SW07</td>
</tr>
<tr>
<td>Stormwater manhole</td>
<td>&gt;900mm</td>
<td>&lt;4.0m</td>
<td>SW08</td>
</tr>
<tr>
<td>Stormwater manhole</td>
<td></td>
<td></td>
<td>Specific Design</td>
</tr>
</tbody>
</table>

*Depth is defined as the distance from the manhole cover level to the invert of the outlet pipe.

**Lobster bend manholes are only to be used with specific Auckland Council approval.
High Energy Manholes

Specific analysis is required for manholes with:

- High energy inlets (e.g. with inlet/upstream velocities in excess of 4m/s)
- Bends
- A significant change in invert levels
- Significant side inlets.

This is to guard against the impact of any extraordinary head losses and the potential "popping" of manhole covers.

4.3.10.1. Location of Manholes

The selection of a suitable location for manholes may influence the pipe alignment. A minimum clearance of 1.0m from the outside diameter of the manhole riser to any structures or boundaries shall be provided to facilitate maintenance and rescue. Auckland Council may determine other specific requirements subject to the individual site characteristics.

Manholes and pipelines shall be located to minimise interference with future building. Where they cannot be located in public land they shall be located within common accessways. If this is not practicable, the following preferences apply:

- Residential areas: within the front, rear and side yards
- Business areas: adjacent to road frontage boundaries.

4.3.10.2. Manhole Material

Manholes are to be constructed of reinforced concrete in accordance with drawings SW05 to SW09 in Appendix B. Benching of the manhole shall be hard finished concrete as opposed to a plaster finish. Benching shall be to the equivalent of the full height to the level of the inlet and outlet pipes as shown in drawing SW05.

4.3.10.3. Manhole Design

**Structural Design**

Manholes shall be designed to be constructed as segmental, panel or one unit structures, made of precast or cast in situ reinforced concrete. The general shape of manholes may be circular, rectangular, or any other shape that satisfies all design requirements of this section. Manholes shall be designed so that structural integrity between its components is maintained during installation and normal service life. The effect of pipe entries on the structural integrity of the manhole risers shall be considered during design.
All manholes shall be designed to support all existing and any predicted future dead loads. Design live loads for reinforced concrete manholes and cast iron covers shall be HN-H0-72 for motorways and arterial roads, HN for local streets and driveways, and 20kN wheel load for non-trafficable areas. Manholes shall also be designed to support lateral earth pressure, hydrostatic pressure and any expected high eccentric lateral pressure due to live load or surcharge load. Manhole foundations shall be designed such that the bearing pressure does not exceed the safe bearing capacity of the soil.

Reinforced concrete pipes produced to AS/NZS 4058:2007 may be used as manhole risers provided that the load class of the pipes is adequate to carry the service loads on the manhole. Use of pipes with oval reinforcement is not acceptable.

**Durability Design**

All components of manholes and access chambers shall be designed for an asset life of 100 years. Circular manhole risers shall be designed and manufactured to meet the 100 year design life requirements of AS/NZS 4058:2007 for normal environment when designed for installation in such an environment, and for marine environment when designed to be installed in marine tidal locations or aggressive soils. The durability design of other reinforced concrete components shall be in accordance with the durability requirements of NZS 3101: Part 1: 2006.

**4.3.10.4. Size of Manholes**

The minimum internal diameter of circular manholes is 1050mm. Manhole sizes shall be in accordance with the table included in drawing SW05 in Appendix B.

**4.3.10.5. Non-Access Chambers**

Non-access chambers may only be used where the depth to invert is less than 1.0m. The maximum outlet pipe diameter for a non-access chamber shall be 225mm. Non-access chambers shall have a maximum of two inlets of no greater than 100mm diameter as shown on drawing SW06 in Appendix B. Additional connections may be allowed on approval from Auckland Council.

Any chambers outside of these criteria will require a standard manhole instead. Non-access chambers shall be constructed in accordance with drawing SW06 in Appendix B. Benching within non-access chambers is not mandatory.

**4.3.10.6. Hydraulic Flow in Manholes**

**Internal Falls through Manholes**

In addition to the normal pipeline gradient, all manholes on pipelines of less than 1m diameter shall have a minimum fall through the base of the manhole of 50mm. The maximum allowable fall through the base of the manhole between inlet and outlet pipes is 300mm.
Manholes on pipelines greater than 1m diameter shall have the fall through the base of the manhole designed to compensate for the energy lost due to the flow through the manhole at the design radius.

Where the outlet pipe diameter at a manhole is greater than the inlet diameter, the minimum fall through the manhole shall be not less than the difference in diameter of the two pipes, in which case the pipes shall be aligned soffit to soffit.

On pipes where the above criteria for internal fall across the base of the manhole is not achievable due to a large difference between the levels of incoming and outgoing pipes, then an open cascade may be able to be used (see Section 4.3.10.7). Manholes on steep grade lines and where a stormwater line changes direction or has a vertical drop shall be designed as an open channel flow, without surcharging the manhole.

**Effect of Steep Grades on Manholes**

To avoid excessively deep channels within manholes, steep grades (>7%) shall be designed out during the design phase where practicable. Where a pipe of grade >7% enters a manhole, the following precautions shall be taken if the topography and the connection pipes allow:

a) No change of grade is permitted at an inlet to a manhole.
b) Steep grades are to be continuous through the manhole at the same grade.
c) Depth of manhole is to exceed:
   ○ 1.5m to invert for 225mm diameter or smaller pipes
   ○ 2.0m to invert for 300mm diameter or larger pipes.
d) Change of direction at the manhole is not to exceed 45 degrees.
e) No open cascades are to be incorporated in a manhole where the entry pipe grade is >7%.
f) The inside bending radius of the channel inside the manhole is to be greater than six times the pipe diameter.
g) The hydraulic gradient at design peak within the manhole shall be contained without surcharging.

**Pipe Bending**

For flexible pipelines laid at gradients in excess of 7%, it may be practicable to reduce manhole depths and water velocities by the installation of vertical bends at the approach to a downstream manhole. This will require specific design to the council's approval.
**4.3.10.7. Manhole Connections**

Connections to manholes shall be made following this order of priority depending upon practicability of the option:

1. At the manhole invert, with the soffit of the inlet pipe level with the soffit of the outlet pipe
2. At the top of manhole benching level, with a channel in that benching provided to direct the flow to the outlet
3. Via an open cascade in accordance with the cascade conditions below
4. In accordance with specific design to the council’s approval.

Cascades are only permitted under the following conditions:

- Where the manhole is more than 2.0m deep
- Where the cascade inlet pipe diameter will be a maximum of 300mm
- Where the cascade will not discharge on to any steps or ladders
- Where the drop height will not exceed 1.0m (from the invert of the cascade inlet pipe to the top of the benching within the manhole).

Where any of the above conditions are not met, specific approval is required.

The base of all manholes shall be benched and haunched to a smooth finish to accommodate the inlet and outlet pipe. For manholes where there is more than one inlet pipe (excluding minor inlets), a specific design and detail drawing of the benching layout shall be provided and shall be subject to council approval. The detail shall include the location of the manhole cover and frame and steps in relation to the benching.

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

Minor pipelines (less than 200mm diameter and not the main flow) connecting to a manhole shall do so at an angle of not greater than 90 degrees to the main pipeline direction of inflow. Where the minor pipeline connects above the design water level only, a connection at an angle in excess of 90 degrees may be permitted with the council’s approval.

The total number of connections to a manhole (other than the primary inlet and outlet pipes) shall not exceed four without the council’s approval.

Connections of polyethylene pipes to manholes shall be in accordance with drawing WW34 in Watercare’s *Water and Wastewater Code of Practice for Land Development and Subdivision (Version 1.5, May 2015).*
4.3.10.8. Flotation

In areas of high water table, it shall be demonstrated to the council’s satisfaction that all manholes are designed against flotation.

The factor of safety against flotation shall be at least 1.25, excluding skin friction in the completed condition, with empty manhole and saturated ground. Where allowance is made for skin friction in the permanent condition the factor of safety shall be at least 1.4. Both factors of safety in the respective conditions shall be met.

Design against flotation shall consider the potential for post-construction ground conditions with saturated non-cohesive backfilling above the piping over the width of the trench.

4.3.10.9. Manhole Covers

Manhole covers shall be hinged with a clear opening of at least 600mm diameter, except for non-access chambers where a clear opening of 500mm diameter is allowable.

Manhole covers for 600mm diameter or over shall be ductile iron. Square and/or rectangular manhole covers are generally unacceptable to the council.

The class of manhole cover and frame to be used shall be determined by the potential loading on the manhole in accordance with AS 3996. Limits are as follows:

- A minimum AS 3996 Class D, or better, heavy-duty manhole cover and frame shall be used in all areas.
- In industrial areas, or for any application where abnormally high loads are likely to be transferred to the manhole cover, AS 3996 Class E or better will be required at the council’s discretion.

Manhole covers on roads shall be aligned so that a vehicle striking a hinged cover in a partially open position shall push that cover towards its closed position. Liaison with Auckland Transport is required for the location of all manhole covers in the carriageway.

Where a manhole is installed within a secondary flow path, the manhole cover shall be aligned to open with the direction of flow (hinge upstream). This will ensure that a cover opening under hydraulic surcharge will close again and will not be prevented from closing by trapped debris swept by the secondary flow.

Scruffy domes as per drawing SW21 in Appendix B should be used for manholes and manhole risers in stormwater ponds and stormwater management devices or in situations where overland flow is to be directed into the stormwater pipe network. More aesthetic alternatives may be considered/required and approved at the council’s discretion.
4.3.11. Connection to the Public Stormwater System

The following requirements shall be met for new connections of individual lots and developments to the public system:

a) Approval from Auckland Council is required for any stormwater connection to a public stormwater pipeline or discharge to a waterway, roadside kerb, swale or rainwater tank, or for on-site disposal via soakage.

b) Each individual lot shall be serviced by an approved stormwater connection that is either a pipeline that is ultimately connected to a consented discharge, or on-site disposal.

c) All discharges to the road kerb, swales or treatment devices within the road reserve will remain in private ownership.

d) For new pipelines which discharge into the public network within the road reserve:
   • A new pipeline serving one or two lots shall only become public at the point where it crosses into the road reserve.
   • A new pipeline serving three or more lots shall only become public at the point where the third lot is connected.

e) For new pipelines which discharge in reserve land, including discharges to the public network, a watercourse or the coastal marine area:
   • A new pipeline serving three or fewer lots shall remain in private ownership.
   • A new pipeline serving four or more lots shall become public at the point where the fourth lot is connected.
   • Only one outlet is permitted when subdividing a lot. The existing outlet shall be used where design confirms sufficient capacity. Subdivision resulting in more than one outlet requires specific Engineering Approval.

f) No pipe downstream of a public pipe can be private.

g) The point of connection is the interface between the public system and the private system. It shall be marked with a blue 25mm diameter uPVC tube extending well above the ground surface. Refer to drawing SW04 in Appendix B. The pipeline from the point of connection to the manhole, public main or outlet shall be in public ownership.
   • Where the private connection pipe becomes public when crossing into the road reserve or public reserve land, the point of connection shall be at the lesser of the first joint on the private connection pipe or 1.0m inside the private boundary.
   • Where the private connection pipe connects directly to a public manhole within the parent lot, the point of connection is at the manhole wall.
   • Where the private connection pipe joins directly to the public main or branch line within the lot served, the point of connection shall be at the lesser of the first joint on
the private connection pipe or 1.0m inside the private boundary.

h) Where a private pipeline does not connect to the public network at a chamber, a rodding eye to allow CCTV access shall be provided.

i) Where a new public pipeline is proposed within public reserve land, the developer shall provide suitable access for all future maintenance operations. Any financial burden, including all costs associated with easement, will fall on the developer.

j) Duplication of small diameter pipelines on similar alignments (i.e. construction of a new pipeline within 10m of an existing alignment) is not permitted. In some circumstances, avoiding duplication is best achieved through utilisation of an existing Auckland Transport pipeline (catchpit lead). The developer shall discuss options with Auckland Council.

Where a public connection into an Auckland Transport pipeline is required due to it being the most practicable option, the pipeline will become public from that connection point and a manhole or chamber will be required at the connection, as shown in drawing SW26 in Appendix B. Transfer of ownership from Auckland Transport to Auckland Council will be required and shall be arranged through the council’s Development Engineers. Assessment of the pipeline to be transferred is required to demonstrate that the pipeline is sized appropriately, is in good condition and complies with this code of practice.

Where the existing Auckland Transport pipeline is of insufficient capacity or condition, the developer shall construct a new pipeline of sufficient capacity for that development and for the upstream Auckland Transport road network and shall reconnect the road drainage to this new pipeline.

k) The depth of the point of connection should allow for 1m of fall between the presumed floor level and the soffit of the pipe at the point of connection.

l) Where phasing of the development requires a private connection pipe to be constructed at a later date, the branch line shall terminate 1.0m within the lot boundary and be sealed by a removable cap, with the cap and pipe painted blue. The location of this point of connection shall be marked by a blue 25mm diameter uPVC tube sited over the end cap of the connection and extending well above the ground surface.

m) Where the catchment extends upstream of the development, there shall be allowance for the stormwater pipeline to be extended through the lot to the upstream boundary. This pipe shall be sized to allow for the Maximum Probable Development (see Section 4.2.8). In order of preference, the options are:

- Build the pipe and connect to a new manhole inside the boundary of the development land, with permission from the landowner
• Build the pipe and connect to a new manhole outside the boundary of the
development land, and provide an easement for the owner of the development land
to connect to this manhole
• Provide an easement-in-gross a minimum of 3m in width in favour of the council to
allow a pipeline to serve the development land to be built in future. An easement is
not appropriate if the pipe cannot be built cost-effectively in the future, for example
where a driveway, building or retaining wall is to be constructed over or near the
future pipe position.

n) In general, the alignment of all public branch lines constructed on private land shall be
designed using the order of preference described in Section 4.3.9.1.

o) The point of connection shall be located so it can service the lowest practical point on the
property and should be capable of serving the whole of the lot. Where part of the lot is not
able to be served for topographical reasons, the area of the likely or proposed building
footprint and paved surfaces shall drain by gravity to the point of connection as a
minimum. The internal diameter of private connection pipes shall be sized based on lot
size and anticipated flows, with minimum pipe sizes in accordance with Section 4.3.9.5.

p) The point of connection shall be indicated accurately on as-built plans, with coordinates
provided. As-builts shall be in accordance with the Auckland Council document
Development Engineering – As-built requirements which is available on the council
website.

q) No new combined sewer connections will normally be approved. Refer to Section 4.6.1.1.

Assets vested prior to the October 2013 publication of the SWCoP will remain public or private in
accordance with legacy rules (codes of practice or infrastructure design manuals). Refer to
drawing SW24 in Appendix B for public versus private boundary definitions for a range of
ownership cases.

4.3.12. Connection of Pipelines to Public Mains

When the pipeline being connected to the public main is larger than 300mm in diameter it shall
be connected at a manhole.

Factory-made fittings or saddles shall be used for connections to public mains up to 900mm
diameter in accordance with drawing SW04 in Appendix B. For all saddles, concrete bonding to
the exterior of the main pipe is required.

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

Where the public main is a concrete pipe, saddle connections are only permitted where the
pipeline being connected is less than half the diameter of the public main.

There are significant lengths of older infrastructure in the more established parts of Auckland such as brick barrel pipelines and brick manholes. Some of these assets have compromised structural integrity, including very limited strength in tension and signs of significant decay. Making connections to older infrastructure requires careful consideration and may require specialist design input. Such connections shall be referred to Auckland Council for design guidance and approval. Any construction proposed within 10m of a stormwater structure that is more than 50 years old is to be referred to Auckland Council for detailed evaluation and approval.

See drawings SW25 to SW29 in Appendix B for example ownership cases involving Auckland Transport and Auckland Council’s Community Services department.

4.3.13. Catchpits

The sizing, selection and spacing of all catchpits (except for field catchpits) shall be in accordance with Auckland Transport Code of Practice (ATCOP).

4.3.13.1. Catchpit Positions

Catchpits shall be located to best capture ponding of surface water. This will generally be at low points. Where possible, catchpits shall be located so as to reduce the flow of stormwater in the channel at pedestrian crossing points. However, catchpits shall not be placed in the direct path of pedestrian movement.

Catchpits are also required at changes in gradient or direction where water may leave the channel e.g. kerb line tangent points at intersections.

4.3.13.2. Catchpit Connections

Catchpits shall be connected directly to a manhole on the stormwater pipeline system. The catchpit lead may be saddled directly to the pipeline if all of the following conditions are met:

- The catchpit lead is 300mm diameter or less
- The trunk stormwater pipeline is greater than 1000mm diameter
- A manhole is not conveniently located for connection.

4.3.14. Runoff and Stormwater Disposal

All system designers considering discharges shall refer to the current relevant Network Discharge Consent and Catchment Management Plan. Refer to Section 4.2.6 for more information on catchment planning.
4.3.14.1. Runoff

Stormwater runoff caused by an increase in impermeable area as a result of development shall not be permitted to discharge across footpaths or berms, or from or to adjacent properties. Sheet flow from upstream lots or sub-catchments shall be intercepted by either the primary drainage system or the secondary overland flow paths wherever such sheet flow may create a nuisance to downstream lots.

Natural intermittent streams and overland flow paths are generally the responsibility of landowners, and there is an obligation on downstream landowners to accept these natural flows from upstream properties. Therefore where development within these systems causes unacceptable effects on downstream properties or where the existing primary drainage system has failed, the landowner of that development property shall be responsible for rectifying the situation by mitigating any negative impacts, based on the pre-development condition.

The council has the ability, under Section 459 of the Local Government Act 1974, to require the landowner to execute, provide, and do generally any works, materials, and things which in the opinion of the council are necessary or expedient for the efficient drainage of the premises and every part thereof.

4.3.14.2. Stormwater Disposal from Development in Brownfield Areas and New Developments in Greenfield Areas

The developer shall always discharge into the public stormwater network (subject to capacity assessment) at the point approved by the council. In designated soakage areas, discharge shall be to private soakage (subject to satisfactory percolation testing in accordance with Auckland Council technical report TR2013/040 (Stormwater Disposal via Soakage in the Auckland Region)).

If discharge to the public system is not possible, other site-specific discharge options may be discussed with the council and submitted for specific approval. The preferred solution will be developed on a case-by-case basis in consultation with Auckland Council and/or Watercare and/or Auckland Transport.

In order of preference, options include:

1. Discharge to the public network, or to private soakage for designated soakage areas
2. Discharge to a watercourse or coastal area
3. A connection may be made to a catchpit lead, subject to the conditions specified in Section 4.3.11. Connection may not be made to a lead discharging to soakage.
4. Discharge to either:
   - The kerb (subject to Auckland Transport approval). Discharge of stormwater to the road kerb shall not be permitted in greenfield areas unless it forms part of a Water
Sensitive Design solution for the wider subdivision.

- A combined sewer line (subject to Watercare approval).

In either case, an approved on-site mitigation device will be required.

### 4.3.14.3. Stormwater Disposal from Combined Sewer Areas

On-site mitigation devices are required when stormwater disposal is in an area which is both:

- Defined as a combined sewer area
- An area where Auckland Council's programme for sewer separation does not indicate a new stormwater network upgrade within 5 years of building consent application.

### 4.3.14.4. Disposal Methods Not Permitted

Stormwater from any improvement shall never be discharged into the following:

- A wastewater-only system
- Footpaths, berms, or adjacent property
- An area with insufficient soakage (refer to Auckland Council technical report TR2013/040 *(Stormwater Disposal via Soakage in the Auckland Region)*).

### 4.3.15. On-Site Stormwater Mitigation

On-site stormwater mitigation devices may be required to reduce the impact of stormwater runoff (quantity) on receiving systems. The installation of stormwater storage devices as part of a site’s private drainage system can ensure that the rate of stormwater discharge does not increase when the site is developed.

All stormwater mitigation devices are subject to specific design and approval by the council, and shall be designed in accordance with the relevant Auckland Council technical guidelines.

The council requires devices to be provided in the following situations:

- Where required by either planning rules or conditions of resource consent
- All new developments in all combined sewer areas
- Instances of kerb discharge
- In catchments where there are known capacity issues with the downstream stormwater system
- Where soakage systems require reduced flow rates in order to match the available infiltration rate.

At the council’s discretion, some developments matching the above criteria may be exempt from
the requirement to install a stormwater mitigation device where this is of wider benefit to the overall catchment.

4.3.16. Cross-Boundary Ownership

4.3.16.1. Private Pipelines in Private Land

Where a lot must drain through another lot to connect to a public pipeline, the point of connection to the public system can be determined in Section 4.3.11. It is the developer’s responsibility to obtain permission from the affected landowner(s) to place the pipe.

4.3.16.2. Private Pipelines in Public Land

**Roads**

No new private pipelines shall be permitted in road reserves, except kerb discharges and other circumstances as per Section 4.3.11 above.

Stormwater pipelines serving only Auckland Transport assets remain the responsibility of Auckland Transport. In cases where a public pipeline is to be connected to an Auckland Transport stormwater pipeline, ownership of the pipeline shall move from Auckland Transport to Auckland Council.

Existing private pipelines within the road reserve are not covered by easement. The council may hold records of these private pipelines in the form of approved building consents and permits and associated as-built plans. If undertaking maintenance and repair work on these pipelines, a Corridor Access Request (CAR) shall be obtained from Auckland Transport.

**Parks and Reserves**

Developers should avoid laying multiple new pipelines across reserve land. Instead, stormwater from a development should be collected into a single pipe that crosses the reserve land. Where a pipe drains up to three lots it shall remain in private ownership of the lot served. Where a pipe drains four or more lots it shall be public. See Section 4.3.11 above for more information on pipeline ownership.

The applicant shall confirm that the reserve land is not a closed landfill. Generally new pipelines are not permitted through closed landfills.

Auckland Council Community Services is the asset owner for parks and reserves. Stormwater pipelines serving only Auckland Council Community Services assets remain the responsibility of Community Services and no public pipeline shall be connected to them.

Where a facility on parks (Community Services) land has both stormwater and park functions,
Community Services is to be consulted early in the design process and may have requirements additional to the CoP standard.

For all work on existing stormwater assets within parks and reserves, specific approval shall be obtained from the council.

**Other Land Owned by Auckland Council**

Where Auckland Council is recorded as the owner of the land in question, queries related to existing easements shall be directed to the Property Department Manager who acts as the land owner for this purpose.

**Other Land Not Owned by Auckland Council**

Any work on land outside of Auckland Council's control requires specific approval from the appropriate authority/landowner.

### 4.3.17. Inverted Siphons

Siphons, as distinct from inverted siphons, are rarely used in stormwater infrastructure and are not acceptable.

Inverted siphon systems require specific approval by the council and shall only be considered when other alternatives have been exhausted.

Inverted siphons may sometimes be necessary to pass major obstacles such as large immovable services or other underground structures. Generally inverted siphons shall be avoided, and other options shall be considered first. Any design of an inverted siphon is to be submitted to the council for consideration and approval. Inverted siphons are potentially high maintenance devices as they are points where debris and silt can build up and block the flow of stormwater. If an inverted siphon is approved for use, the maximum slopes on the downward and upward legs should be 45 degrees and 22.5 degrees respectively to help the movement of debris and solid materials.

For marginal situations, specific head-loss calculations may be required to ensure flow rates can be achieved and to ensure water does not backflow out of the siphon and discharge out of the inlet (e.g. catchpit).

Where a direct connection to a stormwater network is made by way of an inverted siphon system, a gravity chamber shall be installed. The chamber shall be completed prior to connection to the public system to prevent backflow into the private system.

Kerb discharge from inverted siphons will only be permitted as a last resort.
4.3.18. CCTV Inspection

A CCTV survey provides a reliable indication of the quality of assets to be vested in council ownership and shall be required for all new pipes that will form part of the public stormwater infrastructure. The CCTV survey of the pipe shall be undertaken by a suitably trained operator in accordance with the requirements in the current version of the *New Zealand Pipe Inspection Manual*. All costs involved in undertaking this CCTV work shall be borne by the developer, as will any remedial work required to be undertaken and a repeat CCTV if required by the council. For new assets to be vested in the council, the CCTV work shall not be undertaken until the final earthworks have been completed and the CCTV inspection shall be less than 3 months old upon submittal.

CCTV inspections of stormwater assets shall be delivered to the council in the following format:

- Each pipe is to be assigned a temporary ID
- Sketch of the assets, showing the temporary IDs
- USB memory device containing individual inspection video files
- A .CSV export of the inspection and observation data from the proprietary CCTV capture software (e.g. Cleanflow or WinCan).

Laser profile testing which tests pipe ovality, vertical and horizontal deflection, pipe measurements, cracking and pipe distortion may be required by the council.

4.3.19. Soakage Areas

In defined soakage areas, where appropriate, each dwelling shall dispose of its own stormwater through a private in-ground soakage system, which shall be maintained by the property owner.

Soakage devices shall be designed to cater for at least the flows generated by the design standard for primary systems (refer to Section 4.3.5.2). For all soakage systems an overland flow path shall also be provided which is capable of catering for the flows in accordance with the design standard for secondary systems, assuming complete blockage of the soakage device.

*Auckland Council technical report TR2013/040 (Stormwater Disposal via Soakage in the Auckland Region)* should be referred to for design guidance for all soakage systems and approval by the council shall be required. All treatment devices installed in soakage systems to service new development as specified by Auckland Council are deemed to be private, and responsibility for maintenance lies with the individual property owners. Auckland Council declaring such devices public will be entirely at its discretion.

Protection of groundwater quality is important. Some areas have water extraction for potable water use. Some private water extractors also use water for non-potable supplies.
4.3.20. Groundwater Recharge Pits in Recharge Areas

Groundwater recharge is necessary in areas with peat soils to maintain underlying aquifer water levels and geotechnical stability. Dewatered peat soils are subject to shrinking and ground surface settlement.

The requirement for groundwater recharge is to be considered and specific design and council approval is required for any development in an area where peat soils can be anticipated. In particular, there is a significant area of peat and soils with high organic content in the Papakura area. Refer to Auckland Council technical report TR2013/040 (Stormwater Disposal via Soakage in the Auckland Region) for design guidance for all soakage systems. TR2013/040 also defines the likely extent of peat soils within the legacy Papakura District. However, the presence or absence of peat shall be confirmed by geotechnical investigation. Refer to the Proposed Auckland Unitary Plan (PAUP) and operative district plans for other requirements regarding groundwater recharge in peat areas.

4.3.21. Where Access to Adjacent Land is Required

Where access to adjacent land is required, the developer must obtain any required adjacent landowner entry agreements. In all cases the developer is responsible for negotiating and coming to a satisfactory arrangement with affected landowners. This is a private negotiation between individuals and does not involve Auckland Council.

The Local Government Act 1974 (§ 460, 461) and 2002 (§ 181 (2-3)) contains various provisions relating to access by Auckland Council, or others, to private land in order to carry out required drainage works. In exceptional cases these may be considered in relation to a specific development where it is necessary to obtain access to neighbouring private land for private drainage, or to construct public drainage. The developer should note that this is a costly and time-consuming process. A specific Engineering Local Government Act application shall be made to Development Engineering (refer to the Auckland Council website for more information).

4.3.22. Extensions to the Public System

Extensions and upgrades to the public system and diversions of existing systems may be required as part of a development. Engineering Approval for proposed extensions shall be obtained from Auckland Council before any physical works are commenced.

4.3.23. Building Over and Diversions of Public Pipes

Building over stormwater pipelines is not a recommended practice and will only be considered by the council in exceptional circumstances where no suitable alternative exists. Build-over
guidelines also apply to cantilevered buildings. Approval from the council is required before undertaking any physical works activity over or within the zone of influence of the public stormwater network which may cause damage to the network. This includes removing existing cover material or placing additional material. Refer to drawing SW22 in Appendix B for construction clearance requirements and for definition of the zone of influence.

If a diversion will definitely be required in creating new lots, the developer of the original site shall effect the diversion at the time of initial development.

If building over a pipeline is proposed then the following requirements shall be addressed:

   a) Engineering Approval is required for ALL stormwater relay and diversion works.

   b) Alternative options such as relocating the building or diverting the pipeline around the building shall be thoroughly investigated. Diversion of pipelines will not be considered where the diversion will result in more than one change of direction of 90 degrees or more, or significant loss of grade, either of which may reduce the hydraulic capacity of the pipeline. In such cases it will be at the council's discretion as to whether building over is acceptable.

   c) Stormwater pipes are frequently located beneath overland flow paths. Careful attention shall be paid to the consequences of building in such locations and the need to maintain overland flow paths clear of obstructions. Applicants shall submit a detailed design of the overland flow path where the catchment exceeds 4000m², or for smaller catchments at the council's discretion.

   d) Accurate location of the existing pipelines shall be required. Pot holing may be required to prove pipe location prior to works. Adjacent services shall be adequately protected and supported during construction.

   e) The pipeline shall be inspected using CCTV both before and after the works. The pre-construction CCTV inspection shall confirm the condition, pipe material, depth and location of the pipeline and shall be conducted not more than six months prior to construction. Note that the council's GIS information shall NOT be relied upon in regard to any design or build-over decisions.

   f) The CCTV footage and inspection report of the pre-construction condition of the existing pipelines shall be submitted together with detailed long sections and cross sections of the proposed build over. The detailed long sections and cross sections shall clearly indicate the relation between the proposed foundation works (including any piles), the pipeline, any other existing or proposed services and the proposed ground levels either side of the building footprint.

   g) The post-construction CCTV and inspection report shall be completed immediately following construction of the foundation and prior to the laying of the floor slab to verify
that the pipeline has not been damaged as a result of the construction works. An additional CCTV inspection and report may be required at the completion of construction.

h) If the pipeline is either not in satisfactory condition, not in compliance with the council’s standards for public stormwater infrastructure or the council is in any doubt as to the functionality and condition of the pipe, then the pipeline shall be replaced by the developer at their cost to the required Auckland Council standard.

i) As-built records shall be provided in accordance with the Auckland Council document *Development Engineering – As-built requirements*.

j) Any existing earthenware/clay pipes, asbestos cement pipes and corrugated iron culverts shall be considered to be beyond their useful working life and shall be replaced at the cost of the developer irrespective of existing condition.

k) For deep pipelines, where the existing pipe is found to be in a satisfactory condition with only minor defects, in-situ repair techniques may be considered for approval. All associated costs shall be met by the developer.

l) The council may require that an assessment is made to cater for anticipated future development or increased level of service, at the developer’s cost.

m) Selection of the pipe material and the length of pipe to be relayed shall be at the discretion of the council.

n) No horizontal or vertical deflection of pipelines as a result of being built over is acceptable.

o) The support structure for the building shall be totally independent of the pipeline so no additional loading is applied to the pipeline.

p) Piles shall be constructed where there is a need to bridge the pipeline. Piles shall have a minimum separation distance of 1000mm from the outside of the pipe to the edge of the pile (refer to drawing SW22 in Appendix B).

q) For pipes with diameter greater than 375mm or depth to invert greater than 2m the separation distance shall be increased. This situation shall be subject to specific design.

r) For manholes with diameter ≤1200mm and depth ≤4m, piles shall have a minimum separation distance of 1000mm from the outside of the manhole to the edge of the pile (refer to drawing SW22 in Appendix B). A minimum clearance of 5m to any overhanging structure above the manhole shall also be maintained. Manholes larger than 1200mm diameter or deeper than 4m shall be specifically designed, including specific design of required construction clearances.

Note that meeting the above criteria does not necessarily mean that a build over will be approved.
Where pipelines are to be diverted, the following shall apply:

- Where a diversion is necessary, curvature in the pipeline will be considered in order to minimise the number of manholes required. Design will be subject to specific design and approval by the council.
- The pipeline is to be on an even longitudinal grade.
- Diversion pipelines shall be designed to the requirements of this code and in particular Section 4.3.5.

### 4.3.24. Abandonment of Assets

Abandonment of assets is to be done with the council’s approval and to Auckland Council standards. CCTV is required prior to abandonment of the asset to confirm that no connections are currently in use.
4.4. Approval of Proposed Infrastructure

4.4.1. Approval Process

As a guideline, any proposed works affecting stormwater require approval by the council, for example:

- New connections
- Re-laying existing stormwater pipelines
- Diverting existing pipelines
- Raising or lowering manhole lids
- New developments
- Subdivisions
- Building works to be vested in the council.

If the work involves existing or proposed public assets, an Engineering Approval is required. Building consent is required for all works relating to private drainage. In addition, resource consent may be required.

4.4.2. Information Required

Applications to the council shall include sufficient information to demonstrate that the proposed works meet the requirements of all relevant legislation and this CoP as appropriate. The requirements outlined in Chapter 1: General Requirements and Procedures shall also be met, including the following:

a) A plan showing the location of existing and proposed stormwater works and all existing services likely to affect or be affected by the proposed works. Suitable scales of drawings illustrating the location of all existing services at A3 size shall be used.

b) Detailed longitudinal sections showing the levels, grades, bedding type, installation methodology, pipe diameter, pipe material class, capacity and flow velocity of proposed stormwater pipelines. Longitudinal sections and typical cross sections shall also be provided for any modifications to secondary flow paths. Suitable drawing scales at A3 size shall be used.

c) Details and calculations prepared by persons experienced in stormwater catchment analysis, demonstrating that the proposed system is of adequate capacity and highlighting any impact on adjacent areas or catchments that the proposed works may have. The analysis shall also include remedies for any negative impacts.

d) A plan showing the location of any streams, ponds, or wetlands within the site or in close

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proximity to the site. The location in plan and level of the water’s edge and shoulder of the banks shall be indicated as well as the proximity of proposed buildings to the water’s edge and/or shoulder of the banks. Suitable drawing scales at A3 size shall be used.

e) Typical pre- and post-development cross sections through any streams, ponds or wetlands. Suitable drawing scales at A3 size shall be used.

f) All applications to build within floodplains, flood-sensitive areas or overland flow paths shall be supported by a detailed Hydrological Report and Assessment of Environmental Effects (AEE) in accordance with the Resource Management Act (RMA). The AEE shall include both internal and external effects. For example, the effects on upstream, downstream and adjacent properties as a result of the proposal and the effects on the property itself and the proposed future land use as a result of its location within a floodplain, flood-sensitive area or overland flow path.

g) Where a new structure, for example an underground chamber, will create an atmosphere of “confined space” as defined in AS/NZS 2865:2001 Safe Working in a Confined Space, the design engineer shall provide full details of how the risk to personnel during both construction and future maintenance shall be managed.

h) All levels are to be in terms of Local Vertical Datum Auckland 1946.

i) Draft operations and maintenance manuals for any water quantity and/or quality control devices shall be submitted to the council for design approval along with other documents. The manuals shall describe the design objectives of the device, describe all major features, explain operations such as recommended means of sediment removal and disposal, identify key design criteria, and identify on-going management and maintenance requirements such as plant establishment, vegetation control and nuisance control. Accurate design calculations shall be included in the manual.
4.5. **Construction**

Any redesign on site will be subject to SWCoP requirements.

4.5.1. **Pipeline Construction**

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

4.5.2. **Trenching**

Guidance on trenching and embedment design is provided in drawings SW01, SW02 and SW03 in Appendix B.

Where a pipeline is to be constructed through areas with unsuitable foundations, such material shall be removed and replaced with approved material. Alternatively, other methods of construction may be carried out with approval from the council to ensure adequate foundation and side support is provided.

4.5.3. **Reinstatement**

Public areas where construction has taken place shall be reinstated to the pre-construction condition or better as required by the council.

If work has been done within the road corridor, all reinstatement shall be done in accordance with the most up-to-date version of *Auckland Transport Code of Practice* (ATCOP).

4.5.4. **Inspection and Acceptance**

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 undertaken in accordance with the council’s requirements, and CCTV in accordance with Section 4.3.18 of this document, or on request from Auckland Council. As-built documentation shall be submitted in accordance with the Auckland Council document *Development Engineering – As-built requirements* which is available on the council website.

Acceptance will be on the basis of the quality of materials and the standard and accuracy of construction. Areas where works have taken place shall be reinstated to a condition not worse
than before the works took place. Owners affected by the works shall give their written approval of the result of the reinstatement works. The certification of works, as provided by the developer's design professional, signifies that the same professional certifies that the works are constructed appropriately and to the provision of this code.
4.6. Combined Wastewater-Stormwater Systems

4.6.1. Public Systems

No applications for new combined public pipelines will be considered or approved.

4.6.1.1. Connections to Combined Public Sewers

No new combined sewer connections will normally be approved. However, dispensation may be granted in the event that the existing combined sewer is the only option for stormwater disposal. Where dispensation is given, the following conditions shall be met as a minimum:

- Approval is required by Watercare as owners of the combined system.
- Each unit shall have an independent combined connection to the sewer.
- The private wastewater and stormwater pipes shall join together as close as possible to the connection to the combined public sewer to allow for future separation.
- On-site mitigation measures are generally required. Refer to Section 4.3.15.

4.6.1.2. Separation of Public Sewers

All development projects initiated within combined areas shall have separation considered as part of the proposal. A development proposal within a combined area where public sewer separation is in progress shall consider the proposed separation works as part of the proposal. Developers should contact Watercare for areas where public separation projects are programmed. Discharge and associated consents may be required for stormwater disposal and should be discussed with Auckland Council.

4.6.2. Private Systems

Each site shall have separate private systems for wastewater and stormwater.

4.6.2.1. Separation of Private Combined Pipelines

All existing combined private pipelines shall be separated in any of the following cases:

- Development increases impervious area by more than 20m². Note that the removal of any existing structure will not contribute to reducing the area that is classed as impervious and therefore cannot offset the increase in impervious area resulting from the new development.
- Major re-development of the site is proposed
- Any work is undertaken on private drainage (unless work is being done solely within a dwelling i.e. plumbing only).
4.6.2.2. Site and Drainage Plans

A detailed site and drainage plan (including all public and private pipelines) shall be supplied with all relevant consent applications. These plans shall include drainage details for all existing and proposed impervious areas.

4.6.2.3. New Pipelines

Where separation of existing pipelines is required, the preferred option is to install new private stormwater and wastewater pipelines. However, if the existing private combined pipeline is structurally sound and has adequate capacity it may be used for stormwater with a new pipeline installed for wastewater. A stormwater storage device is required for both options (see Section 4.3.15 for further information).
4.6.2.4. **Extent of Private Separation**

The site-separated pipeline shall be taken to approved outlets. Where the site must discharge stormwater into a combined pipeline, the separate pipelines shall join as close as possible to the connection to the combined public sewer. Refer to Diagram 1 below.

![Diagram 1: On-Site Separation of Private Combined Pipelines](image)

- **Diagram 1: On-Site Separation of Private Combined Pipelines**

4.6.2.5. **Costs**

Costs of separating private pipelines are to be met by the property owner or developer.
Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEP</td>
<td><strong>Annual Exceedance Probability.</strong> The probability of exceeding a given storm discharge or flood level within a period of one year. For example, a 1% AEP floodplain is the area that would be inundated in a storm event of a scale that has a 1 per cent or greater probability of occurring in one year.</td>
</tr>
<tr>
<td>AT</td>
<td><strong>Auckland Transport.</strong> A council-controlled organisation responsible for transport, including some stormwater functions in the road corridor.</td>
</tr>
<tr>
<td>ATCOP</td>
<td><strong>Auckland Transport Code of Practice.</strong></td>
</tr>
</tbody>
</table>
| Best Practicable Option | In relation to a discharge of a contaminant or an emission of noise, means the best method for preventing or minimising the adverse effects on the environment having regard, among other things, to:  
- The nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects  
- The financial implications, and the effects on the environment, of that option when compared with other options and  
- The current state of technical knowledge and the likelihood that the option can be successfully applied. |
<p>| CAR              | <strong>Corridor Access Request.</strong> An authorisation for working in the road corridor, administered by Auckland Transport.                                                                               |
| Catchment        | The area draining to a site. It always relates to a particular location and may include the catchments of tributary streams as well as the main stream.                                          |
| CCC              | <strong>Code Compliance Certificate.</strong> A certificate issued by the council at the end of a building project to demonstrate satisfaction that the completed building work complies with the original building consent. |</p>
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCTV</td>
<td>Closed Circuit Television. Used to inspect pipelines in order to determine the interior condition of the pipe.</td>
</tr>
<tr>
<td>Coastal Marine Area</td>
<td>Generally the area below mean high water springs.</td>
</tr>
<tr>
<td>Community Services</td>
<td>The Auckland Council department which is the asset owner for public parks and reserve land.</td>
</tr>
<tr>
<td>CoP</td>
<td>Code of Practice. In legacy councils in the region these were also known as: 'Connection Standards', 'Quality Standards', 'Design Standards' or 'Development Code'.</td>
</tr>
<tr>
<td>Culvert</td>
<td>Any conduit that transfers the flows of a watercourse or waterway across a road or embankment.</td>
</tr>
<tr>
<td>Design Flows</td>
<td>The flows selected as a basis for the design of works in the system.</td>
</tr>
<tr>
<td>Design Storm</td>
<td>The rainfall calculated from historical records that can be expected for a specific return period and duration.</td>
</tr>
<tr>
<td>Engineering Approval</td>
<td>Engineering Approval is required for works that are to be vested in the council’s ownership. This includes public stormwater, wastewater, water supply, roading and park assets. Engineering Approval may also be required in other circumstances, such as a condition of an underlying resource or building consent.</td>
</tr>
<tr>
<td>Floodplain</td>
<td>The area of land that is inundated by water during a specific flood event. In the SWCoP the 1% AEP flood event is used.</td>
</tr>
<tr>
<td>Flood-Sensitive Area</td>
<td>The area bordering the 1% AEP floodplain which is within 500mm in elevation of the predicted 100 year flood level.</td>
</tr>
<tr>
<td>Frac-outs</td>
<td>The inadvertent loss of drilling fluid from the borehole annulus to the surrounding soil as a result of excess downhole fluid pressure. Also known as hydrofracture.</td>
</tr>
<tr>
<td>Freeboard</td>
<td>Additional clearance above estimated flood level to allow for uncertainties in flood level estimation, wave action and localised water level variations.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>GD</td>
<td><strong>Guideline Document.</strong> An Auckland Council publication which provides technical and/or design guidance.</td>
</tr>
<tr>
<td>Invert</td>
<td>The <strong>invert level</strong> is the base interior level of a pipe, or culvert.</td>
</tr>
<tr>
<td>Minor Pipelines</td>
<td>Pipes with an internal diameter of less than 200mm that are not on the main pipe alignment.</td>
</tr>
<tr>
<td>MPD</td>
<td><strong>Maximum Probable Development.</strong> Design case for consideration of future flows allowing for development within a catchment that takes into account the maximum impervious surface limits of the current zone or, if the land is zoned Future Urban in the Proposed Auckland Unitary Plan, the probable level of development arising from zone changes.</td>
</tr>
<tr>
<td>NDC</td>
<td><strong>Network Discharge Consent.</strong> A consent that authorises the diversion and discharge of stormwater, including associated contaminants, from existing and potential future public stormwater networks within urban areas and rural and coastal settlements.</td>
</tr>
<tr>
<td>Non-Access Chamber</td>
<td>An inspection chamber which does not allow a person to enter. Refer to Appendix B, drawing SW06 for a typical detail.</td>
</tr>
<tr>
<td>Overland Flow Path</td>
<td>The route taken by stormwater when flowing over land.</td>
</tr>
<tr>
<td>PAUP</td>
<td><strong>Proposed Auckland Unitary Plan.</strong> Notified 30 September 2013, the PAUP gives provisions for activities and development in the Auckland region.</td>
</tr>
<tr>
<td>Peak Flow</td>
<td>The maximum flow reached in a stormwater system during any storm (or at any time in other reticulation).</td>
</tr>
<tr>
<td>Primary System</td>
<td>The pipes, streams, open watercourses and other elements of built and natural drainage infrastructure that carry the flow of stormwater within the catchment during non-extreme storm events. They generally should have capacity for the 10% AEP flow.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td><strong>Private Stormwater</strong></td>
<td>Any component of the stormwater network that drains water from premises on private land to a receiving environment or up to the point of service connection with the public stormwater network and includes pipes, gutters, downpipes, catchpits, swales, subsoil drains, stormwater treatment devices, rain water tanks and any stormwater management device or redundant stormwater system.</td>
</tr>
<tr>
<td><strong>Public Stormwater</strong></td>
<td>Public stormwater network includes:</td>
</tr>
<tr>
<td></td>
<td>1. Any stormwater pipe, drain, land drainage work or treatment facility, vested in or under the control of the council; and</td>
</tr>
<tr>
<td></td>
<td>2. Any stormwater drain, drain, land drainage work or treatment facility declared by the council to be a public drain under Section 462 of the Local Government Act 1974.</td>
</tr>
<tr>
<td></td>
<td>The stormwater assets of other public entities such as Auckland Transport, Auckland Council Community Services and NZTA are not considered “public” in the context of this document. They may be owned by a public entity, but are not “public” assets that can be connected to.</td>
</tr>
<tr>
<td><strong>RMA</strong></td>
<td><strong>Resource Management Act</strong> 1991. New Zealand’s main piece of legislation that sets out how we should manage our environment.</td>
</tr>
<tr>
<td><strong>Runoff</strong></td>
<td>The portion of rainfall which runs off the land and into the drainage system and overland flow path.</td>
</tr>
<tr>
<td><strong>Runoff Coefficient</strong></td>
<td>The proportion of rainfall landing on a given area which contributes to runoff.</td>
</tr>
<tr>
<td><strong>Secondary Flow Path</strong></td>
<td>The route taken by stormwater runoff when the primary system capacity has been exceeded or is blocked.</td>
</tr>
<tr>
<td><strong>Soakage</strong></td>
<td>Disposal of stormwater into the ground by way of specifically designed pits, trenches or bores.</td>
</tr>
<tr>
<td><strong>Soffit</strong></td>
<td>The highest point of the internal surface of a pipe or culvert at any cross section. Sometimes called the obvert.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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</tr>
<tr>
<td>Stormwater Device</td>
<td>A device or facility used to reduce stormwater runoff volume, flow and/or contaminant loads prior to discharge. Examples are rain gardens, pervious paving and tree pits.</td>
</tr>
<tr>
<td>SW</td>
<td>Stormwater. Rainfall runoff from land, including constructed impervious areas such as roads, pavement, roofs and urban areas which may contain dissolved or entrained contaminants, and which is diverted and discharged to land and water.</td>
</tr>
<tr>
<td>SWCoP</td>
<td>Code of Practice for Land Development and Subdivision Chapter 4 – Stormwater.</td>
</tr>
<tr>
<td>Time of Concentration</td>
<td>The time it takes for water to arrive from the top of the catchment to a location downstream.</td>
</tr>
<tr>
<td>Vulnerable Activities</td>
<td>As defined in the Proposed Auckland Unitary Plan (PAUP).</td>
</tr>
<tr>
<td>WSD</td>
<td>Water Sensitive Design. As defined in the Proposed Auckland Unitary Plan (PAUP).</td>
</tr>
<tr>
<td>Zone of Influence</td>
<td>See drawing SW22 in Appendix B.</td>
</tr>
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</table>
Appendix A – List of Relevant Documents

Auckland Council Publications


Standards


AS/NZS 1254: 2010 PVC-U pipes and fittings for stormwater and surface water applications.

AS/NZS 1260: 2009 PVC-U pipes and fittings for drain, waste and vent application.


AS 2865: 2009 *Confined Spaces.*


AS/NZS 2865: 2001 *Safe working in a confined space.*


AS/NZS 4058: 2007 *Precast concrete pipes (pressure and non-pressure).*

AS/NZS 4130: 2009 *Polyethylene (PE) pipes for pressure applications.*

AS/NZS 4131: 2010 *Polyethylene (PE) compounds for pressure pipes and fittings.*

AS/NZS 5065: 2005 *Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.*

NZS 3101.1&2: 2006 *Concrete structures standard.*

SNZ HB: 2001 *Subdivision for people and the environment.*

**Legislation & Plans**

Approved Code of Practice for Temporary Traffic Management (Version 4).

Auckland Council Bylaws.

Auckland Council Minmum Health and Safety Requirements for Physical Works (HS262).

Auckland Council Regional Plan: Coastal.

Auckland Regional Plan: Air, Land and Water.

Auckland Regional Plan: Sediment control.

Auckland Council Regional Policy Statement.


District Plans:
- Auckland City (including Central, Hauraki Gulf Island and Isthmus)
- Manukau City
- North Shore City
- Waitakere City
- Rodney
- Franklin
- Papakura.


Health and Safety Reform Bill 2013.

Housing Accords and Special Housing Areas Act 2013.


Plumbers, Gasfitters, and Drain Layers Act 2006.

Proposed Auckland Unitary Plan.


Other Documents


Concrete Pipe Association of Australasia. (n.d.). *Concrete pipe in acid sulphate soil conditions technical brief*. Pymble, Australia: Author.


National Institute of Weather and Atmospheric Research.

# Appendix B – Drawings

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<td>Embedment &amp; Trenchfill</td>
</tr>
<tr>
<td>SW02</td>
<td>Pipe Embedments – Standard Embedment for Flexible Pipes</td>
</tr>
<tr>
<td>SW03</td>
<td>Pipe Embedments – Standard Embedment for Concrete Pipes</td>
</tr>
<tr>
<td>SW04</td>
<td>Stormwater Service Connections</td>
</tr>
<tr>
<td>SW05</td>
<td>Standard Stormwater Manhole</td>
</tr>
<tr>
<td>SW06</td>
<td>Stormwater Manholes – Non-Access Chamber</td>
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<tr>
<td>SW07</td>
<td>Stormwater Manhole with In Situ Concrete Base</td>
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<tr>
<td>SW08</td>
<td>Stormwater Manhole Offtake</td>
</tr>
<tr>
<td>SW09</td>
<td>Stormwater Manhole Access</td>
</tr>
<tr>
<td>SW10 to SW18</td>
<td>Deleted. Refer to ATCOP drawing set.</td>
</tr>
<tr>
<td>SW19</td>
<td>Stormwater Inlet and Outlet Structures</td>
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<tr>
<td>SW20</td>
<td>Stormwater Inlet and Outlet Structures (Safety Fences)</td>
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<tr>
<td>SW21</td>
<td>Debris Control Screen</td>
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<td>SW22</td>
<td>Stormwater Pipe and Manhole Construction Clearance Requirements</td>
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<td>SW23</td>
<td>Stormwater Lines – Steep Gradients and Anchor Blocks</td>
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<td>SW24 – Sheet 1</td>
<td>Stormwater Boundaries – Connections in Road Reserve</td>
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<td>SW24 – Sheet 2</td>
<td>Stormwater Boundaries – Connections in Reserve Land</td>
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<td>SW25</td>
<td>Auckland Transport (AT) Ownership Case</td>
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<td>SW26</td>
<td>Connection to Existing Auckland Transport Catchpit Leads</td>
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<td>SW27</td>
<td>Auckland Council Parks (Community Services) – General Ownership Case</td>
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<tr>
<td>SW28</td>
<td>Auckland Council Parks (Community Services) – Responsibility from Service Level Agreement</td>
</tr>
<tr>
<td>SW29</td>
<td>Auckland Council Parks (Community Services) – Ownership &amp; Responsibilities for SW Treatment</td>
</tr>
</tbody>
</table>