



ENGINEERING GUIDELINES

PART 2 CONSTRUCTION SPECIFICATION 2026

**ROADS, STORMWATER, SEWER, WATER SUPPLY & OPEN SPACES
DEVELOPMENT & GENERAL CONSTRUCTION**

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1 Application of Engineering Guideline Specification - Construction Specification

The Engineering Guideline – Construction Specification has been compiled to outline Council's requirements for the planning, survey, design, construction and maintenance of public infrastructure assets, subdivisions and various private site works within the Hilltops Local Government Area.

The Engineering Guideline is referenced in the Hilltops Development Control Plan and consists of the following volumes or parts, which shall be read in conjunction with one another as required and not in isolation. These documents are available on Council's website:

1. Design Guideline
2. Construction Specification
3. Standard Drawings
4. Construction Guideline

The Construction Specification has been prepared to assist Council's Construction Unit and various Service Providers by informing them of Council's requirements with respect to the construction of infrastructure assets, which will eventually be vested in and maintained by Council and to ensure that such works are provided to appropriate, safe and environmentally sustainable standards, ensuring that the principles of ecologically sustainable development are appropriately considered in accordance with the *Local Government Act 1993*.

This Construction Specification and referenced documents provide minimum requirements and references for the construction and maintenance of Engineering Guideline within the Hilltops Local Government Area. Works may include but are not limited to the following:

- Roads
- Intersections
- Pavements
- Pavement restorations
- Paths
- Cycleways
- Traffic facilities
- Earthworks
- Stormwater drainage
- Water supply
- Sewerage systems
- Water quality facilities
- Parks and reserves

2 Glossary of Terms

For the purpose of this Specification, the following definitions apply:

Access Road	Minor Road which carries a low volume of traffic, providing direct access to a limited number of allotments.
Accredited Certifier	<p>Person who holds a certificate of accreditation under the <i>Building Professionals Act 2005</i> in relation to particular matters. An Accredited Certifier in general may issue Compliance Certificates for matters within their area of accreditation.</p> <p>Note: An Accredited Certifier may not certify construction in respect of water and sewer works pursuant to Section 306 of the <i>Water Management Act 2000</i>. Works on public roads under the <i>Roads Act 1993</i> may preclude an Accredited Certifier from being appointed. In the case of the provision of water and sewer servicing, Council will issue a Section 307 Certificate of Compliance under the <i>Water Management Act 2000</i> when requirements have been met.</p>
AEP	Annual Exceedance Probability.
Ancillary Road Asset	Road elements including kerb and gutter, drainage pits, drainage lines, subsoil drainage lines, pavement markings and street furniture.
Applicant	Person or corporation making application to Council for approval for a proposed development.
Asset	Physical component of a road system or network. An asset is considered worthy of separate identification if it delivers services or benefits to the community of sufficient current or future value to warrant control and management on an individual basis. Typical assets include sections of pavements, bridges, culverts, traffic signals, signs, road furniture, road reserves, etc.
Australian Height Datum (AHD)	Datum surface approximating mean sea level as adopted by the National Mapping Council of Australia in May 1971.
Authorities	Authorities such as Telstra, Optus, Ausgrid, Department of Planning, Transport for NSW (formerly RMS), Jemena, Sydney Water, etc.
ARR	Australian Rainfall and Runoff (latest edition).
Blue Book	Managing Urban Stormwater: Soils and Construction, 4th Edition, Landcom, 2004.

Carriageway	The portion of road or bridge used by vehicles (including shoulders and auxiliary lanes or between the face of kerbs).
CBR	California Bearing Ratio.
Certifying Authority	A Certifying Authority may be Council or an Accredited Certifier approved by Council.
Collector Road	Road linking access roads to major roads, possibly providing bus routes and giving road access to allotments.
Constructor	Defined as the organisation responsible for construction of the Works and the Principal Service provider as defined in the <i>Work Health and Safety Act 2011</i> .
Constructor's Representative	Defined as follows: <ul style="list-style-type: none"> • Contracted Works - the Principal Service providers nominated representative as per the relevant contract. • Internal Works - HC officer responsible for delivery.
Consulting Geotechnical Engineer	An experienced and qualified person or company who holds an appropriate level of professional indemnity insurance, engaged by the Service Provider to provide advice, inspection reports and recommendations and testing as required by various parts of this Specification in relation to geotechnical matters.
Contractor Service Provider	Person, private sector entity or consortium engaged by a Developer or Service Provider to execute a contract.
Council	Hilltops Council. Council may also be referred to as the Principal Council under a Construction Contract.
Council's Representative	Staff member nominated by Hilltops Council to act on Council's behalf in the discharge of its contractual responsibilities and/or the person responsible/delegated to make a decision for Council. This person may be referred to as the Superintendent under a Construction Contract.
CPI	Consumer price index.
Cycleway	Portion of a road or footpath devoted to the use of bicycles.
DA	Development application.
BYDA	Before You Dig Australia
DCP	Development Control Plan.

Design	In relation to plant or a structure, it includes a design of part of the plant or structure and redesign or modification of the design.
Detention Basin (Retention/Retarding Basin)	Storage pond, basin or tank used to reduce and attenuate the peak discharge within a drainage system.
Developer's Representative	Defined as the person or organisation appointed by the Developer to administer the Constructor responsible for the delivery of Developer Infrastructure Works.
DORAS	Design of Roads and Streets Manual (TfNSW)
Driveway	Part of an access to/from a road or road related area, which is completely within the adjacent land.
Engineer	(Structural, Geotechnical, Civil, etc) - Where used in this document refers to a person of suitable experience (as a guide not less than 10 years industry experience), who holds an appropriate level of professional indemnity insurance and qualifications to undertake the relevant elements of the work and are eligible for corporate membership of the Institution of Engineers, Australia (or equivalent professional industry body).
Floodplain	As defined by the current NSW Floodplain Development Manual. Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.
Floodway Areas	As defined by the current NSW Floodplain Development Manual. Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood level.
Floodway	As defined by Austroads. A longitudinal depression in a carriageway specially constructed to allow the passage of floodwater across it without damage. The cross section of a stream in flood plus a nominated area for freeboard.
Footpath	Path or paved area reserved for the movement of pedestrians and manually propelled vehicles and motorised mobility devices.

Geocentric Datum of Australia (GDA)	Datum surface approximating the shape of the earth's surface as adopted by the Intergovernmental Committee for Surveying and Mapping in May 1990.
Handover Documents	All documents provided by the Service Provider to Hilltops Council on Practical Completion as specified, including WAE drawings.
HC Representative	Defined as follows: <ul style="list-style-type: none"> • Developer Infrastructure Works - Nominated HC officer(s) for the approved Development. • For Contracted Works - the Superintendent. • For Internal Works - HC Asset Owner.
IPWEA Specification	Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010.
Kerb and Gutter	Combined roadside element forming an open drain to capture and discharge runoff. The term kerb and channel was adopted by RMS to align with Austroads and other Australian States and Territories and may be used interchangeably with the term kerb and gutter.
Lane	Portion of the paved carriageway marked out by kerbs, painted lines or barriers, which carries a single line of vehicles in one direction. A lane is generally between 3.0m and 3.5m wide. A single carriageway road normally has at least one lane in each direction.
Late Fee	Any unauthorised work will incur a late fee in accordance with Council's Fees and Charges.
LEP	Local Environmental Plan.
LGA	Local Government Area. This refers specifically to the Hilltops Local Government Area.
Local Distributor Road	Road linking access roads to major roads, providing bus routes and giving restricted access to allotments.
Local Road	Minor road which carries a higher volume of traffic than an access road but still provides direct access to allotments.
Map Grid of Australia (MGA)	Rectangular co-ordinate system using a Universal Transverse Mercator (UTM) projection based on the Geocentric Datum of Australia (GDA).
NATA	National Association of Testing Authorities, Australia.

NCC	National Construction Code, which comprises of the Building Code of Australia (BCA) as Volumes 1 and 2 and the Plumbing Code of Australia (PCA) as Volume 3.
NSWRFS	NSW Rural Fire Service.
Obstruction	Any object which could impede or prevent the free and/or safe passage of pedestrians and/or vehicles.
Path	Footpath or shared path (refer to each respective definition).
Permanent Restoration	Restoration in accordance with Council's Specification is applied to the road or path after a temporary restoration has completed and left exposed to the public for a specified period of time.
Permanent Survey Mark (PSM)	Survey mark in the style or form for a permanent survey mark as described in the NSW Surveying and Spatial Information Regulation 2017.
PMP	Project Management Plan.
Practical Completion	That stage in the execution of work under a Contract or capital works project when the works are complete except for minor omissions and minor defects that do not prevent the works from being reasonably capable of being used for their intended purpose, as determined by Council's Representative. This definition excludes Developer-constructed works as approved by a Development Consent.
Principal Certifier	For subdivision work, means the certifier appointed as the Principal Council Certifier under section 6.12(1) of the <i>Environmental Planning and Assessment Act 1979</i> . A Service Provider must appoint a Principal Certifier for each development project involving a subdivision. For the purposes of this Specification, Principal Certifier could also mean the Principal Council Certifying Authority.

Principal Contractor Service Provider	<p>Under the <i>Environmental Planning and Assessment Act 1979</i> for building work is that person responsible for the overall co-ordination and control of the carrying out of the building work. A Principal Contractor Service Provider may also be required under the Work Health and Safety Regulation 2017. The Service Provider shall advise Council prior to commencement of any works who is the Principal Council Contractor Service Provider in respect of both. In this Specification the Principal Council Contractor Service Provider may also be referred to as the Service Provider.</p> <p>The Service Provider undertaking construction work for Hilltops Council shall be appointed as the Principal Council Contractor Service Provider and accepts all the obligations associated with this role under the Work Health and Safety Regulation 2017.</p>
Private Property	Property outside of the project, site boundary or road reserve. This is generally neighbouring property owned or leased by private owners and tenants.
Project Manager	<p>The Service Provider shall appoint a person as the Project Manager for the Project. This person must be readily available and have sufficient authority and ability to discuss and resolve problems and act as the principal Council contact with Council's Representative. A Service Provider who chooses to adopt this role must be aware that Council does not become involved in co-ordinating activities or giving advice beyond Council responsibilities.</p> <p>The Service Provider's Project Manager may also be referred to as the Service Provider in this Specification. This person may be referred to as the Service provider's Representative under a Construction Contract.</p>
Proponent	Person or Service Provider that puts forward a proposal to undertake work.
Restoration Order	Request to Council to undertake permanent restoration on behalf of a Service Provider.
Risk	The effect of uncertainty on objectives, as defined in AS/NZS ISO 31000:2018.
Roads Authority	National or state roads authority, municipality, other body or individual responsible for the care, control and maintenance of road infrastructure.
Road Opening	Any form of excavation or digging of the road reserve including test bores for Geotechnical investigation purposes.

Road Opening Permit	Permit authorising the holder to undertake a road opening activity.
Road Pavement	Refer to definition for Carriageway.
Road Reserve	Legally defined area of land between the legal road boundaries within which facilities such as roads, paths and associated features may be constructed for public travel. Where roads have not been formed, it also refers to so called 'paper roads'.
Safety Barrier	Physical barrier separating roadside hazards or opposing traffic and the travelled way, designed to resist penetration by an out-of-control vehicle and as far as practicable, to stop or redirect colliding vehicles.
Sediment Basin	Open water pond designed and constructed as a stormwater detention system to intercept, capture and settle coarse sediment from stormwater flows.
Service Provider	Any parties such as service providers, suppliers, consultants (accredited certifier), developers, authorities, or Council staff responsible for planning, designing and constructing the works.
Shared Path	Paved area particularly designed (with appropriate dimensions, alignment and signing) for the movement of cyclists and pedestrians, but on which cyclists must give way to pedestrians.
Site	Land and structures within the extent of works area/site boundary, including storage areas. The site area includes privately owned property that shall be dedicated to Hilltops Council as a public asset.
Specification	Detailed statement of materials, dimensions and quality for all work that shall be built, installed, or manufactured for Hilltops Council or for work which shall be dedicated to Hilltops Council as a public asset.
State Survey Mark (SSM)	A form of Permanent Survey Mark as described in the NSW Surveying and Spatial Information Regulation 2024.
Stakeholder	An individual or group of individuals such as employees, directors, developers, service providers, consultants and external organisations who have an interest in the project whether through their involvement with the project or because they will be impacted by its outcome.

Sub-service providers	Service providers engaged by the Principal Council Service provider. The identity of proposed sub- service providers and their proposed scopes of works shall be provided to the Certifying Authority prior to engagement. Council reserves the right to not accept any sub-contractor Service Provider working on a site based on previous poor compliance with Council's requirements. Sub-service providers may also be suppliers of materials to be incorporated into the works. Sub-service providers who supply materials for the works, may also be referred to in this Specification as Suppliers.
Surveyor	A registered Land Surveyor as defined in the NSW Surveying and Spatial Information Act 2002 and/or an Engineering Surveyor qualified to carry out Engineering Guideline surveying projects.
SWMS	Safe Work Method Statement.
Temporary Restoration	Restoration in accordance with Council's Engineering Guideline Specification is applied to roads or paths following completion of a road opening activity or trenching. Temporary restorations must be safe and trafficable at all times until permanent restorations are carried out.
TGS	Traffic Guidance Scheme
The Works	<p>Defined as follows:</p> <ul style="list-style-type: none"> • Developer Infrastructure Works - work includes subdivisions and any public infrastructure work associated with an approved Development in the HC local government area requiring a Subdivision Works Certificate (SWC). • Contracted Works - infrastructure work undertaken by a Principal Service provider or subservice provider formally appointed by HC and supervised by HC. • Internal Works - infrastructure work undertaken by HC's day labour workforce.
TMP	Traffic Management Plan.
Unauthorised Works	Works that are carried out without a permit or approval from Council.
Utility Authority	National or state roads authority, municipality, other body or individual responsible for the care, control and maintenance of utility infrastructure.

Utility Services	Public infrastructure services including water, sewerage, drainage, gas, electricity, telephone, telecommunication or other like service.
Vehicle Access Crossing	Part of an access to/from a road, which crosses a footway, verge or other road related area and connects a road to an adjoining driveway within adjacent land.
Verge	Area between the carriageway and the property line. It allows provision for services, footpaths, shared paths, cycle paths, street trees and street furniture.
WAD	Works Authorisation Deed (with Transport for NSW – State Highways).
WAE	Work-as-executed.
Works	All works required to complete the project as specified and approved.
WSAA	Water Services Association of Australia.

3 General Matters

3.1 General

The Engineering Guideline Specification has been compiled to outline Council's general procedures and practices in respect of design and construction requirements for future public infrastructure assets and various private site works in the Hilltops Council Local Government Area (LGA).

Project specific requirements shall be provided by Council's Representative where applicable. Where specifications that are contrary to all or part of this Specification are contained in a Development Consent or Tender/Contract document then those specifications shall be applied.

If this Specification does not cover a requirement for a particular construction activity, then the provisions of the current Australian Standard shall apply unless otherwise instructed by Council's Representative.

When this Specification refers to specifications published by other organisations, such as Transport for NSW (TfNSW), only the technical requirements of those specifications apply unless otherwise stated. Clarification shall be obtained from Council's Representative when a technical requirement is not provided within any specification.

When a specification for a particular item of construction is not defined by this Specification or Australian Standards then Council's Representative shall determine the appropriate specification to be applied.

This Specification is not for the purposes of providing an interpretation of what the Service Provider is required to comply with in regard to various Acts and Regulations. It is expected that the Service Provider is familiar with their obligations to comply with various Acts and Regulations.

3.2 Reference Documents

Reference documents include (but are not limited to) the following:

- Austroads publications.
- Transport for NSW (formerly RMS) documents including manuals, guidelines, specifications and test methods.
- AUS-SPEC and Council's amendments.
- Australian Standards.
- Engineers Australia Publications.
- Institute of Public Works Engineering Australasia (IPWEA) Specifications.
- Water Services Association of Australia documents relating to supply of water and sewerage services and their respective Supplements.
- Australian Road Research Board Sealed Local Roads Manual 2005.
- NSW legislation and Acts, such as, the *Roads Act 1993*.
- NSW Government Flood Risk Management Manual.
- NSW Streets Opening Conference Guide to Codes and Practices for Streets Opening.

- Managing Urban Stormwater: Soils and Construction, 4th Edition, Landcom, 2004 (commonly known as "The Blue Book").
- TfNSW - Design of Roads and Streets (DORAS).
- TfNSW Speed Zoning Standard as amended.
- Technical Directions relating to Clarification to speed zone review process and types of speed zones Amendments to NSW Speed Zoning Standard.
- TfNSW – Kerb Side Electric Vehicle Charging.

In any instance, where because of terminology, the interpretation of this Specification is in dispute, definitions shall be clarified by Council's Representative.

3.3 Conflicting Standards and Guidelines

Refer to Section 3.3 - Conflicting Standards and Guidelines in Council's Engineering Guideline - Design Guideline.

3.4 Pre-construction Information

3.4.1 Co-ordination of Pre-construction Planning Activities

The Service Provider shall ensure that all Development Consent requirements prior to the issuing of a Construction Certificate and requirements for gaining statutory approvals are met prior to the start of any Construction Activities.

This includes the integrating of undertakings made in the Development Application proposal, accompanying environmental and other report recommendations, State or Federal Authorities approvals requirements, Utility Suppliers information, further Council approvals under the *Roads Act 1993*, *Local Government Act 1993*, *Water Management Act 2000*, and Development Consent Conditions.

Consent to work on privately owned land, other than that owned by the Service Provider shall be obtained in advance of the commencement of construction.

3.4.2 Pre-construction Site Activities

The Developer and their Survey Consultant are responsible for the Preservation of Survey Infrastructure (POSI) with reference to the Surveying and Spatial Information Act and the Surveying and Spatial Information Regulation, all centre line pegging, boundary pegging, provision of suitable survey control marks for construction and providing survey marks information.

The Service Provider is responsible for all survey required for construction.

Recovery marks are not to be placed in locations that present a hazard to pedestrian or vehicular traffic.

All pre-construction site activities shall be carried out under the authority and supervision of the conditions pertaining to the site.

3.4.3 Works Subject of Approvals by Other Authorities

Where conditions have been imposed under an integrated approval or where the Service Provider is required by legislation to obtain approval from others the following applies:

- The design and construction of works shall be carried out to meet the relevant Authority's specifications in addition to those of Council.

- The Service Provider is responsible for obtaining authorisation to remove survey marks within the scope of the works, from the Surveyor General of NSW.
- The Service Provider is responsible for obtaining any permits and licences, obtaining required inspection(s), achieving work standards and gaining final approval of relevant Approval Authorities.
- Copies of approvals, permits and licences shall be obtained from Approval Authorities by the Service Provider and shall be provided to Council's Representative prior to commencement of site activities.
- Copies of final approvals of works and documentation verifying compliance of requirements from Approval Bodies shall be provided to Council by the Service Provider before Council's final inspection and approval of the works.

The Service Provider shall notify the Approval Authorities and Council of all changes and obtain any additional approvals that may be required.

3.4.4 Approved Construction Drawings

Approved Construction Drawings are drawings that have been endorsed or approved by Council for the purposes of civil construction. These may include drawings issued with a construction certificate, approval for works under the *Roads Act 1993* and other relevant Acts, or Council Quotation or Tender.

Construction specifications shall be Council's current construction specifications.

Should developer works not commence within 5 years of Council approval of the civil construction drawings, the drawings shall be revised by the Service Provider to meet Council's current Engineering Guideline Specification and then resubmitted to Council for construction approval.

Where details or specifications shown on approved drawings are different to the requirements of this Specification then the requirements of this Specification shall be applied to the works. Departures from this requirement may be made only with approval from Council's Representative.

3.4.5 Extent of Approved Works

The approved works are those works covered by a Construction Certificate and/or Council approved Construction Drawings and shall include any ancillary works required to complete the works.

Ancillary works are those works which are necessary for the new works to safely and effectively function on a sound engineering basis. Ancillary works may not be detailed or fully shown. Ancillary works may involve temporary and permanent protection works about the interface of new works and existing site conditions and works to transition the new works existing site conditions. All ancillary works shall be carried out to the same standards as required by this Specification.

3.4.6 Further Applications to Council During Works

During the course of construction, it may become necessary to make applications to Council where approvals have not already been given for:

- Temporary and permanent road closures.
- Works within the road reserve.

- Tree removal not covered by existing approval.
- Connection to or adjustment and relocation of water and sewer mains and installations.
- Modification of the Construction Certificate to carry out different works.
- Modification of the Development Consent to vary the Development Consent conditions.

Council's consideration of these applications may involve periods of advertising and referral to other authorities.

3.5 Pre-commencement Requirements

Works on any subdivision or works within the road reserve, shall not commence until the Service Provider holds Compliance Certificates confirming pre-commencement conditions of Development Consent have been satisfied; and shall not commence until Council confirms in writing that works can commence; including works within road reserve permits and the conditions of the Surveyor General's Approval to Remove Survey Marks have been satisfied.

Following confirmation of compliance for pre-commencement conditions of Development Consent, the persons having the benefit of the Development Consent shall lodge a Notice of Intention to Commence Subdivision Works with Council/Principal Certifier with a minimum notice of 2 working days.

Once the Notice of Intention to Commence Subdivision Works is acknowledged by Council/Principal Certifier, a mandatory on-site Pre-commencement meeting between the persons having the benefit of the Development Consent, their service providers and Council/Principal Certifier shall be held.

3.6 Departure from Approved Works

Departures from approved works shall result in an instruction from Council's Representative to rectify the works to comply with the approved drawings.

If the approved drawings are inadequate or do not reflect site conditions or prove to be impracticable, additional or alternative and/or remedial works may be necessary. Such works shall be approved by Council's Representative or Accredited Certifier prior to their commencement. Approval may involve the submission of plans, reports and/or a range of applications to Council and other Authorities. In some cases, it shall be necessary for the Service Provider to lodge an Application for Modification of the approved Construction Certificate.

3.6.1 Departure from the Specification

Consideration may be given for products or work methods which do not comply with Hilltops Council's Engineering Guideline Specification. Details of the proposed departure from the Specification need to be submitted to Council's Representative for approval prior to construction or use.

3.6.2 Unapproved Works

Where unapproved works are undetected during construction, the work-as-executed drawings shall be accompanied by a report(s) and calculations prepared by the Service Provider's Consultants providing justification for acceptance of the unapproved works.

The report(s) shall include an explanation as to how the unapproved works comply with Council's Engineering Guideline Specification or adequately satisfies the intent of this document.

Where the report(s) are not approved by Council's Representative, the Service Provider shall rectify the non-compliance to the satisfaction of the Council's Representative.

Approval from Council's Representative or Accredited Certifier of any remedial works is required prior to their commencement. Approval may involve the submission of a range of applications to Council and other Authorities.

3.7 Environmental and Heritage Protection

3.7.1 General

Environment and heritage protection requirements apply to all works which will disturb the soil surface, vegetation (including grasses, shrubs and trees), horticultural features, relic or site materials. These requirements are covered by various Acts and Regulations including the *Heritage Act 1977*, *Threatened Species Conservation Act 1995* and the *Protection of the Environment Operations Act 1991*.

3.7.2 Environmental Requirements Prior to Site Works

Before any clearing begins, Council's approval to remove trees must be obtained as required by conditions of the Development Consent and in accordance with Council's DCP.

The protection of vegetation or other environmental or heritage items must be complied with during construction. The works to be carried out must be consistent with:

- Any specific Development Consent conditions.
- The approved Environmental Management Plan and/or the Erosion and Sediment Control Plan, Soil and Water Management Plan and other approved documentation.
- Any site induction information provided by the Environmental Consultant or Consultant Ecologist.

Construction details and methods must be selected to ensure that the requirements of the approved Environmental Management Plan and Development Consent are complied with.

The location of all trees and vegetation to be preserved should be identified on the Environmental Management Plan or the approved Construction Drawings. The Service Provider shall not proceed with any work until this information has been made available to the Council. In the absence of specific details relating to tree protection being described in consent approval documentation or Construction Certificate drawings or reports, then the requirements of AS 4970 - Protection of trees on development sites shall apply.

The Service Provider is to erect approved protective fences around all trees and patches of native vegetation to be retained and protected prior to commencing any works. Access into such areas for any purpose will not be permitted unless approved by Council.

Council reserves the right to enter onto the land and carry out protection measures in the event they are not implemented prior to commencement of works. The cost of any such protection measures will be required to be fully reimbursed to Council by the Service Provider prior to any further development works proceeding.

3.7.3 Heritage Conservation and Protection

Measures for the protection of heritage items identified in the Development Consent and Approved Plans and drawings are to be completed prior to any clearing or earthworks. The Service Provider is responsible for ensuring that arrangements are in place for any ongoing requirements such as the reporting of additional items of Aboriginal Heritage.

Where a known item or site is affected by or adjacent to a development, specific conditions of consent will require protection measures during construction.

Where during the undertaking of development works a person uncovers or discovers a relic (within the meaning of the *Heritage Act 1977*) or Aboriginal relic or place, they are to:

- Cease work on the site.
- Take appropriate measures to secure and protect the site or relic, including fencing.
- Contact Council's Representative.
- Notify either the Heritage Council and the Office of Environment and Heritage, as appropriate, of the discovery as required under the *Heritage Act 1977* or the *National Parks and Wildlife Act 1974*.

3.7.4 Fire Restrictions

Burning including burning of cleared vegetation and wastes is prohibited except with approval under the *Protection of the Environment Operations Act 1997* and the Protection of the Environment Operations (Clean Air) Regulation 2002.

Where conditions of Development Consent require the carrying out of bush fire hazard reduction works, a certificate is to be obtained under the *Rural Fires Act 1997* for any hazard reduction burning. Requirements for this certificate should be determined through the Integrated Development process.

The Service Provider is to address any bushfire risks associated with this construction activities and implement any mitigation measures identified in the risk assessment.

3.7.5 Construction Noise Control and Vibration

Site assessments shall be completed for both noise and vibration impact with reference to the Construction Noise and Vibration Guideline TfNSW. The Service Provider is to comply with all the statutory regulations and take all practical precautions to minimise noise levels from the development site.

A copy of the site assessments shall be provided to Council prior to works commencement.

3.7.6 Waste Management

All construction wastes are to be stored on-site in a secure manner until they can be removed off-site. Containment or covering of wastes which may be spread by wind or rain is required.

The Contractor Service Provider shall comply with the relevant section of Council's Development Control Plan (DCP) regarding site waste management.

Disposal of construction wastes on site is not acceptable.

3.7.7 Final Site Cleaning

Upon completion of works, all buildings, plant, spoil, debris, excess material and waste arising from the development works shall be removed and the site left in a safe, clean and tidy condition.

All roads, drains, signs and other infrastructure are to be free of sediment, dust, grime and other pollutants. Structures are to be in a ready to use condition.

3.7.8 Council Reserves and Council-Controlled Lands to be Dedicated to Council

Reserves to be dedicated to Council, with the exception of specified Heritage items, shall be left in a safe and tidy condition, free of all hazards to public safety. These hazards include, but are not limited to, wells, shafts, dangerous ruins, building remnants, spoil, stockpiles and waste.

Landscaping and embellishment works shall be carried out in accordance with the approved Landscape Design Plan and Report where required.

3.7.9 Transportation of Materials

Transportation of earth, sand, road construction material, loose debris and any loose materials to or from the development site shall be in a manner that will prevent the dropping of material on surrounding roads. The wheels, tracks and body surface of all vehicles and plant leaving the site shall be free of material that may be unknowingly deposited during operation.

All loads shall be covered to prevent loss of materials during transportation.

3.7.10 Work On or Near Trees

3.7.10.1 Tree Removal and Work on Trees

Council's approval in accordance with Hilltops DCP (Tree Management) must be obtained before removing or performing any work on trees, including trimming, pruning, root cutting or repairs. Any work permitted to be carried out on trees is to be performed by an Arborist (minimum Level 3) approved by Council, in accordance with Council's specifications for tree works.

Trees to be removed are to be clearly marked onsite with a yellow tape to correspond with those marked in red on the approved plans for removal.

Removal of trees is to be undertaken so that there is no damage or injury to trees or other native vegetation to be retained. Council may nominate an appropriate felling method by way of consent conditions where damage to remnant trees is likely to occur during felling. This may mean that precision felling by chainsaws is necessary instead of machine felling.

Road and drainage works involving the removal of trees will be in accordance with current statutory requirement, policies and procedures. Offset planting of all trees removed shall undertake at the minimum ratio 4:1 (4 replacement trees for 1 tree removed). Refer to Council's DCP, and/or the Mitigation Table in the Projects REF and/or Projects BDAR/BAR report.

3.7.10.2 Working Near Trees

Existing trees are legally protected by Council's Tree Preservation Order. The Service Provider shall comply with AS 4970-2009 Protection of trees on development sites for both pre planning and during construction. All trees that will be impacted by the works shall be clearly marked and appropriate protection measure be in place prior to authorisation to commence work., and or complying with Council's Representative's directions.

Prevent damage to tree bark. Do not attach stays and guys to trees. Do not remove topsoil from or add topsoil to the area within the dripline of trees. Review in line with AS 4970-2009 Protection of trees on development sites.

Use hand methods to locate, expose and cleanly remove the roots on the line of excavation. If it is necessary to excavate within the drip line, use hand methods or trenchless methods,

to preserve root systems intact and undamaged. Review in line with AS 4970-2009 Protection of trees on development sites

Be aware of the restrictions on work near trees, if required seek direction from Council's Representative.

Do not cut tree roots exceeding 50mm diameter. If it is necessary to cut tree roots, use means such that the cutting does not unduly disturb the remaining root system. Immediately after cutting, water the tree and apply a liquid rooting hormone to stimulate the growth of new roots. Review in line with AS 4970-2009 Protection of trees on development sites.

Backfill excavations around tree roots with a mixture consisting of three parts by volume of topsoil and one part of well-rotted compost with a neutral pH value, free from weed growth and harmful materials. Place the backfill layers, each of 300mm maximum depth, compacted to a dry density similar to that of the original or surrounding soil. Do not backfill around tree trunks to a height greater than 200mm above the original ground surface. Immediately after backfilling, thoroughly water the root zone surrounding the tree.

3.7.10.3 Habitat Trees

Habitat trees shall only be felled where Council approval has been granted and under the supervision of the Service Provider's Consulting Ecologist or other Environmental Consultant acceptable to Council. Formalised procedure or need to reference the procedure is to be forwarded to Council prior to the works are undertaken.

3.7.11 Working Hours

Where not specified in a Development Consent or required by other Authorities, working hours for works shall be based on the Environment Protection Authority's Environmental Criteria for Road Traffic Noise and the related NSW Office of Environment and Heritage's Interim Construction Noise Guideline. No work shall take place on Sundays or public holidays.

The Service Provider shall consider limiting working hours either throughout the works, in particular instances or timeframes in the vicinity of sensitive developments e.g. hospitals, schools, during public events, etc.

Exceptions may be made for works on existing roads where traffic conditions make works hazardous or would result in unacceptable traffic delays. Arrangements for these works shall be made with Council and/or Transport for NSW (TfNSW) (if applicable) in conjunction with applications under the Roads Act 1993 for the subject works.

3.7.12 Erosion Control

3.7.12.1 Reference Documents

Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. Where not otherwise specified in the relevant Hilltops Council (HC) Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the HC Construction Specifications at the time of the Works approval.

- a) Hilltops Council (HC) Specifications
- b) Hilltops Council Engineering Guideline Specification Section 5, Site Clearing and Bulk Earthworks.

3.7.12.2 Legislation

Protection of the Environment Operations Act 1997 (POEO Act).

3.7.12.3 Other Publications

Landcom - Managing Urban Stormwater, Soils and Construction, 4th Edition, March 2004 ("the Blue Book").

3.7.12.4 Erosion and Sedimentation Control Plan

An Erosion and Sedimentation Control Plan (ESCP) shall be developed for all work equal or under 2,500 square metres where ground disturbance is either known or likely to occur. The ESCP shall be prepared in accordance with Managing Urban Stormwater: Soils and Construction ("the Blue Book").

For sites larger than 2,500 square metres shall require a Soil and Water Management Plan (SWMP).

The ESCP or SWMP shall be prepared in accordance with the Blue Book by a person with demonstrated skills, experience and qualifications. All work that involves any disturbance to the surface of land shall be carried out in accordance with an approved ESCP/SWMP.

3.7.12.5 Erosion and Sedimentation Control Measures

Erosion and sedimentation control measures shall be in accordance with the approved ESCP. Submission to Council of an Erosion and Sedimentation Control Plan (ESCP) shall constitute a **HOLD POINT**.

HOLD POINT

The ESCP/SWMP, including all associated details, shall be submitted to the Councils Representative at least ten (10) working days prior to the proposed date of commencement of site work.

PROCESS HELD: Site establishment and any subsequent site works.

Under no circumstances shall work commence until the Hold Point has been released and all relevant control measures are in place.

3.7.12.6 Earthworks for Erosion and Sedimentation Control Basins

Earthworks for erosion and sedimentation control basins shall be to the planned levels and dimensions shown on the approved design drawings.

The entire storage and embankment foundation area of erosion and sedimentation control basins shall be cleared in accordance with Hilltops Councils Engineering Guideline Specification Section 5 Site Clearing and Bulk Earthworks and shall be stripped of topsoil and any unsuitable material under embankments removed in accordance with this section.

The embankments shall be constructed in accordance with Hilltops Councils Engineering Guideline Specification Section 5 Site Clearing and Bulk Earthworks.

3.7.12.7 Inlets, Spillways and Low Flow Outlets for Sedimentation Control Basins and Sediment Traps

Inlets and spillways shall be constructed in accordance with the approved ESCP.

3.7.12.8 Drop Inlet Sediment Control

Drop inlet sediment traps and inlet control banks shall be constructed on completion of each gully pit unless otherwise directed by the HC Representative. These drop inlet sediment traps and inlet control banks are additional to the temporary sedimentation control measures that may be required under Section 3.7.12.7 during construction of the gully pits.

The drop inlet sediment traps are intended to remove sediment from the surface flow before it enters the drainage system. The inlet control banks shall be constructed as required to prevent the surface flows bypassing the gully pits.

The drop inlet sediment traps shall be constructed as shown on the approved design drawings. The associated inlet control banks shall consist of at least two (2) courses of sandbags containing a 10:1 sand/cement mix. The bags shall be keyed at least 25mm into the surface, dampened sufficiently to ensure hydration of the cement and tamped lightly to provide mechanical interlock between adjacent bags.

3.7.12.9 Cleaning Sedimentation Control Structures

The Constructor shall clean out permanent sedimentation control structures, cleaning out whenever the accumulated sediment has reduced the capacity of the structure by 70% or more, or whenever the sediment has built up to a point where it is less than 300mm below the spillway crest. All permanent sedimentation control structures shall be cleaned out by the Constructor prior to completion of the Works.

Accumulated sediment shall be removed from permanent sedimentation control structures in such a manner as not to damage the structures. The sediment removed shall be disposed of in such locations that the sediment will not be conveyed back into the construction areas or into watercourses. The Constructor shall provide and maintain suitable access to permanent sedimentation control structures to allow cleaning out in all weather conditions.

3.7.13 Temporary Erosion and Sedimentation Control

3.7.13.1 General

The Constructor shall ensure that effective erosion and sedimentation control is provided at all times for the duration of the works and until all disturbed surfaces are fully restored or revegetated to the satisfaction of the HC Representative.

Runoff from all areas where the natural surface is disturbed by construction, including access roads, depot and stockpile sites, shall be free of pollutants. The Constructor shall be responsible for all temporary erosion and sedimentation control measures required for this purpose.

The Constructor shall provide and maintain slopes, crowns and drains on all excavations and embankments to ensure satisfactory drainage at all times. Water shall not be allowed to pond on the Works site unless such ponding is part of an approved ESCP.

3.7.13.2 Temporary Drains

Runoff from areas exposed during the work shall be controlled in accordance with the approved ESCP.

3.7.13.3 Temporary Sediment Traps

Temporary sediment-trapping devices shall be provided during construction in accordance with the approved ESCP to remove sediment from sediment-laden runoff before it enters natural watercourses or adjacent land.

3.7.13.4 Batter Protection

The Constructor shall take all necessary action to protect batters from erosion during the Works. Scour of newly-formed fill batters during and after embankment construction shall be minimised by diverting runoff from the formation away from the batter until vegetation is established.

3.7.13.5 Maintenance and Inspection

The Constructor shall be responsible for operation, monitoring, cleaning out, maintenance, repair and rectification of erosion and sediment control measures as specified in the approved ESCP.

The Constructor shall provide and maintain access from within the road reserve or from other locations acceptable for cleaning out sedimentation control structures.

3.7.13.6 Removal of Temporary Erosion and Sedimentation Measures

All temporary erosion and sedimentation control measures shall be removed by the Constructor when revegetation is established on formerly exposed areas before the end of the Works. All materials used for the temporary erosion and sedimentation control measures shall be removed from the site.

Concurrence from the HC Representative shall be sought to confirm the standard of revegetation is satisfactory prior to the removal of the associated control measures required under the ESCP. This concurrence by inspection shall constitute a **HOLD POINT**.

HOLD POINT

The removal of approved erosion and sedimentation control measures requires the concurrence of the HC Representative. A joint inspection shall be undertaken by the Constructor and the HC Representative.

PROCESS HELD: Removal of approved erosion and sedimentation control measures.

3.8 Haulage, Storage and Quality of Materials

3.8.1 Haulage Routes

Details for the approval of haulage routes shall be supplied at the request of Council's Representative. Details to be provided may include, but are not limited to type, number, and weight of vehicles, planned routes, road condition report, and vehicle management plan.

Where the proposed haulage involves heavy vehicles subject to the Heavy Vehicle National Law, the Service Provider shall also provide details of any National Heavy Vehicle Regulator (NHVR) approvals obtained or required for the proposed route and vehicle configurations.

Visual assessments of the approved haulage route(s) will be carried out by Council prior to, during, and upon completion of works to determine whether the haulage associated with the development has caused any specific damage to the route.

Damage to roads by haulage plant shall be satisfactorily repaired at no cost to Council. Damage which, in Council's view, presents a hazard or may accelerate further deterioration is to be repaired as it becomes apparent. Any temporary restoration works necessary during construction shall be carried out in accordance with this Specification or as agreed between Council's Representative and the Service Provider.

3.8.2 Storage of Materials

All materials shall be stored in a safe, tidy and nonhazardous manner. Safety fencing, barricades, signposting and sediment controls shall be provided as required to ensure such sites are in accordance with Work Health and Safety Regulation 2017, relevant environmental requirements and this Specification. Reinstatement of stockpile areas shall be approved to the satisfaction of Council's Representative.

Storage of pipes, gravel and other materials on public roads or reserves is not permitted unless approval by Council's Representative is provided. The request for approval shall contain supporting documentation to ensure satisfactory restoration is achieved. This shall include (but not limited to) a survey accurate level and detail plan with spot levels and contours, adequately depicting the existing surface topography covering the proposed stockpile and surrounding areas. Following surface restoration of the stockpile site to requirements of this Specification for disturbed areas, a work as executed survey covering the stockpile and surrounding area shall be submitted to Council for review. Refer to Appendix A - Work-as-Executed Drawings and Compliance Documentation Requirements of this Specification

3.9 Materials Quality

Materials used shall comply with relevant standards and the following requirements:

- In 'as new' condition.
- Free of structural damage.
- Free of contamination.
- Defect free.

If required, the Service Provider shall provide to Council's Representative full information describing the source of supply, mode of supply and place of manufacture of any material.

Processed recycled material may be used in pavement, earthworks and drainage construction provided that the properties of the material meet the requirements of the material as required by this Specification or confirmed to be suitable by the Consulting Geotechnical Engineer and Council's Representative.

Recycled material shall conform to the requirements of:

- IPWEA Specification for Supply of Recycled Materials for Pavements, Earthworks and Drainage 2010.
- Applicable TfNSW Specification(s).

- LGNSW - Recycled Materials in Roads and Pavements.

Documentation shall be submitted to Council confirming that the recycled material supplied to site shall have a resource recovery exemption.

When required by this Specification or requested by Council's Representative, test results of the particular materials proposed shall be submitted to Council's Representative or the Accredited Certifier for approval prior to use and delivery to site. Council's Representative may accept materials for which Council holds current acceptable test results. Specific material requirements are detailed in the relevant sections of this Specification.

3.10 Safety, Access, Public Utilities and Damage

3.10.1 Safety

The Service Provider shall be responsible for adequate safety precautions during progress of the works, in accordance with the relevant legislation, regulations, standards and codes of practice. This includes but is not limited to the safety of the public, employees and contractor Service Provider personnel. The provision and erection of any signs, lights and barricades necessary for pedestrian and traffic safety in public roads or places are also part of the responsibility for adequate safety precautions.

3.10.2 Private and Public Amenity

Uninterrupted access and utility servicing must be maintained to all properties throughout the development works unless otherwise approved by Council or other relevant utility authorities. Applications may be made to Council under the *Local Government Act 1993*, *Roads Act 1993*, and *Water Management Act 2000* seeking disruptions to access and servicing. Assessment of these applications may involve landowner notifications and referrals to other authorities.

3.10.3 Damage to Property

The Service Provider shall take adequate precautions to prevent deterioration and damage to private property, public roads, public utilities and reserves during construction.

The Service Provider shall provide dilapidation report by adequately qualified independent persons to identify the condition of private fences, driveways, landscaping, structures and other property improvements that are within proximity to the proposed development works.

Council's Representative may direct the provision of temporary works or restrictions on construction methods considered necessary to protect private lands and improvements. Council shall take into consideration any written agreement with the landowner obtained by the Service Provider gaining permission to undertake works on or adjacent to the private lands before any direction is issued.

Damage to the adjacent road by haulage plant shall be satisfactorily repaired at no cost to Council. Any temporary road restoration works necessary during the course of construction shall be carried out in accordance with this Specification or as agreed between Council's Representative and the Service Provider.

3.10.4 Public Utilities in the Work Area

The Service Provider shall ensure that accurate information is obtained in relation to the location of utilities within the work area and the requirements of all Utility Authorities in regard to working near their assets.

A Before You Dig Australia enquiry shall be made by the Service Provider prior to any excavation work in accordance with the requirements of the Energy Legislation Amendment (Infrastructure Protection) Act 2009.

The Service Provider shall immediately inform the relevant Utility Authority and Council's Representative of any damage occurring to utility mains, services and installations.

Adjustments, relocations and replacement of public utilities shall only be undertaken following approval from the appropriate Utility Authority. The cost of all works associated with this shall be the responsibility of the Service Provider.

3.10.5 Permanent Marks, State Survey Marks and Cadastral Reference Marks

Precautions shall be taken to protect and preserve any Permanent Marks (PM), State Survey Marks (SSM), and Cadastral Reference Marks that are located within or may be affected by the works.

Prior to commencement of works, the Service Provider shall prepare and submit a Preservation of Survey Infrastructure (POSI) in accordance with the requirements of Spatial Services NSW. The POSI shall identify all survey marks within or adjacent to the works area and outline measures to ensure their protection throughout the construction period.

The Service Provider shall be responsible and liable for the replacement of any disturbed or destroyed marks in accordance with the conditions of the Surveyor-General's Approval to Remove Survey Marks, using a Registered Land Surveyor in NSW. All costs associated with the preparation of the POSI, and the reinstatement or replacement of marks shall be borne by the Service Provider.

3.10.6 Private Property and Council-Controlled Lands

3.10.6.1 Private Landowner's Permission

The Service Provider is responsible for gaining written consent to enter or carry out works within private property. Council also requires the Service Provider to obtain the landowners consent for works within Council and interallotment easements over private lands.

The Service Provider shall ensure that this consent is not withdrawn prior to the works being completed. Council's Representative shall be informed immediately upon the withdrawal of consent by a landowner.

The Service Provider shall ensure that the landowner's consent and any conditions are clear. The Service Provider shall make a photographic record of the site prior to the commencement of work to minimise the possibility of any dispute over the effects of construction on the private property.

3.10.6.2 Permission for Works on Council Roads, Lands and Reserves

Under the *Roads Act 1993*, approval to work within a public road reserve is required to be obtained from Council or TfNSW in the case of state-owned roads.

For works required within a Council road reserve as part of a Development Consent, the Service Provider shall obtain a Section 138 *Roads Act 1993* approval known as a Works within Road Reserve permit prior to commencement of work. This includes electricity and telecommunication extensions to the existing networks. In addition, works to connect to Council controlled utilities like water/sewer/stormwater will require a Section 68 permit.

Access onto, use or performance of works on Council owned private land, drainage reserves, public reserves, Crown Land under Council care and any other land or easements controlled by Council may not be carried without specific Council approval.

3.10.6.3 Access to Adjacent Property

The Service Provider shall maintain safe and convenient passage for pedestrians and vehicles to and from property entrances and buildings at all times unless otherwise negotiated by the Service Provider with the property owner and all property tenants. Temporary connections to intersecting roadways shall be provided and maintained as necessary.

Prior to the commencement of construction, the Service Provider shall provide written notice to all traders and occupants of adjacent properties where access to or from those properties may be affected by the works to be undertaken.

3.10.7 Use of Explosives

The Service Provider shall not use explosives for any works.

3.11 Compliance Inspections, Testing and Documentation

3.11.1 Construction - Testing, Inspections and Documentation

It shall be the responsibility of the Service Providers to present to the Principal Council Certifier work-as- executed drawings and documentation demonstrating compliance with the following:

- Development Consent.
- Subdivision Works Certificate (Subdivision Works Construction Certificate).
- Engineering Guideline Approvals issued by Council.
- This Construction Specification.
- Requirements from any other authorities.

3.11.1.1 Mandatory Inspections

Council as the Principal Council Certifier for subdivisions and associated works, require mandatory inspections by Council as the Certifier or an accredited Certifier of the following:

- On-Site Pre-Commence Meeting with Council as the Principal Council Certifier and/or the relevant authority - prior to construction commencing.
- Fill material - agreeance with source, in keeping with pavement report and compaction requirements. For the max 500 mm lifts. (Level 1 geotechnical report on larger projects would be expected). Proof roll and compaction per lift
- Select fill material nomination and review.
- Stabilised select/subgrade nominated design and review.
- Road Pavement Subgrade - certificates of nominated material to be forward for review 2 weeks prior to use. During works, checks include proof rolls, compaction and conformance levels against design.

- Road Pavement Layer - certificates of nominated material to be forwarded for review 2 weeks prior to use. During works, checks include proof rolls, compaction and subbase and base levels against design.
- Water supply pipe works. Review and inspections on nominated materials, in trench prior to backfilling, thrust block construction, valves, backfilling and pressure tests.
- Stormwater system. Review and inspections on nominated materials, in trench prior to backfilling, pit works, backfilling and internal visuals (i.e. CCTV).
- Sewer reticulation. Review and inspections on nominated materials, in trench prior to backfilling, Manhole construction, pump station construction backfilling, pressure tests and CCTV for internal construction check.
- Concrete Works - after preparation of ground surface, placement of formwork and reinforcement ready for placement of concrete, including (but not limited to):
 - Pit construction.
 - Kerb and gutter construction.
 - Rigid pavement construction.
 - Driveway and access ways.
 - Footpath and shared path.
- Structural Elements - as required by the structural certifier and this Specification, including (but not limited to):
 - Bridges.
 - Concrete pavements.
 - Retaining walls.
 - Stormwater pits with specific structural design.
- Pavement - once ready for placement of following elements:
 - Sealing pre and post works.
 - Asphalt, pre, during and post works
- Final completion inspection:
 - The Service Provider shall request a pre-final completion inspection to identify all items that are incomplete or defective. This also includes submission of Works as Executed drawings, and all QA documentation for the works.
- Close out Completion Inspection:
 - The Service Provider shall request a final completion inspection upon completion of all rectified or completed items previously identified during the pre-final completion inspection.
 - It is the Service Providers responsibility to book a mandatory inspection providing a minimum of 48 hours' notice to Council as the Certifier for the works.
 - Construction must not proceed to subsequent works prior to obtaining written confirmation or notification from Council or the Accredited Certifier that the mandatory inspection demonstrated compliance.

3.11.1.2 Inspection and Testing

Inspections and testing shall be undertaken in accordance with this Specification, and all costs shall be met by the Service Provider. See also Section 3.11.1 for basic list of inspection/certification points

Copies of all inspection reports and test results are to be provided to Council's Representative or the Accredited Certifier.

3.11.1.3 Other Inspections

Council as the Principal Council Certifier for subdivisions and works on lands and roads under Council control may carry out other inspections of the following:

- Sediment Control, Environmental, Vegetation and Heritage Protection:
 - Installation of protection measures.
 - To confirm ongoing maintenance of protection measures.
 - To confirm restoration, stabilisation and suitability of site for removal of protection measures.
- Clearing:
 - Prior to commencement of clearing but after set out or marking of trees to be retained and/or delineation of "No Go" areas.
 - During clearing works.
 - When clearing is completed.
- Earthworks:
 - At commencement.
 - During works.
 - At completion of works.
- Subsurface Drainage:
 - Before placement of pipes after trenching.
 - Before backfilling.
 - After backfilling.
 - During final flushing at completion of works.
- Stormwater drainage works:
 - During excavation.
 - During pipe laying and pit construction.
 - During trench backfilling.
 - Grout and proper pipe termination about pit pipe penetration.
- Miscellaneous inspections:
 - Other inspections as detailed in this Specification or as required by Council's Representative.

It should be noted that the pre-final completion inspection needs to be carried out over a number of days depending on the size of the site. Pre-final inspections shall not be started until works are complete and Works as Executed drawings are submitted, unless it is possible to carry out inspections where there is no opportunity for damage to items being inspected from ongoing construction activities to occur. The time when the pre-final completion inspection begins will be up to the discretion of Council's Representative.

When items identified in the pre-final inspection are not rectified or completed at the time of the final completion inspection then additional fees will be charged to the Service Provider for any additional inspection required to complete the final completion inspection.

A satisfactory inspection or approval to proceed from one component of works to the next in no way absolves the Service Provider from the responsibility for remedying defects or uncompleted items of works identified at any time up to the end of the maintenance/defects period.

During the progress of works the following persons:

- Council's Representative.
- Accredited Certifiers.
- Principal Certifier.
- Consultants or specialists employed or engaged by the Service Provider, Council, an Accredited Certifier or the Principal Council Certifier.

Acting only within their role shall at any time:

- Have uninterrupted access to the works.
- Require the Service Provider's equipment or personnel be made available for examination or testing purposes.
- Instruct the removal or amendment of any such work or material not in accordance with the approved plans, appropriate specifications, standards or best industry practice.

3.11.1.4 Work-as-Executed Drawings and other Compliance Documentation

The provision of work-as-executed drawings and other compliance documentation form part of the approved works. For the preparation of work-as-executed drawings refer to Appendix A - Work-as- Executed Drawings and Compliance Documentation Requirements of this Specification.

3.11.2 Council as the Certifier for Subdivision Works

3.11.2.1 Notice for Inspections

Minimum notice of two business days shall be given for mandatory inspections to Council's Representative or the Accredited Certifier.

Failure to request or comply with mandatory inspection requirements may lead to the affected portion of work not being accepted.

3.11.2.2 Inspections Outside Normal Council Hours

It may be acceptable in the particular case to arrange inspections of work outside of Council's normal working hours. The additional cost of these inspections shall be borne by the Service Provider. This cost will be determined by Council and shall be paid prior to the

issue of a subdivision works certificate, a Compliance Certificate or other documentation confirming completion of the subject works.

3.12 Compliance Certificates, Maintenance, Defects and Bonds

3.12.1 Compliance Certificates under the *Environmental Planning and Assessment Act 1979*

When Council is the Principal Council Certifier, compliance certificates required to be issued by the Principal Council Certifier are not required to accompany an application for a subdivision certificate.

A Compliance Certificate may be issued for subdivision works when requested by the Service Provider and the following shall apply:

- A satisfactory final inspection.
- The work-as-executed drawings and associated documentation including all test results are submitted, assessed and accepted by Council.
- Written acceptances of other authorities to relevant aspects of the works have been submitted to Council.
- Development Consent conditions relating to the works being satisfied.

It is the Service Provider's responsibility to obtain Compliance Certificates from any Accredited Certifiers used to certify satisfaction of conditions or aspects of the Development Consent.

Compliance Certificates may be issued for identifiable components or aspects of the development or for compliance with a Development Consent condition.

3.12.2 Local Approvals under the *Local Government Act 1993*

Where Council has given a local approval in relation to works required under a Development Consent, Council will not normally advise of compliance with that Local Approval specifically, unless requested by the Service Provider.

3.12.3 Maintenance/Defects Period and Bonds

3.12.3.1 Subdivision Bond

Council may consider a formal request from a developer to accept an unconditional security for outstanding subdivision works, in order to facilitate the issue of a Subdivision Certificate, provided Council is convinced that the developer will be able to complete such work within a reasonable timeframe. The deferral of such works, however, must not present a safety issue that cannot be satisfactorily managed. Further details can be attained from Councils Subdivision Bonds and Guarantee Policy as amended.

3.12.3.2 Maintenance/Defects Period Bond

The Service Provider remains responsible for remedying defective work up to and throughout the Maintenance/Defects Period. The Maintenance/Defects Period for all Subdivision and Development related works shall be 12 months or greater if deemed appropriate to do so.

Damage or nuisance arising from defective works including that caused by eroded soils which should have been stabilised as part of the development works shall be rectified during the maintenance period without delay.

The Maintenance/Defects Period will commence upon:

- The satisfactory completion of works as evidenced by the final inspection, excepting any bonded uncompleted works as agreed by Council.
- The payment of the Maintenance/Defects Bond.
- The submission of satisfactory work-as-executed drawings, test results and when applicable other Authorities' written approval of the works.
- Council issue of a Subdivision Certificate where applicable.

A Maintenance/Defects Bond shall be lodged as an unconditional Bank Guarantee with no termination date or cash only.

The value of this Maintenance/Defects Bond shall be in accordance with Council's current fees and charges or where not covered by the current fees and charges as determined by Council's Representative.

The Maintenance/Defects Bond is provided to cover any Council incurred costs of abnormal maintenance and/or rectification of any work found to be defective within a period of 12 months from the date of commencement of the Maintenance/Defects Period.

To secure release of the Maintenance/Defects Bond it is the responsibility of the Service Provider to arrange an inspection with Council's Representative approximately 4 weeks before the end of the Maintenance/Defects Period and to rectify any defects identified at that time or prior to that time.

After 1 month from the end of the Maintenance/Defects Period or the notification of defects, whichever is the later, Council may expend bond monies to remedy defects and recover any additional costs from the Service Provider.

Council will not expend bond monies without giving 14 days' notice to the Service Provider of the intended rectification works. This notice does not apply to emergency maintenance works carried out by Council at any time.

The cost of any emergency remedial work carried out by Council during the Maintenance/Defects Period shall be borne by the Service Provider where the remedial work is the result of a defect.

Any temporary repairs carried out by Council shall be removed and the defect(s) satisfactorily rectified by the Service Provider along with any additional works necessary to prevent any reoccurrence.

Where defects are substantial a further Maintenance/Defects Period and Bond may also be applicable to the completed remedial works as determined by Council's Representative.

Where there is a delay of greater than 2 months from the time of issue of a subdivision certificate and registration of a linen plan the maintenance period may be extended by Council's Representative.

3.13 Provision of Utilities

The Service Provider shall make pre-construction arrangements with appropriate Authorities regarding the installation of new infrastructure.

Approved Utility installation diagrams shall be provided for comment to Council's Representative at the time of Construction Drawing assessment, if diagrams are available at that time, or to Council's Representative if they become available after issue of construction approvals.

The following utilities are normally required:

- Electricity supply including street lighting to roads and other public areas.
- Communication services.
- Gas mains if required by the relevant provider.
- Water supply.
- Sewerage systems.
- Electric Vehicle charge points.

The Service Provider shall give adequate notice and make satisfactory arrangements with Authorities for the installation of new infrastructure. All works shall be carried out to the requirements of the relevant Authority and any Council requirements.

Services shall be located within Council's footway allocation in accordance with Section 7.12 "Providing for Utilities" of DORAS.

The Service Provider shall be fully responsible for the repair of any damage caused by other Authorities in providing services to a development.

All trenching is carried out to the Utility Authorities requirements. Backfill shall be adequately compacted to the adjacent natural ground condition to prevent subsequent settlement. Road crossings shall be backfilled in accordance with the requirements of this Specification.

Utility infrastructure works shall be completed to enable connections and supply prior to the release of a Subdivision Certificate or an Occupation Certificate.

3.13.1 Existing Utility Services

The Service Provider, subject to their negotiations with the Utility Authority, is responsible for all costs associated with adjustment and protection of existing utility infrastructure.

3.13.2 Works by Other Authorities

Some Authorities may wish to have full control over some works by undertaking the works themselves, e.g. traffic signal installation, connections to live water supply. The Service Provider is responsible for arrangements with the relevant Authority for the co-ordination of these works with their works program.

Council requires written acceptance from the Authorities of the completed works. Acceptance of the works may include the payment of fees, costs or bonds by the Service Provider to those Utility Providers.

4 Traffic Management

4.1 Requirements

4.1.1 General

The Service Provider shall prepare and submit a Traffic Management Plan (TMP) for all works that may affect any public place or road. The TMP shall include one or more Traffic Guidance Schemes (TGS), prepared in accordance with AS 1742.3: as amended – Manual of Uniform Traffic Control Devices, Part 3 and the TfNSW Traffic Control at Worksites Manual (as amended).

The TMP and supporting TGS's shall address the safe movement of vehicles, pedestrians, and cyclists; staging of works; signage and device requirements; and responsibilities of authorised personnel.

For all Council-controlled roads, the TMP (with supporting TGS) shall be submitted to Council via a Works within Road Reserve permit application for review and comment prior to commencement of any works. No works are to commence until Council has confirmed acceptance of the submitted documentation and release a permit for the said works.

The Service Provider shall also satisfy all relevant requirements of Transport for NSW (TfNSW) for works on roads under the responsibility of TfNSW. This includes Road Occupancy Licence/s on State Highways.

Council issues Roads Act Approvals under Section 138 of the *Roads Act 1993*.

For works that affect road or pedestrian traffic, the Service Provider shall apply to Council for a Section 138 Approval. The application must be accompanied by an approved Traffic Management Plan (TMP) and Traffic Guidance Scheme (TGS).

Where occupation of the road is required under a *Roads Act 1993* Approval, a Notice of Intention to Commence form must also be submitted to Council prior to the commencement of works.

The TMP shall include and address the following issues where relevant. Other site-specific issues not included below may also be relevant to the TMP:

- The total area of works showing all existing adjacent features affected by traffic management proposals.
- Identification of the various construction stages resulting in changed provisions for both pedestrian and vehicular traffic.
- Information for all construction stages detailing signposting, barricading, pavement marking, temporary works, etc.
- Design Drawings for any temporary roadways and detours showing pavement, wearing surface and drainage details.
- Details of arrangements for construction under traffic.
- Traffic Guidance Schemes (TGS) for during and outside work shifts.
- Vehicle movement plans.
- Special consideration of the safety of pedestrians, cyclists and workers.
- The names, addresses and means of communicating with personnel nominated for contact outside normal working hours to arrange for adjustments or maintenance of traffic

control devices and temporary roadways. With confirmation that this has been supplied to the local Police.

- Whether the use of variable message signs (VMS) is required.
- Detour routes.
- Heavy traffic congestions resulting in increased travel times. Detours may alleviate congestion and include special purpose strategic signs (e.g. variable message signs).
- Any impacts on public transport, local residents and businesses, shopping centres, churches, industrial areas, parking stations, public facilities (e.g. football oval) schools, hospitals, etc.
- In the event of an emergency, or unacceptable levels of congestion, you may be ordered to cease works and restore the road to trafficable condition. The amount of time it would take to do this should be considered and communicated in the TMP.

The Service Provider shall advise all affected parties such as emergency services, waste services, adjacent residents and public transport providers with a minimum of 7 days prior to commencement of works. Information provided shall include notification of works and Service Provider contact details.

A Traffic Guidance Scheme (TGS), which may form part of the TMP, must be prepared by a person suitably qualified by TfNSW as defined by the applicable Traffic Control at Worksites Manual. The TGS must include the name of the persons preparing the plan along with their level of certified qualification and certificate number.

The TfNSW Traffic Control at Worksites Manual current edition, read in conjunction with AS 1742.3 Manual of Uniform Traffic Control Devices, Part 3 current edition, is the required standard for all temporary traffic management on Council-controlled roads.

While the Austroads Code of Practice for Temporary Traffic Management (CoPTTM) provides national guidance, it has not been adopted as the governing standard in NSW. Accordingly, the use of outdated versions of the RMS Traffic Control at Worksites Manual is not permitted unless otherwise advised by Council's Representative.

The TGS must satisfy all the requirements of the current RMS Traffic Control at Worksites Manual, or its successor document, and 1742.3 MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES - TRAFFIC CONTROL FOR WORKS ON ROADS current edition.

The TGS shall include and address the following issues where relevant:

- Types and locations of permanent regulatory (R series) and warning (W series) signs.
- Types and locations of temporary signs (T series) including advance warning signs and variable message signs (VMS).
- Locations of permanent and temporary traffic signals.
- Locations of any required Traffic Controllers.
- Locations and lengths of taper and safety buffer areas.
- Locations of safety barrier systems including end terminals.
- Pedestrians and cyclist paths.
- Locations of entry and exit gates to work areas, individually numbered and signposted.
- Details of access to adjoining properties, car parking areas, and side roads.

- Pavement marking details, including types of delineation required, turning arrows, stop/holding lines and other road markings, types and positions of raised pavement markers and other delineation devices.
- Locations of temporary lighting.

Traffic Control measures shall be installed and maintained by persons appropriately qualified by TfNSW. Traffic Controllers shall be persons appropriately qualified by TfNSW.

The implementation and ongoing maintenance of traffic control measures are the responsibility of the Service Provider carrying out the works.

If it comes to the attention of Council that Traffic Control Devices (TCD) are insufficient or not operational (particularly in an after-hours situation), then Council may arrange to reinstate the TCD. The cost of any and all such work shall be charged to the Service Provider.

Changes to any TGS as reviewed by the Roads Authority (TfNSW and/or Council) shall be carried out by a person suitably qualified as noted above. Council acknowledges that changes to TGSs need to be made from time to time to suit site conditions and work staging. The Service Provider carrying out the works is responsible for making appropriate changes to the Traffic Guidance Scheme and implementing those changes on site.

The Service Provider shall conduct operations to offer the least possible obstruction and inconvenience to the public. The length or amount of work under construction at any one time shall not exceed that which can be properly managed having due regard for the rights of the public. Unless otherwise specified or permitted, all traffic (both vehicular and pedestrian) shall be allowed to pass through the works. Signposting and control of the work site shall separate motorists and pedestrians from the workers and machinery.

Other works shall not commence prior to the installation of all traffic management controls as shown on the plans that have been provided by the Service Provider. The Service Provider shall ensure that the required traffic signs, lights, barriers, etc are available for the time works are to commence.

4.1.2 Side Tracks and Working Under Traffic

The Service Provider shall be responsible for the design, construction and operation of any side tracks, detours and working under traffic. These shall be maintained in good condition, removed when works are finished, and the area restored in accordance with the approval or contract. The minimum restoration shall be as per preconstruction conditions.

Installation of all sign posting, pavement marking, safety barriers and traffic control devices shall be completed before the opening of side tracks to traffic.

Maintenance of side tracks shall ensure that:

- The road surface and pavement are kept in a sound condition.
- Any potholes or other failures are repaired without delay.
- Signs, markings and delineators remain intact and are clearly visible.
- All temporary lighting functions effectively.

Where construction under or adjacent to traffic is approved:

- Operation and control of obstructions in existing carriageways shall be planned in accordance with the requirements of the current version of RMS Traffic Control at Worksites Manual, or its successor document, subject to the above requirement.

- The Service Provider shall ensure all carriageways are restored to a safe and trafficable state for through traffic prior to cessation of work each day.
- All permanent sign posting, pavement markings, safety barriers and traffic signals where required shall be completed or reinstated prior to opening completed work to traffic.

4.1.3 Monitoring

The Service Provider shall undertake daily inspection of all TCDs and temporary deviations and detours to ensure all measures are in accordance with their TGS or TMP. These inspections shall include monitoring congestion levels and implementing measures to address unacceptable levels of congestion.

A diary recording of installation dates, operation times, and subsequent removal of temporary speed zones shall be kept by the Service Provider daily. All changes made to the TGS on site shall be recorded. These records shall be made available to Council's Representative upon request.

4.1.4 Traffic Incidents

Council's Representative shall be notified of any traffic incidents that occur within the work site not more than 24 hours after the Service Provider becomes aware of the incident.

A Traffic Incident Report shall be prepared by the Service Provider providing full details of the traffic incident. The Traffic Incident Report shall be submitted to Council's Representative and shall include the following information:

- Time, date and exact location within the work site.
- Weather conditions at the time of the incident.
- TGS in use at the location and time of the incident.
- A written statement that at the time of the incident all traffic control devices were in accordance with the TGS and if not, details of any non-compliance.
- The number of vehicles, pedestrians or workers involved, injuries if any and actions taken by the Service Provider after the incident.

4.1.5 Compliance Documentation for Traffic Management

The Service Provider shall obtain and provide to Hilltops Councils Representative copies of the relevant TMP/TGS and Works within Road Reserve permit from Council.

This also includes satisfactory completion of regular temporary road signage checks and forwarding of these checks to the Hilltops Councils Representative/s. Failure in any of these actions will result in a Stop Work being issued by Council. These Traffic Management actions constitute a **HOLD POINT**.

HOLD POINT

Issue of TMP/TGS along with related Works Within Road Reserve Permit to Hilltops Councils Representative.

PROCESS HELD: Traffic Management.

5 Site Clearing and Bulk Earthworks

5.1 General

5.1.1 Description

This section of the Specification provides required standards for carrying out earthworks for development-related works, general road works and subdivision construction.

The works covered by this section of the Specification include requirements for:

- The clearing and grubbing.
- Excavation, including stripping and stockpiling of topsoil.
- Filling.
- Road pavement subgrade preparation.
- Table drains, catch drains and shoulder drains.
- Testing and inspection.

Where this Specification does not cover a particular aspect of the earthworks being constructed requirements of AS 3798 - Guidelines on earthworks for commercial and residential developments shall apply. Confirmation of any requirement shall be obtained from Council's Representative in any case.

The construction of levees, detention basins and walls of temporary sediment basins (if approved) are not covered by this Specification. Specifications for these and similar water retaining works shall be prepared for the site-specific conditions by a Consulting Geotechnical Engineer engaged by the Service Provider. Any specification for these works shall include construction of these works to Level 1 geotechnical control in accordance with AS 3798.

5.1.2 Soil and Water Management, Erosion and Sediment Control

No clearing, grubbing or earthworks shall occur until the contractor Service Provider has provided to Council, or the Principal Council Certifying Authority, an updated Soil Water Management Plan reflecting the proposed staging of work.

Soil and Water Management Plans and/or Erosion and Sediment Control Plans shall be prepared in accordance with the requirements of Managing Urban Stormwater: Soils and Construction, 4th Edition, Landcom, 2004 known as "The Blue Book". The Service Provider shall have a new plan prepared by a suitably qualified and experienced person in accordance with the requirements of "The Blue Book" should Council's Representative or the Accredited Certifier considers this to be necessary. The new plans shall be subject to acceptance by Council's Representative or the Accredited Certifier.

All soil and water management and erosion and sedimentation control measures and devices shall be installed and maintained in accordance with the accepted plan and in accordance "The Blue Book" and the documents referenced therein prior to and during earthworks and until all rehabilitation and revegetation has been established to Council's or the Accredited Certifier's satisfaction.

All earthworks shall be progressively vegetated and/or landscaped in accordance with "The Blue Book" and approved Landscape plans.

A vegetative cover shall be established on all affected areas prior to issue of final acceptance of works, Occupation Certificate and Subdivision Certificate.

It is the Service Provider's responsibility to ensure best practice Soil Water Management and Erosion Control are maintained to comply with their obligations under the *Protection of the Environment Operations Act 1997*.

5.1.3 Preservation of Existing Trees and Native Vegetation

Trees and native vegetation communities outside the approved construction footprint are to be preserved by approved means to prevent the destruction normally caused by placement of conventional filling and by other earthworks within the critical root zone. All works shall be carried out in accordance with AS 4970 - Protection of trees on development sites.

Prior consultation with and approval(s) from Council's Representative shall be required before works begin where the project may affect trees. These trees may be within the same property as the project or within the adjoining property.

The Service Provider shall ensure that all trees and other vegetation identified for retention, including important habitat(s), (that may include dead or fallen trees) are not disturbed or removed. When requested from Council's Representative and/or nominated in the conditions of Development Consent, a Consulting Arborist and/or Ecologist shall be engaged by the Service Provider to provide advice and compliance reporting during the works.

Trees, stands of trees and areas of vegetation which are to be retained shall be fenced off and protected in accordance with requirements specified in documentation that may form part of the approval documentation.

The Service Provider shall plan all operations to ensure that there is no damage to any trees outside the limits of clearing specified on the approved drawing or other approved documentation.

5.1.4 Consulting Geotechnical Engineer

The Service Provider shall engage the services of a qualified Geotechnical Engineer to provide advice, testing, supervision and reporting during earthworks as requested by Council's Representative. The advice of the Geotechnical Engineer, where in conflict with the requirements of this Specification, shall not be implemented until concurrence with the geotechnical engineering advice has been obtained from the Council's Representative.

5.2 Clearing and Grubbing

5.2.1 General

The Service Provider shall carry out a Dial Before You Dig Australia (DBYDA) search prior to commencement of works and the Service Provider shall implement measures to prevent damage to existing underground and overhead utility services.

Locate and mark existing underground services at the site prior to commencement. Locate any survey marks in the area of interest by contacting the NSW Government Spatial Services Department or Council's Team Leader Survey prior to commencement or contact any other appropriate authority responsible for survey records. If there are survey marks, the Service Provider shall meet all protection and relocation requirements from the relevant Authority.

The Service Provider shall implement measures to prevent timber from falling on private property and the Service Provider shall dispose of any timber so fallen or produce the written consent of the owner to its remaining there.

Any trees, branches or vegetation, in the opinion of Council's Representative that are unsound, could become unsound, present a hazard as a result of the works or cause maintenance issues and negative performance of the works, shall be cut down and removed to the satisfaction of Council's Representative.

Damage of any kind, including damage to trees and fencing occurring during clearing operations shall be repaired by the Service Provider to the satisfaction of Council's Representative.

5.2.2 Areas to be Cleared

The areas to be cleared shall be limited to, the areas occupied by the completed road formation, stormwater drainage works, site regrading areas and water reticulation and sewer reticulation works. No other areas shall be cleared unless specifically approved by Council's Representative or shown in the approved drawings.

Unless otherwise detailed on the approved drawings, limits of clearing are defined as lines 1m outside the intersections of excavation or fill embankments with the natural surface.

Service trenches outside the general limits of clearing shall only be under scrubbed. Where slashing of lower shrubs and ground cover is sufficient to permit the works the slashed material shall be retained on site for soil conservation purposes. Alternatively, the slashed vegetation may be stockpiled for use in vegetation regeneration works.

Unless otherwise specified, remove all vegetation, logs, stumps, boulders, roots, scrub, debris, dumped material and items within the limits of clearing. Demolish and dispose of any minor man-made structures (such as fences and livestock yards), all rubbish and other materials that are unsuitable for reuse onsite. All natural landscape watercourses and natural rock outcrops shall be undisturbed unless approved by Council's Representatives.

All trees and stumps, on or within the limits of clearing, unable to be felled and removed by the clearing methods used by the Service Provider shall be removed by grubbing. Stumps and roots over 75mm diameter shall be grubbed out to a minimum depth of 500mm below the natural surface or 1.5m below the finished surface level, whichever is the lower. Backfill grub holes with suitable spoil from excavations compacted in layers to the density of the surrounding undisturbed soil.

5.2.3 Disposal of Cleared Materials

All materials cleared and grubbed, other than those being chipped for reuse, shall be removed from the site.

Sections of felled trees may be required to be retained on site in accordance with Council's conditional requirements of an approved Vegetation Management Plan.

5.2.4 Chipping or Grinding of Cleared Vegetation

Cleared vegetation shall be chipped or ground where possible. The chippings may be stockpiled for re-use as mulch in accordance with the approved drawings or for Soil Water Management during construction.

Protection of stockpiles shall be provided to ensure leachate does not contaminate any area. Each stockpile of chipped or ground vegetation shall be limited in size to 400m² and 2.5m high.

Excess material that is not to be used on site shall be immediately removed and disposed of at an approved waste management facility or by other lawful means.

Spreading of mulch in isolation over disturbed areas is not accepted to satisfy establishment of a full vegetative cover as required and referred under this Specification.

5.3 Earthworks Excavation

5.3.1 General

All earthworks excavations shall conform to the lines, grades, cross sections, dimensions and allowances for pavement thicknesses, landscaping requirements and other surface finishes shown on the approved drawings.

All rocks and boulders which protrude above the proposed finished surfaces shall be removed.

Materials obtained from excavations that meet specification requirements for fill material shall be used in the upper layers or filled road subgrades and shall be confirmed by the consulting Geotechnical Engineer for suitability.

Rock surfaces shall be left clean and free of spilled soil or debris.

5.3.2 Stripping and Stockpiling of Topsoil

Earthworks shall commence with the stripping of topsoil within the limits of the area for earthworks including areas on which underground servicing, paving, structures or filling are to be constructed. The depth of stripping shall be to a depth determined by the Consulting Geotechnical Engineer. Grass shall be stripped together with topsoil.

Soils shall not be stripped from around existing trees closer than a distance equal to twice the distance from the trunk to the drip line without the approval of the Consulting Arborist or Ecologist. In the case that no Consulting Arborist or Ecologist has been appointed, approval shall be obtained from Council's Representative.

Stockpile locations for topsoil shall be located where shown on the approved drawings. Alternative locations for topsoil stockpiles nominated by the Service Provider which are required due to site conditions or staging of works must first be accepted by Council's Representative before using that location.

Topsoil stockpiles shall not exceed 2.5m in height and have a maximum batter slope of two horizontal to one vertical (2:1).

Erosion and sediment control of soil stockpiles shall be managed in accordance with Section 5.1.2 Soil and Water Management, Erosion and Sediment Control of this Specification.

5.3.3 Disposal of Surplus Material

Surplus material from excavations shall not be disposed of onsite other than in accordance with the approved Construction Drawings.

Spoil sites shall be cleared and grubbed to the extent necessary before any material is deposited. Stripped topsoil as specified above shall be stockpiled for respreading over the placed spoil at the completion of site earthworks.

On completion of stockpiling, the stockpile site shall be rehabilitated in accordance with the approved Erosion and Sediment Control Plan/Soil and Water Management Plan and/or surface restoration requirements of this Specification.

If suitable disposal areas have not been approved on site, the surplus material shall be immediately disposed to a Council approved site or approved disposal facility. Compliance certificate for that generated surplus material will be required prior to leaving the site. Record of acknowledgement of that disposal is to be also made available to Council immediately after that disposal has been made.

5.3.4 Unsuitable Material

The Service Provider shall make available rollers and other plant for the test rolling of stripped surfaces, natural pavement subgrade and floors of excavations/cuttings in the presence of the Consulting Geotechnical Engineer and Council's Representative or the Accredited Certifier.

Any unsuitable material identified onsite during any stage of the earthworks shall be excavated to the extent recommended by the Consulting Geotechnical Engineer and agreed to by Council's Representative. Material removed may be incorporated into the works elsewhere on the site if that material is approved for its proposed use by the Consulting Geotechnical Engineer or Council's Representative. If the material is not approved for use elsewhere on the site, it shall be removed from the site.

Unsuitable material which is removed from below proposed fill areas or from the face of cuttings shall be replaced with fill material confirmed by the Consulting Geotechnical Engineer and approved by Council's Representative for use as fill material and compacted in accordance with the requirements of this Specification.

Unsuitable material which is removed from below pavement subgrade level shall be replaced with approved select fill material. The material shall be compacted in accordance with the requirements of this Specification for subgrade preparation.

5.3.5 Transitions from Excavation Cuttings to Fill

Following the removal of topsoil and before the excavation of any cutting commences the Service Provider shall survey and mark the position of the intersection line between the excavation cutting and fill embankments occurring at the underside of the pavement.

Following excavation to the excavation cutting floor, a terrace shall be excavated for the width of the pavement to a depth of 600mm below and parallel to the cutting floor as shown in Figure 1 or a distance of 20 metres, whichever is the lesser. Alternatively, the terrace is as directed by the Consulting Geotechnical Engineer.

The terrace shall extend into the cut for a distance as recommended by the Sites Consulting Geotechnical Engineer from the line resulting from the intersection of the planes of the Designed Floor Level and the stripped surface.

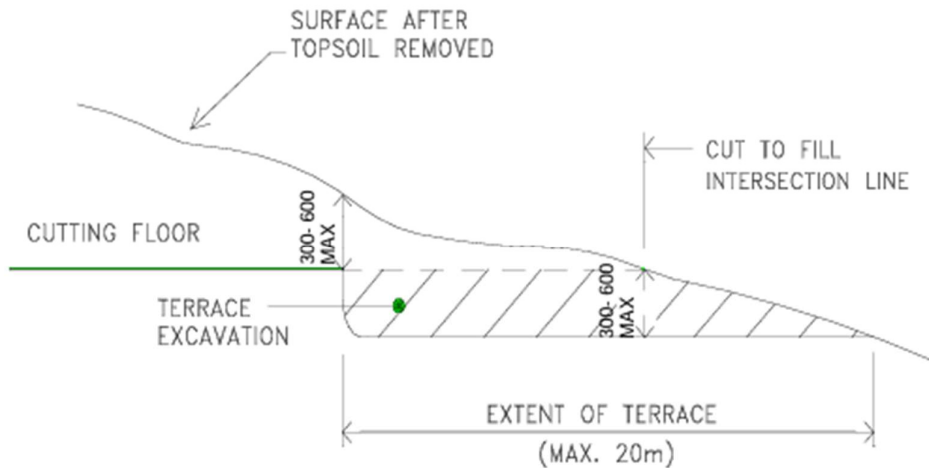


Figure 1: Treatment of Intersection Line between Cutting and Embankment

The material excavated shall be either incorporated in the embankments or spoiled as directed by the Superintendent. Material incorporated in embankments shall be included in the excavated volume for General Earthworks and material spoiled shall be included in the excavated volume of Unsuitable Material to Spoil.

5.3.6 Retaining of Excavated Cuttings

Stability of excavated cuttings shall be designed in accordance with Section 6.2.15 Retaining Wall and Section 6.2.13 Batters of Council's Engineering Guideline – Part 1 Design.

Stability of excavated cuttings shall be ensured by:

- Battering to a maximum of four horizontal to one vertical (4:1) slope angle or as recommended by a qualified Geotechnical Engineer, or
- Installation of a retaining structure as designed by a Qualified Civil or Structural Engineer.

Construction of retaining walls shall be inspected and certified by a Qualified Civil or Structural Engineer who is registered on the National Engineers Register (NER), as meeting the requirements of AS 4678 - Earth-retaining structures. Certificates and reports confirming the compliance of the construction with the design shall be provided to Council's Representative.

When there is no retaining wall design, the Service Provider shall design the retaining wall in accordance with Section 6.2.15 Retaining Walls and Section 6.2.13 Batters of Council's Engineering Guideline – Part 1 Design.

5.4 Earthworks Filling

5.4.1 General

Filling shall not be placed until clearing and stripping of the area has been proof rolled, surveyed to AHD levels, inspected and the suitability of the proposed fill material confirmed by the Consulting Geotechnical Engineer and agreed to by Council's Representative.

Filling shall be placed and compacted to conform to the lines, grades, cross sections and dimensions shown on the drawings and to the requirements of this Specification or other requirements as agreed between Council and the Geotechnical Consultant.

Foundations of shallow fill embankments (depth less than 1m from the top of pavement to the natural surface) shall be inspected and tested by the Consulting Geotechnical Engineer and agreed to by Council's Representative where required to determine if the material meets road subgrade requirements.

Material in the foundations for shallow fill embankments which does not meet the requirements for road subgrade requirements shall be removed and replaced by material of the specified quality as recommended and approved by the Consulting Geotechnical Engineer and agreed to by Council's Representative.

Foundations for shallow embankments shall be prepared for fill embankment construction after removing topsoil and unsuitable material, by loosening the material exposed to a depth of 300mm, adjusting the moisture content of the loosened material and compacting as required by this Specification. The Service Provider shall use equipment and techniques to minimise surface heaving or other foundation damage.

For all other fill embankments, the foundation shall be prepared by grading and levelling the general area, adjusting the moisture content where necessary and compacting the top 200mm as required by this Specification.

Where filling is to be placed on hillsides or against existing fills with slopes which are less than ten horizontal to one vertical (10:1), the slope shall be roughened across the slope to allow placement of filling in layers and to prevent slip failures at the interface.

Where filling is to be placed on hillsides or against existing fills with slopes which are greater than ten horizontal to one (10:1), benching shall be constructed prior to the placement of filling. No fill shall be placed until benching has been inspected and confirmed as suitable by the Consulting Geotechnical Engineer and/or Council's Representative. If fill is placed on a surface with slopes steeper than 4H:1V, bench the surface to form a key for the fill. As each layer of fill is placed, cut the existing ground surface progressively to form a series of horizontal steps greater than 1m in width and greater than 100mm deep. Re-compact the excavated material as part of the filling. Shape to provide free drainage.

Where a lot is to be filled in isolation, the toe of the batter shall merge with the existing surface a minimum of 1m from the adjoining property boundary and within the approved development site unless otherwise approved.

All inspections and testing shall conform to Level 1 inspection and testing of AS 3798 - Guidelines on earthworks for commercial and residential developments.

Aesthetics shall be an important consideration to the finished appearance of earthworks filling.

Service providers are advised to temporarily seal off fill zones by way of compaction by smooth drum in an attempt to lessen the water ingress into the fill zone and encourage water shedding to an appropriately constructed receival point.

5.4.2 Retaining of Fill

Fill shall be retained by either:

- Stabilised batters to slopes recommended and designed by the Consulting Geotechnical Engineer, approved by Council's Representative and accepted by Council's Representative; or

- As shown on the approved Construction Drawings in accordance with the Consulting Geotechnical Engineer's recommendations; or
- By the installation of retaining walls as certified in design and construction by a suitably qualified Civil or Structural Engineer.

Stability of fill shall be ensured by:

- Battering to a maximum of four horizontal to one vertical (4:1) slope angle or as recommended by a qualified Geotechnical Engineer; or
- Installation of a retaining structure as certified in design and construction by a suitably qualified Civil or Structural Engineer.

All completed fill batters shall be inspected and confirmed to have been stabilised in accordance with the recommendations by the Consulting Geotechnical Engineer and approved by Council's Representative.

Construction of retaining walls shall be inspected and certified by a Qualified Civil or Structural Engineer who is registered on the National Engineers Register (NER), as meeting the requirements of AS 4678 - Earth-retaining structures and any other relevant standards, guidelines and best practice requirements. Certificates, inspection records, photos and reports confirming the compliance of the construction with the design shall be provided in accordance with requirements under Appendix A - Work-as-Executed Drawings and Compliance Documentation Requirements.

When there is no retaining wall design, the Service Provider shall design the retaining wall in accordance with Section 6.2.15 Retaining Walls and Section 6.2.13 Batters of Council's Engineering Guideline – Part 1 Design and obtain Works Approval or modification to an issued Subdivision Works Certificate or similar approval prior to commencing construction of the retaining structure.

5.4.2.1 Filling of Verges

Verges shall be finished true to design levels and the surface raked smooth and free of all rubble, stones, sticks or other such matter. Rocks within verges shall be removed to a depth of 100mm below finished surface level and the verge topsoiled with an approved fill such as a clay/loam material containing less than 40% clay. Minimum thickness of topsoil shall be 75mm and a maximum of 200mm. Refer to AS 4419 Soils for landscaping and garden use for topsoil requirements.

Fill containing rock greater than 40mm diameter or clay lumps will not be permitted within 600mm of the finished surface within the verge.

5.4.2.2 Subdivided Lot Filling

All subdivided Lot filling shall be undertaken in accordance with AS 3798 - Guidelines on earthworks for commercial and residential developments.

The Consulting Geotechnical Engineer shall supervise, inspect and carry out all testing and monitoring of lot filling employing a Level 1 inspection and testing regime in order to achieve a desirable lot classification in accordance with AS 2870 - Residential slabs and footings.

Relative compactions requirement will conform to the requirements of **Error! Reference source not found.** Earthworks Relative Compaction Requirements below.

The aforementioned criteria shall apply to all filled lots including lots presenting as a P Classification.

Regardless of the final achievable lot classification, all lot filling shall be compacted to provide ongoing support for ancillary works to buildings and services. This requirement shall be confirmed by the Consulting Geotechnical Engineer and included in the final report.

Road fill batters that extend into lots are considered lot fill under this clause.

A final Geotechnical report including (but not limited to) compaction test certificates, proof rolling verification, lot classifications and recommendations for the future structure minimum foundation requirements required for future buildings of each lot in accordance with AS 2870 - Residential slabs and footings shall be submitted to Council's Representative or the Accredited Certifier prior to the issue of the Subdivision Certificate. This action constitutes a **WITNESS POINT**.

WITNESS POINT

Issue of final Geotechnical report including (but not limited to) compaction test certificates, proof rolling verification, subdivided lot classifications and recommendations for the minimum foundation requirements required for future buildings of each lot in accordance with AS 2870 - Residential slabs and footings.

PROCESS HELD: Subdivided Lot Earthworks conformance and future structure foundation recommendations.

5.4.3 Fill Material – General

All fill material shall be a sound, clean, generally homogenous material, free from large rocks, stumps, organic matter and other undesirable material. All proposed fill material shall require prior approval for its intended use by a Geotechnical Engineer and agreed to by Council's Representative.

Suitable fill materials shall firstly be obtained from excavations on the site. Imported material shall only be used when the site material is of an unsuitable nature for the intended fill or the quantities obtained from the site are not sufficient. The Service Provider shall be required to manage and sort the materials obtained from excavations to ensure that the best available material is used in locations that require higher quality material, such as road embankments.

Rock material shall be broken down and evenly distributed through the fill material. Individual rocks shall not be larger than two thirds of the layer thickness. Sufficient fine material shall be placed around the larger material as it is deposited to fill the voids and to produce dense and adequately compacted filling. Any rocky patches with insufficient fine material to fill the voids shall be reworked with additional fine material being blended.

As a general guide, topsoil fill material is to be placed up to the design finished level to a maximum thickness of 300 mm.

5.4.4 Imported Fill Material

Natural materials imported for filling from an offsite source shall be certified by a qualified Geotechnical Engineer as being Excavated Natural Material (ENM) or Virgin Excavated Natural Material (VENM). Certificates shall be provided to Council's Representative, the Accredited Certifier or any other Authority upon request.

Materials with a resource recovery exemption as issued by the Environmental Protection Authority will also be accepted for imported filling subject to documentation of the exemption being provided to Council's Representative prior to its use and endorsement by the Consulting Geotechnical Engineer that the material is suitable for the proposed purpose.

5.4.5 Approved Fill / Backfill

Approved fill/backfill shall be defined as fill material including sand, soil or broken rock obtained from site excavations or approved borrowed areas remote from site.

Such material shall:

- Have maximum Plasticity Index of 20 in that fraction passing 0.425mm sieve.
- Be free of material greater than 150mm in size.
- Contain less than 2% organic matter.
- Be capable of being brought to a moisture content suitable for compaction as specified elsewhere herein.
- Have a CBR value in excess of 10% when tested in accordance with TfNSW Test Method T117 following a minimum of 10 days soaking and the fraction passing 19mm AS sieve.

Approved fill/backfill material obtained shall only be imported from sites having the necessary development approvals to operate, or from such sites where the Service Provider has approved plans.

Approved imported fill material shall also require approval from the sites geotechnical engineer as being suitable for the purpose intended.

5.4.6 Selected Fill / Backfill

Select fill/backfill shall meet the requirements of approved fill/backfill with the exception that it shall:

- Be free of material greater than 75mm in size.
- Have a CBR value in excess of 20% when tested in accordance with TfNSW Test Method T117.
- Maximum Plasticity Index of 15.

5.4.7 Compaction of Fill Material

Fill material shall be placed and compacted in uniform layers of thickness appropriate to the nature of material and the compaction equipment being used. Layers shall extend for the full width of embankments and shall be placed in horizontal layers. Fill material shall be compacted in a minimum 150mm layer uncompacted thickness. However, greater thicknesses up to 300mm will be permitted subject to the ability of compaction equipment to achieve specified densities in that location.

Each layer shall be compacted to the appropriate density prescribed in this Specification. Where an area is to be planted or ground covered with grass, the top 300mm of the filling shall be compacted to a level not exceeding 95% of the standard maximum dry density.

The moisture content of filling material shall be adjusted by the Service Provider to a level that allows specified densities to be achieved quickly and without excessive effort or compacting of the material. The Service Provider shall seek advice from the Consulting

Geotechnical Engineer in regard to appropriate moisture content for compaction if problems are experienced in achieving the specified densities.

Rain-affected material shall be reworked to provide the required density. Any dispute over the requirement for reworking shall be resolved by demonstration of minimal movement during proof rolling and retesting for density and moisture content.

5.4.8 Backfilling of Structures

No filling shall be placed against concrete bridge abutments, wing walls or retaining walls within 28 days of casting or if the 85% design strength has been achieved, unless advice from the designing and certifying Engineer for the structure otherwise allows. Fill shall be placed and compacted to avoid unbalanced loading or movement of the structure.

Unless otherwise detailed on the approved Construction Drawings, the abutments and wing walls of bridges shall be back filled with a select material in accordance with this Specification. Filling outside this area shall be in accordance with other filling requirements in this Specification.

Material placed adjacent to weepholes must be clean, graded, hard and durable crushed stone or river gravel, wrapped in a geotextile, conforming to the following requirements:

- Maximum particle dimension of 53mm; and
- No more than 5% by mass passes the 9.5mm AS sieve.
- Place and compact filling over and around pipes, culverts, bridges and other structures so as to avoid unbalanced loading or movement.

5.4.9 Geotextiles, Geogrids or Similar

Geotextile fabric, geogrids or the like used in conjunction with filling shall be in accordance with recommendations provided by a Qualified Geotechnical Engineer as shown in associated reports and reflected in the approved drawings and specifications. These recommendations shall include materials specification and placement requirements.

5.5 Road Pavement Subgrades

5.5.1 Subgrade Level

Subgrade level shall be the level that allows the approved design pavement to be constructed on top of the subgrade to achieve the approved finished design levels.

All subgrades shall be compacted, graded and trimmed parallel to the designed surface grade and crossfall. The subgrade shall be trimmed to a level of not more than 0mm above or 50mm below the design subgrade level.

5.5.2 Subgrade Assessment

The sites Geotechnical Engineer or Council's Representative shall inspect all subgrades when earthworks have progressed to a stage where the nature of subgrade material can be assessed. The Sites Geotechnical Engineer shall review the pavement design at this stage and arrange for further CBR and other relevant testing if subgrade conditions do not reflect the subgrade condition that the pavement design was based on. The Sites Geotechnical Engineer shall confirm in a report to be provided to Council's Representative or Accredited Certifier that the subgrade as inspected was suitable for construction of the pavement as designed. If this confirmation cannot be provided, alternatively either further recommendations on the treatment of the subgrade or changes to the pavement design

and/or furnishing of compaction reports/ design level compliance and proof rolls are conducted in conjunction with Council's Representative for acceptance prior to any continuation of the pavement works. Proof rolling of the subgrade layers shall be completed to detect any visual defection in that constructed layer.

Rain affected subgrade material shall be reworked to provide the specified density. Any dispute over the requirement for reworking shall be resolved by demonstration of minimal movement during proof rolling and retesting for density and moisture. No further pavement works shall proceed until rain affected areas have been confirmed suitable by the Consulting Geotechnical Engineer and agreed to by Council's Representative.

5.5.3 Subgrades in Cut

All material in the subgrade surface shall be ripped, loosened and compacted to a minimum depth of 150mm below the design subgrade level for the width of the pavement to 150mm behind back of kerb. The maximum dimension of particles in the ripped or loosened zone shall not exceed 100mm after compaction.

After ripping, loosening and compacting the subgrade shall be trimmed parallel with the finished wearing surface so that their levels do not vary from the designed floor levels by more than the tolerances specified above.

All unsuitable material, as determined by the Consulting Geotechnical Engineer and agreed to by Council's Representative shall be removed and replaced with approved material and compacted to the required density and any specific geotechnical advice arising as a result of onsite investigations and inspections at the time of excavation.

5.5.4 Subgrade Replacement

Subgrade replacement layers shall be placed and compacted to achieve densities and moisture contents specified for subgrades. Materials to be used for subgrade replacement shall be in accordance with the approved pavement design and confirmed as being suitable by the Consulting Geotechnical Engineer and agreed to by Council's Representative.

The completed subgrade or subgrade replacement shall extend a minimum of 150mm behind the rear of the proposed kerb.

The excavation floor or natural surface below subgrade replacement material shall be prepared, compacted and trimmed as specified for subgrades.

5.5.5 Rock Subgrade

Rock at subgrade level shall be thoroughly ripped to a minimum depth of 300mm below the subgrade level or as specified in geotechnical pavement report and shall as a minimum extend to the sides of the formation to provide drainage away from the pavement. Ripped material shall conform to the size requirements described for fill material. Ripped material shall be compacted to form the subgrade construction and present as a tight homogenous surface layer, unless the ripped material is deemed unsuitable for the subgrade. CBR tests may be required on the ripped material should the material be considerably different in nature to the assumed subgrade condition.

5.5.6 Filled Subgrades

Material used in the top 150mm below road pavement subgrade level shall be free of particles larger than 75mm, conforming to the requirement of Select Fill material. Material used from 150mm to 600mm below road pavement subgrades shall be free of particles larger than 150mm, conforming to the requirement of Approved Fill material. Material used

from 600mm to 1.0m below road pavement subgrade shall be free of particles larger than 300mm. In any case, the maximum particle size shall be two thirds of the layer thickness.

Where practicable, avoid placing public utility services in fill zones due to the increased risk of water ingress and subsequent slip failure.

5.5.7 Clay Subgrades

Clay materials, which are moderate to highly expansive, should have a moisture content between 90% and 110% of optimum moisture content for standard compaction when being compacted. To prevent drying out and to limit possible surface heave, clay subgrades shall be covered by the first select fill or pavement layer as soon as practical after compaction and moisture testing has been confirmed.

5.5.8 Unsuitable Subgrade Material

Subgrade materials may be deemed as unsuitable for placement of pavement material over the subgrade surface at any stage up to including the final trimming compacting and compaction testing of the subgrade surface. Subgrades may be deemed unsuitable by the Sites Geotechnical Engineer or Council's Representative. Treatment of the unsuitable subgrade shall be recommended by the Sites Geotechnical Engineer and accepted by Council's Representative.

5.5.9 Services Trenching in Subgrades

Trenches for services shall be excavated when earthworks have reached finished subgrade level unless otherwise approved by Council's Representative. Trench dimensions shall be in accordance with Section 6.3.5 Trench Dimensions, and Section 7 - Utility Services Installation, Road Opening and Utility Restorations of this Specification.

Compaction tests shall be undertaken to confirm that the trench has been compacted to the subgrade compaction requirements.

5.6 Earthworks Drainage

5.6.1 Table Drains

This clause normally applies to non-urban roads or the side of an urban road opposite the kerb and gutter in construction designated Half Width Road Constructions.

Table drains shall be aligned and graded parallel to the shoulders of the roadway and shall be constructed to conform to the requirements of Austroads Guide to Road Design Part 5B: Drainage Open Channels, Culverts and Floodways and particularly Section 2.13.

Unless otherwise shown on the Drawings or directed by the Principal, line open drains with:

- Organic fibre mat and vegetation, where the longitudinal grade of the completed drain is between 1% and 5% inclusive; or
- Concrete, where the longitudinal grade of the completed drain is less than 1% or greater than 5%.

Concrete lining must have a minimum compacted thickness of 100mm measured at right angles to the surface of the lining and must be colour matched with that of its surroundings unless otherwise approved by Council's Representative.

5.6.2 Catch Drains

Catch drains shall be provided at the top of cuttings with:

- A cross section not less than 300mm deep and at least 300mm wide.
- Side slopes not steeper than the batter of adjacent road cutting.
- Minimum 1% grade to ensure a free flow of water.
- Minimum distance of 1m from the edge of cutting, and no further away than necessary to maintain fall for the drain.

The cutting of catch drains shall be carried out before or during excavation for the roadway. Where trees occur in the line of a drain, the drain may be neatly diverted.

Outlet drains shall be provided to direct catch drains into drainage structures or water courses. Outlet drains leading down slopes and batters shall be constructed to minimise scour.

5.6.3 Shoulder Drains

Shoulder drains are provided to drain the subgrade through the shoulder to prevent pavement saturation.

The pavement boxing shall be drained by cutting the shoulder at sags in the longitudinal grade and at locations directed by Council's Representative.

Shoulder drains shall be cut at an angle of 60 degrees with the road centre line on grades steeper than 3% and at right angles to the road centre line on grades up to 3% and shall be of depth equal to the depth of the boxing and 200mm wide and shall be evenly graded to a free outfall. Each drain shall be firmly packed with clean, durable stone of mixed gauges not exceeding 75mm gauge free from material passing a 25mm screen.

5.7 Earthworks Compliance Testing

5.7.1 Compaction Testing Requirements

A Geotechnical Inspection and Testing Authority (GITA) shall be employed by the Service Provider to carry out all testing and inspecting required confirming earthworks compliance with this Specification and any other specification required by the Sites Geotechnical Engineer. A Level 1 Inspection and Testing regime as described in Section 8 of AS 3798 - Guidelines on earthworks for commercial and residential developments is required. The Authority shall hold a current National Association of Testing Authorities (NATA) registration for the relevant tests. All test results certificates/reports shall be forwarded to Council's Representative. Alternatively, the Principal Certifying Authority (PCA) be it either Council or a private individual will conduct the inspections, with the same compliance certification required to be produced by the Service provider.

Copies of the test certificate reports shall clearly describe:

- The date the test was taken.
- The location plan and layer or level of each test.
- The compaction conformance requirement of this Specification.
- If the test is a retest and what test it is a retest of shall be stated.
- All other information as required by NATA.

Compaction compliance requirements for work carried out under Section 5 - Site Clearing and Bulk Earthworks of this Specification are itemised in **Error! Reference source not found.**

A successive layer of earthworks fill shall not be commenced until the underlying layer has proved to be conforming to this Specification as determined by testing and hold point release.

All compaction testing shall be carried out in accordance with the Method of Testing Section of AS 3798 - Guidelines on earthworks for commercial and residential developments. Lot filling shall be in accordance with the Compaction Criteria Section of AS 3798. The Compaction Criteria for all other earthworks shall be in accordance with **Error! Reference source not found.**

The Service Provider shall obtain and provide to Hilltops Councils Representative copies of test certificates, level conformance and any other documentation that may be required to verify that the earthworks performed on that subject lot or area comply with the specified standards. This is also in conjunction with the proof roll test that is to be carried out jointly between the Service provider and Hilltops Councils Representative/s.

Table 1: Earthworks Relative Compaction Requirements

Item	Compaction Requirement - Minimum Relative Compaction	
	Minimum Density Ratio (at standard compaction) (Cohesive Soils)	Minimum Density Index (Cohesionless Soils)
Backfilling of grub holes	95%	70%
Replacement of unsuitable material in cuttings other than subgrades	95%	70%
Replacement of over excavated material	95%	70%
General fill and foundation of embankments	95%	70%
Top 300mm of road embankments or 0 to 300mm below subgrade	100%	75%
Backfill within 2m of structures	100%	75%
	Pavements in accordance with pavement requirements	
Replacement of unsuitable subgrade material	100%	75%

Notes for **Error! Reference source not found.**: At the time of relative density testing moisture contents are to be 60% to 90% of optimum for standard compaction except for

moderately to highly expansive clays which shall be 90% to 110% of optimum for standard compaction.

5.7.2 Proof Rolling of Subgrades

In addition to the required compaction testing, road pavement subgrades shall be proof rolled in the presence of the Geotechnical Consultant, Council's Representative, or the Accredited Certifier.

Proof rolling shall be carried out in accordance with the requirements of Austroads and any additional recommendations made by the Geotechnical Consultant/Councils Representative.

A minimum loaded bogie drive heavy vehicle is to be used (fully laden water cart or tipper fully loaded with weigh bridge ticket) for the proof roll test. The vehicle is to be driven as slow walk pace, with observers placed either side of the vehicle. These observers are to watch for any pavement deflection and rebound as the bogie axle set passes. Suitable marking of surface with paint or other means is to be done to mark the location.

A multi-tyred roller shall be capable of generating sufficient loading as recommended by the Geotechnical Consultant to adequately assess subgrade stability and uniformity if selected.

5.7.3 Earthworks Level Tolerances

Before the placement of covering materials and on completion of cutting, filling and all incidental operations, the finished surfaces shall conform to the tolerances in level and shape as itemised in Table 2.

Testing of earthworks tolerances in terms of levels is to be certified by a Registered Land Surveyor, exemption to this requirement may be provided by Council's Representative. The results of levels taken to confirm level tolerance shall be presented on the work-as-executed drawings.

Testing of earthworks for straightness shall be carried out by the Service Provider in the presence of Council's Representative at a time suitable for Council's Representative to attend the site.

Table 2: Earthworks Level Tolerances

Item	Tolerance
Cut subgrade	Level: 0mm above design and 50mm below design Straightness: 20mm maximum departure from 3m straight edge both ways
Fill subgrade	Level: 0mm above design and 50mm below design Straightness: 20mm maximum departure from 3m straight edge both ways.
Unpaved areas in cut or fill	Level: ± 15 mm in existing road verges Level: ± 25 mm in subdivision road verges Level: ± 100 mm in batters
Subdivision Lot regrade areas	Level: ± 100 mm

5.7.4 Test Method for Compliance

Test methods used for the determination of compaction compliance shall be in accordance Section 7 of AS 3798 - Guidelines on earthworks for commercial and residential developments. Field densities are to be determined by Direct methods. Approval of Indirect methods to determine field densities will be considered following a submission to Council's Representative from the Geotechnical Consultant and/or the Geotechnical Testing and Inspection Authority detailing the use of the method and correlations with backfill materials.

5.7.5 Frequency of Testing

The frequency of testing shall be in accordance with Table 3 below. If Table 3 does not cover a particular situation the Sites Geotechnical Engineer or Council's Representative shall specify the required frequency of testing.

Table 3: Earthworks Methods and Frequency of Testing

Characteristic Analysed	Test Method for Compliance	Frequency of Testing whichever requires the most tests: (minimum of 1 test per isolated area in any case)
Compaction and moisture content of general fill material outside of lot areas	See 5.7.4	1 per layer per 1000m ² or 1 test per 500m ³
Compaction and moisture content of fill on lot areas for depths in excess of 300mm	See 5.7.4	In accordance with Table 8.1 in AS 3798
Compaction and moisture content of fill material in footpaths areas (kerb line to boundary or proposed boundary)	See 5.7.4	1 test per 500m ² per layer or 1 test per 100 linear metres per layer.
Compaction and moisture content of backfill to structures; replacement of unsuitable subgrade; replacement of unsuitable foundation or other confined operations	See 5.7.4	1 test per 100m ³ distributed evenly through-out full depth and area or 1 test every layer
Compaction and moisture content of top layer of fill (subgrade); cut subgrade and foundation of shallow fill	See 5.7.4	1 test per 500m ² or 1 test in first 10 m from intersection and there on per 50 linear metres and 1 test in cul-de-sac trafficable lane.

Characteristic Analysed	Test Method for Compliance	Frequency of Testing whichever requires the most tests: (minimum of 1 test per isolated area in any case)
Compaction and moisture content of foundation for fill embankments other than shallow fill embankments	See 5.7.4	1 test per 2000m ² per layer or 1 test per 200 linear metres
Material properties - CBR of fill and cut subgrade	AS 1289.6.1.1	1 per 800m ² where subgrade does not reflect design assumptions.
Level tolerances of cut and fill batters not associated with roads	Level and co-ordinated position by Registered Land Surveyor	1 full cross section per 50m length. Provide levels at all changes in grade and at intermediate points no more than 5m apart.
Straightness of subdivision road verges	3m straight edge	1 location on the left hand and one 1 on the right-hand side verges every 50m apart 30mm deviation from straight edge
Level tolerances of cut subgrade and fill subgrade	Level and co-ordinated position by Registered Land Surveyor	1 full cross section per approved drawings chainage otherwise 20m maximum linear length. Provide levels at all changes in grade and at intermediate points no more than 3m apart. Maximum 20 mm deviation from straight edge
Compaction requirements of service trenches greater than or equal to 300mm wide in road subgrades	See 5.7.4	1 test per trench 1 test per 200m ³ distributed evenly through-out full depth and area 1 test every two layers per 20 linear metres of trench
Straightness of cut and fill batters	3m straight edge	At 1 location to the left and right of the centre line every 50m apart, both perpendicular and parallel to the centre line. Maximum 40 mm deviation from straight edge
Straightness of subgrade	3m straight edge	1 per 20m road length. Maximum 20mm deviation from straight edge

5.7.6 Determination of the Location of Field Compaction Tests and Field Sampling

For all Earthworks testing the Geotechnical Inspection and Testing Authority (GITA) shall determine the location where sampling and testing will be taken independently of any advice or request by the Service Provider(s) responsible for the earthworks. Any evidence of tests and sampling locations being determined by the GITA in collaboration with the Service Provider(s) responsible for the earthworks shall be deemed as non-complying tests. In this case a new set of tests shall be required to be carried out in locations nominated by Council's Representative.

5.7.7 Non-complying Earthworks and Retesting Requirements

5.7.7.1 General

A non-compliance report shall be submitted to Council's Representative for any non-complying works for which the Service Provider is requesting acceptance. This report shall contain information in support of the request. Work shall not proceed further on any non-complying item until Council's Representative has considered the non-compliance and approved the works to proceed.

5.7.7.2 Non-complying Tolerances

For non-complying tests for straightness, the Service Provider shall immediately rectify the non-compliance and retest the entire area of rework prior to covering up of the subject area.

The Service Provider shall confirm via the Registered Land Surveyor that the levels fall within the compliant tolerances. If the level tolerances are non-compliant, the Service Provider shall rectify the non-compliance and have the Registered Land Surveyor re-level the entire area of rework prior to covering up. All complying levels shall be confirmed on the work-as-executed drawings prepared by the Registered Land Surveyor.

5.7.7.3 Non-complying Relative Compaction Test Results and Retesting Requirements

Where compaction does not comply on the basis of an inspection or test results the Service Provider shall rework the layer tested in an area in accordance with the following:

- Subdivision Lot Fill

Rework and retest as required by the Sites Geotechnical Engineer and/or the Geotechnical Inspection and Testing Authority (GITA).

- General fill (outside lot (of work) areas)

An area of 1,000m² evenly surrounding the failed test location shall be reworked. A retest in the failed test location plus an additional test in the rework area will be required.

- Verge area fill

Rework 25m either side of the failed test location for the full width of the kerb to boundary or proposed boundary. A retest in the failed test location plus an additional test in the rework area will be required.

- Backfill to structures, isolated replacement of unsuitable subgrade, replacement of unsuitable foundation or other confined operations.

Rework total area. One retest anywhere in the reworked area.

- Top layer of subgrade (cut or fill) and foundation of shallow fill (<1m)

Rework 25m either side of failed test location for the full width of the subgrade or 500m² surrounding the failed test location in the case of shallow fill foundation. A retest in the failed test location plus an additional test in the rework area will be required.

- Foundations for fill embankments other than shallow fill embankments

An area of 2,000m² evenly surrounding the failed test location shall be reworked. A retest in the failed test location plus an additional test in the rework area will be required.

Areas shall not be accepted as complying for compaction until the test results from the retests and additional tests required above confirm compliance.

5.7.7.4 Compliance Documentation for Earthworks

The Service Provider shall obtain and provide to Hilltops Councils Representative copies of test certificates, level conformance and any other documentation that may be required to verify that the earthworks performed on that subject lot or area comply with the approved design and specified standards. This also includes satisfactory completion of the proof roll test that is to be carried out jointly between the Service provider and Hilltops Councils Representative/s. These actions constitute a **HOLD POINT**.

HOLD POINT

Provision of satisfactory test certificates, joint witnessed proof roll test, level conformance and other related documentation for earthworks.

PROCESS HELD: Earthworks construction.

6 Stormwater and Subsurface Drainage Construction

6.1 General

Works covered by this section of the Specification include construction of all piped and box culvert stormwater drainage and subsurface drainage. The construction of open earth drains and retention basins shall be in accordance with the requirements for earthworks in Section 3 - Site clearing and bulk earthworks.

6.2 Acceptable Materials for Stormwater Pipes and Box Culverts

6.2.1 General

All stormwater drainage conduits that are to become Council's asset following completion of the works shall be any of the following:

- Reinforced concrete pipe (RCP) minimum 375mm diameter class 4 minimum within trafficable areas and street verges with rubber ring joints.
- Reinforced concrete pipe (RCP) minimum 375mm diameter class 2 minimum rubber ring joints within non traffic able areas and drain roads via interallotment drainage to outlet.
- Precast reinforced concrete box culverts (RCBC) minimum 600mm x 300mm internal dimensions with cast in-situ or precast (preferred) base slabs.

Fully cast in-situ box culverts may be approved for construction. Full construction specification and details shall be provided on the Construction Drawings and approved by Council's Representative.

Conduit systems that are not to become Council's responsibility for maintenance, including interallotment stormwater drainage only (does not convey/drain any stormwater water from roadways) shall be:

- RCP of any size with rubber ring joints.
- Polyvinyl chloride (PVC) pipes maximum 300mm diameter.
- Interallotment pipe to be rubber ring jointed.
- Polypropylene pipes (PP) or high-density polyethylene (HDPE) pipes maximum 600mm diameter with rubber ring joints.
- Reinforced concrete box culverts.

All stormwater conduits located in areas subject to frequent saturation or prolonged submergence, such as pits, culvert inlets and outlets, detention basins, or drainage channels, shall be constructed using materials with a high durability classification suitable for long-term exposure to moisture, aggressive soils, and fluctuating groundwater conditions.

In the Hilltops Council area, consideration shall be given to soil aggressivity, water quality, and potential chemical exposure (e.g. fertilisers, road run-off, or effluent-affected flows) when selecting materials.

Materials shall comply with the relevant Austroads and Australian Standard requirements for durability, ensuring performance over the intended design life.

6.2.2 Pipes

RCPs shall comply with the requirements of AS 4058 - Precast concrete pipes. RCPs shall be of the class detailed on the approved drawings.

PVC pipes shall comply with the requirements of AS 1260 - PVC-U pipes and fittings for drain, waste and vent application and AS 1254 - PVC-U pipes and fittings for stormwater or surface water applications as applicable. 100mm diameter PVC pipes shall be Class SN6 to AS 1260, solid walled, solvent welded. PVC pipes larger than 100mm diameter shall be Class SN8.

Polypropylene pipes (PP) shall comply with the requirements of AS 5065 - Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.

Use of rubber ring joints with all pipes shall comply with the requirements of AS 1646 - Elastomeric seals for waterworks purposes.

Cutting of pipes on site shall only be carried out by a method that is specified or acceptable to the manufacturer and Council's Representative.

All pipes delivered to site are to be inspected for but not limited to flaws, breakages and correct size/grade for the purpose intended. Those pipes with detected breaks/flaws are to be placed to one side and not used for the project. The action constitutes a **HOLD POINT**.

HOLD POINT

Inspection of all pipes delivered to site for, but not limited to, flaws, breakages and correct size/grade for the purpose intended.

PROCESS HELD: Precast concrete pipe supply and delivery.

6.2.3 Precast Reinforced or Unreinforced Concrete Pits and Headwalls

Precast reinforced or non-reinforced concrete pits shall comply with the requirements of AS 3850 - Prefabricated Concrete Elements, AS 3996 – Access Covers and Grates, AS 3600 – Concrete Structures, AS/NZS, 4671 – Steel Reinforcing Materials.

Any penetrations required in precast pits units or headwalls required to connect stormwater drainage pipes shall be provided in the precast unit either at the time of manufacture or design as allowable knock outs. Any modifications or penetrations required to pits that differ to these two scenarios shall be approved and certified by the manufacturer. The certification shall state that the design adequacy of the precast unit will not be affected in any way by the modification.

The pit/headwall shall be designed for the intended traffic loading expected about its location. Drainage pits commonly comply with AS/NZS plumbing codes, while covers must adhere to AS3996 load ratings based on location (e.g., Class B to D for traffic). Certification of all pits shall be made prior to installation. Any pits found without certification may be removed from site at the discretion of the Hilltops Council Representative.

All pits and headwalls delivered to site are to be inspected for but not limited to flaws, breakages and correct size/grade for the purpose intended. Those pits with detected

breaks/flaws are to be placed to one side and a suitable directive issued for either to make good or not used for the project. The action constitutes a **HOLD POINT**.

HOLD POINT

Inspection of all pits and headwalls delivered to site for, but not limited to, flaws, breakages and correct size/grade for the purpose intended.

PROCESS HELD: Precast concrete pit supply and delivery.

6.2.4 Precast Reinforced Concrete Box Culverts

Precast reinforced concrete box culverts (RCBC) shall comply with the requirements of AS 1597 - Precast reinforced concrete box culverts.

Starter bars, where required, shall be cast into or set into units with an epoxy binder specifically made for this purpose where specified on the approved Construction Drawings.

Any penetrations required in precast RCBC units required to connect stormwater drainage pipes shall be provided in the precast unit at the time of manufacture. Any modifications or penetrations required to box culvert units after delivery to site shall be approved and certified by the manufacturer. The certification shall state that the design adequacy of the precast unit will not be affected in any way by the modification.

All box culvert and headwall sections delivered to site are to be inspected for but not limited to flaws, breakages and correct size/grade for the purpose intended. Those sections with detected breaks/flaws are to be placed to one side a suitable directive issued for either make good or rejection and not used for the project. The action constitutes a **HOLD POINT**.

HOLD POINT

Inspection of all box culvert sections including headwalls delivered to site for, but not limited to, flaws, breakages and correct size/grade for the purpose intended.

PROCESS HELD: Precast Reinforced Box Culvert supply and delivery.

6.2.5 Compliance Documentation for Supplied Precast Pipes and Box Culverts

The Service Provider shall obtain and provide to Hilltops Councils Representative copies of test certificates and any other documentation that may be required to verify that the supplied stormwater pipe, pits and/or box culverts comply with the specified standards. This action constitutes a **WITNESS POINT**.

WITNESS POINT

Provision of test certificates and other related documentation for pipe/pit/box culverts.

PROCESS HELD: Precast concrete unit supply.

6.2.6 Pits Constructed In-situ

Pits constructed in-situ shall be noted on the approved drawings, with related certification provided by a Structural Engineer.

6.3 Trench Excavation and Bedding**6.3.1 General**

All conduits shall be laid in trench conditions except where otherwise specifically shown on the approved drawing. This may require the completion of filling earthworks in the area of the trench prior to trench excavation. The requirement to complete filling to finished surface levels or road pavement subgrade level may be relaxed with the approval of Council's Representative where conduits are located in deep fill embankments.

Pipes, if shown on the approved drawings, shall be laid under embankment conditions and laid in accordance with full details to be provided by the designing Engineer or a suitably qualified Engineer engaged by the Service Provider. The details shall be submitted to Council's Representative for acceptance prior to construction.

The Service Provider shall set out the trench alignment clearly marking the specified end points, changes in directions and pit locations with pegs and stakes. The depth to invert shall be clearly marked on the stakes for all stormwater drainage construction.

All trench alignments shall be cleared and/or stripped of topsoil prior to commencing trench excavation in accordance with Section 5 - Site Clearing and Bulk Earthworks.

6.3.2 Trenches across Road Reserves

Where it is necessary to construct drainage across road reserves refer to Section 7 - Utility Services Installation, Road Opening and Utility Restorations of this Specification.

Where final surfacing of the trench will not be carried out immediately following backfilling, a temporary surface consisting of cold mix asphaltic concrete shall be installed and maintained in a trafficable and safe condition by the Service Provider until final surfacing can be installed. As a minimum, temporary cold mix asphalt surfacing shall be installed to form a slight raised hump to allow for compaction by traffic. The Service Provider shall monitor the performance of the cold mix installed and if the surface level of the cold mix compacts to create a step of more than 20mm to the top of the existing pavement level the Service Provider shall add more cold mix as appropriate.

Final surfacing shall overlap existing pavement material by a minimum of 300mm either side of the trench wall. The line where the new surfacing matches an existing surfacing shall be saw cut parallel to the line of the trench.

6.3.3 Trench Floors

Trenches shall be excavated to the depths and widths specified to allow installation of conduits, pipes or box culverts with adequate embedment with allowance for thrust blocks to the line, levels, grade, and cover specified on the approved drawings. A uniform fall to the discharging end of the pipelines or box culverts shall be achieved in the trench floor.

Unsuitable material which includes soft soils, irregular or fragmented rock and saturated soil, shall be removed from the trench invert and replaced with compacted granular material to provide uniform support.

Where rock is encountered for the full formation area it shall be neatly excavated to the underside of the bedding material.

Where rock is found in an isolated section of trench floor it shall be removed and replaced with compacted granular material to a depth of 150mm - 300mm below the base of the bedding layer.

Over excavation or uneven surfaces in rock foundations shall be corrected with mass concrete to provide a uniform surface at least 50mm above the highest points of rock.

Where pipes are to be laid directly on trench floor and for pipes with sockets or flanges protruding beyond the barrel outside surface, chases shall be cut into the bed of the foundation as necessary, in the appropriate positions, so that each pipe is supported along the full length of the barrel and the socket is not subjected to point loading. Same shall be done for appurtenances where all additional protrusion below the plane of the pipe barrel shall be accounted for in preparing the bed to minimise point loading along the pipeline.

For all box culverts, the trench floor or foundation shall be inspected by Council's Representative and where considered necessary the Sites Geotechnical Engineer shall confirm that adequate bearing capacity exists for support of the box culvert structure. The Consulting Geotechnical Engineer's confirmation of adequate bearing capacity shall be documented in a report and submitted to the Council's Representative.

The foundations shall be compacted so that the relative compaction as determined by TfNSW Test Method T166 Relative Compaction of Road Construction Materials is not less than 95% for standard compaction effort.

Inspection of pipe trench prior to lay shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the prepared trench ready to take pipework according to design and specification.

PROCESS HELD: Pipeline trench construction.

6.3.4 Surface Restoration

Where the excavation of trenching has removed and/or disturbed an existing surface, that surface shall be reinstated with new materials to the requirements of Section 7 - Utility

Services Installation, Road Opening and Utility Restorations and Section 15 - Restoration and Finishing of Surfaces.

6.3.5 Trench Dimensions

Trench dimensions and conditions for pipe, conduit or box culvert installation shall generally be in accordance with the current versions of:

- AS 3725 - Design for installation of buried concrete pipes.
- AS 2566 - Buried flexible pipelines.
- AS 2032 - Installation of PVC pipe systems.
- AS 1597 - Precast reinforced concrete box culverts.
- WSA 02-2014-3.3 – Gravity Sewerage Code of Australia Regional NSW Edition Version 1.1.
- WSA 03-2011-3.3 – Water Supply Code of Australia Regional NSW Edition Version 1.1.
- WSA 07-2007 – Pressure Sewerage Code of Australia.
- Council's Engineering Guideline - Standard Drawings.

The standard width of trenches for subsurface drainage shall be 300mm.

The width of trenches for curved pipelines shall be adequate to allow correct jointing of rubber ring jointed pipes while providing the minimum clearances from the pipe to the trench walls as required by the above standards.

For box culverts the trench width shall be the width of the culvert base slab plus 150mm minimum each side.

Trench excavation shall include the required depth to achieve minimum bedding thickness.

6.3.6 Pipe Cover

Pipes of the type and class shown on the approved drawings shall be used and laid to the invert levels as shown on those drawings except where the design invert level nominated on the drawings does not provide sufficient cover for either the class of pipe being used or to enable works above the pipe to be completed without encroachment of the pipe into those works. Should this occur, the pipes shall not be laid, and the contractor Service Provider shall seek clarification or further advice from Council's Representative.

The cover provided at property access should where possible meeting the requirements as specified above, but a reduction in the cover may be acceptable following approval from Council's Representative.

The requirements of AS 3725 - Design for installation of buried concrete pipes shall be satisfied for cover, load, pipe class and bedding in relation to reinforced concrete (RC) pipes.

Cover for all other pipe types shall be in accordance with WSA 02-2014-3.3 for gravity sewer, WSA-03-2011-3.3 for water, WSA-07-2007-1.1 for low pressure sewer to be applied in conjunction with the requirements of AS 2566 - Buried flexible pipelines or AS 2032 - Installation of PVC pipe systems. In any case the standard or the requirement providing the largest cover shall be used.

TfNSW has specific requirements for stormwater drainage systems within their road network - refer to TfNSW QA Specification R11 Stormwater Drainage for further details.

6.3.7 Protection and Drainage of Works

The Service Provider shall provide for the diversion and control of stormwater during construction of stormwater drainage. Where trenches cannot be drained by gravity, the Service Provider shall provide pumping equipment to keep the excavation dewatered and the discharge shall be located and controlled so as not to cause erosion or damage to the environment.

Concurrence of Council's Representative is required for the construction of any temporary damming or diversions of watercourses or drains entering or passing through the works site. Council's Representative may require the submission of a Geotechnical Engineer's design or limit the period that the temporary dam or diversion may stay in place and impose other conditions or requirements relevant to the particular case. Approvals from other Authorities may also be required.

Where compaction of backfill is required and the trench has been externally dewatered, the dewatering equipment shall remain operating until the compaction of the trench backfill has been completed.

If any material in the trench excavation has been damaged by water, it shall be removed and replaced with suitable backfill material. If any excavated material has been excessively moistened by uncontrolled inflowing water, or has been contaminated, the material shall be removed from the work site and replaced with suitable backfill material.

Water in trenches shall be lowered to the bottom of the trench during bedding, pipe laying and backfilling operations to allow the foundation, bedding and backfilling material to be compacted to the specified relative compaction. Where required, a dewatering system shall be created at the lowest point of a continuous trench in a sump during these processes to meet the specified requirements.

6.4 Trench Material

6.4.1 Bedding, Haunch, Side Zone and Backfill Material

Unless otherwise indicated by this Specification, bedding, haunch, side zone and other backfill materials shall be in accordance with the following applicable Australian Standards and codes:

- AS 3725 - Design for installation of buried concrete pipes.
- AS 2566.1 - Buried flexible pipelines - Structural design.
- AS 2566.2 - Buried flexible pipelines - Installation.
- AS 2032 - Installation of PVC pipe systems.
- AS 1597.1 - Precast reinforced concrete box culverts.
- Small culverts (not exceeding 1200mm span and 1200mm height).
- AS 1597.2 - Precast reinforced concrete box culverts - Large culverts (exceeding 1200mm span or 1200mm height and up to and including 4200mm span and 4200mm height).
- WSA 02 – Sewerage Code of Australia - SEW-1201 Embedment & trench fill typical arrangement.
- WSA 03 – Water Supply Code of Australia - WAT-1201 Embedment & trench fill typical arrangement.

- WSA 07 – Pressure Sewerage Code of Australia – Section 19 & 20.

Recycled materials may be used, provided they meet the requirements of the relevant standards and specifications. The Service Provider shall obtain sample coarse particle size distributions from the manufacturer which is representative of the material to be used on site and submit them to Council's Representative for approval prior to use.

Refer to the IPWEA Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010 for further information; and TfNSW QA Specification 3154 Granulated Glass Aggregate and TfNSW QA Specification 3580 Aggregate Filter Materials for Subsurface Drainage for the applicable material and subsurface application requirements.

6.4.2 Compliance Testing for Bedding, Haunch and Side Zone Material

Test results (not more than 3 months old) provided by the suppliers of bedding, haunch, side zone material and other backfill materials shall be supplied by the Service Provider and submitted to Council's Representative prior to delivery of the material to site. Where the in-situ material may be considered suitable for use as embedment, the Service Provider shall organise for the test to be carried out by NATA Accredited specialist under Council's supervision. Council's Representative may request further testing in accordance with Table 4 on material delivered to site to confirm compliance of the delivered material. All test results shall be submitted to Council's Representative.

Table 4: Stormwater Trench Bedding and Backfill Material Testing

Characteristic Analysed	Test Method	Minimum Frequency of Testing
Backfill Material Grading	AS 1289.3.6.1	1 per 200m ³ or part thereof for bedding, haunch and side zone material.
Backfill Material Plasticity	AS 1289.3.3.1	1 per 200m ³ or part thereof for bedding and haunch zone material.

AS 1289.3.6.1 - Methods of testing soils for engineering purposes - Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving.

AS 1289.3.3.1 - Methods of testing soils for engineering purposes - Soil classification tests - Calculation of the plasticity index of a soil.

Provision of test certificates of bedding, haunch side zone and other back fill materials shall constitute a **WITNESS POINT**.

WITNESS POINT

Test results (not more than 3 months old) provided by the suppliers of bedding, haunch, side zone material and other backfill materials shall be supplied by the Service Provider and submitted to Council's Representative prior to delivery of the material to site.

PROCESS HELD: Material certification backfill.

6.4.3 Non-complying Test Results for Bedding, Haunch and Side Zone Material

6.4.3.1 General

A non-compliance report shall be submitted to Council's Representative for any non-complying works that the Service Provider is requesting acceptance of. This report shall contain information in support of the request. Work shall not proceed further on any non-complying item until Council's Representative has considered the non-compliance and approved the works to proceed.

6.4.3.2 Non-complying Material Test Results

In any case where material grading and plasticity does not comply on the basis of test results the Services Provider shall remove the non-complying material from the site or use it elsewhere on the site as general fill. Council's Representative may request further testing on material to confirm the extent of non-compliance.

6.5 Bedding

Pipe bedding shall not be placed if the trench foundations do not have suitable bearing capacity. The Service Provider shall confirm the suitability of foundation material from the Sites Geotechnical Engineer or Council's Representative.

Bedding material shall comply with the grading in Table 5.

Table 5: Bedding Material Criteria

Sieve Size (mm)	Mass Passing (%)
19.0	100
2.36	100 - 50
0.6	90 - 20
0.3	60 - 10
0.15	25 - 0
0.075	10 - 0

Any material passing the 0.075mm sieve shall have low plasticity as described in Appendix A of AS 1726 - Geotechnical site investigations.

Bedding and backfilling of Buried Flexible Pipelines and PVC Pipe Systems shall be carried out in accordance with AS 2566 - Buried flexible pipelines and AS 2032 - Installation of PVC pipe systems respectively unless the Utility Authority that will take over the pipe or conduit as their asset specifies other backfilling requirements.

Bedding and backfilling of box culverts shall be in accordance with the requirements of AS 1597 - Precast reinforced concrete box culverts. Material within 1m of road pavement subgrade levels shall be compacted to road pavement subgrade compaction requirements described in Section 5- Site Clearing and Bulk Earthworks of this Specification.

Bedding and backfilling of reinforced concrete pipes or fibre-reinforced concrete pipes shall be in accordance with the requirements of AS 3725 - Design for installation of buried concrete pipes. Pipe class shall be calculated assuming a HS support condition for pipes under road pavements and for pipes not under a road pavement, except that all pipe backfill consisting of granular material complying to the requirements for Select Fill in Side Zones in accordance with AS 3725 shall be provided to at least 150mm above the top of the pipeline or in the case of a pipe laid below a road pavement the material shall extend to the pavement subgrade level.

The bedding material shall extend over the full width of the trench and shall be compacted by tamping, rolling and/or vibration to a minimum standard compaction of 90% of maximum dry density under non trafficable areas and minimum standard compaction of 95% of maximum dry density under trafficable area in accordance with AS 2566.

The bed level shall be graded to provide for a uniform fall to the discharging end of the pipeline, with line and level as shown on the approved drawings.

For pipes with sockets or flanges protruding beyond the barrel outside surface, chases shall be dug into the bed and foundation, if necessary, in the appropriate positions so that each pipe is supported along the full length of the barrel and the socket is not subjected to point loading. Same shall be done for appurtenances where all additional protrusion below the plane of the pipe barrel shall be accounted for in preparing the bed to minimise point loading along the pipeline

6.6 Laying and Jointing of Pipes, Conduits and Installation of Box Culverts

6.6.1 Pipes

Laying and jointing of all pipe types shall be in accordance with the manufacturers' recommendations. Failure to follow manufacturer's recommendations will result in the pipeline being deemed non-compliant.

Unless otherwise specified, commence laying pipes at the outlet end and proceed upstream.

Pipes shall be laid and jointed to the lines, grades and levels shown on the approved drawings. Pipe barrels shall bear uniformly on the prepared bedding over their full length. Pipelines shall be cleaned of debris and obstructions as laying and jointing proceeds.

The design levels or alignment for stormwater drainage culverts shall not be varied without the approval of Council's Representative.

Pipes shall be laid in straight lines between pits/headwall and on a uniform vertical grade such that no ponding of water occurs unless otherwise shown on the approved drawings.

For pipe laying tolerances, refer to Section 6.6.4 Construction Tolerances.

Where shown on the approved Construction Drawings stormwater pipes shall be laid to a curved alignment, concentric with the curved line. For curved pipelines, the minimum radius achieved by pulling joints shall be in accordance with the manufacturer's recommendations. When splayed pipes are used the splays shall be factory formed.

Rubber ring joints shall be fitted in the manner described by the manufacturer with socket facing upstream.

Materials and jointing requirements for PVC pipes shall be in accordance with AS 2032 - Installation of PVC pipe systems.

Deflections at rubber ring joints on PVC pipes are only permitted to the limit set by the manufacturer. In any case jointing shall comply with the manufacturer's recommendations.

All constructed pipelines shall be cleaned of foreign matter, soil and construction materials prior to inspection. Soil and debris arising from cleaning the pipes shall not be transferred to the existing downstream drainage system until the stormwater system has passed the final inspection.

Lifting holes in pipes shall be fitted with purpose manufactured plugs before commencing backfilling.

At the discharge end of pipes terminating at gully pits, standard pits or headwalls a 5m length of 100mm diameter subsurface pipe shall be laid in the bottom of the trench discharging through the wall of the gully pit or headwall at 50mm above the invert level of the drainage pipe. The subsurface pipe shall be enclosed in a seamless tubular filter fabric and the subsurface pipe shall be sealed at the upstream end. When the discharging pipe is 1200mm diameter or larger, two 3m lengths of subsurface pipe shall be provided.

All pipes are to be soundly grouted externally and internally about the pit/headwall penetration with a sand/cement mix.

6.6.2 Box Culverts

Reinforced concrete cast in-situ base slabs and walls (if applicable) shall be constructed in accordance with the structural details and specification shown on the approved Construction Drawings. Should cast in-situ base slab and/or wall details not be shown on the approved drawings the Service Provider shall engage the services of a qualified Structural Engineer to provide the required drawing details and specification. The details and specification shall be accepted by Council's Representative prior to base slab construction.

Precast Crown and floor slabs may be acceptable to Councils Representative, Crown Units to be designed to AS 1597.2 - Precast reinforced concrete box culverts - large culverts and precast floor slabs designed by a qualified structural engineer.

Concrete for cast in-situ box culvert elements shall not be poured until the reinforcement and formwork has been inspected and approved by the Structural Engineer and accepted by Council's Representative. A certification report shall be prepared by the Structural Engineer. This report shall confirm the construction of all cast in-situ elements is in accordance with the design requirements. A copy of this report shall be provided to Council's Representative.

Precast box culvert crown units are not to be placed on the base slab until it has cured for a minimum of 14 days and all formwork removed. This requirement shall only be changed at the request of the Structural Engineer and with approval of Council's Representative.

Precast box culvert units shall be installed in accordance with the requirements of AS 1597.1 Precast reinforced concrete box culverts - small culverts and AS 1597.2 - Precast reinforced concrete box culverts - large culverts and the following additional requirements:

- All mortar joints shall be protected from the sun and cured in an approved manner for a minimum of 48 hours.
- External crown unit cell joints shall be covered with a centrally located strip of approved bituminous impregnated fibre material a minimum of 200mm in width which shall be adequately bonded to the box culverts.
- Precast base unit slab joints shall be placed on a strip of geotextile A44 or equivalent with a minimum of 250mm lap to each unit. Once base units are in place, the geotextile fabric is wrapped up the base slab side and placed under the outermost crown unit legs to ensure no infiltration of surrounding soil or sand through the joint.

- Staggering of precast base slabs with units encouraged to assist over all structure alignment.
- Alternative grouting alternatives can be submitted to Councils representative for consideration.
- All lifting hooks shall be removed, and exposed steel treated with an epoxy sealant.
- Construction vehicles and plant shall not place load on the box culvert until 28 days after casting of the base slab unless otherwise specified by the Structural Engineer responsible for the design and certification of the base slab.

6.6.3 Connection of Stormwater Pipe or Box Culverts to Existing Structures

Where stormwater drainage conduits are shown to be connected to existing junction pits, inlet pits or other box culverts and details of the connection are not provided on the approved Construction Drawings, the existing structure shall be cored where possible or otherwise saw cut and walls broken out to the minimum extent necessary. The area of the breakout or coring shall be reinstated to the satisfaction of Council's Representative.

If more than one wall of an existing stormwater pit is required to be broken out or cored, then the entire pit shall be reconstructed unless otherwise approved by Council's Representative.

6.6.4 Construction Tolerances

Stormwater Pipelines and Box Culverts shall be constructed within the tolerances shown in Table 6.

Table 6: Construction Tolerances for Stormwater Drainage Lines

Grade Line (vertical alignment)	Tolerance (per pipe length or part thereof deviation from the design grade line level)
Less than 1%	± 10mm
1.01 to 4.0%	± 15mm
4.01% to 7%	± 20mm
7.01% upwards	± 25mm
Horizontal alignment	± 50mm

Notwithstanding the above vertical tolerances, each length shall fall in the direction of the design grade line. No adverse grades shall be permitted on any section of the pipeline or box culvert.

Notwithstanding the above horizontal tolerances, where pipe joints are pulled to suit curved kerb alignments, the maximum deflection recommended by the manufacturer shall not be exceeded.

Construction tolerances shall be demonstrated by work-as-executed levels and positions confirmed on site by a Registered Land Surveyor and shown on the work-as-executed

drawings. Refer to Appendix A - Work-as-Executed Drawings and Compliance Documentation Requirements for details.

6.6.5 Compliance Inspections and Documentation

Compliance with Sections 6.2 to 6.6 of this Specification will be demonstrated by:

- Observations made during site inspections by the Council's Representatives during the installation of pipes, box culverts and conduits.
- Work-as-executed information confirming compliance with level and position tolerances.
- Provision of Structural Engineer's certification where applicable.
- Condition assessment and reporting of the sewer and stormwater network including access/maintenance chambers to be carried out in accordance with the latest version of WSA 05 - Conduit Inspection Reporting Code.
- Provision of the results of testing as specified.

All documentation demonstrating compliance shall be provided to Council's Representative prior to the final inspection.

6.7 Backfilling

Under this section of the Specification, backfilling is the remainder of filling in the trench above the bedding to finished surface level or pavement subgrade level.

Backfilling shall be carried out in a manner which shall not cause damage to or move the pipes or box culverts.

6.7.1 Pavement Areas

Where pipes are laid under road pavement or kerb and gutter, backfill shall extend from the top of the bed zone up to pavement subgrade level and shall be fill material complying with the requirements shown in Table 5 Bedding Material Criteria for the bed zone.

The material shall be placed over the full width of the trench in layers not exceeding 150mm compacted thickness and compacted by vibration to achieve a minimum standard compaction of 95% of its maximum dry density. The top 200mm shall be compacted to achieve a minimum standard compaction of 98% of its maximum dry density or as specified in **Error! Reference source not found.** Earthworks Relative Compaction Requirements.

6.7.2 Paths, Easements and Reserves

Where pipes are laid in areas not subject to vehicular loading, backfilling of reinforced concrete pipes or fibre-reinforced concrete pipes shall be in accordance with the requirements of AS 3725 - Design for installation of buried concrete pipes for a minimum H2 support condition. The backfill shall extend from the top of bed zone up to the designed surface level less any allowances for landscaping. Backfill material shall consist of fill material complying with the requirements for bed zone material placed to a level half way up the pipe barrel and compacted to achieve a minimum standard compaction of 90% of maximum dry density. The remainder of the backfill shall consist of Imported Fill/Backfill as specified Section 5.4.4 Imported Fill Material Compacted to Achieve 95% Standard Relative Compaction Refilling of sheeted trenches shall be carried out to the following requirements:

- No struts, walling or other supports shall be removed until the top of compacted refilling has reached the level of these supports.

- No wall sheeting shall be totally removed from the trench until the level of the compacted refill is within 1.5m of the surface.
- No wall sheeting shall be removed, in dewatered trenches, until the level in water table between natural ground and refill material is less than 500mm.
- The wall sheeting shall be withdrawn or removed in such a manner that the pipe and compacted bed and haunch support are not disturbed during such withdrawal or removal.

Bedding and backfilling of box culverts shall be in accordance with the requirements of AS 1597 - Precast reinforced concrete box culverts. Material within 1m of road pavement subgrade levels shall be compacted to road pavement subgrade compaction requirements described in Section 5 - Site Clearing and Bulk Earthworks of this Specification.

6.8 Trench Backfilling Compliance Testing

6.8.1 Compaction Testing Requirements

A Site Geotechnical Engineer shall be employed by the Service Provider to carry out all testing and inspections required to ensure backfilling compaction and material grading comply with this Specification. All samples shall be tested by a National Association of Testing Authorities (NATA) Registered Laboratory. All test results certificates/reports shall be forwarded to Council's Representative.

Copies of the test certificate/reports shall clearly describe:

- The date the test was taken.
- The location and layer or level of each test.
- The compaction conformance requirement of this Specification.
- If the test is a retest and what test it is a retest of.
- All other information as required by NATA.

Compaction conformance requirements for work carried out under Section 6 - Stormwater and Subsurface Drainage Construction of this Specification are itemised in Table 7.

A successive layer of trench backfill shall not be placed until the underlying layer has been proven to be conforming to this Specification as determined by testing. If the Service Provider decides to place successive layers and the underlying layer does not conform to the compaction criteria all successive layers or work above the non-conforming layer shall be removed and the non-complying layer reworked and retested.

Table 7: Trench Bedding and Backfill Relative Compaction Requirements

Item	Compaction Requirement (Minimum Relative Compaction)	
	Minimum Density Ratio (at standard compaction) (Cohesive Soils)	Minimum Density Index (Cohesionless Soils)
Box culvert bedding	95%	70%
All other bedding, haunch zones, side zones	In accordance with: AS 3725, AS 2566, AS 2032 and AS 1597.1 or AS 1597.2	
150mm above pipe to 150mm below subgrade level under pavement areas	95%	70%
Within 150mm road subgrade under pavement areas	100%	75%
Backfill using site excavated material or suitable imported material from 150mm above the pipe to finished surface level not under a road pavement	95%	70%

AS 3725 - Design for installation of buried concrete pipes

AS 2566 - Electric resistance welded steel air heater tubes

AS 2032 - Installation of PVC pipe systems

AS 1597.1 - Precast reinforced concrete box culverts - small culverts

AS 1597.2 - Precast reinforced concrete box culverts - large culverts

6.8.2 Test Method for Compliance

Test methods used for the determination of compaction compliance shall be in accordance with Section 8 of AS 3725 - Design for installation of buried concrete pipes and AS 1289 - Methods of testing soils for engineering purposes. Field densities shall be determined by Direct methods. Approval of Indirect methods to determine field densities will be considered following a submission to Council's Representative from the Consulting Geotechnical Engineer detailing the use of the method and correlations with backfill materials. In the case of penetrometer testing being used as an Indirect method of testing the frequency of testing shall be as described below.

The specified testing shall be taken at random test locations established in each trench in accordance with the specified minimum testing frequency stipulated in Table 8. Prior to testing the Service Provider shall work the trench foundation, bedding or backfill to ensure uniform moisture content and compaction of all material within the trench.

Compaction testing of the bedding layer may not be required provided the Service Provider has demonstrated that bedding material has been consistently compacted by mechanical means where trenches are 700mm or wider and the bedding material has a moisture content that allows optimum compaction. The Sites Geotechnical Engineer, the Accredited Certifier, or Council's Representative may direct compaction testing on the bedding to confirm compaction should there be any doubt that the compaction effort provided is not achieving the compaction requirement.

Compaction testing of interallotment stormwater trench backfill may not be required for pipe diameters of 300mm diameter or less provided the Service Provider has demonstrated that backfilling material has been consistently compacted for the full depth of the trench.

6.8.3 Indirect Penetrometer Testing

Indirect Penetrometer or Dynamic Cone Penetrometer (DCP) testing of backfill, where approved by the Council's Representative, shall be used in accordance with the following.

6.8.3.1 Trenches Below Pavements and Kerb and Gutter

This testing shall consist of:

- For pipe diameter less than 900mm – Dynamic Cone Penetrometer (DCP) testing at subgrade level shall be required to the depth of the trench both sides of the pipe.
- For pipe diameter greater than 900mm – DCP testing at top of pipe to the bottom of the trench both sides of the pipe and at subgrade level to the top of pipe level.
- For multi-celled lines – additional DCP testing between cells shall be required for the full depth of the trench in accordance with the dot points above.

6.8.3.2 Trenches in Areas Outside of Road Pavement and not under Kerb and Gutter

This testing shall consist of:

- For pipe diameter less than 900mm – DCP testing at finished level less any surface treatment shall be required to the depth of the trench one side of the pipe.
- For pipe diameter greater than 900mm – DCP testing at top of pipe to the bottom of the trench one side of the pipe and at finished level less any surface treatment to the top of pipe level.
- For multi-celled lines – additional DCP testing between cells shall be required for the full depth of the trench in accordance with the dot points above.

Direct density testing shall be carried out sufficiently in the opinion of the Site Geotechnical Engineer to correlate DCP test results with densities.

For penetrometer testing a maximum spacing of 50m between tests on each side of the pipe applies with a minimum of 2 tests on each side of the pipe being taken between pits/drainage structures/outlets.

DCP test results shall be presented by the Sites Geotechnical Engineer with supporting information, including correlations to indicate the adequacy of the results.

6.8.4 Frequency of Testing

The method of testing shall be in accordance with Section 8 of AS 3725 - Design for installation of buried concrete pipes. The frequency of testing shall be in accordance with Table 8. If Table 8 does not cover a particular situation the Consulting Geotechnical Engineer or Council's Representative shall specify the required frequency of testing.

Table 8: Trench Bedding and Backfill Relative Compaction Method and Frequency of Testing

Characteristic Analysed	Minimum Frequency of Testing
Compaction and moisture content of backfilling for transverse trenches less than 1200mm wide (under roads, paths and driveways)	1 test in haunch zone, side zone or up to 150mm above pipe at discretion of Councils representative and 1 test between 150mm above pipe and subgrade or finished surface
Compaction and moisture content for transverse trenches greater than 1200mm wide (under roads, paths and driveways)	1 test in haunch zone, side zone or up to 150mm above pipe; and 1 test between 150mm above pipe and subgrade or finished surface
Compaction and moisture content for longitudinal trenches (under roads, paths and driveways)	1 test in haunch zone, side zone or up to 150mm above pipe at discretion of Councils representative; and 1 test between 150mm above pipe and subgrade, or finished surface every 50m, or at least 1 set of tests between pits or structures greater than 10m spacing
Compaction and moisture content for trenches elsewhere	1 test in haunch zone, side zone or up to 150mm above pipe at discretion of Councils representative; and 1 test between 150mm above pipe and subgrade, or finished surface every 100m, or at least 1 lot of tests between pits or structures greater than 50m spacing

6.8.5 Determination of the Location of Field Compaction Tests and Field Sampling

For all trench backfill testing the Sites Geotechnical Engineer shall determine the location within the length of the trench where sampling and testing will be taken independently of any advice or request by the Service Provider(s) responsible for the works. Any evidence of tests and sampling locations being determined by the Sites Geotechnical Engineer in collaboration with the Service Provider(s) responsible for the earthworks will be deemed as noncomplying tests. In this case a new set of tests shall be required to be carried out in locations nominated by Council's Representative. Noncomplying Trench Compaction Results and Retesting Requirements.

6.8.5.1 General

A noncompliance report shall be submitted to Council's Representative for any noncomplying works the Service Provider is requesting acceptance. This report shall contain information in support of the request. Work shall not proceed further on any non-complying item until Council's Representative has considered the non-compliance and approved the works to proceed.

6.8.5.2 Non-complying Compaction Test Results and Retesting Requirements

Where compaction does not comply on the basis of an inspection or test results the Service Provider shall rework the layer inspected and/or tested for a length of 25m either side of the test location or the total length between pits/structure if that length is less than 50m. Retest of the layer shall be taken anywhere in the reworked area. The retest report shall be clearly labelled as a retest.

6.9 Concrete Drainage Structures

6.9.1 General

This section covers the requirements for structures that are cast in-situ or precast concrete required as part of stormwater drainage systems. Drainage structures include inlet pits, junction pits, headwalls, open concrete channels, and other structures associated with the stormwater drainage construction. This section does not cover concrete kerb and gutter.

Before any work is commenced on a particular drainage structure under an embankment, the area occupied by the structure and 5m either side of the structure shall:

- Be cleared and grubbed (refer Section 5.2 Clearing and Grubbing); and
- Have topsoil removed in accordance with Section 5.3 Earthworks Excavation of this Specification; and
- Have the embankment foundations prepared in accordance with Section 6.7 Backfilling of this Specification, including removal of unsuitable material.

All drainage structures contained in the body of an embankment shall be installed in the normal trench conditions.

Generally, all drainage structures, other than those detailed in Council's Engineering Guideline - Standard Drawings, shall be designed and specified with a B1 exposure classification in accordance with the requirements of AS 3600 - Concrete structures as a minimum. However, a greater exposure classification like U exposure Classification shall be required to be adopted where the location of the structure dictates (soft or running water).

All drainage structure designs arranged by the Service Provider shall be submitted to Council's Representative for acceptance.

All drainage structures shall be designed and constructed to address all safety related issues including (but not limited to):

- Pit openings.
- Access and bicycle/pedestrian friendly grates.
- Requirement for guardrail.
- Safety fences or railings.

Council's Representative may instruct the Service Provider to address safety issues through additional works should safety issues not be adequately addressed on the drawings.

A subsurface drainage line is to be constructed in the shadow and full length of any stormwater pipeline. Outlets for this 100mm diameter slotted subsurface pipe shall be cast into the wall of the full pit or headwall at the same invert level as the drainage pipe. The slotted subsurface pipe shall be brought to surface at the upstream end and incorporated into a lidded inlet flush out point, be enclosed in a seamless tubular filter fabric and backfilled with 7mm drainage media. When the discharging pipe is 1200mm diameter or larger, two 5m lengths of subsurface pipe shall be provided on each side of the pipe.

All drainage structures shall be constructed on foundations that provide adequate bearing support for the structure. Council's Representative may direct the Service Provider to have a Consulting Geotechnical Engineer confirm that the foundation bearing capacity for a structure is adequate.

Drainage structures shall be constructed to the applicable level tolerances for adjacent pipe or box culvert grades. The more conservative tolerance shall be adopted where differing grades enter the same structure.

The location for drainage structures shall be constructed within ± 100 mm from the designed locations unless otherwise approved by Council's Representative.

All drainage structures, other than those located in road pavements or other paved areas shall be provided with a turf surround at the finished adjacent surface as shown in Council's Engineering Guideline - Standard Drawings unless otherwise detailed or a different treatment is required to comply with environmental considerations, landscaping requirements or vegetation management.

All grated surface inlet pits including interallotment drainage pits shall be constructed so the grate inlet is 80mm below the surrounding surface level. The surround of the surface inlet pit shall be graded towards the grate level.

Pits and headwall dimensions, unless covered by a standard drawing in Council's Engineering Guideline - Standard Drawings, shall be in accordance with the sizes shown on the approved drawings. The required dimension of the pit shall be confirmed with the person(s) that prepared the design if the depth of the pit varies from that shown on the drawings. Any changes in pit sizes shall be brought to the attention of Council's Representative.

Using a proprietary epoxy-based repair mortar may be accepted for use in minor defect repairs or to make a smooth connection of inlet and outlet pipes to pit walls, subject to approval by a Council Representative. A sand and cement mix shall not be used for construction of drainage structures.

6.9.2 Standard Drawings

Standard drawings relating to drainage structures are contained in Council's Engineering Guideline - Standard Drawings.

Any variations to the requirements of the Standard Drawings must be accepted by Council's Representative prior to construction/installation.

Headwalls with concrete aprons shall be constructed in accordance with the latest TfNSW Standard Drawings incorporating the requirements as noted below. TfNSW Standard Drawings can be obtained from the Transport for NSW website.

6.9.3 Precast Pits and Structures

Details of precast structures shall be submitted to Council's Representative for acceptance prior to the Service Provider ordering these products.

Precast pits shall not be accepted for any stormwater drainage pits to be constructed in the road reserve without prior approval from Council's Representative. Precast pits that are accepted for use in the road reserve shall have a minimum wall thickness of 100mm unless otherwise approved and have pre-formed openings for the pipe sizes being used.

Integral precast kerb inlet and grate units shall be placed on a 150mm minimum N20 concrete/kerb mix bed and are acceptable provided they conform to the requirements of Council's Engineering Guideline - Standard Drawings. All lintels and grates in road reserves shall be Load Class D in accordance with AS 3996 - Access covers and grates.

Cracked or damaged precast structures including pipes shall not be accepted at any stage of the works.

Where precast pits are accepted for use by Council's Representative, all other requirements applying to cast in-situ stormwater pits shall apply.

6.9.3.1 Interallotment Stormwater Drainage Pits

Only wet cast precast pits or knock out precast concrete pits are acceptable for use as interallotment stormwater pits. Inlet and outlet pipe penetrations shall be cut using a concrete saw or core drilled to minimise the extent of concrete bandage used to seal the connection between pipe and pit wall.

Where the depth of interallotment stormwater pits needs to be altered on site to suit site levels the pit size requirement shall also be altered to reflect the design requirements of Council's Engineering Guideline – Design Guideline.

Interallotment stormwater pits shall have a galvanised steel grated inlet fitted flush to the top of the pit. The grate shall be secured to the pit with a galvanised chain to prevent removal.

6.9.4 Cast In-situ Stormwater Pits

All cast in-situ concrete drainage structures, other than those shown in Council's Engineering Guideline - Standard Drawings or shown on TfNSW Standard Drawings referred to in this Specification, shall be designed and constructed in accordance with the requirements of AS 3600 - Concrete structures.

Where required by Council's Representative, the Service Provider shall engage a Civil or Structural Engineering Consultant to provide a detail and specification for the required drainage structure if design details of cast in-situ drainage structures are not either of the following:

- Shown on the approved Construction Drawings.
- Approved to be a precast structure from a recognised precast concrete manufacturer.
- Detailed in Council's Engineering Guideline - Standard Drawings.

Internal and external surfaces of walls of all cast in-situ structures shall be formed, unless the depth of the structure, nature of the ground or any existing constraints permit walls to be cast without external forms, subject to the approval of Council's Representative. The ground strata providing the external form must be undisturbed and trimmed to an even vertical surface so that resulting wall thickness is increased by at least 50mm, but not more than

100mm over that detailed on the approved drawings. In any case external formwork shall be used for the top 300mm of all walls.

Pits 1.5m in total depth do not require reinforcement. For pits between 1.35m to 3.0m, reinforcement is to be placed as per Council's standard drawings. For pits deeper than 3m, these are to be designed and certified by a Structural Engineer.

Any concrete poured for cast in-situ drainage structures shall be vibrated during placement. Following the removal of formwork, concrete visually displaying insufficient compaction by evidence of excessive surface honeycombing shall be removed and reconstructed unless an alternative method of repair is accepted by Council's Representative.

For all cast in-situ pits the base shall be poured first to allow the walls to be fully supported on the base. Walls shall be bonded to the base by cement grout to form a tight joint. The minimum base, wall and lid thickness for cast in-situ pits shall be 150mm. Pits poured in multiple height sections shall require N12 starter bars of minimum length 400mm and at 300mm centres to be placed in the walls of preceding lift.

Cast in-situ pits shall be constructed from concrete strength grade N25 minimum if no reinforcement is required in the pit. If reinforcement is required, the concrete strength grade shall be N32 minimum.

Where required by Council's Representative, the invert of all pits, regardless of being cast in-situ or precast, shall be benched and streamlined using N20 concrete as a minimum, to provide a smooth finish and minimise turbulence of flow from inlet pipes to outlet pipes. Care shall be taken with benching and streamlining not to block subsurface drainage outlets.

Where drainage structures abut concrete paving, kerb and gutter or other concrete structures, a 10mm wide expansion/isolation joint shall be provided. The joint shall consist of preformed jointing material complying with TfNSW QA Specification 3204 - Preformed Joint Fillers for Concrete Road Pavements and Structures unless otherwise shown on the approved drawings. Total isolation of drainage structures is required where they are located within or abutting rigid pavements.

The class of grate used for all pits, unless specified on the approved drawings or on Council's Engineering Guideline - Standard Drawings, shall be suitable for the intended use in accordance with AS 3996 i.e. Load Class D heavy-duty for roads and Load Class C medium-duty in reserves to suit maintenance plant.

All grates shall be hot-dip galvanised after fabrication.

Concrete to support grates shall have a slump of 70-80mm and vibrated into place. Kerb mix is unacceptable for this work.

Sealed or covered junction pits shall be constructed to the same standard as inlet pits except a sealed cover shall be provided as described below in this Specification.

Step irons that are galvanised are to be incorporated into the stormwater pits, from access depths of 600 mm.

6.9.5 Headwalls, Wing Walls and Energy Dissipaters

Headwalls, wing walls and energy dissipaters shall be constructed as detailed and shown on the approved Construction Drawings. Any adjustment to the location of these structures to suit site conditions shall be accepted by Council's Representative.

Headwalls and wing walls shall be constructed to retain batters effectively and shall be extended if required to minimise adjacent batter slopes resulting in easily maintainable slopes. Such extensions may require additional structural details to be obtained by the

Service Provider. Any additional details obtained by the Service Provider shall be submitted to Council's Representative for acceptance.

Headwalls, where not detailed on the approved Construction Drawings or Council's Engineering Guideline - Standard Drawings, shall be constructed to comply with TfNSW Standard Drawings for concrete headwalls with concrete aprons, except that the following shall be applicable:

- Concrete strength grade shall be N32 minimum.
- Cover to all reinforcement shall be 40mm minimum, subject to the applicable exposure classification applicable to the subject location of the works.

Suitable requirements, in accordance with the requirements of AS 3600 - Concrete structures, for concrete strength grade and cover to reinforcement shall apply in high water table areas.

Where rock is encountered at the bottom of excavations for wing walls and headwalls, the depth of cut-off walls in uniform rock over the full width of the foundations may be reduced to less than that shown on the approved Construction Drawings or the Standard Drawings but must not be less than 150mm deep into sound rock.

Minimum scour protection or energy dissipater requirements shall include D50 200mm rock size over "C" strength grade geotextile to TfNSW Specification D&C R63 Geotextiles (Separation and Filtration) requirements in the absence of a specifically designed scour protection measure.

6.9.6 Access Opening Covers for Junction Pits and Drainage Structures

Circular sewer access chamber covers shall not be used on any stormwater drainage structure. Other circular covers specifically for the purpose of stormwater pit or structure shall require approval from Council's Representative. Where a circular type lid is approved it shall be clearly inscribed or marked in a permanent fashion with the letters "SW".

In path areas, road pavements and other paved areas and elsewhere if detailed, junction pits shall have Class E extra heavy-duty or Class D heavy-duty in accordance with AS 3996, as applicable, Gatic or equivalent type covers. In other areas not likely to be subject to vehicular traffic precast concrete covers and surrounds may be used.

Finished surface levels shown for drainage structures on the drawings shall be taken as guide only. The Service Provider shall be responsible for the establishment of accurate levels so that covers shall be finished:

- Flush to adjacent pavement levels in paved areas.
- 25mm above finished surface in landscaped areas.
- 75mm above natural surface elsewhere.

6.9.7 Backfilling of Drainage Structure Excavations

Backfilling of drainage structures shall not commence within 14 days of concrete being placed or until the compressive strength of concrete has reached at least N20 unless otherwise shown on the approved drawings.

Where external formwork has been used for any drainage structures, stabilised sand (3% to 5% cement) shall be used for backfilling excavations around drainage structures when located within the road carriageway. In areas of existing or proposed road pavement, stabilised sand shall be used to the natural pavement subgrade level.

In other areas selected granular backfill shall be placed and compacted against the full height of the vertical faces of structures for a minimum width of 500mm. Selected backfill shall consist of a granular material meeting the same requirements as side zone material in AS 3725 - Design for installation of buried concrete pipes and as specified in Section 6.9.3 Precast Pits and Structures of this Specification.

Where the sides of the excavation are steeper than four horizontally to one vertically (4:1), they shall be cut back in the form of successive horizontal terraces at least 500mm in width, as the backfill is placed.

Backfill to drainage structures shall be carried up to level in layers simultaneously. Compaction shall be in accordance with the requirements for backfilling of structures in Section 5 - Site Clearing and Bulk Earthworks of this Specification.

6.9.8 Modifications to Existing Structures

In the case of minor modifications to existing structures not being shown on the approved drawings the following shall apply. Where existing structures are to be raised or lowered, break out sufficient parts of the walls to expose reinforcement and to allow at least 150mm of new concrete below the new cover or frame. Splice new reinforcement to old as necessary, form and place concrete as specified for new structure.

In the case of major modifications to existing structures where details of the modification are not shown on approved Construction Drawings then the Service Provider shall engage a qualified Structural Engineer to provide advice on the modification of the structure. Copies of the advice shall be provided to Council's Representative. The qualified Structural Engineer shall inspect all aspects of the modification construction and provide certification that the modification construction has been carried out in accordance with their recommendations.

6.9.9 Galvanising of Steel Fixtures

All steel fixtures including grates, frames, step-irons, ladders, etc shall be hot-dip galvanised. Galvanising shall comply with the requirements of the appropriate following standard(s):

- AS/NZS 1214 - Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series).
- AS/NZS 4680 - Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.
- AS/NZS 4534 - Zinc and zinc/aluminium-alloy coatings on steel wire.
- AS/NZS 4792 - Hot-dip galvanized (zinc) coatings on ferrous hollow sections, applied by a continuous or a specialized process.

The average galvanising coating to items other than threaded fasteners shall be in accordance with the above standards. Threaded fasteners shall have an average galvanising coating of 375g/m². Surplus material shall be removed from threads of bolts so that no recutting is required.

6.9.10 Compliance Inspections and Documentation for Drainage Structures

6.9.10.1 Precast Drainage Structures

The Service Provider shall, when requested by the Accredited Certifier or Council's Representative, provide copies of test certificates, Certification of structural adequacy, and any other documentation that may be required to verify that the supplied drainage structure complies with the specified standards and is suitable for the location in which it is being used.

6.9.10.2 Cast in-situ Drainage Structures

The Service Provider, when requested by the Accredited Certifier or Council's Representative shall provide copies of test certificates and any other documentation that may be required to verify that the supplied materials comply with the specified standards.

The Service Provider shall provide copies of all structural designs and certification reports as required by this Specification to Council's Representative. When a standard drawing is not used for the construction of a drainage structure, the Service Provider shall have the Designing Engineer inspect the structure during construction and certify that the construction is in accordance with the design and shall perform structurally as intended by the design.

The Service Provider shall provide to Council's Representative, when requested, copies of reports by the Consulting Geotechnical Engineer verifying the foundation bearing capacity and backfill compaction of drainage structures are adequate for the proposed structure.

6.10 Subsurface Drains

6.10.1 General

Subsurface drainage lines shall be installed along both sides of the road pavement, integral with stormwater drainage where stormwater drainage is under kerb and gutter and with stormwater drainage road crossing. Subsurface drainage shall also be required at the interface of new pavements and existing pavements where the new pavement material and/or depth is not consistent with the existing pavement material. Subsurface drainage lines may also be required in other areas as detailed on the approved drawings, such as both sides of box culverts, under kerb and gutter in road pavements, or as described in geotechnical reports and Pavement Design Reports, or if required to control subsurface water that becomes evident during construction.

Where the road shoulders are unsealed, the trenches for the subsurface pipes shall be placed 300mm clear of the outer edge of the pavement. If the shoulders are to be bitumen seal e.g. where concrete kerb and gutter, gutter, lined or pitched table drains are used, subsurface pipes shall be placed adjacent to the gutter or drain and beneath the outside edge of the sealed shoulder.

If transverse drains are also required to control water which collects beneath the pavement from springs, or by penetration through the pavement, these drains shall be laid to intersect the longitudinal drains at approximately 45° to their direction of fall.

All subsurface drainage shall be installed in a trench backfilled with filter material in accordance with this Specification.

This section of the Specification does not apply to subsurface drainage to be installed as part of a water treatment device such as a bio-filtration basin or swale or similar. Details for these types of subsurface drainage shall be shown on the approved drawings or contained within other specifications referred to on the approved drawings.

6.10.1.1 Standard Drawings

The general location, arrangement and some other requirements for subsurface drainage are described in Council's Engineering Guideline - Standard Drawings.

6.10.2 Subsurface Drainage Materials

6.10.2.1 Pipes

Pipes for subsurface drains shall be 100mm diameter corrugated flexible PVC perforated drainage pipe class 1000 complying with the requirements of AS 2439 - Perforated plastics drainage and effluent pipe and fittings. A filter sock shall be required on all pipe installed with a washed sand or 7mm aggregate filter type material.

Other pipe types may be accepted for use following submission of documentation to Council's Representative confirming their compliance with AS 2439 - Perforated plastics drainage and effluent pipe and fittings and suitability for the proposed use. Other pipe types that will be considered are perforated or slotted pipes of other material including PVC, PP and geo-composite plastic filter strips. The filter strip may be either a rigid or flexible plastic core with slots or openings and shall be totally encased in a specially manufactured and fitted geo-textile fabric.

Brought to ground and capped by a precast metal cap and concrete surround at 80m centres where outlet cannot be terminated in a pit or fill zone. A marker with SS is also to be erected near the flush point or on boundary when in an urban setting.

Joints, couplings, elbows and tees shall conform to the manufacturer's specifications using the manufacturer's appropriate accessory fittings unless otherwise approved by Council's Representative.

6.10.2.2 Aggregate Filter Materials

Aggregate filter materials shall conform to the requirements of TfNSW QA Specification 3580 Aggregate Filter Materials for Subsurface Drainage.

Filter Material shall conform to the following grading requirement (TfNSW Test Methods T201 - Particle distribution of aggregates (by washing) and T203 - Particle distribution of aggregates finer than 75µm (by washing) shall determine the grading):

Table 9: Subsurface Drainage Aggregate Filter Material

AS Sieve Size (mm)	Passing by Mass (%)
9.5	100
4.75	90 - 100
2.36	75 - 100
1.18	50 - 90
0.6	30 - 60
0.3	10 - 30
0.15	2 - 10
0.075	0 - 3

6.10.2.3 Sand Filter Material

Sand filter material shall conform to the particle size distribution requirements in Table 10 after pre-treatment in accordance with TfNSW Test Method T102 - Pre-treatment of Road Construction Materials by Compaction, Method A.

Table 10: Subsurface Drainage Sand Filter Material Grading Requirements

AS Sieve Size (mm)	Passing by Mass (%)
4.75	100
2.36	95 - 100
0.425	20 - 80
0.3	0 - 30
0.15	0 - 10
0.075	0 - 1

Particle size distribution shall be in accordance with TfNSW Test Method T201 - Particle distribution of aggregates (by washing) with the addition of the 425µm AS sieve. The percentage passing the 75µm AS sieve shall be determined by TfNSW Test Method T203 - Particle distribution of aggregates finer than 75 µm (by washing).

After pre-treatment, sand filter material must have a coefficient of saturated permeability of at least 8m/day when compacted to 100% of standard compaction and tested in accordance with TfNSW Test Method T1311 - Determination of Permeability of a Soil - Constant Head Method.

6.10.2.4 No Fines Concrete Filter Material

No fines concrete shall only be used for subsurface drainage filter material when specified by the Consulting Geotechnical Engineer or required by Council's Representative. The no fines concrete shall have an aggregate to cement ratio between 6:1 and 8:1 by mass. The water cement ratio shall be 0.35 to 0.45 by mass. The aggregate size distribution shall conform to Table 11 and shall have minimum 98% by mass of aggregate with one fractured face.

Table 11: Subsurface Drainage No Fines Concrete Aggregate Grading Requirements

AS Sieve Size (mm)	Passing by Mass (%)
26.5	100
19.0	95 - 100
9.5	0 - 5

6.10.2.5 Alternative Filter Material

The use of filter materials not meeting the specified grading requirements may also be approved for use subject to adequate grading and permeability testing and a report from the Consulting Geotechnical Engineer confirming suitability as a filter material for road pavement subsurface drainage.

6.10.2.6 Geotextile

Geotextile filter/separation layer when used in the subsurface drainage trench with aggregate filter material shall meet the requirements of TfNSW D&C Specification R63 Geotextiles (Separation and Filtration).

6.10.3 Compliance Testing

The Service Provider shall provide a copy of filter material grading and aggregate size distribution test results prior to the supply of the material to the site.

Following delivery of filter material to the work site, the Service Provider shall arrange for the Consulting Geotechnical Engineer to carry out a minimum of 2 random particle size distribution tests on filter material per 500 linear metres of subsurface drainage lines or part thereof for material delivered to the site. The requirement for site testing of filter material shall be relaxed where there is less than 100m of subsurface drainage being constructed.

The Consulting Geotechnical Engineer shall determine where sampling and testing shall be taken independently of any advice or request by the Service Provider(s) responsible for the works.

6.10.4 Trenches

Subsurface drainage trenches shall be:

- A minimum 300mm wide unless otherwise described in the approved Pavement Design Report; and
- A minimum 600mm below the subgrade base; and
- Excavated after pavement construction has reached pavement subgrade level or following placement of subgrade replacement and select layers.

Filter material shall extend from the bottom of the subsurface trench through to the bottom of pavement sub-base material.

Trenches shall generally be graded at the same grade as the road. Trenches shall be graded such that the subsurface drains can discharge into a drainage structure. Where discharge is not to a drainage structure the subsurface drain shall be tailed out at minimum 1% grade until it is able to discharge at finished surface level.

The bottom of the trench shall be graded to remove any localised ponding greater than 20mm. If the trench is over excavated or localised ponding could occur, the trench floor shall be filled with non-porous natural subgrade material and compacted to 100% minimum density ratio (at standard compaction), to prevent ponding from occurring.

Unsuitable material in the base of the trench shall be removed and replaced with non-porous natural subgrade material compacted to 100% minimum density ratio (at standard compaction).

6.10.5 Bedding, Laying, Jointing and Placing Filter Material

Filter material shall not be used if it is contaminated by other soil or other deleterious matter.

The minimum grade for subsurface drainage lines shall be 1% unless otherwise approved by Council's Representative. The filter material shall be used as bedding material and shall be placed below the pipe 50mm thick.

Pipe joints shall be made using a purpose made external joint coupling. Filter material shall be placed in the trench to avoid segregation.

Filter material shall be compacted to 95% min. of its Maximum Dry Density at standard compaction Index of 70%. The first layer above the pipe shall be 300mm deep. The filter material shall be placed and compacted in such a way as to ensure that the pipe does not move and is not damaged.

All faces of filter material in contact with topsoil or similar fine-grained material shall be covered with geotextile material.

In trenches with hard rock bases, the requirement for trimming the base shall be relaxed subject to there being no adverse effect on overall drainage performance.

6.10.6 Flushing Points and Outlets

6.10.6.1 Flushing Points

Flushing points of drains shall be turned up and capped at the surface for final inspection.

6.10.6.2 Outlets

Subsurface drains shall discharge into stormwater inlet pits and stormwater junction pits, where possible or at toe of fill zones. Outlets directly connected to pipes or to the surface shall only be used where absolutely necessary. Outlets to the surface shall have a purpose made precast or cast in-situ headwall and a stabilised tail out drain to direct any flow to the stormwater drainage system. Treatment of the tail out drain shall be confirmed on site with Council's Representative.

Direct connection to existing subsurface drainage lines shall be the Service Provider's or service provider's responsibility and to confirm that the existing subsurface drainage line is free draining prior to subsequent pavement construction. Council shall not be held liable if direct connection is carried out on the assumption that the existing subsurface drainage line is free flowing and functional.

6.10.7 Compliance Testing, Inspections and Documentation

Compliance with this Specification shall be demonstrated during site inspections by the Accredited Certifier or Council's Representatives during the installation of subsurface drainage.

The Service Provider shall supply to Council's Representative test result documentation that verifies that the supplied materials relating to subsurface drainage comply with the specified standards.

Work-as-executed drawings shall show the location of subsurface flushing points and outlets. GPS data of the subsurface drainage infrastructure shall also be recorded and provided to Council alongside relevant metadata of the infrastructure such as height, width, length, pipe size, pipe material, geotextile description, etc.

6.10.7.1 Pre-final Inspection

Subsurface drainage lines shall be cleaned of debris, silt and the like before the pre-final inspection. All flushed material shall be captured prior to it leaving the site system.

During the pre-final inspection all subsurface drainage lines shall be flushed whilst Council's Representative is on site. Flushing shall demonstrate that the subsurface drainage line flows freely without any obstruction.

6.10.7.2 Final Inspection

All compliance documentation shall be submitted to Council's Representative prior to the final inspection.

All uncompleted items and defects found during the pre-final inspection shall be completed and/or rectified prior to the final inspection.

Subsurface lines found to be defective by flushing at the pre-final inspection shall be flushed again in the presence of Council's Representative during the final inspection.

6.11 Stormwater Outlets to Kerb and Gutter

For the installation of stormwater outlets to kerb and gutter, refer to Council's Engineering Guideline - Standard Drawings.

For new subdivisions minimum one (1) galvanised steel outlets shall be provided for each proposed standard lot (frontage typical 20m) that drains to the kerb and gutter. Outlets shall be located at the point in the kerb and gutter that is perpendicular to the front boundary from a point on the front boundary that is 1m offset from the lowest boundary. Additional outlets are to be provided for wider lots on a pro-rata basis to this stated ratio.

A 90mm diameter uPVC stormwater pipe shall be provided from the kerb outlet to a minimum 500mm within the proposed lot boundary at 1% grade. The end of the pipe within the proposed lot shall be fitted with a tee fitting and riser to 300mm above the finished surface level. Both the open end of the tee and riser shall be capped. The cap on the riser shall be marked with the letters "SW".

In existing residential areas where kerb and gutter exist, stormwater outlets shall be provided where required. The existing kerb shall be neatly saw cut and removed a minimum of 75mm either side of the galvanised steel outlet. The outlet unit shall be set in place using locking tabs and a proprietary epoxy-based repair mortar. Sand cement mix shall not be acceptable.

For road upgrades, the Service Provider shall extend and connect property stormwater outlets to the new kerb and gutter with a heavy-duty cast iron steel kerb adaptor with locking tabs.

6.11.1 Maximum Discharge and Spacing for Kerb-Outlet Stormwater Discharges

Where a lot or development proposes to discharge stormwater via a kerb-outlet to the road reserve, the following shall apply:

1. The maximum allowable discharge (Q) via a single kerb-outlet shall be 30 L/s, unless otherwise approved by Council.
2. For discharges exceeding 30 L/s, or where the downstream road reserve or kerb/gutter conveyance is unable to accommodate the flow, the developer shall connect to the Council's piped stormwater network rather than use a kerb-outlet.

3. The minimum clear spacing between adjacent kerb-outlets exceeding the Max Discharge (Q) shall be 12 metres, or as shown on the Council's standard drawing.

6.12 Retention Basins

6.12.1 General

6.12.1.1 Scope

The work to be executed under this Specification consists of:

- a) Basin materials
- b) Basin excavation
- c) Basin wall construction
- d) Revegetation and scour protection
- e) Signage

6.12.2 References

Documents referenced in this specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

Where not otherwise specified in the relevant specifications or the approved design drawings, the Constructor shall use the latest versions of the reference documentation, including amendments and supplements, listed in the Specifications at the time of the Works approval.

- Hilltops Council (HC) Engineering Guideline Specifications
 - Section 3 General Matters – including tree felling and control of erosion and sedimentation.
 - Section 5 Site Clearing and Bulk Earthworks.
 - Section 6 Drainage
 - Section 15 Restoration and Finishing of Surfaces
- Australian Standards
 - References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS.
 - AS 1289.3.8.1 - Methods of testing soils for engineering purposes Soil classification tests - Dispersion - Determination of Emerson class number of a soil.
 - AS 1289.5.1.1 - Determination of the dry density/moisture content relation of a soil using standard compactive effort.
 - AS 1289.5.4.1 - Compaction control test - Dry density ratio, moisture variation and moisture ratio.
 - AS 1289.5.7.1 - Compaction Control Test (Rapid Method).
- Legislation
 - *Environmental Planning and Assessment Act 1979* (EP&A Act).
 - *Dams Safety Act 2015*.

HOLD POINT

All proposed deviations from the approved design drawings, HC Standard Drawings, this Specification or the documents referenced within it, shall be submitted for approval to the HC Representative with supporting evidence at least five (5) working days prior to the work being undertaken.

Process Held: The lot or element affected by the proposed deviation

6.12.3 Basin Materials

Materials used to construct the core of fill walls of basins must NOT include the following materials:

- Materials with clay (less than 2 microns) content less than 15%.
- Hard clay lumps which will not readily absorb the required moisture content.
- Materials with Emerson Class Number of 1 or 2.
- Materials that have a permeability coefficient of more than 10⁻⁸m/s.
- Materials that are prone to piping and surface erosion.
- Materials that contain rubbish, roots or organic material.
- Materials contaminated through past site usage.
- Materials with plasticity index of less than 10.
- Over wet materials.
- Material, stones or rock fragments with dimensions greater than 75mm.
- Demolition rubble Materials shall also be in accordance with Section 5 Site Clearing and Bulk Earthworks.

6.12.4 Basin Excavation

Excavation of basins shall be carried out in accordance with Section 5 Site Clearing and Bulk Earthworks.

6.12.5 Basin Wall Construction

Construction of basin walls shall be carried out in accordance with Section 5 Site Clearing and Bulk Earthworks.

a) Foundation Preparation for Basin Wall Construction

Scarify the stripped and prepared surfaces as indicated in preparation for pre-rolling. Should the cleared foundation area be dry and cracked prior to scarifying, thoroughly water the area and ensure that compaction of the scarified material complies with the Construction requirements. Pre-roll the foundation with one (1) pass of a padfoot roller immediately after scarification / watering and immediately prior to placement of fill materials.

b) Basin Wall Construction

Prior to compaction of the layers, condition all material by breaking fill up into fragments less than 75mm size, laying out in layers of uniform loose thickness, and bringing up to an appropriate water content by aeration and drying or wetting. Spread and compact fill in layers not exceeding 150mm thickness prior to compaction. All layers of fill placed in the works must be uniformly compacted over the full area and depth of the layer to achieve the acceptable compaction specified before the next layer is commenced. Compact fill using a padfoot roller. In confined places or where a padfoot roller may damage adjacent structures hand operated tamping equipment is to be used.

A gravel crest layer of minimum 100mm shall be constructed on the basin crest. A minimum topsoil cover of 100mm shall be applied to the batters and crest.

c) Testing Requirements

Moisture Content - Maintain moisture content of the fill at the time of placing and compacting within +2% to -1% of Optimum Moisture Content (OMC) when the particular material is subjected to the Standard Compaction Test (AS1289.5.1.1).

Fill Density - Compact each layer until the dry density ratio is in excess of 98% of the maximum dry density as determined by the standard compaction test (AS1289.5.3.1).

The density and moisture content of the compacted fill shall be monitored using the Nuclear Densometer Method or Compaction Control Test - Rapid Method given in TfNSW Test Method T162.

Control test frequency shall be one test per 100m³ of fill material.

All of the above points shall constitute a **HOLD POINT**.

HOLD POINT

The Constructor shall submit to the HC Representative and/or the Developer's Representative (for Developer Infrastructure Works) all test results verifying conformity of compaction, moisture content and material requirements.

Process Held: Retention Basin Construction

6.12.6 Batter Tolerances

The tolerances for the absolute location of the crest and toe of batters, shall be ± 50 mm. Batters must not have undulations in the general plane of the batter. The grade of batters must not increase above 1 in 6 due to construction tolerances and ongoing Work Health and Safety consequences impacting mowing activity.

The design volume of a detention basin must not be decreased by more than 2% due to construction tolerances.

6.12.7 Revegetation

The floors of all earth basins and walls of batters 0.5m above floor level shall be appropriately stabilised to prevent erosion and scouring with turf of an appropriate species.

The remainder of internal and external batters of earth basins shall be provided with topsoil and seeded with appropriate grass species.

6.12.8 Signage

Signage shall be provided at all retention/detention basins indicating the depth of water. Signs are to be erected such that two signs and one depth indicator are visible from any one point of the basin embankment at any time.

6.13 Limits and Tolerances

6.13.1 Summary of Limits and Tolerances

The limits and tolerances applicable to the various clauses in this Specification are summarized in Table 12.

Table 12: Summary of Limits and Tolerances

Item	Activity	Limits/Tolerances	Specification Clause
1	Batter Slopes		
	a) absolute position	± 50mm	6.12.07
	b) volume	- 2%	6.12.07
	c) Batter Slopes	1 in 6 maximum slope	6.12.07
4	Compaction		
	Fill embankments - Compaction	Relative compaction > 98% (standard)	6.12.06
	Fill embankments - Moisture content	+2% to -1 % of (OMC)	6.12.06

Note: Plus (+) is towards the roadway/surface and minus (-) is away from the roadway/surface. Tolerances are measured at right angles to design surfaces.

6.14 Demonstration of Final Compliance for Stormwater Works

6.14.1 Inspections and Documentation

Confirmation of compliance of stormwater works shall only be given at a final inspection for the whole of the works for a development or staged release of the development. However, use of sections of stormwater lines for the control of stormwater within the works may commence upon completion of sections of the stormwater works provided that erosion and sediment control measures including scour protection in outlet drains is provided.

Work-as-executed drawings shall be prepared prior to the final inspection. These drawings shall show the following:

- Finished surface levels at all pits and structure and between pits and structures.

- Finished invert levels and pipe or box culvert grades.
- Changes to the horizontal position of any stormwater line, pit or structure.
- Confirmation of the installed pipe diameter, pipe type and class of pipe.
- Confirmation of the size of installed box culverts.

Work-as-executed information shall demonstrate compliance with the specified level tolerances.

6.14.1.1 Pre-final Inspection

No section of the stormwater system shall be given a pre-final inspection until all contributing lines have been completed and connected, bituminous surfacing of contributing roads has been completed, and all unpaved areas of the site have been adequately stabilised in order to prevent sediment entering the stormwater system.

Pipes and structures shall be cleaned of debris, sediment and the like before the pre-final inspection. Flushing of stormwater systems to clean the system is only allowed where there is no other practical method. All flushed material shall be captured prior to it leaving the site system.

The Service Provider shall organise to carry out condition assessment of the internals of the stormwater structure via an accredited CCTV provider. The condition assessment shall be done and reported in accordance with the latest version of WSA 05: Conduit Inspection Reporting Code.

6.14.1.2 Final Inspection

All uncompleted items and defects identified during the pre-final inspection shall be completed and/or rectified prior to the final inspection.

All compliance documentation relating to stormwater drainage and associated structures shall be submitted to Council's Representative prior to the final inspection.

7 Utility Services Installation, Road Opening and Utility Restorations

7.1 General

This section of the Specification provides minimum technical standards and requirements for the opening and restoration of Council-controlled land including road pavement and ancillary road reserve assets in order to preserve the integrity and long-term serviceability of the road reserve.

For drainage installations see Section 6 - Stormwater and Subsurface Drainage Construction.

Utility Authorities, Council, service providers and private individuals may from time-to-time be required to open Council's road for the installation, accessing and/or repair of various public utility services including electricity, water and sewerage, gas and telecommunications.

When a road is to be opened or excavated, Council requires appropriate notification of such proposals to be provided by the proponent and where necessary seek approval through the completion of a Road Opening and Restoration Permit Application form, available on Council's website, or consent under Section 138 of the *Roads Act 1993*.

At all times, utility services shall be installed within the Council footway allocation as per the NSW Streets Opening Conference Guide to Codes and Practices for Streets Opening and Councils typical cross section found in the Hilltops Council Engineering Guideline – Standard Drawings. Any situations where deviation from footway allocation is unavoidable, specific approval as a non-conforming application must be sought from Council's Representative prior to commencement of works (emergency works excluded).

When road openings are restored, the permanent restoration works are required to be inspected by Council's Representative to ensure that the road has been returned to its previous state (or better) and a condition consistent with Council's required reinstatement standards.

Where practicable, avoid placing public utility services in fill zones due to the increased risk of water ingress and subsequent slip failure.

This section applies to Utility Authorities, Service providers, Private individuals and Council staff.

7.2 Responsibility and Process for Council

In this Section, Council includes any Service Provider engaged to carry out the required works on behalf of Council.

Council, being a Roads Authority, is responsible for maintaining its road pavement and ancillary road reserve assets in a good and safe condition.

The *Roads Act 1993* Section 101 empowers the Roads Authority to direct persons who dig up public roads to make restoration of those roads or to take action to recover costs associated with the restoration of disturbed roads.

The Roads Act 1993 Section 101 (in part):

101 Restoration of public road following excavation, etc

1. A roads authority may direct any person by whom a public road is dug up to restore the road to its previous condition.

2. If a public road is damaged as a result of a leakage from, or breaking or bursting of, any object or work placed in, on or over the road, the appropriate roads authority may direct the person:
 - a) who was responsible for placing the object or work in, on or over the road, or
 - b) who has the care or control of the object or work, or
 - c) whose act or omission caused the leakage, breaking or bursting, to restore the road to its previous condition.
3. A direction under this section may specify:
 - a) the manner in which or the standard to which, and
 - b) the period (being at least 14 days) within which, the direction must be complied with.

Council itself is not required to complete a Road Opening Permit application for a road opening activity. However, Council shall consult with all relevant Council stakeholders prior to commencement of the activity. For example, Council's Water and Sewer team shall consult Council's Assets and Operational Teams if a road opening activity involves the installation of a sewer main within the road pavement and/or in the vicinity of drainage assets.

Council is responsible for undertaking all searches and obtaining necessary approvals associated with their proposed works. Other requirements to be addressed shall include:

- Complying with any relevant legislation.
- Environmental Impact Statement.
- Environmental Assessment or Review of Environmental Factors.
- Environmental Management Plan.
- Safety requirements.
- Conditions of approval.

Where a road activity affects any State Roads, TfNSW shall also be contacted.

All utility services should be installed within the Council's footway allocation in accordance with the NSW Streets Opening Conference 2009 and Councils Standard utility cross section. Council's Representative shall be consulted where deviation from footway allocation is unavoidable.

Council is required to consider any issues raised, requirements and conditions of approval prior to commencing a road opening activity.

Council's Representative shall also be consulted regarding requirements for road reinstatement.

Council shall ensure works are being undertaken in accordance with this section of the Engineering Guideline - Specification. Council shall quality assure their excavation, backfilling and restoration works.

A quality assurance checklist shall be completed for the execution of all works including excavation, backfilling and restoration. Copies of quality checklists including all inspection and testing results shall be forwarded to Council's Representative within 7 days of practical completion of works. At any time, Council's Representative may undertake random inspection of the works being carried out on site.

At least 7 days prior to commencement of physical work, Council shall notify:

- All relevant stakeholders including Council's Representative.
- All affected residential frontage properties.

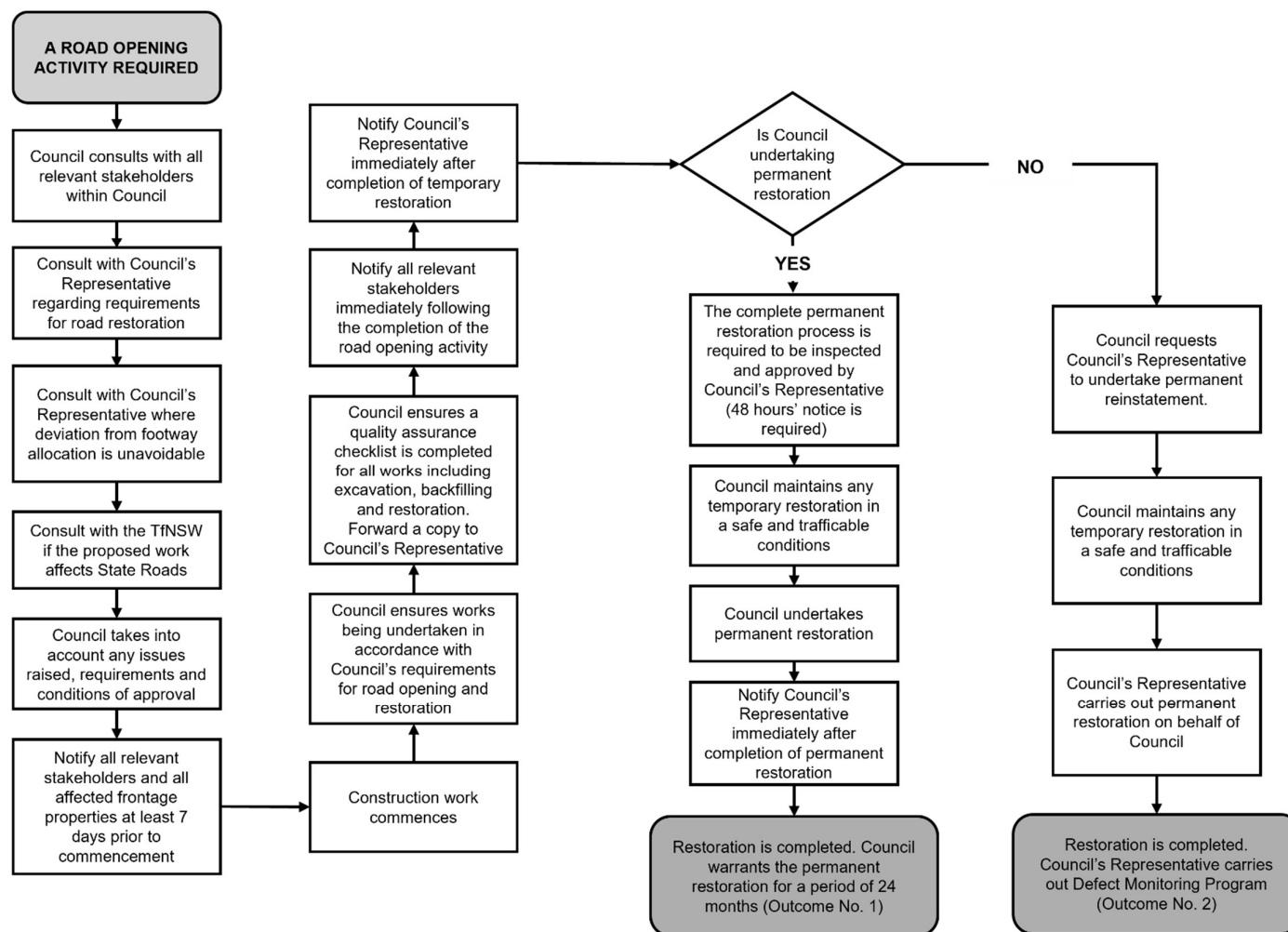
Council's Representative shall be notified immediately following the completion of all temporary and permanent restoration works.

Council shall maintain any temporary restoration in a safe and trafficable condition.

Council's Representative shall be consulted regarding who will be undertaking permanent restoration for the proposed works as well as any permanent restoration arrangement on behalf of the Council. If it is decided that Council shall be undertaking permanent restoration, the complete permanent restoration process shall be inspected and approved by Council's Representative. Forty- eight hours' notice is required prior to permanent restorations being undertaken.

The permanent restoration is required to be warranted for a period of 24 months by Council. During this period, the repair of defects such as subsidence and surface deterioration shall be the responsibility of Council.

Figure 2: Road Opening Flow Chart - Council



7.3 Responsibility and Process for Utility Authorities

In this Section, Utility Authorities includes any Service Provider or contractor Service Provider engaged to carry out the required works on behalf of a Utility Authority.

Before commencing a road opening activity, it is the responsibility of utility authorities to provide a Notice of Proposed Works to Council in accordance with the provisions of the following:

- *Electricity Supply Act 1995* (Section 45).
- *Telecommunications Act 1997* (Schedule 3).
- *Gas Supply Act 1996* (Section 47).

Such notice shall contain relevant information including (but not limited to):

- Works description.
- Location details.
- Anticipated commencement date.
- Proposed start/finish dates.
- Design Drawings.

In situations where a road opening activity has been carried out without notifying Council, the utility authority will be charged with a late fee in accordance with Council's Fees and Charges (available on Council's website). Council shall also be notified when the original proposal has been altered.

Utility Authorities are responsible for undertaking all searches and obtaining necessary approvals associated with their proposed works. Other requirements to be addressed shall include:

- Complying with any relevant legislation.
- Environmental Impact Statement.
- Environmental Assessment or Review of Environmental Factors.
- Environmental Management Plan.
- Safety requirements.
- Conditions of approval.

Utility Authorities are required to notify Council's Representative of any proposed work and allow sufficient time for Council's Representative to carry out detailed assessments of the proposal with respect to Council's assets and services to the community. The utility authority is required to provide as much notice as possible with a minimum of 4 weeks for major works and a minimum of 2 weeks for minor maintenance work.

Council shall commence its assessment of a proposal once all relevant information is submitted. The utility authority shall be advised of the outcome and any requirements and/or conditions for the proposed works following the completion of the assessment.

The utility authority is required to take into account any issues raised, requirements and conditions of approval prior to the commencement of the proposed work.

All utility services shall be installed within the Council's footway allocation in accordance with the NSW Streets Opening Conference 2009 and Councils Standard Drawing Typical cross

section. Council's Representative shall be consulted where deviation from footway allocation is unavoidable.

Utility authorities shall ensure works are being undertaken in accordance with Council's requirements, standards and specifications for road opening and restoration. Additionally, utility authorities shall quality assure their excavation, backfilling and restoration works.

A quality assurance checklist shall be completed for the execution of all works including excavation, backfilling and restoration. Copies of quality checklists including all inspection and testing results shall be forwarded to Council's Representative within 7 days of practical completion of works. At any time, Council's Representative may undertake random inspection of the works being carried out on site.

At least 7 days prior to commencement of physical work, the Utility Authority shall notify:

- Council's Representative.
- All affected residential frontage properties.

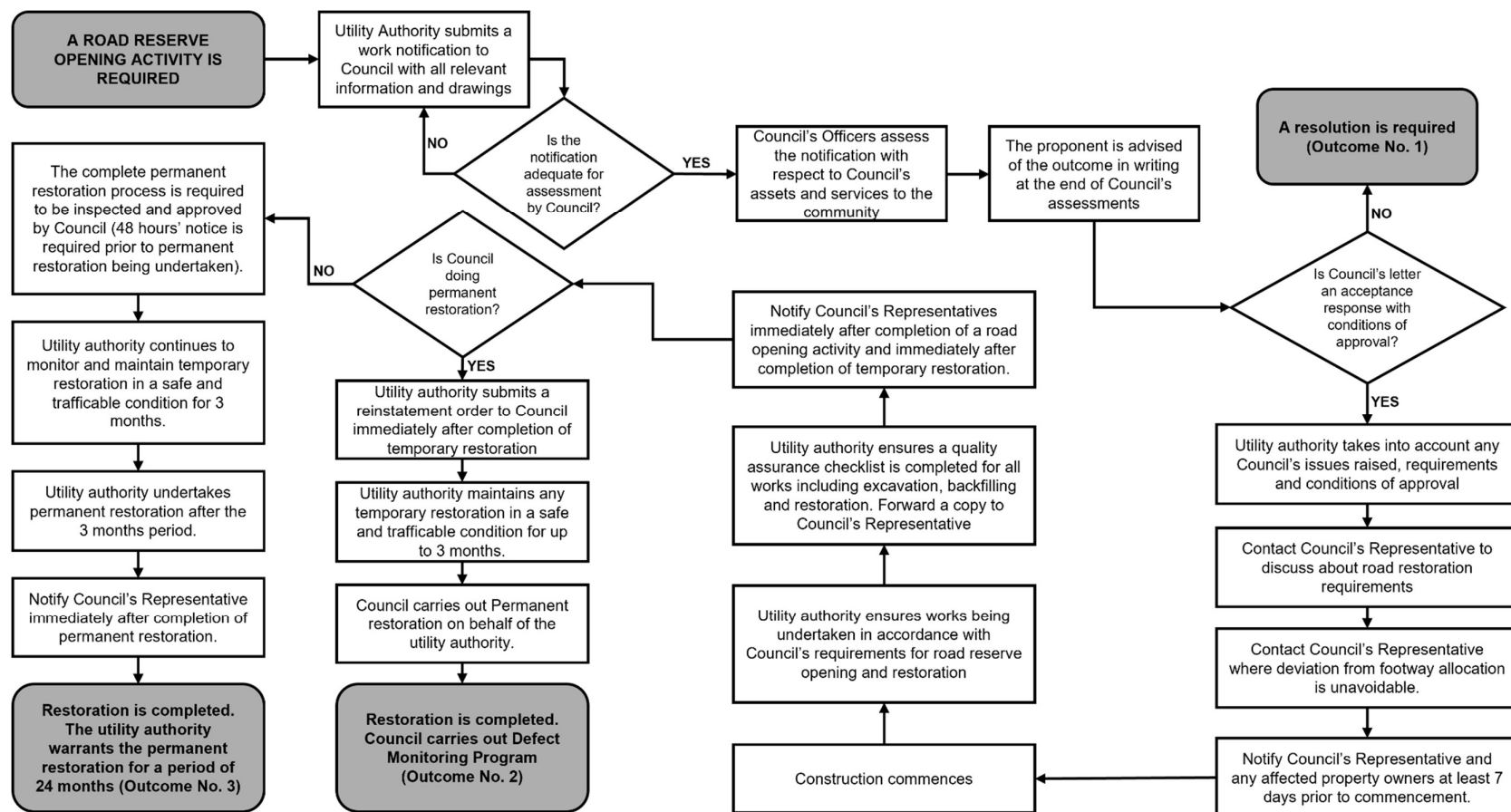
Council's Representative shall be notified immediately following the completion of all temporary and permanent restoration works.

Council shall be informed about who shall undertake permanent restoration for the proposed works. If it is decided that Council will not be undertaking permanent restoration on behalf of a utility authority, the complete permanent restoration process shall be inspected and approved by Council's Representative. Forty-eight hours' notice is required prior to permanent restorations being undertaken. Any inspection carried out by Council's Representative may be subject to an inspection fee.

The utility authority is required to warrant its permanent restoration for a period of 24 months during which time Council will carry out routine defect monitoring program for all completed restorations. During this period, the repair of defects such as subsidence and surface deterioration is the responsibility of the utility authority. Where works carried out are considered by Council to be unsatisfactory, the utility authority will be given 14 days' notice to rectify the fault. Where works are not rectified within this time frame Council may elect to undertake the rectification with costs being charged to the utility authority.

Where Council is engaged or required to undertake permanent restorations on behalf of utility authority, reinstatement orders shall be submitted to Council, immediately after completion of work. The utility authority is responsible for maintaining any temporary restoration in a safe and trafficable condition for up to a period of 3 months after Council has been formally engaged to undertake a permanent restoration. After which time, the maintenance of temporary restoration becomes the responsibility of Council relieving the utility authority of future liability.

Figure 3: Road Opening Flow Chart - Utility Authorities



7.4 Responsibility and Process for Private Individuals

In this Section, Private Individuals includes any Service Provider or contractor Service Provider engaged to carry out the required works on behalf of a Private Individuals or other parties who are not Council or Utility Authorities.

Before commencing a road opening activity, it is the responsibility of private individuals to obtain a Works within Road Reserve (WRR) (Section 138) permit, which is available on Council's website. A WRR Permit form must be completed, and associated permit fee and bond for restoration charges shall be paid by the private individual in accordance with Council's Fees and Charges. The permit will be valid for 12 months from the date of issue. In situations where private individuals have carried out a road opening activity without a road opening permit, they will be charged with a late fee in addition to the standard fees and charges.

Where a WRR activity is associated with a current Development Consent, the applicant shall also complete a WRR application form. A WRR application form is available on Council's website.

The private individual is responsible for undertaking all searches and obtaining necessary approvals associated with their proposed works. Other requirements to be addressed shall include:

- Complying with any relevant legislation.
- Environmental Impact Statement.
- Environmental Assessment or Review of Environmental Factors.
- Environmental Management Plan.
- Safety requirements.
- Conditions of approval.

All utility services shall be installed within the Council's footway allocation in accordance with the NSW Streets Opening Conference 2009 and Councils Standard Drawing – Typical Cross section. Council's Representative shall be consulted where deviation from footway allocation is unavoidable.

The private individual is required to take into account any issues raised, requirements and conditions of the permit approval prior to commencing a road opening activity.

The private individual shall ensure works are being undertaken in accordance with Council's requirements, standards and specifications for road opening and restoration. The private individual shall quality assure their excavation, backfilling and restoration works.

A quality assurance checklist completed by the private individual shall be completed for the execution of all works including excavation, backfilling and restoration. Copies of quality checklists including all inspection and testing results shall be forwarded to Council's Representative within 7 days of practical completion of works. At any time, Council's Representative may undertake random inspection of the works being carried out on site.

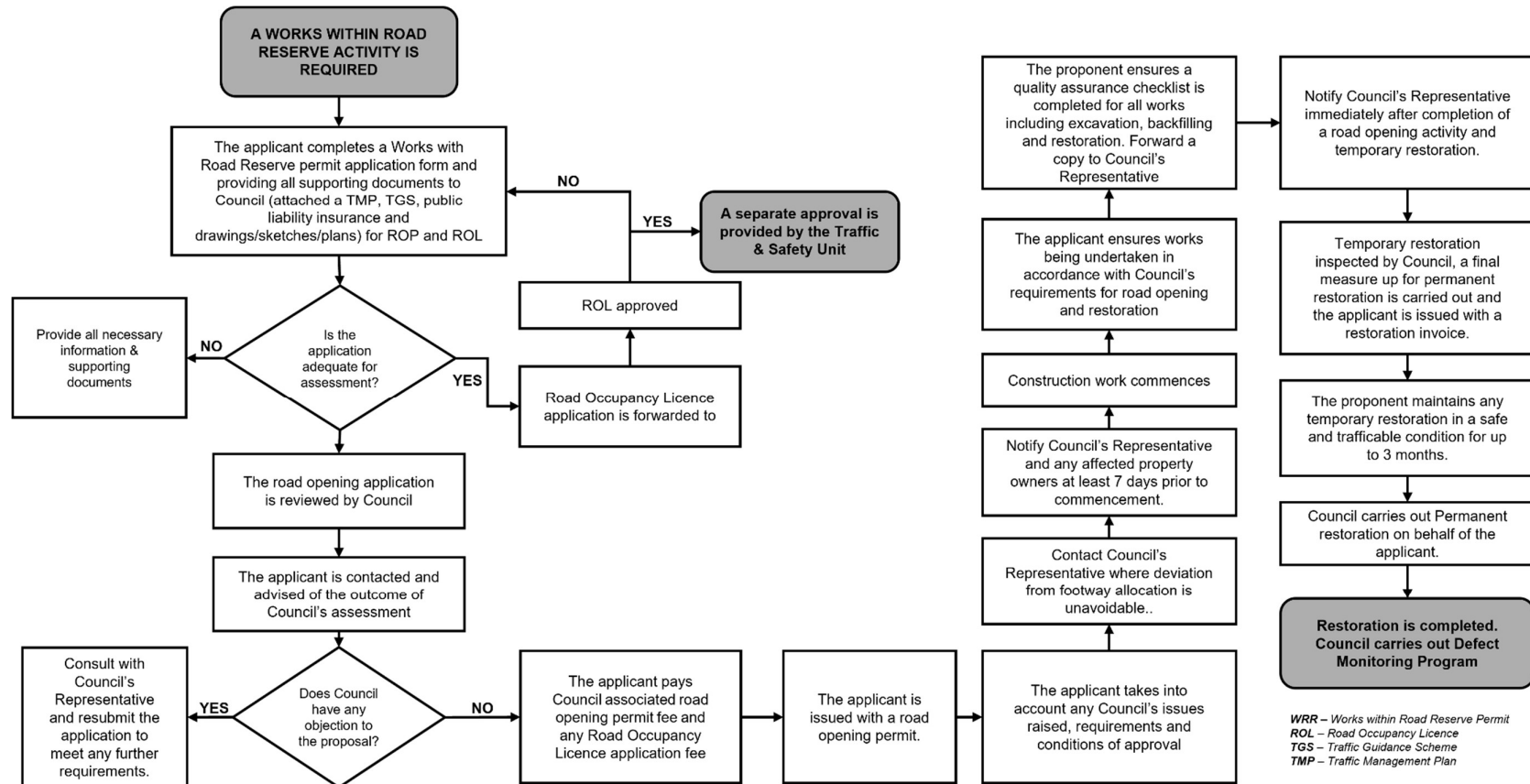
At least 7 days prior to commencement of physical work, the Private Individual shall notify:

- All relevant stakeholders including Council's Representative.
- All affected residential frontage properties.

Council shall undertake all permanent restorations on behalf of the private individual. However, the private individual is required to maintain any temporary restoration in a safe and trafficable condition for a period of up to 3 months after Council has been formally engaged to undertake a permanent restoration. After which time, the maintenance of temporary restoration becomes the responsibility of Council.

Prior to Council undertaking permanent restoration works, any temporary restoration shall be inspected by a Council's Representative, a final measure up for permanent restoration shall be required and a restoration invoice shall be issued to the applicant.

Figure 4: Road Opening Flow Chart - Private Individuals



7.5 Utility Service Installation within the Road

7.5.1 Allocation of Spaces in Footways

There are allocations for utility services within road carriageways. All utility services shall be installed within Council's footway allocation in accordance with Councils Standard Drawing - Typical Cross Section – Urban, the NSW Streets Opening Conference (2009) and the Design of Roads and Streets in NSW (DORAS), which provides guidance on coordinated utility placement and maintaining safe, functional street environments.

The first 300mm parallel to the property alignment shall be utilised at all times for the placement of utility structures such as cabinets, pillars and pedestals, consistent with the NSW Streets Opening Conference (2009) and DORAS principles, unless this space is already occupied by other utility services.

Any above ground structure placed close to the roadway may pose safety hazards to vehicular traffic. Under no circumstances shall any above ground utility structures be installed within 500mm from the back of kerb without Council's approval.

The Service Provider shall not utilise the Water Authority's defined street allocation services corridor for installation of utility infrastructure including cables, conduits, kiosks, pillars, poles or street lighting columns without written consent from the Water Authority.

Where deviation from the standard footway allocation is unavoidable, specific approval as a non-conforming application must be sought from Council's Representative prior to the commencement of works.

7.6 Services Conduits Installation

Prior to excavation of trenches for services conduits, the Service Provider shall liaise with the Service Authorities and the Accredited Service Provider Contractor Service Provider to confirm the servicing trench and co-ordination requirements of the Service Authorities.

The locations of all road crossing and longitudinal conduits and cables shall be recorded and shown on WAE drawings to be provided upon request to Council's Representative.

All services conduits, pits and other materials shall be supplied as specified by each of the Service Authorities.

The Service Provider shall set out the location of all trenching for conduits, pits and bends.

Any conflict between proposed service conduits or pits and approved Engineering Guideline shall be brought to the immediate attention of Council's Representative. Changes to approved Engineering Guidelines shall not be made without the acceptance of Council's Representative.

All trenches shall be graded at a minimum of 0.5% fall, unless prior approval is given by Council's Representative. Conduits under roads and other objects shall project at least 1000mm beyond obstructions such as kerb, subsurface drains, stormwater and water mains, and otherwise clearances to obstructions are as required by the Service Authority specified by Council's representative. The trench shall be excavated beyond these obstructions.

The installation of service conduits under existing road pavements shall be carried out by a trenchless method such as under boring unless otherwise approved by Council's

Representative. Full details of any road under bore must be provided to Council's Representative for acceptance prior to any the under bore proceeding.

Conduits shall be capped with a non-perishable removable cover prior to backfilling to prevent the entry of foreign material.

Warning tape/protection mat installed above installed services, will be as specified by the utility asset owner.

7.6.1 Compliance Inspections and Documentation

The Service Provider shall provide copies of letters from each of the Service Authorities confirming installation relating to servicing complies with their requirements.

Work-as-executed drawings shall show the plan location and type of all service road crossings. Compliance to this Specification is to be demonstrated during site inspections by Council's

Representative during the installation of all services conduits. This action shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the installation of service conduits.

PROCESS HELD: Service conduit installation.

Where there is doubt that trenches in existing road pavements have not been restored in accordance with this Specification, the Service Provider will be required to core the restoration to demonstrate compliance.

7.6.2 Non-complying Work

Where utility service conduit installation observed by Council's Representative to not comply with this or any section of this Specification the Service Provider shall be instructed verbally or in writing of the non-compliance. The non-complying item(s) must be required to be rectified prior to the final inspection.

7.7 Clearances to Council's Underground Assets

7.7.1 Water and Sewer

Minimum clearances to Council's existing water supply and sewer reticulation mains shall be to the Water Services Association of Australia (WSAA) Water and Sewer Design Codes of Australia standards or Council's minimum clearance standards, whichever is greater.

The following conditions including minimum horizontal and vertical clearances to water and sewer assets have been compiled to assist utility providers with clearances required to Council's assets.

Table 13: Utility Clearances from Water and Sewer

	Gas			Telecommunication		Electrical	
	Main Size	Minimum Clearance (mm)		Minimum Clearance (mm)		Minimum Clearance (mm)	
	& (mm)	H	V	H	V	H	V
WATER	≤ 200	300	150	300	150	500	300
	>200≤450	600	150	600	300	1000	300
	>450	1000	500	1000	500	1000	500
SEWER	≤300	300	150	300	150	500	300
	>300	600	150	600	150	1000	300
	RM≤200	300	150	300	150	500	300
	RM>200	600	150	600	150	1000	300

A minimum 1000mm horizontal (H) and 500mm vertical (V) clearance applies on large major trunk mains, sewer rising mains and larger gravity mains critical to the operation of the water and sewer systems.

Utility services shall not to be installed on the same vertical alignment as the Water Authority's main.

The proponent cannot utilise the Water Authority's defined street allocation services corridor for installation of utility services without written consent of the Water Authority (Council).

The pipe material of Council's assets may also present additional considerations for any proposed installation. Clearances may need to be increased to ensure disturbance does not incur damage to existing water and sewer assets. Compaction of trenching within close proximity to asbestos cement (AC) and cast iron (CICL) assets is restricted to methods not incorporating mechanical vibration.

Service poles located within 1.5m of water and sewer mains are to be embedded below the invert of the mains. Where poles are to be placed with reduced horizontal clearances to mains, placement shall not incur damage to mains or destabilisation of pipe support. Additionally, poles shall not to be placed within 1.5m of sewer maintenance structures.

7.7.2 Stormwater Drainage

Minimum clearances shall be provided to Council's existing and/or proposed stormwater drainage assets in accordance with requirements shown in the Table 14 and Figure 5.

Table 14: Utility Clearance from Stormwater

Council Stormwater Drainage Assets		Proposed Underground Utility Installations		
		Minimum Clearances* (mm)		
Category	Sub-category	Ca ¹	Cb ²	Ch ³
Pipe	Ø ≤ 900	300	200	300
	900 < Ø ≤ 1500	600	300	500
	Ø > 1500	600	500	1000
Box Culvert	Any size	The same as the pipe with equivalent cross-sectional area		
Pit/ Headwall	Any size	Not Acceptable	The same as the largest conduit connecting to it	

¹ Clearance above stormwater asset

² Clearance below stormwater asset

³ Horizontal clearance from stormwater asset, where proposed utility installation is running parallel

Ø Internal diameter (mm)

*Measured from the external dimensions of the stormwater drainage assets

Council Stormwater Drainage Assets		Proposed Underground Utility Installations	
		Minimum Clearances* (mm)	
Channel/Table Drain	Lined (concrete or similar)	500	500
	Unlined (e.g. turf or rock)	1000	1000

Notes:

1. Sewer mains should be installed below stormwater to minimise the possibility of backflow contamination in the event of a main break.
2. Also, where possible, water mains should be installed above stormwater and sewer mains to minimise the possibility of backflow contamination in the event of a main break.
3. For cases where there is no alternative and the main must cross under the sewer, the design shall nominate an appropriate trenchless construction technique or other water main construction and protection treatment, effectively joint-free in the vicinity of the sewer.
4. Horizontal and vertical clearances can be further reduced to 2m for distances up to 2m, where mains are to be laid past installations such as concrete pits, service poles and small structures, providing the structures will not be destabilised in the process.

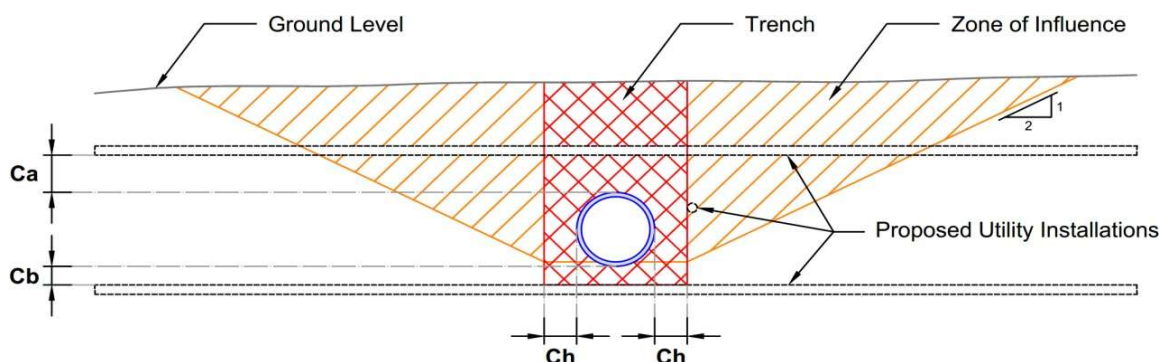


Figure 5: Typical Stormwater Clearance Requirements

Utility services that are located within 1% AEP flood zones and/or sea level rise affected zones, consideration shall be given to minimise the hazards to community and interruption to service resulting from potential flooding and future sea level rise. Information on 1% AEP flood zones and sea level rise affected zones is available on Hilltops Council's website.

Utility services shall not to be installed on the same vertical alignment as the existing and/or proposed stormwater drainage assets.

The section of the proposed mains, cables and/or conduits passing over the trench of the existing and/or proposed stormwater drainage conduits shall be joint free and self-supporting.

Pits, cabinets, poles, kiosks and/or substations shall not be installed within the trench of the existing and/or proposed stormwater drainage assets.

Pits, cabinets, kiosks and/or substations shall be installed outside the zone of influence of existing and/or proposed stormwater drainage assets, unless underpinning of the proposed structures are undertaken.

Poles shall be installed outside the zone of influence of existing and/or proposed stormwater drainage assets. However, if poles are to be installed within the zone of influence of existing and/or proposed stormwater drainage assets, the poles shall be installed to a depth that is below the zone of influence.

There shall be no installation of utility infrastructure within existing and/or proposed stormwater drainage easements and/or drainage reserves.

Should the clearances required for installing the proposed mains, cables and/or conduits passing over existing stormwater drainage assets cannot be met, the installation shall be below the existing stormwater drainage assets, unless prior approval has been given by Council's Representative.

When the proposed utility mains, cables and/or conduits are concrete encased, the clearance below the stormwater asset may be reduced by the following:

- 100mm for stormwater pipes that are smaller than 1500mm in diameter or box culverts with equivalent cross-sectional area.
- 150mm for stormwater pipes that are larger than 1500mm in diameter or box culverts with equivalent cross-sectional area.
- 150mm for a lined channel and/or table drain.
- 300mm for a creek, unlined channel and/or table drain.

7.7.3 Depth of Underground Services

Generally, the minimum depth of cover for underground utility services shall be 600mm within footways and 750mm for trench crossings and pits within the carriageway and 900mm for approved longitudinal trenches within the carriageway. For some utilities these depths will increase, see Table 15. All utility service providers need to be contacted to confirm their individual requirements.

Table 15: Nominal Depth of Cover of Utility Service

	Footway (mm)	Carriageway (mm)
Electrical		
LV Cable	600	600
HV Cable to 22kV	600	750
HV Cable 33kV and above	900	900
Gas		
≤ 400kPa		600

	Footway (mm)	Carriageway (mm)
≥1000kPa	600	900
≥3500kPa	1200	1200
Water main		
≥750mm diameter	800	800

WARNING: Table 15 outlines the depth of underground utilities and indicates only the depths at which the various utility providers are nominally laying services. **It has been prepared for information purposes only.** Existing and future services/utilities may be located at different depths from those indicated. Therefore, Service Providers intending to excavate or bore shall check with the utility providers/authorities concerned before commencing work. They must exercise care in areas where utilities are indicated by the utility providers/authorities and all utilities shall be located by hand excavation/non-destructive method, before any mechanical equipment is used.

7.7.4 Construction of Trenches

All longitudinal trenches, trench crossings and pits within the road reserve shall be constructed in accordance with Council's Engineering Guideline Specification - Standard Drawings SD 1103.

Compaction and compaction testing of backfill and pavement material shall be in accordance with Table 16 and Table 17 below, which are adapted from AUS-SPEC 1152 (Utilities). Council reserves the right to undertake Quality Control testing, including material compaction and thickness testing.

Table 16: Trenches within Footways

Trench Zone	Zone Thickness	Backfill Material	Compaction Requirement	Minimum Testing Requirement
Wearing Surface/ Course	Grassed:			
		Surface shall be top dressed and turfed with turf rolls and established with appropriate watering		
	Asphalt Pavement:			
	40mm AC	Heavy-duty AC14 or as determined by Council's Representative		
	Concrete:			
	100mm (path) or 125mm (VAC)	N25 Reinforced Concrete with SL72 mesh		

Trench Zone	Zone Thickness	Backfill Material	Compaction Requirement	Minimum Testing Requirement
Trench Backfill	600mm (min)	Select backfill material (sand as min). Not to use excavated material unless free draining, inorganic, free from stones > 100mm with the fraction passing a 19mm AS sieve with a 4-day soaked CBR $\geq$ that of the adjacent select material zone to AS 1289.6.1.2	Uniformly compact each 150mm layer over the full area and required depth within the trench to 80% relative density when tested in accordance with AS 1289.5.6.1 (Density Index Method)	1 per 2 layers per 100 linear metres of trench or per 20 road openings for openings of less than 10m ² plan area whichever results in the most frequent testing. Testing methods shall be in accordance with AS 1289.5.6.1
Bedding Zone	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification

Table 17: Trenches within Carriageways

Trench Zone	Zone Thickness	Backfill Materials	Compaction Requirement	Minimum Testing Requirement
Wearing Surface (Course)	Flexible Pavement:			
	Temporary:			
	50mm	Emulsion 7mm tack coat		
	Permanent:			
	Asphalt: as per cross section cut through (nominal 50mm unless directed by Council) on a 200mm thick base course section OR Sealed 300mm layer of base course with 14/7 seal.			
	Heavy-duty AC14 on tack coat or as determined by Council's Representative OR 14/7 hot bitumen seal			

Trench Zone	Zone Thickness	Backfill Materials	Compaction Requirement	Minimum Testing Requirement
Rigid Pavement:				
Temporary:				
	50mm	AC (Hotmix only)		
Permanent:				
	Match existing thickness (like for like)	Doubly reinforced concrete (N32 min) with SL82 mesh		
Base Course	Temporary: 250mm Permanent: 200mm min.	Select Pavement Material ARRB SR41 or DGB20 or equivalent	Uniformly compact each 150mm layer over the full area and specified depth within the trench to a relative compaction of 98% when tested in accordance with AS1289.5.2.1 (Maximum Modified Dry Density) or 102% when tested in accordance with AS 1289.5.1.1 (Maximum Standard Dry Density)	1 per pavement layer, per 100 linear metres of trench or per 20 road openings for openings of less than 10m ² plan area whichever results in the most frequent testing. Testing methods are to be in accordance with AS1289.5.1.1 or AS1289.5.2.1
Subgrade (Trench Backfill)	Varies	Select backfill material (sand as minimum). Not	Uniformly compact each 150mm layer over the	1 per 2 layers per 100 linear metres of trench

Trench Zone	Zone Thickness	Backfill Materials	Compaction Requirement	Minimum Testing Requirement
		to use excavated material unless free draining, inorganic, free from stones > 100mm with the fraction passing a 19mm AS sieve with a 4-day soaked CBR $\geq$ that of the adjacent selected material zone to AS1289.6.1.2 Stabilised sand can be submitted as an alternative backfill material	full area and required depth within the trench to 80% relative density when tested in accordance with AS1289.5.6.1 (Density Index Method).	or per 20 road openings for openings of less than 10m ² plan area whichever results in the most frequent testing. Testing methods are to be in accordance with AS1289.5.6.1
Bedding Zone	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification Stab sand alternative council rep	In accordance with Utility Authority's Specification	In accordance with Utility Authority's Specification

AS 1289.5.1.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort.

AS 1289.5.6.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material.

AS 1289.6.1.2 - Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for an undisturbed specimen.

7.8 Specification for Road Restoration

All longitudinal trenches, trench crossings and pits located within the road reserve shall be restored in accordance with Council's Engineering Guideline Specification - Standard Drawings.

Where paths, road pavements or vehicle access crossings are constructed from other materials such as quarry pavers, pattern pave concrete, bluestones, coloured concrete, or bricks, Council's Representative shall be consulted regarding the restoration of these surfaces.

7.8.1 Quality Restoration Standards for Road Pavements

7.8.1.1 Flexible Pavement

- Extend restoration to a minimum of 200mm outside excavation lines with no depression in the restoration surface. Width of remaining surface adjacent to the gutter shall be greater than 1.0m. Restoration surface shall match the road cross section.
- Saw cut trench line shall be completed.
- All joints shall be crack sealed (to a maximum of 75mm wide) and any longitudinal joints shall not be within wheel paths. There shall be no separation between joints.
- Restored trenches shall be free from broken edges and surface levels along the edges shall be flush with the surrounding pavement.
- Restoration wearing course shall be free of potholes, ravelling, rutting, shoving and any cracks greater than 1mm.
- Restore any pavement markings, signal detectors and signposts.
- Service manholes shall be flush with surrounding pavement.
- Trench restoration shall include any saw cuts extending past the trench alignment.
- The finished surface shall be swept clean at the completion of works. All rubbish, soil and other materials resulting from the sweeping shall be removed from the site.

7.8.1.2 Rigid Pavement

- For unreinforced plain concrete, reconstruct reinforced full slab.
- Extend the reconstruction of new reinforced slab 500mm outside excavation lines or extend to the nearest joint if the remaining dimension of slab is less than 1.0m. The concrete slab shall be dowelled at 500mm centres with 20mm diameter galvanised bars along longitudinal edges.
- Restoration shall have no depression and finish surface shall match the road cross section and the surrounding surfaces.
- Surface levels along the edges shall be flush with the surrounding surfaces. Restoration surface shall be free of cracking and dusting.
- Restored trenches shall have clean saw cut edges.
- Restore any pavement markings, signal detectors and signposts.
- Service manholes shall be flush with surrounding surface.

- The finished surface shall be swept clean at the completion of works. All rubbish, soil and other materials resulting from the sweeping shall be removed from the site.

7.8.2 Quality Restoration Standards for Footpath Paths

7.8.2.1 Concrete Pavement

- For paths with a width of 1.5m or less, slab replacement shall extend 200mm outside excavation or to expansion joint if within 1.0m and have full depth expansion joint into the existing slab to both sides of trench as required in accordance with Council's Engineering Guideline Specification - Standard Drawings.
- For paths with a width of 1.5m or less, longitudinal public utility service installations require full path replacement.
- For paths with a width greater than 1.5m, restoration of concrete surface shall extend 200mm outside the excavation lines and in all directions. All joining faces shall have full depth expansion joints into existing slab to both sides of trench as required in accordance with Council's Engineering Guideline Specification - Standard Drawings.
- Restored trenches shall have clean saw cut edges with no chipping. Surface levels along the edges shall be flush with the surrounding surfaces. Restoration surface shall be free of cracking and dusting.
- Control joints shall be placed in accordance with Section 10.2.4 New Reinforced Concrete Paths and Council's Engineering Guideline Specification - Standard Drawings.
- Service manholes shall be flush with surrounding surfaces and shall be free from concrete slurry.
- There shall be no water pooling on the restored surfaces.
- Finished surface shall be in accordance with Section 10.2.4 New Reinforced Concrete Paths.
- Surface colour to match existing colour.
- The finished surface shall be swept clean at the completion of works. All rubbish, soil and other materials resulting from the sweeping shall be removed from the site.

7.8.2.2 Asphalt Pavement

- For paths with a width of 1.5m or less, restoration shall extend to the full width.
- For paths with a width greater than 1.5m, restoration shall extend 200mm outside the excavation lines in all directions.
- Asphalt colour coating and pattern shall match the existing pavement.
- Restored trenches shall be free of broken edges and surface levels along the edges shall be flush with the surrounding pavement.
- Restored asphalt pavement shall be free of potholes, ravelling, rutting, shoving and any cracks greater than 1mm. Restoration surface shall have no depression.
- Restore any pavement markings and sign posts.
- There shall be no separation between pavement joints.

- Service manholes shall be flush with surrounding surfaces.
- Trench cross section shall match path cross section.
- The finished surface shall be swept clean at the completion of works. All rubbish, soil and other materials resulting from the sweeping shall be removed from the site.

7.8.2.3 Grassed

- Restoration surface levels shall be flush with the surrounding path surface.
- Restoration surface shall have no depression.
- Surface shall be top dressed, turfed with turf rolls and established with appropriate watering for the entire disturbed area. Turf shall not be placed so that it causes stormwater runoff to concentrate. Turf laid adjacent to concrete works shall be laid flush with the surface of the concrete. Refer to 15.5.2 Turf requirements.

7.8.3 Concrete Vehicle Access Crossings

- Where excavation is between the path and the property boundary, the full strip panel between the property boundary and the back of path of the vehicle access crossing shall be reconstructed.
- Where excavation is within the path section of the vehicle access crossing, the full extent between the front and rear of path shall be reconstructed.
- Where excavation is within the apron of the vehicle access crossing, the full length of slab between the layback and the path shall be reconstructed.
- New concrete pavement finish shall match the existing pavement characteristics including texture, colour, pattern and joint pattern.
- The restoration surface shall have no depression.
- New concrete slabs shall have control joints and expansion joints as required in accordance with Council's Engineering Guideline Specification - Standard Drawings.
- Saw cuts shall be clean and straight along expansion or control joints with no chipping.
- Finished surface shall be broom brushed in accordance with Section 10.2.5.3 Surface Finish of this Specification.
- The profile of layback shall match Council specifications and surface finish shall be smooth steel float finish in accordance with Section 10.2.5.3 Surface Finish of this Specification.
- Any disturbed grassed area shall be restored with turf rolls and re-established.
- Service manholes shall be flush with surrounding surfaces.
- The finished surface shall be swept clean at the completion of works. All rubbish, soil and other materials resulting from the sweeping shall be removed from the site.

7.8.4 Other Assets

For other assets (such as kerbs, gutters, traffic islands and roundabouts) that are not covered in this section, Council's Representative shall be consulted to discuss about the extent of restoration for these assets.

7.9 Additional Requirements

Where longitudinal trench wearing surface joints are located under a wheel path, the entire road lane is required to be resurfaced. Refer to Council's Engineering Guideline Specification - Standard Drawings. At intersections and roundabouts complete resurfacing may be required to avoid joints under wheel paths. Inspection of installations by Council's Representative shall be required to determine restoration requirements. Refer to standard drawing for trenching requirements in the vicinity of roundabouts located in Council's Engineering Guideline Specification - Standard Drawings.

Pits and trench crossing wearing surfacing joints shall be perpendicular to traffic flow. Refer to Council's Engineering Guideline Specification - Standard Drawings.

Maintain connection of house stormwater pipes discharging into carriageway gutters at all times. If damaged, repair or replace to the same diameter and in a sound manner to the satisfaction of Council's Representative. Provide a watertight seal to all joints and connections.

Council's Works within Road Reserve Permit application form has been designed to allow applicants applying for a Road Opening permit to also apply for a Road Occupancy Licence (ROL). A Traffic Guidance Scheme (TGS) shall be submitted with a Road Opening Permit application if the proposed works interfere with pedestrian or vehicular traffic. TGSs shall be prepared by a Safework accredited Traffic Control person.

Council approval shall be obtained in the case of any modification to the approved Notice of Proposed Works or Works within Road Reserve Permit.

All works undertaken shall comply with the standards of the following as a minimum:

- AUS-SPEC 1152 - Road Opening and Restoration (Utilities).
- AUS-SPEC 1151 - Road Opening and Restoration.
- NSW Streets Opening Conference.
- Council's Engineering Guideline Part 2 Construction Specification.

Where there is a discrepancy between the referenced standards, this document shall be considered as the minimum standard required. Any work or proposed work that does not comply shall be considered as non-conforming and specific approval shall be sought from Council. All non-conforming applications shall make reference to an industry standard such as AUS-SPEC 1152 or TfNSW QA Specification M209 Road Openings and Restoration as a minimum standard. Any proposed trenching works running adjacent to existing kerb and gutter is also considered as non-conforming.

Council may require the Service Provider to indemnify any non-conforming work (or parts of it) to ensure Council is not disadvantaged in allowing for any future road activities.

Full width or complete section replacement of the asset shall be required wherever Council considers that the road opening has compromised the integrity or operation of an existing structure.

Any conflicting utility services and survey marks both existing and proposed shall be identified and located before a Road Opening Permit shall be issued. This is the sole responsibility of the Service Provider.

It is the responsibility of the Service Provider to address all requirements associated with the proposed works such as:

- Complying with any relevant legislation.
- Environmental Impact Statement.
- Environmental Assessment or Review of Environmental Factors.
- Environmental Management Plan.
- Safety requirements.
- Conditions of approval.

Considerations shall be made for issues such as:

- Sediment and water runoff control.
- Potential damage to public trees and vegetation.
- Dust and noise control.
- Public safety.

Once a road opening activity is approved by Council, the Service Provider shall be required to obtain relevant approvals from other service owners before work commences. This obligation lies entirely with the Service Provider and any damage to other services will be the sole responsibility of the Service Provider and Council will assume no liability for damage.

Should the Service Provider wish to modify the Standard Drawing(s) or propose an alternative restoration plan, a detailed design and scope of works shall need to be provided to Council's Representative referencing all relevant sections of Council's Engineering Guideline Specification. It would be expected that this option would generally only be relevant for significant works involving multiple roads and extensive longitudinal trenches.

All costs associated with the opening, removal, temporary and permanent restorations of road assets will be borne by the Service Provider. Council is the preferred provider of permanent restoration following the completion of restoration works. A schedule of rates for the provision of permanent restoration is available on Council's website or upon request from Council's Representative.

8 Flexible Pavement Construction

8.1 General

The works covered by this section of the Specification covers the construction of flexible road pavements comprising layers of pavement material placed above the subgrade or subgrade replacement surface.

The pavements covered by this section of the Specification are to be constructed in accordance with the approved Pavement Design Report prepared by a Geotechnical Engineer and accepted by Council's Representative or resulting from subsequent recommendations by the Service Provider's Consulting Geotechnical Engineer due to further subgrade assessment as required during construction.

Flexible pavements layers covered by this section of the Specification may consist of:

Select layer:	Layer placed immediately above natural or filled subgrade.
Sub-base:	The material laid on the subgrade below the base either for the purpose of making up additional pavement thickness required, to prevent intrusion of the subgrade into the base, or to provide a working platform.
Base/Base course:	One or more layers of material usually constituting the uppermost structural element of a pavement and on which the surfacing may be placed. It may be composed of fine crushed rock, natural gravel, broken stone, stabilised material, asphalt or Portland cement concrete.
Semi-rigid pavement:	Where the base and/or the sub-base are constructed of bound materials.
Bound material:	A granular or subgrade material to which binders such as lime, cement or bitumen are added to improve structural stiffness.
Modified material:	Granular materials to which small amounts of stabilising agent have been added to improve their performance (e.g. by reducing plasticity) without causing a significant increase in structural stiffness.
Wearing surface:	That part of the pavement specifically designed to resist abrasion from traffic and to minimise the entry of water. This is covered in Section 12 - Bituminous Sealing and Section 13 - Asphalt Surfacing of this Specification.

8.2 Materials

8.2.1 General

Material shall be supplied to comply with the Traffic Category applicable to the pavement. Traffic categories are as defined in Annexure 3051/A of TfNSW QA Specification 3051 Granular Base and Sub-base Materials for Surfaced Road

Pavements or the Categories R1 and R2 in the IPWEA Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010 (referred to as IPWEA Specification from hereon).

Reclaimed asphalt pavement (RAP) material may be used in asphalt pavement mix design in accordance with the following specifications, subject to the Geotechnical Engineer's/Pavement Designer's approval and if agreed to by Council's Representative:

- TfNSW QA Specification 3152 Aggregates for Asphalt.
- TfNSW QA Specification 3153 Reclaimed Asphalt Pavement Material.
- TfNSW QA Specification R116 Heavy Duty Dense Graded Asphalt.
- TfNSW QA Specification R117 Light Duty Dense Graded Asphalt.

Refer to the relevant asphalt specifications for permissible level of RAP for the applicable product and pavement application requirements.

At least 14 days prior to material placement, copies of recent test results (not more than 3 months old) of the supplied material and certification by a NATA registered geotechnical laboratory of compliance with TfNSW QA Specification 3051 Unbound and Modified Base and Sub-base Materials for Surfaced Road Pavements, or the IPWEA Specification shall be provided to Council's Representative for approval.

No material shall be delivered until Council's Representative has approved the source of the material supply.

Any changes to the approved material and source shall be made in writing to Council's Representative. No delivery of material under the alternative proposal shall take place without the approval of Council's Representative. The cost of testing associated with any alternative proposal shall be borne by the Service Provider.

8.2.2 Select Layer Material

Approved select layer material shall be defined as fill material including sand, soil or broken rock obtained from site excavations or approved borrowed areas remote from site. Such material shall:

- Have a maximum Plasticity Index of 20 in that fraction passing the 0.425mm sieve.
- Be free of material greater than 75mm in size, contain less than 2% organic matter, and be capable of being brought to the required moisture content.
- When tested in accordance with TfNSW Test Method T117 - California Bearing Ratio of Remoulded Specimens of Road Construction Materials following a minimum of 10 days soaking, the fraction passing 19mm AS Sieve shall have a CBR value in excess of 20.
- Select Layer material requirements shall be confirmed and nominated by the project Geotechnical consultant. All select layer material specifications shall be submitted to Council for review forming part of the pavement design and or Geotechnical report for the project.

Approved select layer material obtained shall only be imported from sites having the necessary approvals and waste classification certification for its intended use and comply with Table 18.

Table 18: Select Layer Material Requirements

Test Method	Description	Select Layer Material Requirements ⁴				
		Type CBR15	Type CBR12	Type CBR10	Type CBR8	Type CBR6
AS 1289.3.1.1	Liquid Limit	Max 40	Max 40	Max 40	Max 45	Max 45
AS 1289.3.4.1	Linear Shrinkage	Max 7	Max 8	Max 8	Max 9	Max 10
AS 1289.3.6.1	Passing 0.075mm sieve	Max 45	Max 45	Max 50	-	-
AS 1289.3.6.1	Plasticity Index x% Pass 0.425mm sieve	Max 900	Max 1000	Max 1200	Max 1500	Max 1800
AS 1289.6.1.1	% swell in CBR test ^{1,2}	Max 1.0x	Max 1.3	Max 1.6	Max 2.0	Max 2.5
AS 1289.6.1.1	10-day soaked CBR (95% modified ^{1,2,3} compaction)	Min 15	Min 12	Min 10	Min 8	Min 6

Notes for Table 18:

1. Moisture content for CBR tests are to be as follows:

- for materials with a Unified Soil Classification of GW, GP, GC, SW, SP, SC, or CL, 2.0% (+/- 0.5%) dry of the modified optimum moisture content.
- for materials with a Unified Soil Classification of GM or SM, 2.0% (+/- 0.5%) wet of the modified optimum moisture content.
- for materials with dual classifications consisting of soil groups from both those listed above, one test each at 2.0% (+/- 0.5) dry and 2.0% (+/- 0.5%) wet of the modified optimum moisture content.

The lowest CBR value of the two tests shall be taken as being representative of the material tested.

2. The surcharge mass to be applied during soaking and testing of the test specimen shall be 4.5kg, or as determined from Figure 7 of AS 1289.6.1.1 based on a wet density for the overlying materials of 2.0 t/m³.

3. The period of soaking will be 10 days or until swelling movements have ceased, whichever is longer.
4. Select layer material pre-treatment:
 - Select layer material shall be pre-treated prior to testing. Pre-treatment of samples shall be carried out in accordance with the requirements of Table 18 and as detailed below.
 - Pre-treatment shall comprise cycles of Modified compaction in accordance with Test Method AS 1289.5.2.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort using the size of mould and the associated compactive effort applicable to the size and grading of the sample. The sample shall be conditioned to a moisture content between 90% to 110% of the optimum moisture content for pre-treatment. Fragments larger than 53mm in size shall be initially broken down to a size less than this value. Pre-treatment must be carried out on all materials for use in tests prescribed in Table 18. Pre-treatment is in addition to any compaction required for those tests. The pre-treatment, if any, must be shown on all test reports.
5. For fine grained and medium grained soils, as defined in AS 1289.0 - Methods of testing soils for engineering purposes - Definitions and general requirements, pre-treatment shall be followed by the following:
 - Materials retained on the 19mm sieve shall be replaced by an equal proportion by mass of materials passing the 19mm sieve and retained on the 4.75mm sieve.
 - Percentage by mass of materials retained on the 19mm sieve and the fact that it was replaced shall be included in all test reports.

AS 1289.3.1.1 - Methods of testing soils for engineering purposes - Soil classification tests - Determination of the liquid limit of a soil - Four point Casagrande method.

AS 1289.3.4.1 - Methods of testing soils for engineering purposes - Soil classification tests - Determination of the linear shrinkage of a soil - Standard method.

AS 1289.3.6.1 - Methods of testing soils for engineering purposes - Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving.

AS 1289.6.1.1 - Methods of testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen.

Table 19: Sample Origin – Sampling Location – Pre-Treatment

Sample Origin	Sampling Location	Pre-Treatment
Excavated Sedimentary Rock	Compacted in-place materials	1 cycle of modified compaction
	All other locations	3 cycles of modified compaction
All Other Sources	Compacted in-place materials	No pre-treatment required
	All other locations	1 cycle of modified compaction

8.3 Construction

8.3.1 Delivery and Spreading

The pavement base, sub-base and select material shall be constructed in accordance with the approved design. Council's Representative shall approve the selection of materials to meet the required pavement composition. Pavement base, sub-base and select material shall not be placed on the subgrade or underlying layers of pavement until requirements applying to those layers are met and test results confirmed.

Material shall not be placed over a layer, except for moderately to highly expansive clay sub grades, with moisture content exceeding 90% of the laboratory optimum moisture content as determined by AS 1289.5.2.1, or that has become rutted or mixed with foreign matter. Moderately to highly expansive clay sub grades shall be maintained at 90 to 100% of optimum moisture until covered by subsequent layers. If at any time the subgrade material should become rutted, or mixed with the pavement material, the Service Provider shall at his own expense remove the material, reshape and compact the subgrade and/or sub-base material, and replace the pavement material with suitable fresh material.

Base, sub-base and select materials, when delivered, shall have moisture contents within $\pm 2\%$ of the modified optimum moisture content.

The material shall be spread in uniform layers as near as practicable to the required thickness by direct tipping from suitable vehicles or using a mechanical spreader.

Spreading shall be undertaken by a method that will ensure segregation does not occur. The Service Provider shall submit full details of the proposed method of spreading for the approval of Council's Representative at least 2 weeks before pavement construction is commenced.

The sub-base material shall be spread in uniform layers of between 100mm and 200mm to provide the compacted sub-base thickness as specified on the approved drawings. The base material shall be spread in one uniform layer that will provide the compacted thickness as specified in the approved drawings.

Spreading shall be undertaken by a method which will ensure segregation does not occur and movement of material is kept to a minimum. The Service Provider shall submit

full details of the proposed method of spreading for approval of Council's Representative at least 14 days before commencement of sub-base operations.

Sub-base material shall not be placed on the roadway more than 24 hours in advance of compaction.

8.3.2 Compaction and Trimming

During compaction the surface shall be kept trimmed and material added where necessary to produce a tight dense surface parallel with the finished wearing surface so that the compacted thickness of each layer is in accordance with Section 8.3.2 above.

Where a course of a particular material is composed of several layers they shall be of approximately equal thickness within these limits. The surface to receive an additional layer, of similar material, shall be lightly scarified prior to placement and compaction of the following layer.

Each single layer shall be compacted so that the relative compaction over its entire area and depth meets the requirements of Section 8.4 Pavement Construction Compliance Criteria.

At the time of compaction of each layer the moisture content of the material shall be adjusted to permit the specified compaction to be attained to a moisture content between 60% and 90% of the optimum moisture content as required in Section 8.4.2 below. Material containing excess moisture shall not be compacted until it has dried out to the specified moisture content. If there is insufficient moisture in the material for it to be compacted as specified, water shall be added. No additional payment will be made for wetting or drying the material to be compacted.

Surfaces of base material (i.e. surfaces to receive a bituminous surfacing) shall be constructed slightly higher than the specified levels and cut to profile by power grader or trimming machine towards the end of the compaction process. Rolling shall then continue to produce the specified density and a tight, even surface without loose stones or a slurry of fines.

The top of the base, sub-base or select material layers shall be trimmed and compacted to produce a tight dense surface parallel with the finished wearing surface so that the levels do not vary from the levels shown on the approved drawings or as determined by Council's Representative in accordance with Table 21 Pavement Layer Tolerance.

Prior to placement of the next pavement layer where the material has been left for an extended period or has been subject to rain, a visual inspection including proof rolling shall be carried out by the Service Provider in the presence of the Geotechnical Consultant and Council's Representative. Should a dispute arise regarding the adequacy of the material, additional moisture content and compaction testing shall be carried out by the Service Provider to prove compliance.

Placement of successive pavement layers shall closely follow satisfactory testing of the underlying layer. The test results for the underlying layer shall be verified for the Service Provider by the Geotechnical Consultant in writing prior to a continuation of construction of subsequent layers.

Where a layer that has been accepted by Council's Representative and is subsequently contaminated as a result of the Service Provider's activities, Council's Representative may withdraw their acceptance of the layer.

8.3.3 Matching to Existing Pavements

Where the pavement is to be joined to an existing pavement it shall be done in accordance with Engineering Guideline Specification - Standard Drawings and must not compromise ride quality.

8.4 Pavement Construction Compliance Criteria

8.4.1 Compaction Requirements

Base, sub-base, select layer and subgrade material shall be compacted to the following relative compaction ratios in accordance with TfNSW QA Specification R71 Construction of Unbound and Modified Pavement Course and TfNSW Guide to QA Specification R44 Earthworks, as summarised in Table 20.

Table 20: Minimum Relative Compaction

Design ESAs < 1x10 ⁷	
Layer	Standard Maximum Dry Density
Base course	102%
Sub-base course	100%
Select layer	100%
Subgrade	98%
Design ESAs > 1x10 ⁷	
Layer	Modified Maximum Dry Density
Base course	100%

Proof rolling prior to compaction testing shall be required to demonstrate adequate stability of the select layer material when requested by the Consulting Geotechnical Engineer or Council's Representative. Proof rolling is not to be used as a measure that satisfactory compaction has been achieved.

8.4.2 Moisture Content

Base, sub-base and select material shall have moisture contents in the range of 60% - 90% of the laboratory optimum maximum moisture content as determined by AS 1289.5.1.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort or AS 1289.5.2.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort as applicable, when tested for compaction.

8.4.3 Surface Tolerances

On completion of placement, compaction and trimming, base, sub-base and select material courses shall comply with the tolerances itemised in Table 21 below. Surface shape shall be such that water cannot accumulate at any point.

Testing of pavement layer tolerances shall be carried out by the Service Provider in the presence of Council's Representative at a time suitable for Council's Representative to attend the site.

Each pavement layer is to be surveyed by the Service Provider for level and thickness conformance. Copies of this survey information shall be provided to Council's Representative upon request.

Table 21: Pavement Layer Tolerance

Item	Criteria	Tolerance
Pavement Layers		
Base	Surface Level	± 10mm if adjacent to concrete gutter for asphalt + 10mm to 0mm if adjacent to concrete gutter for flush seals + 10mm to 0mm if no gutter
	Thickness	+ 25mm to 0mm
	Straightness	15mm maximum departure from 3m straight edge placed on the surface both parallel and perpendicular to the pavement centre line
Sub-base	Surface Level	± 10mm
	Thickness	+ 10mm to - 25mm
	Straightness	15mm maximum departure from 3m straight edge placed on the surface both parallel and perpendicular to the pavement centre line
Select material/subgrade	Thickness	+ 0mm to - 30mm
	Straightness	20mm maximum departure from 3m straight edge placed on the surface both parallel and perpendicular to the pavement centre line
Pavement Width		
Width of pavement	Design centre line to pavement edge	- 0mm to + 300mm from dimensions specified
	Average	Average width from 3 random locations to be not less than the dimension specified

Notes for Table 21: Tolerances apply to the top of pavement layer. Pavement layer levels are determined from design surface levels with allowance for design layer thickness or surfacing type as follows:

1. For flush sealed pavements against concrete edge strips, lips of gutters etc the finished base course shall not be below the lip level, etc.
2. For AC surfaced pavement the top of base course surface shall be at a depth equal to the proposed AC thickness below the design pavement surface level.

8.4.4 Surface Deflection

Council's Representative shall determine IF deflection testing is to be undertaken to ensure the constructed pavement thickness is below the maximum acceptable deflection.

All pavement layers are subject to a proof roll using either a 15 tonne fully ballasted multi tyres roller OR single steer, bogie drive tipper loaded to legal capacity. The test vehicle travels at slow walking pace over the nominated area for testing. Observers are to be situated on both sides of the vehicle and adjacent to the loaded bogie tyre set. As the vehicle moves forward, observers observe the finished surface for deflection. Where such areas are noted to exhibit vertical movement by eye, it is to be flagged immediately to the service provider for locating and reworking. Where the majority of the area is deemed to be moving, the area has failed and is required to be reworked. If the proof roll does not detect any movement, it is deemed satisfactory in terms only of the proof roll. The area shall comply with all the other test parameters of compaction and level conformance to trigger a full pass of that area/section of work. The respective finished layer proof roll shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the proof roll with the other nominated compliance details stated in Section 8.4.

PROCESS HELD: Compliance of pavement layer.

Where deflection testing is required acceptable final surface Benkleman Beam deflections shall conform to the maximum permissible values in Table 22 below.

Council acceptance of pavement thickness designs in no way negates the maximum deflection criteria from being complied with.

Progressive Benkleman Beam Deflection testing at the top of subgrade, select and sub-base layers is not required for compliance. However, as a check to ensure proposed pavement thickness above these layers will result in the required maximum acceptable deflections at the pavement surface, this additional testing is recommended. The Service Provider should seek the advice of the Geotechnical Consultant regarding this issue.

Table 22: Pavement Surface Maximum Acceptable Deflections

Design Traffic (ESAs)	Unbound Pavement (mm)	Bound Pavement (mm)	Design Traffic (ESAs)	Unbound Pavement (mm)	Bound Pavement (mm)
1 x 10 ⁴	2.10	1.22	7 x 10 ⁵	1.05	0.65
2 x 10 ⁴	1.95	1.18	8 x 10 ⁵	1.00	0.62
3 x 10 ⁴	1.90	1.15	9 x 10 ⁵	0.98	0.58
4 x 10 ⁴	1.82	1.10	1 x 10 ⁶	0.94	0.56
5 x 10 ⁴	1.77	1.08	2 x 10 ⁶	0.935	0.55
6 x 10 ⁴	1.72	1.05	3 x 10 ⁶	0.930	0.51
7 x 10 ⁴	1.67	1.02	4 x 10 ⁶	0.92	0.48
8 x 10 ⁴	1.62	1.01	5 x 10 ⁶	0.91	0.47
9 x 10 ⁴	1.55	1.00	6 x 10 ⁶	0.905	0.46
1 x 10 ⁵	1.50	0.95	7 x 10 ⁶	0.90	0.45
2 x 10 ⁵	1.42	0.85	8 x 10 ⁶	0.89	0.44
3 x 10 ⁵	1.28	0.81	9 x 10 ⁶	0.88	0.43
4 x 10 ⁵	1.20	0.75	1 x 10 ⁷	0.87	0.425
5 x 10 ⁵	1.15	0.72	2 x 10 ⁷	0.84	0.395
6 x 10 ⁵	1.10	0.70			

8.4.5 Surface Deviation and Ride Quality

The pavement wearing course shall have a smooth longitudinal surface profile without obvious irregularities, subject to the satisfaction of Council's Representative - refer to Table 8.6 for Surface Deviation and Ride Quality testing requirements. Any non-conformities shall be rectified by the Service Provider before acceptance of the works by Council's Representative.

8.5 Compliance Testing and Sampling Requirements

8.5.1 General

Testing requirements for flexible pavement works shall be in accordance with this Specification. However, some pavements for major access roads, industrial subdivisions

and commercial access roads may be subject to a site-specific specification for testing. Site specific requirements will be contained in the Council accepted pavement design documentation or other approved documentation relating to the particular pavement.

A Consulting Geotechnical Engineer shall be employed by the Service Provider to carry out all testing and inspecting, other than tolerance testing, required to confirm materials and construction compliance for flexible pavements and any other specification required by the Consulting Geotechnical Engineer. The Consulting Geotechnical Engineer shall hold a current NATA Registration for the relevant tests. All test results certificates/reports shall be forwarded to Council's Representative.

For all Flexible Pavement testing the Consulting Geotechnical Engineer shall determine the location where sampling and testing will be taken in accordance with the location and frequency of testing requirements in Table 23 - Pavement Construction Test Methods and Frequency of Testing below. This shall be carried out independently of any advice or request by the Service Provider responsible for the works.

8.5.2 Materials

Pavement material test results from a NATA registered organisation confirming that the material to be supplied to the site complies with this Specification shall be provided to Council's Representative prior to the use of the material on site. These test results shall not be more than 3 months old.

Site testing for compliance of materials that have been delivered to site and placed will be limited to the following:

- Particle size distribution, plasticity index, liquid limit and plastic limit for sub-base and base layer materials.
- Plasticity index, liquid limit, plastic limit, linear shrinkage and 4-day soaked CBR for select layer material.

Testing shall be carried out at the frequency shown in Table 23 - Pavement Construction Test Methods and Frequency of Testing below. Full testing of material quality requirements may be

requested to confirm total compliance in the case that the Consulting Geotechnical Engineer and

Council's Representative consider this necessary.

8.5.3 Relative Compaction

All flexible pavement layers shall be tested for relative compaction to the full depth of the layer. Where a pavement layer is made up of multiple courses, each course shall be tested separately.

A minimum of 2 tests per course of compacted pavement material shall be carried out for any road less than 75m in length or section of pavement construction less than 75m in length.

The requirement for relative compaction testing may be relaxed by Council's Representative on small road shoulder type construction for a single residential lot where the width of the new pavement is less than 1m or where new kerb and gutter is founded on an existing compacted pavement of layer of 150mm thickness or more.

8.5.4 Deflection

When requested by Council's Representative tests to determine final surface deflections shall be carried out for all new pavements.

8.5.5 Frequency and Location of Testing

The frequency of testing shall be appropriate to verify conformity and shall not be less than that stated in Table 23 below or as described below unless otherwise approved by Council's Representative. If Table 23 does not cover a particular situation, the Consulting Geotechnical Engineer in consultation with Council's Representative shall specify the required frequency of testing.

Table 23: Pavement Construction Test Methods and Frequency of Testing

Item or Characteristic to be Tested	Test Methods for Compliance	Frequency of Testing (whichever results in the most tests)
Sub-base and base pavement material quality conforming to TfNSW - Pre-Supply Testing	In accordance with tests specified in TfNSW QA 3051 or the IPWEA Specification	Test results that are less than 3 months old from each material supplier for each material to be supplied
Sub-base and base pavement material quality - Initial Testing refer to 8.5.2 above	In accordance with tests specified in TfNSW QA 3051 or the IPWEA Specification	1 per pavement layer for every 200 linear metres of pavement or 1 per layer for each road greater than 75m length
Sub-base and base pavement material quality conforming to TfNSW - Full Testing refer to 8.5.2 above	In accordance with tests specified in TfNSW QA 3051 or the IPWEA Specification	When required by Consulting Geotechnical Engineer or Council's Representative
Select material quality - Pre-Supply Testing	In accordance with tests in Table 8.1	Test results that are less than 3 months old from each material supplier for each material to be supplied
Select material quality - On- Site Testing	In accordance with tests in Table 18	1 per every 200 linear metres of pavement or one for each road greater than 75m length
Standard or modified maximum dry density and optimum moisture content for each different pavement material type	AS 1289.5.2.1 AS 1289.5.1.1	1 test for each different material type or as required by the GITA

Item or Characteristic to be Tested	Test Methods for Compliance	Frequency of Testing (whichever results in the most tests)
Relative compaction and moisture content for each course placed within a layer of pavement material	AS 1289.5.4.1 AS 1289.5.3.1 AS 1289.5.8.1 AS 1289.5.7.1	Locations of tests to be determined as described in Section 8.5.6 below by 'roll of a dice' method. 2 tests in sections of pavement or roads less than 50m long. 3 tests in sections of pavement or roads between 50m and 85m long. For roads or sections of pavement greater than 85m length generally 1 test in the first 12m by chainage, the next test in next 10m to 60m after the first, then tests at 50m intervals following until a test within the last 60m of the road, then a test with the last 12m. 1 additional test in each turning head or cul-de- sac
Surface deviation (see note 1 below)	Deviation from 3m straight edge laid in any direction by no more than 5mm	1 test per 20m ² minimum.
Ride quality	In accordance with tests specified in TfNSW QA R71 and TfNSW Test Methods T182 or T188	Continuous reading per Lot when this test is required by Council's Representative
Deflection	AGPT05-11	Tests in alternative wheel paths at maximum 20m intervals both sides of the road

Note 1: This test is not required to be carried out by the Consulting Geotechnical Engineer. The Service Provider is to carry out this test in the presence of Council's Representative.

Abbreviations in Table 23:

Transport for NSW QA Specification 3051 - Granular Base and Sub-base Materials for Surfaced Road Pavements.

Transport for NSW QA Specification R71 - Construction of Unbound and Modified Pavement Course.

IPWEA Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010.

AS 1289.5.1.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort.

AS 1289.5.2.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort.

AS 1289.5.3.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of the field density of a soil - Sand replacement method using a sand-cone pouring apparatus.

AS 1289.5.4.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio.

AS 1289.5.7.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Compaction control test - Hilf density ratio and Hilf moisture variation (rapid method).

AS 1289.5.8.1 - Methods of testing soils for engineering purposes - Soil compaction and density tests - Determination of field density and field moisture content of a soil using a nuclear surface moisture density gauge - Direct transmission mode.

AGPT05-11 Austroads Guide to Pavement Technology Part 5: Pavement Evaluation and Treatment Design.

8.5.6 Determination of Relative Compaction Test Locations

The location of relative compaction tests for road pavements shall be determined in accordance with TfNSW QA Specification Q6 as detailed below unless another random selection process has been approved by Council's Representative.

The validity of Lot testing depends on and requires the random selection of test site locations. At the start of the selection process, every point in the Lot must have an equal chance of being selected. Test site selection is to be in accordance with TfNSW QA Specification Q6, Annexure L3, and is to be prepared and calculated carried out by the laboratory. Laboratories must be able to demonstrate their random site selection process conforms to QA Specification Q6, L3.

8.5.7 Non-complying Tests and Retesting Requirements

8.5.7.1 General

A non-compliance report shall be submitted to Council's Representative for any non-complying works that the Service Provider is requesting acceptance of. This report shall contain information in support of the request. Work shall not proceed further on any non-complying item until Council's Representative has considered the non-compliance and approved the works to proceed.

8.5.7.2 Non-complying Tolerances

In the case of non-complying tests for straightness the Service Provider shall immediately rectify the non-compliance and retest the entire area of rework prior to covering up of the subject area.

In the case of non-compliant level tolerances, the Service Provider shall rectify the non-compliance and re-level the entire area of rework prior to covering up. All complying levels shall be confirmed by level checks by the Service Provider on each pavement layer which shall be provided to the Council's Representative.

8.5.7.3 Non-complying Relative Compaction and Moisture Test Results and Retesting Requirements

Where relative compaction and moisture content does not comply based on test results the Service Provider shall rework the layer or course for a length of 25m either side of failed test location for the full width of the pavement.

Retesting of the reworked area shall be carried out in accordance with the requirement for testing a 50m or shorter road as described in this Specification. If the failed test is in a 50m or shorter section of pavement or the road is shorter than 50m then the whole length of the section or road shall be reworked and retested in accordance with this Specification. Locations for retests shall be determined by 'roll-of-the-dice' methods as described in this Specification. Test certificates for retests shall clearly state that they are retest of a particular test and provide details of that particular test.

8.5.7.4 Non-conforming Material

All non-conforming material as determined by testing shall be removed and replaced with conforming material. Additional testing may be carried out by the Service Provider to determine the extent of the non-complying material. The extent of this testing will be at the discretion of the Service Provider. However, until additional test results that may isolate a non-compliant material to a particular area are provided to Council's Representative all material of the type on the site will require removal.

8.5.7.5 Non-conforming Deflection Tests

When a deflection test fails to meet the maximum deflection test criteria, treatment of the failed section shall be deemed as a length of 25m either side of the failed test location. This 50m length of pavement shall be treated, reworked or reconstructed as determined by the Service Provider in consultation with the Consulting Geotechnical Engineer.

Retesting will be required to demonstrate the failed section achieves the maximum deflection criteria.

8.6 Compliance Inspections and Documentation

The Service Provider shall provide copies of the following documents:

- All pavement compaction tests and retests, material tests, Benkelman beam test certificates if applicable and reports as required by this section of the Specification.
- Service Provider's level conformance survey for the completed sub-base and/or base layer as related to the approved design.

Compliance to this Specification is to be demonstrated during site inspections by the Accredited Certifier or Council's Representative during the construction of flexible pavements. This action shall constitute a **HOLD POINT**.

HOLD POINT

Councils' representative shall be issued with all pavement compaction tests and retests, material tests, Benkelman beam test certificates if applicable and reports as required by this section of the Specification in addition to the level conformance survey for the completed sub-base and/or base layer as related to the approved design.

PROCESS HELD: Select, Subbase and Base course construction

8.7 Opening of Base, Sub-base and Select Material Layers to Traffic

The flexible pavement shall not be opened to traffic, other than construction traffic, until the specified bituminous surfacing has been completed unless otherwise approved by Council's Representative. If the base layer of pavement is approved to be opened before final surfacing, it shall be surfaced first with a suitable temporary seal or primer seal. Any damage to the seal prior to placement of asphalt will require resealing of the damaged area. Any requirement for resealing will be determined by Council's Representative.

9 Standard Pavements and Other Pavement Requirements

9.1 General

This section covers the construction requirements for pavements to be constructed in accordance with Council's Engineering Guideline Specification.

9.2 Standard Pavement

9.2.1 Flexible Pavement for Road Shoulder, Half Road and Kerb and Gutter

This section applies to pavement design up to 40m in length and 3m in width.

Where no pavement design has been prepared, Council's Representative may give approval for use of the following standard flexible pavement configurations on access roads. Refer to Table 6.1 Road Hierarchy and Road Width Schedule in the Engineering Guideline Specification - Design Guideline for road classification details.

Flexible pavement materials and construction shall conform to the requirements of Section 8 - Flexible Pavement Construction for material quality and testing unless otherwise approved by Council's Representative.

9.2.1.1 Standard Flexible Pavement – Sand/Silty Sand Subgrade CBR Greater than or Equal to 7.0

- Subgrade greater than or equal to CBR 7.0
- 150mm thick sub-base
- 150mm thick base
- Single coat 14/7mm double-double seal

9.2.1.2 Standard Flexible Pavement – Sandy Clay/Clayey Sand/Clay Subgrade CBR Greater than or Equal to 3.0 up to 7.0

- Subgrade greater than or equal to CBR 3.0
- 300mm thick sub-base
- 120mm thick base
- Single coat 10mm seal
- 30mm AC10

Or

- Subgrade greater than or equal to CBR 7.0
- 300mm thick sub-base
- 150mm thick base
- 14/7mm double-double seal

For subgrades with a CBR less than 3.0 a Consulting Geotechnical Engineer shall be engaged to recommend treatment or replacement options to modify the subgrade which result in a subgrade CBR equal to or greater than 3.0.

9.2.2 All Weather Surface

Where the approved drawings or conditions of Development Consent require an All-Weather Surface or All-Weather Pavement the following minimum construction is required:

- Width of the pavement shall be a clear 4m unless otherwise shown or conditioned.
- Surface crossfall shall be one way and vary between 2% and 6% to suit the topography, 4% is desirable.
- Pavement shall consist of a 200mm minimum thickness of compacted road base material type complying with Section 8 - Flexible Pavement Construction. The use of alternative road base materials shall require acceptance by Council's Representative.
- Road base shall be founded on a subgrade meeting the requirements of Section 5 - Site Clearing and Bulk Earthworks. The subgrade shall be proof rolled and inspected by Council's Representative.
- Surface shall be sealed with a minimum single 10mm seal or 14/7mm double-double seal for the full 4m width, or other width as approved or conditioned.
- Table drains, cross drains and piped culverts are to be provided where shown on the approved drawings or where required on site to provide a runoff regime similar to that of the pre-construction site condition.
- All drains, stormwater inlets and outlet areas shall be adequately stabilised and disturbed areas revegetated.

9.2.3 Residential Lot Battle-Axe Handle Driveway Pavements

Where no detail or geotechnical pavement report is provided as a part of the approved documentation, residential lot battle-axe handle driveway pavement subgrade and sub-base construction shall conform to the requirements of Section 5.5 Road Pavement Subgrades and Section 8 - Flexible Pavement Construction of this Specification.

The minimum requirement for residential lot battle-axe handle driveways shall be:

- Width of the concrete pavement shall be 3m minimum or as shown on the construction certificate drawings.
- Natural or filled subgrade shall be compacted to 100% standard relative compaction and display no soft areas when proof rolled.
- A 75mm minimum thick layer of road base or sub-base quality material compacted to 100% standard relative compaction shall be placed on the subgrade and below the concrete.
- The pavement shall be a 125mm minimum thick N32 normal strength grade concrete reinforced with SL72 mesh placed with 50mm minimum top cover.
- Full depth dowelled expansion joints shall be provided in the concrete pavement at maximum 6 metre centres. Dowels shall be 400mm long R12 at 400mm centres centrally placed in the slab and held in place with a proprietary product such as "Connelly Joint" or equivalent. The top of the key joint shall have a smooth plastic strip or similar flush with the finished surface. One half of the dowel shall be treated with a permanent debonding agent such as bitumen or a proprietary dowel joint product to allow movement. A cap shall be provided to the end of debonded dowels to allow for movement.

- Concrete shall be initially steel float finished and then before initial set broom brushed to a non-slip texture. A nominal 100mm wide steel edging tool shall be used to provide a 10mm radius to smooth the perimeter border and all edges.
- All service conduits where required to service the future rear allotment shall be placed before the concrete access pavement is poured.

In the case that a higher standard of construction is nominated on the drawings then the standard on the drawings shall be adopted.

The vehicle access crossing located within the road reserve or proposed road reserve shall be constructed in accordance with Section 10.2.5 Vehicle Access Crossings of this Specification and Council's Engineering Guideline Specification - Standard Drawings.

9.2.4 Rural Area Vehicle Access Crossings

Rural vehicle access crossings may be constructed in flexible pavement in accordance with Section 9.2.1. The pavement shall extend to the existing road pavement and the seal coat shall overlap the existing road pavement seal. The access shall be adequately drained to prevent stormwater runoff onto the public road.

9.2.5 Compliance Inspections, Testing and Documentation for Standard Pavements

Construction compliance shall be demonstrated during inspections by Council's Representative and the following details provided:

- Relative compaction testing in accordance with Section 5 - Site Clearing and Bulk Earthworks (subgrade).
- Proof rolling.
- Relative compaction testing in accordance with Section 8 - Flexible Pavement Construction (road base and sub-base).
- Material quality tests from the supplier when requested by Council's Representative.
- Copies of delivery receipts confirming the material type supplied when requested.
- Results required by concrete batching plants for conformance with Australian Standards where applicable.
- Level and crossfall conformance against approved design.

Council's Representative may request sampling and testing for determination of concrete strength or other nominated properties to confirm the strength grade or properties of the concrete being provided, or where the Service Provider proposes to open the pavement to traffic prior to concrete reaching its full 28-day strength.

The above noted Compliance Inspections, Testing and Documentation for Standard Pavements Shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the proof roll with the other nominated compliance details stated in Section 9.2.5.

PROCESS HELD: Compliance of base course.

9.3 Other Pavements**9.3.1 Rigid Pavements**

Designs and construction specifications for rigid pavements not covered by this Specification shall be provided by the Service Provider and approved by Council's Representative.

The construction specification for a rigid pavement shall need to have consideration for the type and location of the rigid pavement. However, the specification shall include but not be limited to:

- Concrete materials, admixtures, mix requirements and concrete property requirements.
- Jointing requirements including location plan view, time frame for provision of saw cuts and sealant requirements.
- Site testing requirements to confirm compliance of the specified concrete.
- Placing, finishing and curing requirements.
- Construction tolerance.
- Opening to traffic.

9.3.2 Compliance Inspections and Reporting and Testing for Rigid Pavements

Council's Representative will inspect the works at various stages to confirm general compliance with the accepted design and specification. The Service Provider's Consulting Geotechnical Engineer shall carry out inspections at the following stages and certify compliance with the design and specification:

- Subgrade preparation.
- Forming and placement of reinforcing steel (if applicable) and set up for joints in sub-base.
- Finished sub-base.
- Forming and placement of reinforcing steel (if applicable) and set up for joints in base.
- Finished base including sealed joints.
- Completion of all concrete testing confirming concrete property requirements.

Certificates confirming compliance at the above stages shall be submitted to Council's Representative upon completion of the stage. Regardless of a certificate being issue by the Consulting Geotechnical Engineer at any of the above stages Council's Representative may reject the works if non-complying work has been observed.

All cracked or damage concrete shall be removed and replaced to the extent as directed by Council's Representative following consultation with the Service Provider's Consulting Geotechnical Engineer.

When requested results of compliance testing in accordance with AS 1379 - Specification and supply of concrete as carried out by the concrete supplier shall be provided to Council's Representative in addition to specified site and project testing contained in the accepted specification.

A Testing Authority shall be employed by the Service Provider to carry out all testing required by the accepted specification and any additional testing requested by Council's Representative. The cost of any additional testing requested shall be met by the Service Provider. The Authority shall hold a current NATA Registration for the relevant tests. A copy of all test results shall be provided to Council's Representative.

The review on site of the set out including string line, formwork and steel reinforcement in accordance with design and specification shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the pre pour set out/string line, formwork and steel reinforcement to design and specification.

PROCESS HELD: Pre pour set out, form work and steel fixing.

Post pour inspection shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed concrete according to design and specification with inspection of overall alignment, surface finish, expansion and isolation joints dummy joints and curing control where applicable.

PROCESS HELD: Post pour rigid pavement.

9.3.3 Heavily Bound Pavements (Stabilised)

Heavily Bound Pavements were nominated for use shall be constructed in accordance with the approved Pavement Design Report and construction specification prepared by

the Service Provider's Consulting Geotechnical Engineer which has been approved by Council's Representative.

Specifications for the supply and placement of the heavily bound materials shall be based on TfNSW QA Specification 3051 - Granular Base and Sub-base Materials for Surfaced Road Pavements and TfNSW QA Specification R75 In situ Pavement Stabilisation Using Slow Setting Binders. All clarifications for the supply, placement and saw cutting requirements shall be contained in the approved Pavement Design Report.

Compliance testing requirements for the supply and placement of heavily bound base shall be contained in the approved Pavement Design Report or nominated by Council's Representative in the pavement report acceptance.

9.3.4 Full Depth Asphalt Pavements

Full depth asphalt (FDA) pavement construction and materials shall comply with the technical requirements of TfNSW QA Specification R116 - Heavy Duty Dense Graded Asphalt and QA Specification R117 - Light Duty Dense Graded Asphalt, as applicable. Testing in accordance with R116 and R117 shall be carried out to verify compliance unless otherwise specified in the approved Pavement Design Report. FDA pavements shall be constructed in accordance with the thickness design contained in the approved Pavement Design Report.

9.3.5 Interlocking Segmental Block Pavements

Interlocking segmental block pavements shall be detailed on the approved drawings. Should a design not be available the Service Provider shall arrange a design prepared by a suitably qualified Civil Engineer.

Interlocking segmental block pavements shall be designed and constructed in accordance with Guides published by the Concrete Masonry Association of Australia, Section 7.9 Interlocking Segmental Block Pavement Design from Council's Engineering Guideline Specification - Design Guideline and Standard Drawings.

Pre lay inspection of the prepared base shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the pre lay base course with checks against base in terms of compaction/thickness/trim, set out/string line and any formwork to design and specification. Materials of pavers and bedding sand is also to be completed at this point.

PROCESS HELD: Pre lay base check set out, form work.

Post lay inspection shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed segmental pavers according to design and specification with inspection of overall alignment, interlock (sanding) and surface finish.

PROCESS HELD: Post lay segmental pavers.

9.3.6 Concrete Thresholds and Access Ways

Raised concrete thresholds, flush concrete threshold and access ways shall be a minimum 250mm thick, reinforced with two layers SL82 mesh and constructed in accordance with the geometry and details shown on the approved drawings.

All concrete used in concrete thresholds or access ways shall be standard strength grade N32 (32 Mpa) in accordance with AS 1379 - Specification and supply of concrete.

All concrete used in thresholds or access ways shall be cured using a compound complying with AS 3799 - Liquid membrane-forming curing compounds for concrete which is applied to the surface of the fresh concrete.

Damaged or cracked concrete in all concrete thresholds shall be removed and replaced prior to the final inspection.

The proposed jointing layout and type of jointing shall be constructed in accordance with the approved Construction Drawings unless otherwise instructed by Council's Representative.

Compliance inspections shall be carried out as detailed in Section 9.3.2.

9.3.7 Alternative Pavements

Pavements other than those covered by this Specification may be considered. Details of full pavement design by a Consulting Geotechnical Engineer with material specification and proposed compliance testing shall be submitted to Council's Representative for approval at the design approval stage.

10 Minor Concrete Works

10.1 General

The works covered by this section of the Specification comprise of the construction of various concrete elements which include concrete kerbs, kerb and gutter of various cross sections, mower strips and edging, vehicle access crossings, kerb ramps, dish gutters, dished crossings, concrete paths, small open drains and other minor concrete paving.

Standard Drawings relating to this section of the Specification are contained in Council's Engineering Guideline Specification - Standard Drawings. Any variations to the requirements of the Standard Drawings must be accepted by Council's Representative.

The Service Provider proposing to construct the elements of work described in this section of the Specification must conform to all requirements of this Specification including (but not limited to):

- Contacting Council's Representative to arrange a site meeting prior to the commencement of any works at least 5 days prior to the proposed commencement of works.
- Prepare and submit to Council's Representative a Traffic Guidance Scheme, as required by Section 4 - Traffic Management of this Specification.

Failure to comply with these requirements and others contained in this Specification and any additional requirements of Council's Representative will in most cases result in the works being deemed non-compliant. In cases of non-complying work the Service Provider shall be required to remove the non-complying work and reinstate the site to its original condition.

Where the Service Provider is in doubt about the expected finished quality of works they shall seek clarification from the Council's Representative.

10.1.1 Material Requirements

10.1.1.1 Sub-base and Base Course Materials

Where nominated on the Standard Drawings the sub-base and base material shall comply with the requirements of Section 8 - Flexible Pavement Construction.

10.1.1.2 Concrete

Concrete conforming to AS 1379 - Specification and supply of concrete shall be supplied to site for the various concrete elements as specified below.

For machine slip-formed or extruded kerb, kerb and gutter, edging, V-drains and dish drains laid on flexible pavement materials, the concrete shall have the following requirements:

- Minimum concrete strength grade of N25.
- Minimum effective Portland cement content 280kg/m³.
- Slump to be generally 10mm to 40mm depending on machine requirements.
- Nominal maximum aggregate size shall be 10, 14 or 20mm. If not specified when ordering, typically 20mm would be the default nominal maximum aggregate size.

- Recycled materials may be used in the concrete mix were approved by Council's Representative. Refer to the IPWEA Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010 for further information.

For formwork formed kerb, kerb and gutter, edging, V-drains and dish drains laid on flexible pavement materials, the concrete shall have the following requirements:

- Minimum concrete strength grade of N25.
- Minimum effective Portland cement content 280kg/m³.
- Slump shall generally be 70mm to 80mm or as required by Service Provider to achieved surface finish equivalent to a smooth steel trowel type surface.

For paths (cycleways, footpaths and shared paths), median infill, kerb ramps, edge strips and vehicle access crossings, the concrete shall have the following requirements:

- Minimum concrete strength grade of N25 where the element is reinforced.
- Minimum concrete strength grade of N32 for reinforced industrial vehicle access crossings.
- Minimum effective Portland cement content 280kg/m³.
- Air entrainment shall be between 4.5% and 5.0%.
- Maximum slump 80mm.
- Nominal maximum aggregate size should be 10mm for workability and surface finishing reasons.
- Kerb ramps shall be integrally coloured minimum concrete strength grade of N32 and reinforced in accordance with the Standard Drawings.

For open reinforced concrete drains sprayed or hand placed, the concrete shall have the following requirements:

- Minimum concrete strength grade of N25.
- Minimum effective Portland cement content 280kg/m³.
- Air entrainment shall be between 4.5% and 5.0%.
- Maximum slump 80mm or as required by Service Provider for spraying.

For footings for small signs, utilities plant, fence post backfill and other minor works, the concrete shall have the following requirements:

- Minimum concrete strength grade of N25.
- Minimum effective Portland cement content 270kg/m³.
- Air entrainment shall be between 4.5% and 5.0%.
- Maximum slump 80mm.

For kerb, kerb and gutter, edging and V-drains, hand placed, or slip formed, tied or untied along the edge of rigid pavement concrete base unless otherwise specified in the accepted rigid pavement design, the concrete shall have the following requirements:

- Minimum concrete strength grade of N32.
- Minimum effective Portland cement content 320kg/m³.

- Slump as required by Service Provider to achieve surface finish equivalent to a smooth steel trowel type surface but not greater than 80mm.
- Minimum 3 cylinders to be taken per load.

10.1.1.3 Reinforcement

Steel reinforcement shall comply with AS/NZS 4671 - Steel reinforcing materials as appropriate.

Where specified, galvanising shall comply with AS/NZS 4680 - Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.

Reinforcement shall be placed in accordance with the approved drawings or in Council's Engineering Guideline Specification - Standard Drawings.

10.1.1.4 Joint Fillers and Sealers

Joint fillers and sealers shall be proprietary products specifically made for the purpose being used. Details of proposed products to be used or already used shall be provided if requested by Council's Representative. Should a product already used is found and be confirmed as not being suitable for the situation it has been used, then the work containing the filler or sealer shall be deemed not to comply and shall be replaced with a suitable product.

10.1.1.5 Curing Compound

Curing Compounds shall comply with AS 3799 - Liquid membrane-forming curing compounds for concrete, and must be either:

- Wax emulsion complying with AS 3799 Type 1; or
- A hydrocarbon resin compound complying with AS 3799 Type 1-D.

Wax emulsion curing compounds shall not be used on areas subject to pedestrian traffic.

10.1.2 Earthworks and Surface Preparation

Earthworks and preparation of surfaces shall be as specified in Section 5 - Site Clearing and Bulk Earthworks of this Specification.

Where earthworks are required within the road reserve excavated material shall not be deposited on existing grassed areas or pedestrian routes without prior approval from Council's Representative.

Subgrade, sub-base and base material compaction under kerbs, kerb and gutters, V-drains, dish drains or other concrete elements along the edge or within flexible pavement areas shall be in accordance with the requirements of Section 8 - Flexible Pavement Construction of this Specification. A minimum of 150mm thick compacted sub-base quality material shall be placed under all concrete elements in these locations.

Subgrade, sub-base and base material compaction under V-drains, dish drains, paths, cycleways, vehicle access crossings not along the edge or within flexible pavement areas shall be compacted to a relative compaction of 100% standard maximum dry density for the full depth of the layer. A minimum 75mm thick compacted layer of road base material shall be placed under all concrete elements unless approved by Council's Representative or otherwise shown in Council's Engineering Guideline Specification - Standard Drawings.

10.1.3 Concrete Works – General Requirements

10.1.3.1 Set out and Forming

All concrete elements covered by this section of the Specification shall be set out on site and formed in accordance with the proposed line and level shown on the approved drawings.

Formwork shall comply with AS 3610 - Formwork for concrete and be fixed firmly in place. Forms shall extend for the full depth of the concrete and minimise spillage of unformed concrete from below the form. Excessive unformed spillage shall be removed once the concrete has reached initial set.

Where a concrete element has been formed by extrusion or slip form from a purpose made machine all excess concrete spilt beyond the required shape shall be trimmed once the concrete has reached initial set.

10.1.3.2 Removal of Forms

The Service Provider shall maintain all forms in place until the concrete is hardened enough to withstand formwork movement and removal without damage.

The following are the minimum periods, or as extended by the Council's Representative, if air temperature falls below 10°C, which forms shall be kept in place after placement of concrete:

- Footpaths, driveways and similar: 2 days

Sides of reinforced concrete walls when height of each day pour is:

- Under 600mm 1 day
- 600mm to 3m 2 days
- 3m to 6m 3 days
- 6m to 9m 5 days

Supporting forms under deck slabs of culverts: 10 days

In case of concrete containing special additives, conform to stripping times as specified by the Structural Design, manufacturer's recommendation and if required by the Council Representative.

Forms shall be removed in such a way so that the concrete will not be cracked, chipped or otherwise damaged. Crowbars or other levering devices exerting pressure on the fresh concrete to loosen the forms shall not be used.

Hole-formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

10.1.3.3 Repair of Defects

As soon as the forms are removed from mass or reinforced concrete work, the Service Provider shall repair all rough places, holes and porous spots by removing defective work and after wetting, filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete and bring to an even surface with a wooden float. Similarly, the Service Provider shall repair all cavities caused by removal of fitments or tie wires and pack with cement mortar.

The Service Provider shall cut back any tie wires or other fitments extending to outside surfaces after removal of forms, to a depth of at least 40mm with sharp chisels or cutters.

If required, the Service Provider shall coat the surfaces of bolt cavities, tie wire holes, and all defects prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water, generally as required by the manufacturer.

10.1.3.4 Removing Existing Concrete Works

Where existing concrete elements are required to be removed, they shall be saw cut square and vertical at the limit of the required removal. A full depth expansion joint shall be constructed where new concrete meets the existing concrete.

10.1.3.5 Placement of Reinforcement

Reinforcing steel shall be placed on full plastic chairs to achieve a minimum cover of 30mm to the exposed finished surface of the concrete and 40mm to the slab edge or a formed joint. Sufficient chairs shall be placed so the steel maintains cover during placement of the concrete.

Lap splices in reinforcing shall be in accordance with AS 3600 - Concrete structures, or as shown on the approved drawings or manufacturer's recommendations.

10.1.3.6 Handling and Placing of Concrete

Concrete shall be placed and finished to:

- Limit segregation or loss of material.
- Limit premature stiffening.
- Result in dense homogeneous hardened concrete which is monolithic between joints and edges.
- Expel entrapped air and result in a dense material around all reinforcement and embedments.
- Result in the specified thickness and surface finish.

Sub-base or base material onto which concrete shall be placed shall be dampened prior to placement of concrete to reduce loss of water from the placed concrete.

Concrete shall not be placed:

- During rain or when rain is predicted.
- When the air temperature in the shade is below 5°C or above 38°C.

In the case that concrete has been placed and the likelihood of rain has become evident since the start of placement the Service Provider shall take measures such as covering the concrete with plastic sheeting to avoid rain and frost damage. Rain damaged concrete shall not be accepted as complying with this Specification.

10.1.3.7 Finishing of Unformed Surfaces

Finishing of unformed surfaces in all cases shall achieve:

- The dimensions and grades shown on the approved drawings and detailed in Council's Engineering Guideline Specification - Standard Drawings.

- Minimum cover to reinforcement.
- The specified surface finishes for the element being constructed.
- Minimisation of plastic and drying shrinkage cracking.

10.1.3.8 Concrete Joints

Concrete placement may include the following types of joints:

- Control joints (shrinkage and /contraction joints) - formed joint with shear key or weakened plane joint.
- Expansion joints (dowelled).
- Isolation joints.
- Construction joints.
- Tied joints between existing and new concrete elements.

Full depth isolation joints shall be provided when any concrete element abuts another concrete element, for example, a joint between a vehicle access crossing and kerb and gutter, a joint between a dished crossing and a drainage pit, and a joint between a concrete path and utility pit.

All concrete joints shall be constructed and positioned in accordance with Council's Engineering Guideline Specification - Standard Drawings. Alternative methods of achieving shrinkage control joints may be proposed by the Service Provider for approval by Council's Representative.

Unplanned cracking in concrete shall not be accepted.

10.1.3.9 Curing

The use of curing compounds shall comply with Section 10.1.1.5. Where concrete elements are cured with a commercial curing compound, the concrete shall be cured and applied at the rates recommended by the manufacturer's specifications.

10.1.3.10 Bedding Base / Sub-base Tolerances

Base or sub-base layers alongside or within the flexible pavement areas shall have tolerances in accordance with Section 8.4.3 of this Specification.

Base layers in other locations shall have the following tolerances:

- The level shall not deviate by more than 10mm above or 25mm below the design surface level less the allowance for the proposed concrete thickness.
- The thickness shall not be less than the specified thickness.
- The straightness shall not deviate by more than 10mm from a 3m straight edge.
- Deviations on vertical or horizontal curves shall not exceed 10mm from the true vertical or horizontal alignment.

10.2 Specific Concrete Element Requirements

10.2.1 Kerbs, Kerb and Gutter, Kerb Ramps, Unreinforced Dish Drains and Unreinforced V-drains

10.2.1.1 Set Out and Forming

Kerbs, kerb and gutter, kerb ramps, unreinforced dish drains and V-drains shall be set out to the line and level shown on the approved drawings, or were replacing existing elements to the same line and level as the existing elements, unless otherwise shown on the approved drawings, or otherwise directed by Council's Representative.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the kerb line set out and string line for proposed kerb top for either formwork or slip form paver to follow according to design and specification.

PROCESS HELD: Pre pour set out of design kerb line.

Isolated lengths up to 40m on any project may be formed using formwork. For lengths exceeding this length a purpose made slip form or extrusion machine shall be utilised.

The shape of the required element shall be in accordance with Council's Engineering Guideline Specification - Standard Drawings SD 0501.

10.2.1.2 Surface Finish

A finish equivalent to that achieved with a smooth steel trowel shall be achieved.

Kerb ramps shall be initially steel float finished and then before initial set, broom brushed to a slip- resistant texture. This shall be achieved by drawing a moistened nylon broom lightly across the surface at right angles to the pedestrian direction of travel across the entire kerb ramp, including the angled kerb ramp wings. A nominal 100mm wide steel edging tool shall then be used to provide a 10mm radius smooth perimeter border to all edges, including all edges adjacent to expansion joints and isolation joints, but not adjacent to control joints within the kerb ramp.

Additional water shall not be added to the surface of any concrete in order to achieve the required smooth finish.

Additional water shall not be added to the surface of slip formed or extruded elements for finishing purposes. Extrusion machines may utilise a slurry box to aid in achieving the required finish.

10.2.1.3 Joints

Full depth expansion/isolation joints shall be placed at the following locations:

- Expansion joints at tangent points of curves of less than 25m radius.

- Isolation joints where the concrete element abuts any other concrete elements or structures.

Shrinkage control joints shall be placed at maximum 3m centres. Joints in these elements when tied to a rigid pavement shall be in accordance with the requirements of the rigid pavement design. Joint locations shall match those in the adjoining rigid pavement if no requirements are specified.

10.2.1.4 Stormwater Pipe Outlets in Kerb and Gutter

See Section 6.11 Stormwater Outlets to Kerb and Gutter.

10.2.1.5 Kerb Survey Marks

Existing survey marks shall not be disturbed. Where existing kerb and gutter is to be reconstructed the Service Provider shall be responsible for the replacement of any disturbed marks to the conditions of the Surveyor General's Approval to Remove Survey Marks using a Registered Land Surveyor.

10.2.1.6 Termination of Kerb and Gutter

Where a length of kerb or kerb and gutter is terminated in isolation and without joining a structure, the kerb shall be longitudinally ramped down to the surrounding surface over a length of 700mm minimum (500mm absolute minimum) in accordance with Council's Engineering Guideline Specification - Standard Drawings SD 0512.

10.2.1.7 Tolerances

The finished concrete shall not vary from the design horizontal alignment or vertical level by more than 10mm. The finished work shall not deviate from a 3m straight edge by more than 10mm. Deviations on vertical or horizontal curves shall not exceed 10mm from the true vertical or horizontal alignment.

10.2.1.8 Inspection and Compliance

Post kerb works inspection shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed kerb and gutter according to design and specification with inspection of overall alignment, surface finish kerb terminations where applicable, stormwater pipe outlets where applicable, expansion and isolation joints dummy joints and curing control where applicable.

PROCESS HELD: Post pour kerb and gutter.

10.2.2 Reinforced Dish Drains, Reinforced V-drains and Edge Restraints

10.2.2.1 Set Out and Forming

Reinforced dish drains, reinforced V-drains and edge restraints shall be set out to the line and level shown on the approved drawings or were replacing existing elements to the same line and level as the existing unless otherwise shown on the approved drawings, or as otherwise directed by Council's Representative.

All elements shall be formed with formwork and hand placed concrete.

The shape of the required element shall be in accordance with Council's Engineering Guideline - Standard Drawings SD 0501.

The review on site of the set out including string line shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the drain/edge restraint set out and string line including formwork and reinforcement where applicable for proposed element according to design and specification.

PROCESS HELD: Pre pour concrete drains and/or edge restraints of set out, formwork and Steel Reinforcement work in accordance with design and specification.

10.2.2.2 Surface Finish

A finish equivalent to that achieved with a smooth steel trowel shall be achieved.

Water shall not be added to the surface of the concrete in order to achieve the required smooth finish. The Service Provider shall ensure that the concrete supplied is suitable to achieve the required finish without the addition of water to the surface.

All exposed corners are to be finished with a 10mm radius.

10.2.2.3 Joints

Full depth expansion/isolation joints shall be placed at the following locations:

- Expansion joints at tangent points of curves of less than 25m radius.
- Isolation joints where the concrete element abuts any other concrete elements or structures at 18m maximum centres.

Shrinkage control joints are required at 3m maximum centres.

Joints in these elements when tied to a rigid pavement shall be in accordance with the requirements of the rigid pavement design. If no requirements are specified joint locations shall match those in the adjoining rigid pavement.

10.2.2.4 Tolerances

The finished concrete shall not vary from the design horizontal alignment or vertical level by more than 10mm. The finished work shall not deviate from a 3m straight edge by more than 10mm. Deviations on vertical or horizontal curves shall not exceed 10mm from the true vertical or horizontal alignment.

10.2.2.5 Post Pour Inspection and Compliance

Post concrete drain/edge restraint works inspection shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed reinforced dish or V drain or edge restraint according to design and specification with inspection of overall alignment, surface finish, pour terminations where applicable, expansion and isolation joints, dummy joints and curing control where applicable.

PROCESS HELD: Post pour Dish / V drains and edge restraint.

10.2.3 Unreinforced Concrete Paths

All new concrete paths shall be reinforced in accordance with Section 10.2.4 below.

10.2.4 New Reinforced Concrete Paths

All new concrete paths shall be reinforced in accordance with this Specification. All new footpaths shall be a minimum of 1.5m in width unless specified to be another width by the conditions of Development Consent or separate *Roads Act 1993* approval. When it is necessary for the footpath to be adjacent to the back of kerb or the footpath is adjacent to a school boundary, the minimum width shall be 1.8m to ensure a 1.5m minimum path width alongside each layback.

All new shared paths shall adopt the width shown on the approved drawings. If dimensions are not shown, then the shared path shall have a minimum width of 2.5m and be constructed in accordance with Council's Engineering Guideline - Standard Drawings SD 0601.

10.2.4.1 Set Out

Reinforced concrete paths shall be set out to the line and level shown on the approved drawings. Where not shown on the drawings, the edge of paths shall be parallel to the property boundary and 900mm from the property boundary, where the path is located between the road carriageway and the property boundary. The Service Provider shall seek clarification of path locations from

Council's Representative in all cases as some variations to the alignment may be necessary for reasons not obvious to the Service Provider.

10.2.4.2 Reinforcement

Reinforced concrete paths shall be 100mm thick and reinforced with SL72 mesh unless otherwise shown on the approved drawings. Steel, polypropylene, nylon or other material fibres may be used as an alternative concrete reinforcement for shrinkage crack control, subject to the approval of Council's Representative.

10.2.4.3 Crossfall

Crossfall on all paths shall be between 1% and 2.5% sloping towards the kerb.

10.2.4.4 Pre Pour Inspection and Compliance

Pre pour inspection on set out, formwork, reinforcement where applicable and grade / crossfall shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed set out, formwork, reinforcement, where applicable and grade / crossfall according to design and specification. Also to be included is any locations of expansion joints, dummy joints and dowelled or similar structural connections.

PROCESS HELD: Pre pour formwork review.

10.2.4.5 Surface Finish

Paths shall be initially steel float finished and then before initial set broom brushed to a slip-resistant texture. This shall be achieved by drawing a moistened nylon broom lightly across the surface at right angles to the path direction of travel. A nominal 100mm wide steel edging tool shall be used to provide a 10mm radius to smooth the perimeter border along both longitudinal edges of all paths.

10.2.4.6 Joints

Joints shall be provided in paths in accordance with AS 3727.1 Pavements: Residential and as shown in Council's Engineering Guideline Specification - Standard Drawings and Section 10.1.3.8 Concrete Joints.

10.2.4.7 Tolerances

The finished concrete shall not vary from the design horizontal alignment or vertical level by more than 20mm. The finished work shall not deviate from a 3m straight edge by more than 10mm under a 3m straight edge longitudinally or transversely. Deviations on vertical or horizontal curves shall not exceed 20mm from the true vertical or horizontal alignment.

10.2.4.8 Post Pour Inspection and Compliance

Post concrete drain/edge restraint works inspection shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed concrete path according to design and specification with inspection of overall alignment, surface finish, pour terminations where applicable, expansion and isolation joints, dummy joints and curing control where applicable.

PROCESS HELD: Post pour footpath reinforced or unreinforced.

10.2.5 Vehicle Access Crossings**10.2.5.1 Set Out and Forming**

Vehicle access crossings shall be located where shown on the approved drawings or as directed by Council's Representative. Grades and levels of vehicle access crossings shall be constructed as shown in Council's Engineering Guideline Specification - Standard Drawings.

The Service Provider must not alter vehicle access grades without approval from Council's Representative.

When a proposed vehicle access crossing requires alteration of an existing concrete path, sufficient length of the concrete path shall be saw cut and removed to allow transition in vertical and horizontal alignment to accommodate the vehicle access crossing profile and maintain the path crossfall as shown in Council's Engineering Guideline Specification - Standard Drawings.

10.2.5.2 Gutter Crossing and Layback

Where a new gutter crossing and kerb layback are required the entire existing kerb and gutter shall be removed and reconstructed in accordance with Section 10.2.8.

On sites where the older deep kerbs and channel exist (300 mm or more in depth) a gutter bridge is to be constructed to bridge over the gutter, maintaining a stormwater flow path and assist in vehicle access levels from street to property. See Council's Engineering Guideline Specification - Standard Drawings for design details.

10.2.5.3 Pre Pour Inspection and Compliance

Pre pour inspection on set out, formwork, reinforcement where applicable and grade / crossfall shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed set out, formwork, reinforcement, where applicable and grade / crossfall according to design and specification. Also to be included is any locations of expansion joints, dummy joints and dowelled or similar structural connections.

PROCESS HELD: Pre pour Gutter crossing / layback.

10.2.5.4 Surface Finish

Vehicle access crossings shall be initially steel float finished and then before initial set, broom brushed to a slip-resistant texture. This shall be achieved by drawing a moistened nylon broom lightly across the surface at right angles to the vehicle travel direction over the access crossing. A nominal 100mm wide steel edging tool shall be used to provide a 10mm radius smooth perimeter border to all edges.

Where vehicle access crossings and/or property driveways have excessive longitudinal grades and/or horizontal curves or are unable to be constructed in accordance with the grade requirements in Council's Engineering Guideline Specification - Standard Drawings, and a site-specific design has been undertaken due to existing constraints, greater skid-resistance may be achieved by using a steel-tynd comb or similar treatment to groove the concrete surface.

Council permits the construction of vehicle access crossings within the road reserve in plain concrete, integrally coloured concrete, flat stamped concrete, stencil-patterned concrete (and asphalt), provided that the surface finish is of good quality, high strength, durable and slip-resistant with no trip hazards and is approved by Council's Representative.

Vehicle access crossings constructed during Council Road upgrade projects shall be constructed in plain concrete to Council's Engineering Guideline Specification - Standard Drawings. Council permits the application of good quality, high strength, durable, skid-resistant and slip-resistant post-construction surface finishes on plain concrete vehicle access crossings. This additional work may be carried out by the property owner at least 28 days after concrete placement, at the property owner's expense. Modification of the plain concrete kerb layback surface finish is not permitted.

Council does not permit construction of vehicle access crossings with pavers, tiles, stamped concrete with an uneven surface and exposed aggregate surface finishes in urban residential, rural or industrial areas.

Pavers may be used in commercial and Central Business District public spaces, to compliment adjoining paved areas where architectural requirements dictate their use. Pavers used shall meet the requirements of AS/NZS 4455.2 Masonry units, pavers, flags and segmental retaining wall units - Pavers and flags. Pavers shall be laid on sand or mortar bedding in accordance with the paver manufacturer's specifications and over a suitably designed and reinforced concrete base as shown on the vehicle access crossing details in Council's Engineering Guideline Specification - Standard Drawings.

Where specifications contained in a Development Consent or Tender/Contract document are contrary to this section of the Specification, then those specifications shall be applied.

10.2.5.5 Joints

Joints shall be provided in vehicle access crossings in accordance with AS 3727.1 Pavements: Residential and as shown in Council's Engineering Guideline Specification - Standard Drawings.

Expansion joints shall be placed at maximum 6m centres, at the property boundary and at the joint between the vehicle access and the kerb layback. Isolation joints shall be placed where the vehicle access crossing abuts other concrete elements, structures or utility pits.

10.2.5.6 Tolerances

The finished concrete shall not vary from the design horizontal alignment or vertical level by more than 10mm. The finished work shall not deviate from a 3m straight edge by more than 10mm longitudinally or transversely. Deviations on vertical or horizontal curves shall not exceed 20mm from the true vertical or horizontal alignment.

10.2.5.7 Post Pour Inspection and Compliance

Post concrete layback/gutter bridge inspection shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed concrete for layback/gutter bridge according to design and specification with inspection of overall alignment, surface finish, pour terminations where applicable, expansion and isolation joints, dummy joints and curing control where applicable.

PROCESS HELD: Post pour layback/gutter bridge.

10.2.6 Reinforced Open Concrete Drains – Sprayed or Hand Placed

10.2.6.1 Set Out and Forming

Open concrete drains shall be located where shown on the approved drawings or as directed by Council's Representative. Grades, levels and cross-sectional areas of open drains shall be as detailed on the approved drawings.

Open drains shall have a minimum thickness of 100mm unless otherwise shown on the approved drawings.

10.2.6.2 Pre Pour Inspection and Compliance

Pre pour inspection on set out, formwork, reinforcement where applicable and grade / crossfall shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed set out, formwork, reinforcement, where applicable and grade / crossfall according to design and specification. Also to be included is any locations of expansion joints, dummy joints and dowelled or similar structural connections.

PROCESS HELD: Pre pour open concrete drains – splayed or hand placed.

10.2.6.3 Surface Finish

Open drains which are hand placed and finished shall be steel floated to a smooth finish. A steel edging tool shall be used to provide a 10mm radius to smooth all edge corners.

Sprayed concrete shall have a consistent dense surface finish with no irregularities, bumps or depressions.

10.2.6.4 Joints

Unless otherwise shown on the drawings, expansion joints shall be placed at maximum 4m centres. Isolation joints shall be placed where open channels abut other concrete elements or structures.

Shrinkage control joints are not required unless otherwise shown on the approved drawings.

10.2.6.5 Tolerances

Deviations on vertical or horizontal curves shall not exceed 40mm from the true vertical or horizontal alignment. There shall be no isolated depressions in the surface finish that will pond water. Continual fall in the invert of the channel is required. The cross section of the resultant channel shall not be smaller than that specified on the approved drawings.

10.2.6.6 Post Pour Inspection and Compliance

Post pour open concrete drains – splayed or hand placed inspection shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed concrete for layback/gutter bridge according to design and specification with inspection of overall alignment, surface finish, pour terminations where applicable, expansion and isolation joints, dummy joints and curing control where applicable.

PROCESS HELD: Placed pour open concrete drains – splayed or hand placed.

10.2.7 Provisions for Existing or Proposed Utilities and Service Mains

Where a proposed vehicle access crossing, path or other concrete element is to be constructed before the planned installation of service mains and utilities, conduits or sections of mains shall be first installed under the concrete element in accordance with requirements of the relevant authorities.

Where a proposed vehicle access crossing or other concrete element is to be constructed over existing service mains or utilities, provision shall be made for access to valves, water service stop cocks or similar. If the depth to existing mains or utility is being reduced the relevant authority shall be contacted by the Service Provider to obtain that Authorities requirement and approval.

Regardless of whether cover is being reduced, increased or remaining the same, where a vehicle access crossing or other concrete element is to be constructed over an asbestos cement water main, the Water Authority shall be contacted prior to any works, to determine the exact location of the main and to determine if that section of main requires replacement.

For further details about road openings and restorations see Section 7 - Utility Services Installation, Road Opening and Utility Restorations.

10.2.8 Construction and Replacement of Kerb and Gutter, Dish Drains and V-drains Along the Edge of Existing Pavement Areas

The existing pavement shall be saw cut a minimum 300mm out from and parallel to the new concrete element.

Remove the existing pavement to a depth of 150mm below the base of the proposed concrete element and extend 150mm beyond the footprint of the proposed element.

A 150mm thick layer of sub-base quality material shall be placed and compacted to the requirements of Section 8 - Flexible Pavement Construction of this Specification. A minimum of 2 relative density tests shall be required on the new sub-base unless otherwise advised by Council's Representative.

The new concrete element shall then be constructed in accordance with this Specification.

The area between the saw cut in the pavement and the concrete element shall be filled with compacted deep lift asphaltic concrete in accordance with this Specification.

This section is applicable to vehicle access construction where a new gutter crossing with layback is required.

10.3 Compliance Inspections, Testing and Documentation Requirements

Compliance with this Specification shall be demonstrated during inspections by Council's Representative, testing as required by Section 5 - Site Clearing and Bulk Earthworks and Section 8 - Flexible Pavement Construction of this Specification where applicable, relative compaction testing on bedding sub-base layers, provision of material quality tests from the supplier when requested and provision of copies of delivery receipts confirming the material type supplied when requested.

Testing of concrete supplied other than that required by concrete batching plants for conformance with Australian Standards, should not be required; however, Council's Representative may request sampling and testing for determination of concrete strength or other nominated properties in the case where there is doubt about the strength grade or properties of the concrete being provided or where the Service Provider proposes to open the concrete element to traffic prior to concrete reaching its full 28-day strength.

Level tolerance and horizontal alignment of elements shall be demonstrated by work-as-executed surveys and drawings prepared by a Registered Land Surveyor. The requirement to provide work- as-executed drawings on small infill or isolated kerb and gutter works or single vehicle access construction may be relaxed by Council's Representative in cases where levels are dictated by existing site features.

10.3.1 Non-complying Work

Where works are observed by Council's Representative to not comply with this Specification the Service Provider shall be instructed verbally or in writing of the non-compliance. The non-complying works(s) shall be rectified or removed before the works proceed further.

Where test results for relative compaction show non-compliance, the material shall be reworked and re-compacted. Retesting shall be required to demonstrate compliance.

Where material quality test results demonstrate non-compliance with this Specification, that material shall be removed and replaced with complying material.

11 Major Concrete Works

11.1 General

The works covered by this section of the Specification comprise the construction of major concrete elements, products and structures including:

- Buildings and building elements.
- Bridges.
- Large cast in-situ drainage structures including box culverts, open channels and non-standard pits.
- Retaining walls.

All structures covered by this section of the Specification are required to have had a design and a specification for the construction of the structure prepared by a Certified Practising Civil or Structural Engineer. All concrete structures shall be designed and constructed in accordance with AS 3600 - Concrete structures.

The specification for the construction of the structure prepared by the Certified Practising Civil or Structural Engineer will take precedence over any conflicting requirement of this Specification.

11.2 Certification of the Design and Construction

Certification of the design stating compliance with relevant Australian Standards will be required prior to construction. Inspections and certification of the construction confirming compliance with the design specifications shall be required as construction progresses. Certification at the completion of the structure shall be required to confirm that the structure has been constructed in accordance with the design and specification, is structurally adequate and shall meet the serviceability requirements intended by the design.

These certifications shall be provided by a suitably qualified Civil/Structural and Geotechnical Engineer(s). Copies of all certifications shall be provided to Council's Representative (refer to Appendix A - Work-as-Executed Drawings and Compliance Documentation Requirements).

11.3 Construction and Material Requirements

11.3.1 General

All works shall comply with the requirements of Section 17 - Material and Construction Requirements of AS 3600 - Concrete structures. The following additional specific requirements shall apply where not specified in the specification for the construction of the structure as prepared by the Certified Practising Civil or Structural Engineer.

The requirements of AS 3600 shall take precedence over the following requirements. Any conflicts between AS 3600 Section 17 and the specification for the construction of the structure prepared by a Certified Practising Civil or Structural Engineer shall be brought to the attention of Council's Representative.

11.3.2 Formwork and False Work

11.3.2.1 General Requirements

Formwork and false work shall comply with the relevant requirements of AS 3610 - Formwork for concrete.

Certification that formwork and false work are structurally sound and suitable for the purpose they have been constructed shall be required from a Certified Practising Civil/Structural Engineer prior to the placement of any concrete.

Formwork shall be provided to produce hardened concrete to the lines, levels and shapes shown on the approved drawings or as specified by Council's Representative. Formwork shall have adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workers and equipment, without loss of shape. Forms shall be mortar tight and designed to allow removal without risk of damage to the completed structure. Joints in the formwork shall be perpendicular to the main axis of the shape of the concrete.

Subject to approval by the design and Certifying Engineer, false work may be supported on completed sections of the works provided that the construction loads imposed thereon do not result in over-stressing or instability and that due allowance is made for any deflection of the supporting sections.

The Service Provider on the advice of the Certified Practising Civil/Structural Engineer shall undertake structural strengthening or modification of such sections necessary for their use as support structures.

11.3.2.2 Concreting Against Rock and Firm Ground

Concrete may be placed against rock faces, provided that the cover to the reinforcement on the rock face is increased by a minimum of 25mm. Before any concrete is placed against a rock face all leakage and percolation of water which could cause damage to the wet concrete shall be effectively sealed. Concrete shall not be poured against horizontal or inclined rubble, fill or earth surfaces in lieu of formwork.

11.3.2.3 Formed Surface Finish

Finishes to formed surfaces shall be produced in accordance with the requirements and recommendations of AS 3610 - Formwork for concrete and the specification for the structure. If the surface class is not specified, the class listed in Table 24 shall be used.

Table 24: Class of Surface for Formed Work

Surface	Class
Footings and other buried structures, rear surfaces of retaining walls, surfaces to be faced with stone	Class 5
Bridge and other surfaces which shall receive heavy applied finishes	Class 4
Concealed surfaces of walls, beams, slab soffits, stairs, abutments, bridge decks, etc	Class 3
Surfaces to receive a granular or plaster finish, and all exposed surfaces	Class 2

Surface	Class
Surfaces not specified	Class 2

Review of site formwork and Surface finish shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed formwork according to design and specification and compliance of the surface finish exhibited by the formwork.

PROCESS HELD: Placed formwork and surface finish.

11.3.3 Reinforcement

11.3.3.1 General Requirements

Steel reinforcement supplied to the site and incorporated into the works shall conform to AS/NZS 4671 - Steel reinforcing materials and AS 3600 - Concrete structures.

All steel shall be free from loose or thick rust, loose mill scale, grease, tar, paint, oil, dirt, mortar or other unspecified coating. If the steel has more than a thin film of rust, it may be rejected for use in the works and shall be immediately removed from the site by the Service Provider. Reinforcement shall be stored and supported above ground and protected from contaminants.

Reinforcement shall be readily identifiable as to grade, origin and its final location in the works. The necessary tie wire, support chairs, spacers, supplementary reinforcement and the like shall be supplied for adequate fixing of the reinforcement.

NOTE: All steel supplied shall be certified by the Australasian Certification Authority for Reinforcing and Structural Steels. Via this authority, the Service Provider shall provide a certificate of compliance with the relevant standard AS/NZS 4671 - Steel reinforcing materials or alternatively provide test certificates from a NATA registered testing authority for all reinforcement steel delivered to site. Test certificates shall show results of mechanical tests and chemical analysis.

Where the material cannot be identified with a test certificate, samples shall be taken, and testing arranged by the Service Provider. The samples shall be selected randomly and consist of three specimens each at least 1.2m in length.

The cost of all samples and tests shall be borne by the Service Provider.

11.3.3.2 Splicing

All reinforcement shall be furnished in the lengths detailed on the approved drawings. If splicing is required, it shall be in accordance with the provisions of AS 3600 - Concrete

structures. All splices shall be at the locations shown in the approved drawings or described in the specification for the structure.

11.3.3.3 Fabric Splices

A lap splice for fabric shall be made so that the 2 outermost transverse wires of 1 sheet of fabric overlap the 2 outermost transverse wires of the sheet being lapped plus 25mm.

11.3.3.4 Weld Splices

Bars may only be welded by an approved electrical method as directed by Council's Representative. No welding will be allowed on cold-worked or hard grade reinforcing bars.

Welding shall conform to the requirements of AS/NZS 1554.3 - Structural steel welding - Welding of reinforcing steel and shall be carried out in the presence of Council's Representative.

Unless otherwise approved by Council's Representative, the welded splice shall meet requirements of tensile and bend tests specified for the parent metal.

11.3.3.5 Storage

Reinforcement, unless concreted promptly, shall be stored under a waterproof shelter and supported above the surface of the ground, and shall be protected from injury and from deterioration due to environmental exposure.

11.3.3.6 Bending

Reinforcement shall be carefully formed to the dimensions and shapes shown on the approved drawings. Reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the approved drawings shall not be permitted.

11.3.3.7 Protective Coated Reinforcement

Unless otherwise shown on the approved drawings, if an element is specified to contain protective coated reinforcement, the same coating type shall be provided to all that element's reinforcement and embedded ferrous metal items, including tie wires, stools, spacers, stirrups, plates, ferrules and the like.

Galvanised reinforcement shall comply with AS/NZS 4680 - Hot-dip galvanized (zinc) coatings on fabricated ferrous articles, and the following requirements.

Minimum coating mass:

- For wire: Type A.
- For reinforcement: 100 microns of 98% pure zinc metal.
- Preparation: Pickling to AS 1627.5 - Metal finishing - Preparation and pre-treatment of surfaces - Pickling.
- Passivation: After galvanising, the galvanised coating shall be passivated by immersion in a bath of 0.2% sodium dichromate solution.

If damage occurs to the coating, either the damaged reinforcement shall be replaced, or repairs may be carried out to AS/NZS 4680 - Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.

Starter bars and the like left projecting from cast concrete for future additions, otherwise unprotected and expected to be exposed to the weather for more than 1 month, shall be coated with a cement wash.

11.3.3.8 Placing and Fixing Reinforcement

Reinforcement shall be spaced accurately to the pitches and position as shown on the approved drawing. Reinforcement shall be secured against displacement by tying at all intersections with annealed iron wire ties not smaller than 1.25mm diameter, or by approved clips. The ends of wire ties shall be bent away from nearby faces of forms so that the ties do not project into the concrete cover.

Bars forming a lapped splice shall be securely wired together in at least two places, unless welded and shall comply with AS 3600 - Concrete structures.

11.3.3.9 Reinforcement Supports

Reinforcement shall be supported by purpose-made plastic chairs. Steel shall not be supported on metal supports which extend to the surface of the concrete, on wooden supports, or on pieces of coarse aggregate or loose rock.

For exposure classifications more severe than A1, as defined in AS 3600 - Concrete structures, reinforcement shall be accurately supported by plastic supports of adequate strength and of a shape appropriate to the location.

Damage to waterproofing membranes or vapour barriers shall be prevented by placing a plastic plate under each support to prevent puncturing when reinforcement is supported over membranes.

Chairs shall be spaced sufficiently close together to ensure that the specified cover is maintained during placement of concrete, and to ensure that crushing of the chairs or penetration into the formwork does not occur. The reinforcement shall not have permanent deflection or displacement of more than 2mm during placing and consolidation of the concrete.

Inspection of placed reinforcement on supports shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the placed reinforcement according to design and specification and compliance of reinforcement steel used.

PROCESS HELD: Reinforcement placement.

11.3.4 Placing and Compaction of Concrete

11.3.4.1 General Requirements

The Service Provider shall plan and control the placing, compacting, curing and finishing operations to prevent cracking in the various concrete elements.

No concrete shall be placed in the works until the false work, formwork, reinforcement and stressing materials have been inspected, all foreign material has been completely removed from the forms and certification has been given by the Civil/Structural Engineer responsible for inspecting and certifying the formwork and false work.

Formwork shall not be disturbed or adjusted during the concreting operation and shall remain undisturbed up to the minimum removal time specified.

11.3.4.2 Placing

Concrete shall be deposited within the forms as near as possible to its final location.

Excessive use of vibrators and tamping rods to move the concrete along the forms is not permitted.

Movement of concrete to the pour face may be by means of suitable conveyors, clean chutes, troughs or pipes which shall be made of metal, or have metal linings, or by pumping.

Water shall not be used to facilitate the movement.

Unless adequate protection is provided, concrete shall not be placed during rain or when rain appears imminent.

Prior to placing concrete, the area shall be clean and moist, but free from any water ponds. No concrete shall be placed if:

- The temperature of the concrete is less than 10°C or exceeds 35°C.
- The ambient air temperature is likely to be greater than 35°C during placement or within 2 hours subsequent to placement.
- The ambient air temperature measured at the point of placement is likely to exceed 35°C during placing and finishing operations, the Service Provider shall take practical precautions to ensure that the temperature of the concrete does not exceed the permitted maximum so that the concrete can be placed and finished without defects.

Special attention shall be paid to providing early curing for hot weather concreting operations. The Service Provider is to provide a proposal for the protection of concrete in cold or hot weather.

Concreting operations shall be carried out in a continuous manner between approved construction joints or from end to end in the case of precast items. Fresh concrete shall not be placed against concrete which has taken its initial set. If an interruption (around 45 minutes) occurs that causes the initial set at the leading edge of the concrete, a construction joint approved by the Civil/Structural Engineer responsible for the design shall be placed.

The concrete shall be deposited in the forms, without separation of the aggregates. Concrete shall not be dropped freely from a height greater than 1.2m or be deposited in large quantities at any point and moved or worked along the forms. Buckets shall have the capability of a controlled rate of discharge. If placing operations necessitate a drop of more than 1.6m, the concrete shall be placed using a flexible tube reaching to the base of the formwork.

Concrete shall be deposited in horizontal layers not exceeding 600mm in thickness and compacted such that each succeeding layer is blended into the preceding one by the compaction process.

Concrete shall not be moved after it has been in the forms for more than 10 minutes.

The Service Provider shall keep on site and make available for inspection a logbook recording each placement of concrete including:

- Date.
- The portion of work.
- Specified grade and source of concrete.
- Slump measurements.
- Volume placed.

Concrete affected by rain before it has set, including during mixing, transport or placing, shall be deemed as non-compliant.

11.3.4.3 Compaction

Concrete shall be compacted immediately after placing by immersion and/or screed vibrators accompanied by hand methods, continuous spading or slicing as appropriate to remove entrapped air and compact the mix. At least 1 reserve vibrator, in working order, shall be provided as standby during concreting operations.

Form vibrators shall be used where use of immersed vibrators is impracticable. Concrete shall be fully compacted and entrapped air removed, but the concrete shall not be over vibrated such that segregation is caused. Vibrators shall not come into contact with partially hardened concrete, or reinforcement embedded in it. Vibrators shall not be allowed to rest on reinforcement or be used to move concrete along the forms.

Exposed surfaces of the concrete shall be struck off and finished with a wooden float. Where shown on the approved drawings corners and edges shall be left neatly rounded or chamfered. Re-entrant angles shall be neatly filleted.

Sections 11.3.4.2 and 11.3.4.3 shall constitute a **HOLD POINT**.

HOLD POINT

Inspection during pour, reviewing compliance of slump, delivered concrete compressive strength, ambient air temperature, ad-mixtures uses, additional water added since batched, placement, compaction, location of the pour, service provider logbook entry of the pour confirmation.

PROCESS HELD: Inspection of pour for compliance of inspections and compliance certifications.

11.3.5 Curing and Protection

11.3.5.1 General

All finishing operations shall be completed prior to the application of any curing. The finishing operations shall be such as to provide a dense surface free from visible surface cracking.

For all types of curing regimes, the concrete surface shall be maintained at a temperature not less than 5°C throughout the curing period.

All exposed surfaces shall be cured using a commercial curing compound in accordance with AS 3799 - Liquid membrane-forming curing compounds for concrete, for a minimum period as detailed in the specification for the structure. During this time the work must be adequately protected from the effects of excessive surface evaporation, rain, running water, vandalism, any traffic and other causes likely to damage the concrete. All costs involved in making good or replacing any work that has been damaged due to the above-mentioned factors shall be the Service Provider's responsibility.

The action of inspection of the finished surface by the Hilltops Councils representative shall constitute a **HOLD POINT**.

HOLD POINT

Site Inspection by Hilltops Councils Representative of the finished surface according to design and specification. Includes a check on surface deflection, honey combing air pockets and other voids created during the pour that requires rectification by the Service provider and prior to application of curing compounds.

PROCESS HELD: Finished surface review.

Wax-based or chlorinated rubber-based curing compounds shall not be used on surfaces forming substrates to concrete toppings, bridge decks, cement-based render and the like.

11.3.5.2 Protection

The Service Provider shall obtain the approval of the Inspecting/Certifying/Design Engineer before loading the concrete structure. The concrete shall be protected from damage due to load overstressing, heavy shocks and excessive vibrations, particularly during the curing period.

Finished concrete surfaces shall be protected from damage from any cause, including mortar splashes and stains, timber stains, rust stains, chemical attack, additives, curing compounds, protective coatings, rain, running water and the like.

11.3.6 Project Assessment of Concrete

The specification for the structure prepared by the Practising Civil or Structural Engineer shall specify the requirements for project assessment including details of how the assessment shall be made if different from AS 3799 - Liquid membrane-forming curing compounds for concrete.

In the case that no Project Assessment of the concrete is specified the Service Provider shall confirm with the Certified Practising Civil or Structural Engineer who prepared the specification that no Project Assessment is required.

11.4 Compliance

11.4.1 Compliance Inspections, Testing and Documentation Requirements

Inspections and certification of the construction confirming compliance with the design and specifications will be required as construction progresses and will be required to be carried out by the Certified Practising Civil or Structural Engineer who prepared the design or their appointed representative. Certification will be required at the completion of the structure to confirm that the structure has been constructed in accordance with the design and specification, is structurally adequate and will meet the serviceability requirements intended by the design. Copies of all certificates shall be provided to Council's Representative. This action shall constitute a **HOLD POINT**.

HOLD POINT

Review of effected inspections and applicable compliance certifications, including all materials, in accordance with design and specification.

PROCESS HELD: Review of inspections and compliance certifications.

The results of all project assessment testing shall be supplied to Council's Representative. The results of testing carried out by the Service Provider's concrete supplier confirming compliance with AS 3799 - Liquid membrane-forming curing compounds for concrete shall be supplied to Council's Representative.

Certification that the reinforcing steel supplied for the structure complies with AS/NZS 4671 - Steel reinforcing materials shall be provided to Council's Representative.

Council's Representative may also carry out inspections of the construction of the structure for compliance with the design, the design specification and this Specification where applicable. Any non-compliance observed shall be brought to the attention of the Service Provider and the Certified Practising Civil or Structural Engineer or their appointed representative responsible for providing construction and completion certification of the structure as required by this section of the Specification. This action shall constitute a **HOLD POINT**.

HOLD POINT

Inspection of construction of structure for compliance with design, specification and this specification.

PROCESS HELD: Inspection of structure for compliance during construction.

11.4.2 Non-complying Work

Where works are observed, by the Practising Civil or Structural Engineer or their appointed representative responsible for providing construction and completion certification or Council's Representative, to not comply with the specification for the structure, this Specification or AS 3600 - Concrete structures, the Service Provider shall be instructed verbally or in writing of the non-compliance. The non-complying item(s) shall be rectified before the works proceed further.

Where test results from concrete suppliers and/or the project assessment show a non-compliance, remedial action shall be taken by the Service Provider following the advice of the Certified Practising Civil or Structural Engineer responsible for the design.

Where other material quality test results demonstrate a non-compliance with the specification for the structure, this Specification or AS 3600 - Concrete structures, remedial action shall be taken by the Service Provider following the advice of the Certified Practising Civil or Structural Engineer responsible for the design.

Failure by the Service Provider to rectify any non-complying work to the satisfaction of the Practising Civil or Structural Engineer or their appointed representative responsible for providing construction and completion certification and Council's Representative shall result in the works not being issued with a Compliance Certificate.

12 Bituminous Sealing

12.1 General

This section specifies:

- The type of bituminous seal required in specific situations.
- The requirements for supplying and constructing primers, primer sealing and sealing where required in accordance with this Specification.

12.1.1 General Requirements

All hot bitumen primers, primer seals and seals shall be supplied and installed in accordance with applicable TfNSW QA Specifications - Pavement (Bituminous) R101-R123 and associated Guidelines.

All bitumen emulsion primer seals or seals shall be provided in accordance the applicable TfNSW QA Specifications - Pavement (Bituminous) R101-R123 and associated Guidelines and the recommendations of the bitumen emulsion manufacturer and/or supplier.

Unless otherwise shown in the Council-accepted pavement design, bituminous seals will be required as defined below:

- 10mm seal is required on the surface of base course pavement layers, under all asphalt surfacing layers.
- 7mm and 14mm 2-coat or seal on roads classed by Council as rural roads or streets.
- 10mm single coat seal is required on all road shoulders nominated to be sealed and on All Weather Surfaces.

Other sealing types may be required where shown on the Council accepted pavement design.

Generally, Class 170 or 240 (preferred) (to AS 2008 Bitumen for pavements) hot bitumen is to be used as the binder for sprayed sealing works with the addition of cutting oil as required depending on site conditions.

Cutback hot bitumen class shall be within the appropriate class for the primer (AMC00 to AMC1), primer binder (AMC2 to AMC4) or seal (AMC5 to AMC7) in accordance with AS 2157 - Cutback bitumen.

Cationic rapid setting bitumen emulsion may be used as the primer seal binder for minor works only and shall be subject to approval by Council's Representative.

Sealing shall only be carried out following suitable preparation of the road base surface which is to be sealed. The surface to be sealed must comply with the requirements of Section 8 - Flexible Pavement Construction of this Specification and shall be:

- Homogeneous in nature without segregation of similar size particles.
- Uniform in texture to achieve a uniform bond.
- Hard and dense to resist embedment of sealing stone.
- Capable of being broomed without laminating or tearing of the surface.
- Free from loose material or foreign matter.

- Surface to be kept slightly damp up to the point of sealing as directed by the sealing supervisor.

All surfaces to be sealed shall be inspected by Council's Representative prior to commencement of sealing operations. This action shall constitute a **HOLD POINT**.

HOLD POINT

Inspection of prepared base surface prior to sealing operations.

PROCESS HELD: Approval of prepared seal surface.

The type of binder used in sealing shall be selected by the Service Provider with due consideration to required curing times before placement of traffic on the seal or placement of asphalt surfacing over the seal or primer seals.

Completed and cured seals must be observed to be consistently and securely adhered to the underlying pavement layer. Seals that strip or detach from the underlying material in mat-like fashion under traffic or with minimal force applied will be rejected.

12.1.2 Bitumen Emulsion Seals

Cationic rapid setting (CRS) bitumen emulsion may be used as the binder for minor works only and shall be subject to approval by Council's Representative. Bituminous emulsions shall comply with AS 1160 - Bituminous emulsions for the construction and maintenance of pavements. CRS bitumen seals shall be constructed in accordance with the latest Austroads Guidelines and TFNSW design guide. The following are only a very general guide for minor works.

- For 10 mm aggregate rate of approximately 1.8 to 2.2L/m².to be used.
- 10mm aggregate shall be applied at a rate of approximately 120 to 140m²/m³.

Again, it's noted the above is for minor works only with prior approval from Council's Representative pending a design or rate of application is submitted prior to the works.

12.2 Compliance

12.2.1 Compliance Inspections, Testing and Documentation Requirements

The following inspections will be required to be carried out by Council's Representative:

- Prior to surface preparation by the sealing Service Provider.
- Following surface preparation by the sealing Service Provider.
- Prior to spraying of binder.
- During spraying of binder and placement of aggregate.
- Following completion of the seal.
- Seal design for approval shall constitute a **HOLD POINT**

HOLD POINT

Submission of seal design in a TfNSW 395K seal design form or equivalent with relevant material test certificates (especially sealing aggregate) for review and approval.

PROCESS HELD: Seal design for approval.

- Test certificates prior to seal design submission

The Service Provider shall provide a copy of their quality plan, test certificates, seal design and daily records similar to the TfNSW 500C form Daily Bitumen sealing record relating to sealing works if requested by Council's Representative.

Review of testing and compliance documentation shall constitute a **HOLD POINT**.

HOLD POINT

Submission of all relevant testing certificates and documentation including daily spray sheets for review.

PROCESS HELD: Compliance of Reseal Works Documentation.

12.2.2 Non-complying Work

Where works are observed by Council's Representative to not comply with this Specification the Service Provider will be instructed verbally or in writing of the non-compliance. The non-complying item(s) will be required to be rectified before the works proceed further.

Where material quality test results demonstrate a non-compliance with this Specification that material shall be removed and replaced with complying material.

Where a seal fails to perform as a result of material quality, a poor design, or an error on the part of the Service Provider then the Service Provider shall propose a method of rectification for the acceptance of Council's Representative. Compliance Certificates will not be provided until all rectification works are complete.

13 Asphalt Surfacing

13.1 General

This section covers the requirements for the following:

- Design of asphalt mixes.
- Requirements of constituent materials in asphalt mixes.
- Preparation for placement of asphalt.
- Placement and compaction of asphalt.
- Compliance inspections, testing and documentation to demonstrate compliance.

The types of asphalt covered by this Specification are:

- Dense Graded Asphalt (or Asphaltic Concrete) (DGA or AC).
- Fine Gap Graded Asphalt (FGGA).

13.1.1 General Requirements

Asphalt surfacing may be required in all new urban residential, industrial and commercial development roads regardless of the pavement being full road, half road or shoulder construction.

Asphalt surfacing may be required in rural cul-de-sac/turning circles and rural intersections unless otherwise detailed on the approved drawings.

The Service Provider supplying the asphalt shall have established, implemented and maintain a Quality System in accordance with this Specification and the requirements of AS/NZS ISO9001 - Quality management systems - Requirements.

This requirement does not apply to a Service Provider placing a small area of asphalt up to 120m² associated with pavement shoulder or kerb and gutter construction.

13.1.2 Asphalt Surfacing Type and Thickness

Asphalt surfacing shall be supplied and placed using the following types and thickness of asphalt unless otherwise specified in the approved Pavement Design Report.

Urban Residential Developments with design ESA up to 3 x 105 shall have a minimum 30mm thick AC10 on a 10mm seal in accordance with Section 12 - Bituminous Sealing.

Urban Residential Developments with design ESA up to 3 x 105 to 1 x 107 shall have a minimum 40mm thick AC10 on a 10mm seal in accordance with Section 12 - Bituminous Sealing.

Rural Intersections and cul-de-sacs/turning circles shall have a minimum 40mm thick AC10 on a 10mm seal in accordance with Section 12 - Bituminous Sealing.

Industrial/commercial developments shall have an asphalt surfacing thickness in accordance with the approved Pavement Design Report. The thickness will be specified following consideration of the heavy vehicle loadings and likely vehicle turning and braking forces.

Surfacing other than dense graded asphalt shall only be used where specified in the approved Pavement Design Report.

The asphalt surfacing shall not be laid within 7 days of the placing of a seal. This requirement shall only be changed with the approval of Council's Representative following consideration of information presented by the Service Provider justifying an earlier placement of asphalt. In any case the Service Provider shall obtain their own advice as to the appropriate length of time that a seal should be allowed to cure prior to the placement of asphalt over the seal. That advice shall take into consideration the amount of cutter present in the bitumen binder of the seal.

Asphalt that is adversely affected due to being placed over a seal that has not been allowed to fully cure shall be fully removed along with the underlying seal and replaced.

Seals that have been affected by the trafficking of vehicles over the seal shall be resealed to the satisfaction of Council's Representative prior to placement of asphalt.

13.1.3 Asphalt Mix Design

Asphalt mix designs shall be carried out by the Service Provider or their asphalt suppliers in accordance with the specifications nominated in this section. Any documentation relating to mix designs shall be provided upon request to Council's Representative.

AC7 is the typical mix design required for footpaths to ensure the surface voids are closed in as much as piratically possible.

Submission and confirmation of Asphalt Mix design shall constitute a **HOLD POINT**.

HOLD POINT

Submission of proposed Asphalt Mix design to Council's Representative for review and approval.

PROCESS HELD: Compliance of Asphalt Mix Design.

13.2 Supply and Placement of Asphalt

13.2.1 Asphalt for Traffic Loading

Asphalt for pavements shall be supplied, placed, finished and tested in accordance with the requirements of TfNSW QA Specification R116 Heavy Duty Dense Graded Asphalt and QA Specification R117 Light Duty Dense Graded Asphalt, as applicable. The following clarifications in relation to the requirements of R116 and R117 shall apply:

13.2.1.1 Generally

- Superintendent or Principal shall mean Council's Representative.
- A Project Quality Plan is not required.
- Documentation required in Annexure R116/D and R117/D shall be provided when requested by Council's Representative.

- Referenced documentation shall be those that are current at the date of the pre-construction site meeting.
- Hold points shall not be applicable unless requested by Council's Representative.

13.2.1.2 Supply of Asphalt

- If not specified in the approved Pavement Design Report, binder shall be Class 320 bitumen.
- Submission of mix designs to Council's Representative is not required unless requested by Council's Representative.

13.2.1.3 Placing Asphalt

- Course layer thicknesses shall be as nominated in this section of the Specification or as nominated in the approved Pavement Design Report.
- Nomination of the minimum temperatures and measurement of temperatures will not be required unless requested.
- Nomination of tack coat application rates will not be required unless requested.
- A placement trial will not be required.

13.2.1.4 Finished Pavement Properties

- Compaction control testing on cores is not required unless requested by Council's Representative.
- When compaction testing is requested a Lot shall be the section of pavement nominated for testing. A minimum of three cores will be required in any section of pavement requiring testing for compaction.
- For the purpose of determining course thickness compliance a Lot shall be a section of pavement up to 100m length.
- Cores for determining course thickness compliance shall be taken when requested by Council's Representative. A minimum of three cores will be required in any section of pavement requiring testing for course thickness.
- The surface shape requirements shall apply to all road pavements. Surface shape requirements shall be tested by Council's Representative.
- Determination of ride quality in accordance with TfNSW QA Specification R116 and QA Specification R117, as applicable, Section 4.5 Ride Quality will only be required when requested by Council's Representative.

13.2.1.5 Conformity

- Areas that exhibit cracking, ravelling, bony or fatty material, or have been damaged during construction in the opinion of Council's Representative, shall be removed and replaced. The extent of the removal and replacement will be directed by Council's Representative.
- Sampling and testing of the asphalt mix or placed asphalt shall only be required if requested by Council's Representative.
- Results of any tests requested by Council's Representative shall be provided to Council's Representative prior to the pre-final inspection.

- The Service Provider shall rectify any area of non-conforming asphalt works as determined by Council's Representative following consideration of finished pavement properties and test results.
- Any reference to Schedule of Rates and deductions do not form part of this Specification.

13.2.1.6 Other Requirements for Asphalt Supply and Placement

Where procedures for the supply and placement of asphalt are not covered in TfNSW QA Specification R116 Heavy Duty Dense Graded Asphalt and QA Specification R117 Light Duty Dense Graded Asphalt, as applicable, the procedures of AS 2150 - Hot mix asphalt and Austroads Guide to Pavement Technology - Part 4B shall be adopted.

Asphalt placed against the lip of gutter shall not be lower than the lip level or 10mm higher than the lip level. The criteria shall be applied during the pre-final inspections and at the end of the defects liability period. This requirement shall be applied regardless of the requirements of other specifications and standards referred to in this section.

13.3 Compliance

13.3.1 Compliance Inspections, Testing and Documentation Requirements

The following inspections and tests will be required to be carried out by Council's Representative:

- Prior to placement of asphalt - inspection of seal and preparation.
- During placement of asphalt.
- Following completion of asphalt surfacing.
- Surface shape using a 3m straight edge with no more than .10 mm defection in all directions.
- Jointing to be smooth.
- Pre-final inspection.

The Service Provider shall provide a copy of test certificates, design calculations and records relating to asphalt works if requested by Council's Representative.

The Service Provider shall arrange and meet the cost of testing requested by Council's Representative.

The above compliance action shall constitute a **HOLD POINT**.

HOLD POINT

All required inspections and tests will be required to be carried out by Council's Representative by site inspection:

- Prior to placement of asphalt - inspection of seal and preparation.
- During placement of asphalt.
- Following completion of asphalt surfacing.
- Surface shape using a 3m straight edge with no more than 10mm deflection in all directions.
- Jointing to be smooth.
- Pre-final inspection.

PROCESS HELD: Compliance of Asphalt supply and placement.

13.3.2 Non-complying Work

Where works are observed by Council's Representative to not comply with the Specification requirements the Service Provider will be instructed verbally or in writing of the non-compliance. The non-complying item(s) will be required to be rectified before the works proceed further.

Where material quality test results demonstrate a non-compliance with this Specification, that material shall be removed and replaced with complying material.

Where asphalt surfacing fails to perform as a result of material quality, poor design, or an error on the part of the Service Provider, the Service Provider shall propose a method of rectification for the acceptance of Council's Representative. Compliance Certificates will not be provided until all rectification works are complete.

In the case of asphalt being low at the lip of kerb and gutter or flush kerb, the asphalt shall be removed and replaced from the lip alignment to the crown alignment of the road or other alignment as agreed to by Council's Representative. Should removal of the asphalt result in the removal of the primer seal below the asphalt then the primer seal shall be reinstated prior to any asphalt being placed.

14 Cold Milling of Asphalt and Base Course

14.1 General

This section covers the requirements for the removal of pavement materials from road pavements by cold milling, including the treatment of the milled vertical surfaces and the cleaning up, removal and disposal of the milled materials.

For traffic safety reasons, the Service Provider shall ensure that all milling or profiling work is not carried out any sooner than 48 hours prior to new asphalt being placed on the milled surface.

All traffic control will be undertaken in accordance with Section 4 - Traffic Management of this Specification.

14.2 Detection and Documentation of Hidden Object

The Service Provider shall undertake a comprehensive investigation to determine the location of all hidden objects within the limits of work. This shall include, but is not limited to the following:

- Make enquiries with the relevant Authorities to confirm the exact locations of all objects within the proposed milling area.
- Survey the area to be milled for hidden objects using a locating device or metal detector. The locations and extent of any objects (metal objects, public utilities, etc) detected must be clearly marked on site. Determine whether the Hidden Object is within the depth to be milled.
- Submit a report, 5 working days before commencing works, with the following information:
 - Survey details of any hidden objects or utilities.
 - Written advice confirming that all authorities' requirements have been satisfied.

Protection of underground utilities shall be in accordance with this Specification Section 7 - Utility Services Installation, Road Opening and Utility Restorations.

14.3 Cold Milling Operation

Set out the cold milling work area as shown on the drawings or as specified by Council's Representative. Mark all milling depths and locations of any hidden objects or utilities on the road surface.

Perform cold milling to the nominated depth(s), width, length, alignment and road sections as per drawings or as directed by Council's Representative.

Demonstrate the use of controls to the satisfaction of the Council's Representative. Control the cold milling machine either by levelling beam or stringline and automatic sensors unless otherwise approved.

There shall be a 5mm maximum difference in levels between adjacent runs, depths and surface levels.

If milling near access chambers or other similar structures, operate the cold milling machine as close as possible to the structure without causing damage to it. Remove the remaining asphalt and base course by hand or other approved method.

14.3.1 Milling to Achieve Specified Depth of Cut

Milling to achieve a specified depth of cut may be directed in one of the following ways:

- Where nil tolerance on depth of cut applies for 'greater than specified' refer to Figure 6 below.
- Where above and below depth of cut has been specified refer to Figure 6 below.

14.3.2 Milling to Retexture a Surface

Groove depths in the existing surface to be between 5mm to 10mm depth. Do not fully remove the existing surface. Groove spacing to be 10mm maximum.

14.3.3 Milling to Optimise Final Ride Quality

When the Service Provider is milling to optimise final ride quality, the outcome shall be achieved by cutting to an average depth predetermined by survey and to tolerance as specified in Table 25. The nominal cutting width must be 2m.

The milling machine must be equipped and operated using a minimum 6m averaging beam or an equivalent non-contact system. The Service Provider must set the milling operations to a constant speed and the cutting sequence must start from the crown and proceed towards the kerb.

The Service Provider shall verify the shape and profile of the milled surface by the use of a 3m straight edge after each cut. The milled surface must not deviate from any point on the bottom of the straight edge by more than 5mm.

14.3.4 Cold Milling over Concrete Structures

Where cold milling is required over existing concrete structures the Service Providers shall undertake a comprehensive investigation to determine the thickness of the existing asphalt over each Concrete Structure.

Carry out the investigation as follows:

- Determine the proposed pattern of milling works and mark on the pavement the lines of movement of the depth sensing foot on each side of the milling machine.
- Investigate the thickness of asphalt by taking small diameter cores (e.g. 25mm), at 3m intervals (over concrete bridge elements) or 20m intervals (over other concrete structures) along each line of movement of a depth sensing foot, at least 24 hours prior to the commencement of milling.

Submit the findings of the investigation to Council's Representative at least 24 hours before commencement of milling.

The depth of cut shall conform to the requirements of Table 25.

14.3.5 Temporary Ramps

Where the milled surface is to be temporally opened to traffic the edges of the milled surface shall be tied into the existing road surface.

There are two methods allowed for forming temporary ramps, these are, bevelling and the placement of cold mix asphalt.

When bevelling with the cold milling machine ensuring any lip remaining at the toe or head of the bevel does not exceed 10mm in height. Ensure surface and horizontal tolerance conform to Table 25.

The use of cold mix asphalt shall conform to the following:

- Apply an emulsion tack coat to the milled surface prior to the placement of cold mix asphalt.
- Maximum thickness and layering of cold mix asphalt shall conform to Table 25.
- Leave the cold mix asphalt ramp in place no longer than 1 week.
- Maintain the ramp in good condition.
- Compact all cold mix.

14.3.6 Tolerances

Table 25: Tolerances for Cold Milling Operations

Nature of Milling Work	Tolerance, Depth of Cut (mm)		Groove Spacing	Surface Texture
	Greater than specified	Less than specified	(mm)	Depth (mm)
Cutting to depth $\leq$ 40mm	0	8 max	15 max	2.5 max
Cutting to depth > 40mm where the floor of the cut is asphalt or bound material	10 max	5 max	15 max	Not specified
Cutting to depth > 40mm where the floor of the cut is unbound material	15 max	5 max	15 max	Not specified
Cutting to depth within nominal 40mm of the surface of a Concrete Structure and/or waterproofing membrane that is to be retained	0	8 max	10 max	2.5 max
Producing a surface suitable for spray sealing without prior correction	Not specified	Not specified	10 max	1.5 max
Milling to achieve specified level	10 max	0	Not specified	Not specified

Nature of Milling Work	Tolerance, Depth of Cut (mm)		Groove Spacing	Surface Texture
	Greater than specified	Less than specified	(mm)	Depth (mm)
Producing a surface to optimise ride quality	5 max	5 max	Not specified	Not specified
On Concrete Bridge Element	0	8 max	10 max	1.5 max

Depth of cut and other associated terminology is shown in Figure 6 and Figure 7.

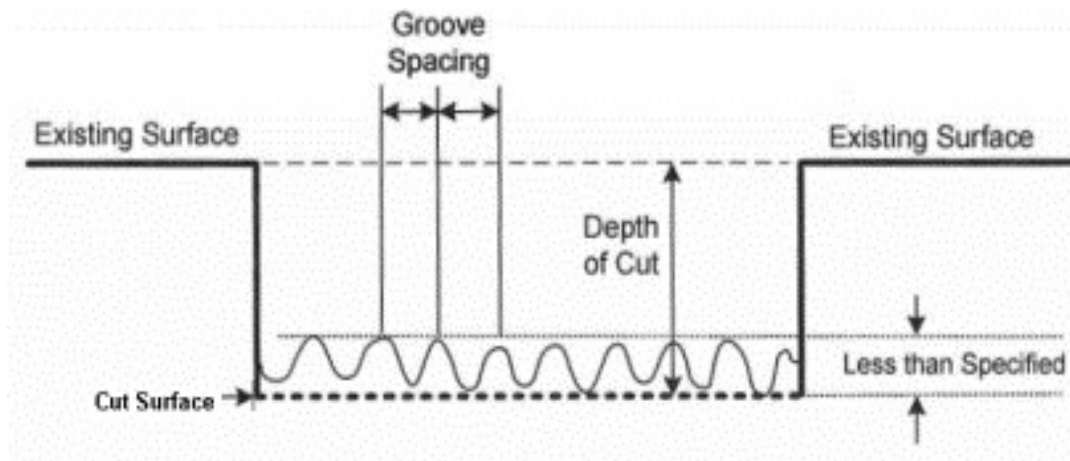


Figure 6: Where Nil Tolerance on Depth of Cut Applies for Greater Than Specified

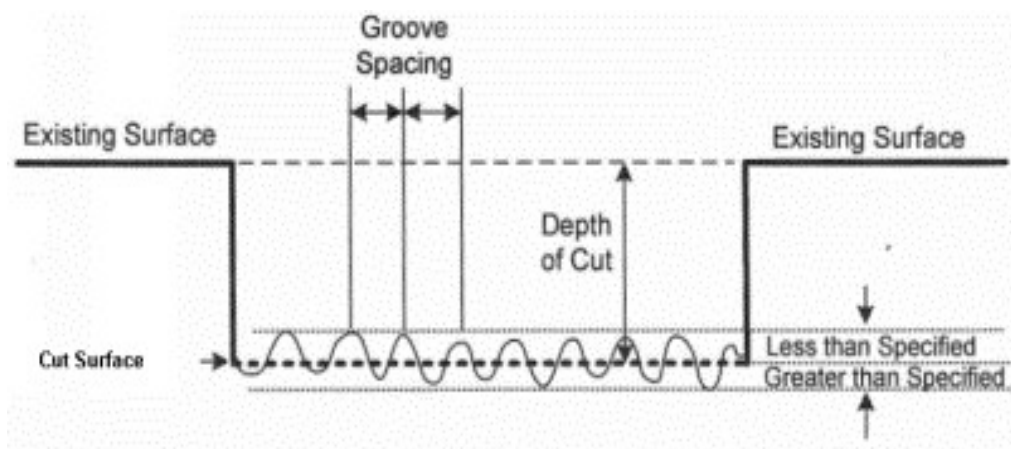


Figure 7: Where Above and Below Depth of Cut has been Specified

Table 26: Tolerances for Cold Milling Operations

Activity	Limits/tolerances
Cuts of cold milling machine	
Difference in levels between adjacent runs, depths and surface levels	< 5mm
Temporary ramps	
Dimensions for transverse joints	Speed limit > 60km/h: minimum taper length of 2.5m per 50mm variation in levels. Speed limit ≤ 60km/h: minimum taper length of 1.5m per 50mm
Dimensions for longitudinal joints	Provide a ramp of minimum 1.0m length for each 50mm variation in levels
Interface with structures	Provide ramps with a minimum taper length of 1.5m for each 50mm depth of cut
Methods of forming ramps	
Bevelling	Ensure any lip remaining at the toe or head of the bevel does not exceed 10mm in height
Cold mix asphalt	Maximum thickness ≤ 40mm. Where site conditions require greater thickness, place the cold mix asphalt and compact in layers between 25 and 30mm thick
Levelling of stockpiles	Height = 2m with uniform shape

14.4 Milled Surface

Following the cold milling operation remove all loose material from the road pavement, gully pits and median areas.

Sweep the pavement and leave the site in a clean and tidy state. Remove all cold milled material from the site and transport to stockpile site(s) or otherwise remove from the site as directed.

Prior to covering the milled surface, arrange to inspect the surface with Council's Representative prior to the removal of milling equipment from site.

14.4.1 Unsuitable Material

The Service Provider shall remove any planes of weakness within the asphalt, cement, concrete and/or pavement materials, or any unsuitable material existing at the base of the cut, which is not removed by the milling operation to the extent directed by the Council's Representative.

14.5 Clean Up and Disposal of Milled Material and Temporary Ramp Material

The Service Provider shall at the completion of cold milling, remove all loose milled material. The material removed will become the property of the Service Provider unless otherwise specified.

If the milled material remains the property of Council, deliver the milled material to the nominated stockpile site(s). Shape the milled material in uniform stockpiles with regular sides and, where appropriate, slope the top to promote water runoff. Clearly identify the milled material by signposting.

If the milled material becomes property of the Service Provider, remove it from the site in accordance with the Waste Management Plan.

The Service Provider shall notify Council's Representative, before the commencement of milling operations, how and where the milled material will be reused, recycled, stockpiled or discarded.

15 Restoration and Finishing of Surfaces

This section covers the requirements for reinstatement, restoration and finishing of surfaces other than pavement surfaces, concrete path surfaces or other hard surface treatments.

Areas to be landscaped shall be finished in accordance with the approved Landscape Plan.

Areas for Vegetation Management shall be finished in accordance with the approved Vegetation Management Plan.

A vegetative cover shall be established on all areas prior to issue of final acceptance of works, Occupation Certificate and Subdivision Certificate.

Spreading of mulch in isolation over disturbed areas is not accepted to satisfy establishment of a vegetative cover as required and referred under this Specification.

15.1 General Requirements

15.1.1 Removal of Rubbish and Excess Materials

All rubbish, excess construction materials, timber, loose roots and other materials not to be incorporated into the works must be removed from the site progressively and at the completion of site works.

15.1.2 General Surface Grading

Unless otherwise shown on the drawings, all disturbed areas shall be graded to an even surface. The finished surface shall not have ridges and hollows that pond or direct runoff in other than a sheet flow fashion. Ridges shall be trimmed, and depressions filled as necessary to produce a surface which will drain freely and is suitable for the operation of tractor-mounted mowers. Regraded areas are to be shaped and graded at a minimum of 1% to avoid depressions and to generally direct surface flow to the drainage system designed for that catchment.

Concentrations of surface water shall not be diverted towards trees. Filling within natural drainage paths is not to cause permanent or semi-permanent increases in the levels of the water table or standing water surface levels where upstream trees would be adversely affected. The diversion of natural drainage flows away from existing trees shall be avoided. Measures shall be taken to maintain existing surface and subsurface flows about retained vegetation and through the site.

Provisions must be made along the toe of the fill batters or base of retaining walls to permit the free passage of stormwater and subsurface water away from adjoining properties. Reductions in stormwater disbursement from adjoining properties shall not be permitted.

15.1.3 New Surface Treatments

The following requirements apply to all exposed areas not to be treated in accordance with an approved Landscape Plan.

All disturbed areas not to be landscaped in accordance with the approved Landscape Plan or Vegetation Management Plan shall be scarified, topsoiled, grass seeded and established to a vegetative cover over 80% of its area. Urban areas to contain an approved grass type as referenced in Section 15.1.10.

In addition, all areas used for access tracks and any areas compacted by vehicles, stockpiles or storage of materials shall be ripped to a minimum depth of 300mm regardless of the requirements of Section 5.1.2 Soil and Water Management, Erosion and Sediment Control. Stones and rocks larger than 50mm shall be removed from the surface after ripping.

Ripping will not be required where rock outcrops are evident.

Proposed lot areas are to be topsoiled, grass seeded and established to a vegetative cover upon completion of grading to final surface levels with 80% cover to minimise erosion as per approved Landscape or Vegetation Management Plan.

Cut and fill road batters are to be topsoiled, stabilised with jute mat or equivalent and revegetated as shown on works approval drawings unless an alternative treatment is approved.

Temporary construction fencing of areas once topsoiled and undergoing revegetation shall be installed by the Service Provider. Fencing shall be as required to effectively discourage vehicular or construction plant access.

Further guidance on the suitability of various batter surface stabilisation techniques can be found in the TfNSW publication Guideline for Batter Surface Stabilisation using vegetation.

15.1.4 Verges

Verges shall be scarified and topsoiled in accordance with the requirements Section 15.1.9 Topsoil and turf placed in accordance with Section 15.5.2 Turf.

15.1.5 Pavement and Hard Surfaces

All hard surfaces shall be swept clean at the completion of the works. All rubbish, soil and other materials resulting from the sweeping are to be removed from the site.

15.1.6 Restoration of Existing Surface Finishes

Unless otherwise shown on the approved drawings or covered elsewhere in this Specification, all existing surfaces finishes that are disturbed during construction are to be reinstated to the requirements of this Specification. In the case of private property surface restoration shall be as agreed between the property owner and Service Provider.

15.1.7 Surface Defects

Any surface treatment, that in the opinion Council's Representative becomes defective during the defects liability period as a result of normal usage or neglect, shall be removed and replaced and be subject to a further defects liability period.

15.1.8 Finishing Adjacent Surfaces

Areas immediately adjacent to all concrete elements shall be topsoiled and turfed as shown in Council's Engineering Guideline Specification - Standard Drawings or as required by landscaping or Vegetation Management Plan requirements.

Provide two turf strips (900mm wide minimum) each side flush with constructed paths. The residual footway/verge width each side of constructed paths shall be topsoiled and turfed for subdivision development works and where these areas (back of kerb to

property boundary) are otherwise completely disturbed by road and/or path works, as shown in Council's Engineering Guideline Specification - Standard Drawings.

Adjacent surface levels to concrete elements shall be finished so that they do not intercept, pond or concentrate stormwater sheet flows.

15.1.9 Landscaping

The work to be executed under this Specification consists of:

- a) The vegetation of cut and fill batters, median areas, pathways, verges, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising, sowing of seed and may include surface protection work, hydroseeding, hydro mulching and straw mulching.
- b) The supply of plants, planting at locations as shown on the approved design drawings, fertilising, mulching, staking, watering and maintenance of plants.

15.1.10 Reference Documents

Documents referenced in this section of the specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

Where not otherwise specified in the relevant Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the Specifications at the time of the Works approval.

- a) Hilltops Council (HC) Specifications
 - Section 3 General matters (includes Control of Erosion and Sedimentation).
 - Section 5 Site Clearing and Bulk Earthworks.

- b) Australian Standards

References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS.

- AS 1160 - Bitumen emulsion for construction and maintenance of pavements.
- AS 2507 - The storage and handling of pesticides.
- AS 4419 - Soils for landscaping and garden use.
- AS 4454 - Composts, soil conditioners and mulches.
- AS 4843 - Synthetic weed blocking fabric.
- AS 4970 – Protection of Trees on Development Sites
- AS4373 – Pruning of Amenity Trees
- AS 2023 – Tree Stock for Landscape Use.

- c) Other Publications: Hilltops Council Engineering Guideline Section 1 Design

15.2 Vegetation of Slopes and Drains

15.2.1 Execution and Timing of Work

In association with the work to be executed under this Specification, the Constructor shall implement effective erosion and sedimentation control measures in accordance Section 3 – General matters (includes Control of Erosion and Sedimentation).

The work to be completed includes the vegetation of cut and fill batters, pathway verges, median areas, open drains and other areas within the site. Vegetation includes the initial surface preparation, topsoiling, fertilising and either sowing of seed or turfing as shown on the approved design drawings. Exposed ground shall be vegetated before the area exceeds one hectare or lesser area in compliance with Hilltops Council (HC) requirements.

15.2.2 Materials

a) Topsoil

All disturbed areas, including fill areas must be scarified to a minimum depth of 75mm and top dressed with topsoil to a minimum depth of 75mm. Once topsoiled, the area is to be revegetated as shown on the approved drawings and as detailed in this Specification.

Topsoil shall comply with AS 4419 - Soils for landscaping and garden use. In the case of topsoils stripped from the site some modification to the soil may have to be made by mixing additional materials.

Topsoil sourced from the site shall be used first in preference to importing topsoil. Topsoil sourced from the site is not to contain stumps, roots, clay lumps or rocks greater than 25mm diameter.

Site topsoil shall not be modified where an approved Vegetation Management Plan specifies soils to be used in their natural state or similar.

The Constructor shall use topsoil stockpiled on site in accordance with Section 5 Site Clearing and Bulk Earthworks. Where imported topsoil is required, it shall comply with AS 4419 and shall:

- Be of a friable, porous nature.
- Be free of weeds and weed seeds, bulbs, corms and vegetable propagules.
- Contain no refuse or materials toxic to plant growth or human health.
- Contain no stumps, roots, clay lumps or stones larger than 50mm in size.
- Have an organic content of at least 3% by mass.
- Have a pH neither less than 5.5 nor more than 7.5.
- Have a soluble salt content not exceeding 0.06% by mass.

The Constructor shall submit to the HC Representative name(s) of the proposed topsoil supplier/s inclusive of the test results demonstrating compliance with the above at least ten (10) working days prior to delivery to the Works site.

b) Herbicide

Herbicide used shall be a suitable type registered for that use herbicide listed in Annexure 15A and in accordance with HC 's pesticide notification program. Chemical proposed shall be specified in the Landscape/Vegetation Management Plan.

c) Seed

A general turf species blend is shown in the tables below for relevant areas:

Table 27: A Playground Mix

Turf Species	Percentage of Total
Annual Rye	20
Creeping Red Fescue	15
Perennial fine leaf Rye	40
Kentucky Blue Grass	10
Unhulled Couch	15
Mix Sowing rate 3.5 -5kg per 100 square metres.	

Table 28: General or Roadside Mix

Turf Species	Percentage of Total
Annual Rye	20
Tall fescue	50
Creeping Red Fescue	10
Unhulled Couch	15
Mix Sowing rate 3.5 -5kg per 100 square metres.	

Note: The above blends are general in nature. The actual species or cultivar and percentages will depend on the supplier of the blend.

All seed used shall be of the species and varieties listed in Annexure 15A and shall be sown at the application rates specified therein. The Constructor shall submit to the HC Representative the name/s of the proposed seed supplier(s) at least ten (10) working days prior to application at the Works site.

The Constructor's attention is drawn to the lead time that may be required to procure some native seed species. The native seed shall be delivered to the site in separate lots for each species and variety, clearly labelled to show species, variety and weight.

All seed must be accompanied by a "Certificate of Authenticity" which shall be furnished by the Constructor to the HC Representative upon request at any stage of the work. Grass and clover seed shall be pre-packed commercially with an accompanying certificate of germination.

The Constructor shall not take possession of the seed more than seven (7) days before sowing is to occur. The seed shall be stored in clean, airtight containers and kept away from direct sunlight. It shall not be exposed to the elements at any stage during storage.

The Constructor shall replace at his own expense any exotic seed batch found not true to type.

d) Turf

Turf shall consist of 25mm depth of dense, well rooted, vigorous grass growth with 25mm depth of topsoil. The type of grass turf to be used shall be selected from Annexure 15A and in accordance with the approved design drawings. Turf shall be free of weeds, soil pests and diseases. The turf shall be supplied as rolls in long lengths of uniform width, not less than 300mm, and shall be in sound unbroken condition.

e) Fertiliser

Fertiliser shall can be either an organic type or inorganic as listed in Annexure 15A with Nitrogen: Phosphorus: Potassium (N:P:K) ratios of 8:3.6:2.

f) Vegetable Mulch

Vegetable mulch used in hydro mulching shall consist of straw, chaff, wood fibre, paper pulp or similar material all finely shredded to a maximum dimension of 10 mm. Meadow hay or weeds shall not be used and paper pulp if used shall not exceed 50% by mass of the total mulch.

g) Water

Water used shall be potable and fit for purpose.

h) Binder

The binder used in hydro mulching and straw mulching shall be Grade ASS, slow setting anionic bitumen emulsion, complying with AS 1160.

i) Wetting Agent

The soil wetting agent added in hydro mulching or hydroseeding shall be listed in Annexure 15A and applied at the application rate specified therein.

j) Pesticide

Pesticide used shall be a liquid or powder registered for that intended control for the pest and in accordance with HC 's pesticide notification program. The storage and handling of pesticides shall be in accordance with AS 2507.

15.2.3 Vegetation of Slopes 3 to 1 or Flatter

a) Preparation of Surface

Slopes shall be sprayed with herbicide applied at the rate specified in Annexure 15A to kill weed infestation. Sprayed areas shall remain undisturbed for fourteen (14) days. The surface shall then be tyned to a depth of 200 mm to produce a loose

surface and all large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling.

b) Topsoiling

Topsoil shall be uniformly applied to provide an average compacted thickness of 50mm with a minimum compacted thickness of 30mm at any location. The topsoiled area shall be cultivated to a depth of 50mm to provide a roughened surface with soil lumps not exceeding 50mm dimension.

This finished compacted layer is to match the surrounding hard surfaces.

c) Mixing of Seed

The Constructor shall give the HC Representative notice at least two (2) working days before each sowing operation. Seed shall be sown on the day of application of pesticide.

d) Incorporation of Pesticide

Immediately before sowing, all grass and native seed shall be treated with pesticide. The Constructor shall supply and spread a suitable pesticide in accordance with the manufacturer's minimum application rate.

e) Sowing

Sowing shall be carried out with an appropriate mechanical seeder. Where practicable, passes shall follow finished surface contours. Seed shall be sown at a depth of 5mm or shall be raked or harrowed to provide 5mm cover.

Alternatively, where Kikuyu/Couch is proposed, areas are to be sprayed with a broadleaf herbicide mix at the top-dressing stage, then rotary hoed to incorporate runners (stolens) into the topsoil then over seeded.

Seed and fertiliser shall be evenly distributed over the areas to be sown at the rates specified in Annexure 15A. Fertiliser shall be applied concurrently with the seeding operation.

f) Turfing

Turf shall be placed on the prepared moist topsoiled surface. Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow. Turf seams shall then be top dressed with topsoil then lightly rolled.

Between four (4) and six (6) weeks after placement, the turf shall be lightly top dressed with topsoil to correct any undulations or unevenness in the established turf.

g) Watering

The Constructor shall water areas to be sown to a moist condition and shall rewater areas to a moist condition without surface runoff on a daily basis for a minimum of fourteen (14) days after sowing, or as otherwise directed by the HC Representative, to promote and maintain growth.

Any vegetation determined not fit for purpose following the Maintenance Bond period and related final inspection is to be replaced at the Constructor's cost.

15.2.4 Vegetation of Slopes Steeper Than 3 to 1

a) General

Where shown on the approved design drawings or directed by the HC Representative, slopes shall be vegetated by one of the following methods:

- (i) Topsoiling and hydro mulching.
- (ii) Topsoiling, hydroseeding and straw mulching.
- (iii) Hydroseeding.

b) Preparation of Surface

Weeds shall be killed by spraying with herbicides as specified under Section 15.4.1(a).

No more than seven (7) days before seeding, all loose material shall be removed from fill batters and cut batters, which are not stepped, by dragging a heavy steel chain of minimum weight of 30 kilograms per metre of length or by other methods approved by the HC Representative.

c) Topsoiling

Where batters have been stepped, the steps shall be loosely filled with topsoil. Elsewhere, topsoil shall be uniformly applied to provide an average thickness of 50mm with a minimum compacted thickness of 30mm at any location

d) Hydro mulching or Hydroseeding

The hydro mulch or hydroseed shall comprise the materials shown in Table 29. The materials shall be applied at the application rates shown in Table 29. Dry surfaces shall be watered by a fine spray before the application of the hydro mulch. The mixing and treatment of seed shall be carried out in accordance with Section 15.5.1(c).

During preparation of the hydro mulch or hydroseed slurry, liquid form pesticide shall be added to the storage tank, to facilitate surface application, at a rate of 5 litres of pesticide to the equivalent volume of hydro mulch or hydroseed slurry to be spread on one (1) hectare of surface in accordance with Table 29.

Storage tanks, containers and equipment to be used in hydro mulching or hydroseeding of slopes shall be clean and free of contamination from previous operations.

A slurry mixture shall be produced by addition of the specified materials in the tank and agitated to maintain a uniform consistency during application. It shall be applied uniformly over the whole surface.

Hydro mulch or hydroseed shall not be applied under the following weather conditions at the site:

- When temperature is higher than 35 degrees Celsius.
- When wind exceeds 15 km/h.
- Where, in the opinion of the HC Representative, the surface is too wet.
- During rain periods or when rain appears imminent.

Application rates shall be in accordance with Table 29.

Table 29: Materials and Application Rates

Material	Application Rate per Hectare	
	Hydro mulching	Hydro seeding
Vegetable Mulch (kg)	2,500	Nil
Water (Litre)	35,00	20,000
Binder (Litre)	700	Nil
Fertiliser	Refer Annexure XXX was C276A)	
Seed	Refer annexure XXX (was C273A)	
Wetting Agent (litre)	35	20
Pesticide (Litre)	5	5

e) Straw Mulching

The mulch to be applied after hydroseeding shall comprise a matrix of straw and an anionic slow setting bitumen emulsion binder. Meadow hay shall not be used. The straw mulch shall be uniformly applied by a suitable blower unit at a rate of 250 bales (each of 20 kilograms) of straw per hectare of surface. The bitumen emulsion shall be incorporated as a spray into the air stream of the mulch blower at a rate of not less than 2,500 litres of bitumen emulsion per hectare of surface. The finished straw mat shall have a minimum thickness of 20mm at any location.

f) Watering

The Constructor shall water treated areas in order to promote and maintain growth as specified under Section 15.5.1(g).

15.2.5 Vegetation of Non-Concrete Open Drains

a) Preparation of Surface

The Constructor shall ensure that the excavation of open drains to the specified profiles is followed by the vegetation of the surface within seven (7) days as specified in this Clause. Topsoil shall be spread to provide an average compacted thickness of 50mm with a minimum compacted thickness of 30mm at any location.

b) Sowing

Before sowing, the surface shall be watered. Seed and fertiliser shall then be applied uniformly at the rates specified in Annexure 15A by one of the following procedures:

- (i) Mechanical sowing.
- (ii) Hydro mulching or hydroseeding.
- (iii) By hand.

c) Surface Protection

Where shown on the approved design drawings or directed by the HC Representative, one of the following protective treatments shall be applied immediately to all or part of the sown surface.

(i) Spraying with Bitumen Emulsion

An anionic slow setting bitumen emulsion, conforming with Grade ASS of AS 1160, shall be sprayed over the surface at a rate of one (1) litre of bitumen emulsion per square metre of surface.

(ii) Lining with Organic Fibre Mat

The channel surface shall be lined with an organic fibre mat listed in Annexure 15A. The runs of matting shall be laid along the direction of water flow. The matting shall be laid loosely on the soil surface and not stretched. The upstream end of the matting shall be slotted into a trench 150mm wide by 150mm deep and pinned to the base of the trench at 200mm centres. The trench shall be backfilled with soil and compacted by foot. The pins shall be 'U' shaped, 4mm gauge wire, 50mm wide and 150mm long legs.

Adjacent runs of matting shall be overlapped 100mm with the higher run lapped over the lower run. The matting shall be pinned along the sides of each run at 500mm centres and along the middle of each run at 1m centres. End overlaps shall be 150mm wide with the higher run end lapped over the start of the lower run and pinned at 200mm centres.

(iii) Turfing

Turf shall be as specified under Section 15.2.5(c).

Runs of turf shall butt hard against each other and be placed perpendicular to the direction of water flow in the drain and pinned into position at 500mm centres.

Seams of turf shall be top dressed with topsoil.

d) Watering

The Constructor shall water treated areas in order to promote and maintain growth as specified under Section 15.2.5(d).

15.3 Landscape Planting

15.3.1 Execution and Timing of Work

The work to be executed includes the ground preparation, the supply of plants, planting at the locations as shown on the approved design drawings, fertilising, mulching, staking, watering and maintenance of plants.

The Constructor shall give the HC Representative a minimum notice of two (2) working days prior to the commencement of planting. Landscape planting shall not be carried out in extreme weather conditions (above 35°C or below 10°C).

15.3.2 Materials

a) Topsoil

Topsoil shall comply with the requirements of Section 15.3.2(a).

b) Herbicide/Weed Blocking Fabric

Herbicide shall comply with the requirements of Section 15.3.2(b). Synthetic weed blocking fabric shall comply with AS 4843.

c) Fertiliser

Fertiliser shall be a slow-release type in pellet form or encapsulated granules, listed in Annexure C273A, with a nine (9) months' release period and having Nitrogen: Phosphorus: Potassium (N:P:K) ratio ranges of 15-20: 7-12: 7-12.

d) Mulch

All mulches used for landscape planting shall consist of organic material complying with the requirements of AS 4454. Mulch shall be composted or pasteurized as indicated in Annexure 15A. The use of other materials as ground cover shall be as indicated on the approved design drawings. A 10kg sample of mulch proposed by the Constructor shall be submitted for approval to the HC Representative at least ten (10) working days before its intended use. The mulch subsequently used shall be consistent in every respect with the sample approved by the HC Representative.

e) Plant Material

The Constructor shall obtain all plants from a nursery located in an area having a similar climate to Works site (refer to AS 2023).

There shall be no substitution of any species without the HC Representative's approval. All plant material shall be true to species and sizes. Plants shall be healthy, of good form, not soft or forced and with large robust root systems. They shall not be rootbound and shall be free from disease and insect pests. All container soil mix shall contain between 20% and 25% clay by volume. Trees shall have a single leading shoot. For hardening off purposes, all plants shall be delivered to a site within the locality of the site at least twenty (20) working days before planting out. Plant root systems shall be maintained moist at all times with particular attention being paid to watering during the on-site period before and during planting. Plant stock shall be classified as indicated in Table 30 and planted in accordance with the approved design drawings.

Table 30: Plant Stock

	Type or Stock				
	50mm Tube	Gro Tube	Semi Advanced	Advanced Stock	Super Advanced
Plant Container Dia mm	50	75	150	200	300
Depth mm	75	100	150	200	300
Plant Height (mm) leaf and stem	200min 300 max	300min 400max	300min 400max	300min 500max	500min 750max

f) Stakes

All stakes shall be 50mm square by 1,500mm long hardwood or recycled plastic and sharpened at one end.

15.3.3 Planting

a) Mass Planting in Mulched Bed

The area to be planted shall be sprayed with herbicide, as specified under Section 15.3.3(a). Sprayed areas shall remain undisturbed for ten (10) working days. Alternatively, where approved by the HC Representative, a synthetic weed blocking fabric shall be applied to the area to be planted.

The surface shall be ripped at 500mm centres to a depth of 300mm and the top 200mm of the planting bed broken up by cultivation to a maximum size of 50mm. Mulch, 100mm thick, shall be spread over the planting bed. After removal of the localised mulch, planting holes shall be excavated to the dimensions and depths as shown in Table 30 above and the material removed.

The specified number of fertilizer pellets as shown in Table 30 above shall be placed beside the rootball of each plant. The planting hole shall be backfilled with topsoil complying with Section 15.3.3(a) and care taken to avoid mixing mulch with topsoil. A stake shall be driven 300mm deep and 200mm clear of each 'Advanced' and 'Super Advanced' size stock and the stock tied to it by a strip of 50mm wide hessian webbing.

Each backfilled hole shall receive a minimum of 10 litres of water before the mulch is respread over the disturbed area. The mulch shall be left just clear of the plant stem.

b) Individual Planting

A planting hole shall be if not specified in approved drawings

- Depth: 5 times the pot/root ball width and
- Width 2 times the width of pot/root ball.
- Excavated material spread evenly around each hole.
- Fertilising to be carried out to manufacturers recommendations and applicable hole size.
- The planting hole shall be backfilled with topsoil complying with Section 15.3.3(a) and compacted by foot up to surface level.
- A stake shall be driven 300mm deep and 200mm clear of each 'Advanced' and 'Super Advanced' size stock and the stock tied to it by a strip of 50mm wide hessian webbing.
- Each backfilled hole shall receive 50 litres of water.

Weed infestation for a distance of 800 mm surrounding each proposed planting shall be killed by spraying with a herbicide as specified in Section 15.4.1(a). All due care shall be taken to avoid damage caused by contact between herbicide and the plant by means of spray drift etc. Alternatively, where approved by the HC Representative, a synthetic weed blocking fabric shall be applied to the 800mm area surrounding each proposed planting.

Immediately after planting, mulch 100mm thick, starting just clear of the plant stem, shall be spread over an area of 600mm radius surrounding the plant.

15.3.4 Care of Landscape Planting

The Constructor shall water all plants, from the time of planting, at the rate of 50 to 100 litres per plant every third day for the first 3 months especially over summer and as required through the nominated construction and/or defect period whichever is applicable.

Missing plants, dead plants and plants nominated by the HC Representative as unhealthy shall be replaced by the Constructor. Replacement plants shall be of similar size and quality and of identical species and variety to the plant being replaced. The cost of replacement shall be borne by the Constructor.

Weed and grass growth in mulched areas shall be killed by treatment with herbicide in accordance with the manufacturer's instructions at monthly intervals during the construction period and contract maintenance period. Contact of the herbicide with the new plants shall be avoided and any damage repaired or damaged plant material replaced by the Constructor at no cost to Hilltops Council.

15.4 Limits and Tolerances

15.4.1 Summary of Limits and Tolerances

The limits and tolerances applicable to the various clauses in this Specification are summarised in Table 31.

Table 31: Summary of Limit Tolerances

Item	Activity	Limits / Tolerances
1.	Topsoil	
	a) Organic Content	>3% by mass
	b) pH	>5 <7.5
	c) Soluble Salt	<0.06% by Mass
2.	Turf	
	Turf	Widths >300 mm
3.	Vegetable Mulch	
	a) Material	Max. size 10 mm
	b) Paper Pulp	<50% by mass of total mulch
4.	Topsoiling	
	Topsoiling	Minimum compacted thickness at any location of 30mm
5.	Straw Mulching	

Item	Activity	Limits / Tolerances
	a) Straw Mat	Finished Thickness >20mm
6.	Landscape Planting	
	a) Temperature	Planting not to be undertaken when temperatures > 35°C or < 10°C
7	Mulch	
	a) Fines	Shall not exceed 5% by volume.
	b) Woodchip	Maximum size < 50mm.
8	Plant Material	
	a) Container Soil Mix	Contain > 20% < 25% by volume of clay.

Table 32 provides guidance on application rates of various materials.

Table 32: Landscaping Materials

Material	Type	Minimum Application Rate
1. Herbicide *	Glyphosate	9litres/200 litres water / ha
2. Seed		
a) Grass (General / Roadside mix shown as in Table 28. See Table 27 for playground blend).	Annual Rye	3.5 - 5 kg/ha for total blend shown in Table 27 and Table 28
	Tall fescue	
	Creeping Red Fescue	
	Unhulled Couch	
b) Native	<i>Acacia dealbata</i>	
	<i>Acacia buxifolia</i>	
	<i>Acacia decurrens</i>	
	<i>Acacia pravissima</i>	

Material	Type	Minimum Application Rate
	<i>Leptospermum petersonii</i>	
	<i>Hardenbergia violacea</i>	
	<i>Kennedia prostrata</i>	
	<i>Acacia implexa</i>	
	<i>Banksia marginata</i>	
	<i>Bursaria spinosa</i>	
	<i>Callistemon pallidus</i>	
	<i>Dodonaea viscosa</i>	
3. Turf Grass		
a) Medians	Couch	Refer to Approved Design Drawings
b) Verges/Footpaths	Couch	Refer to Approved Design Drawings
c) Other Areas	Couch	Refer to Approved Design Drawings
4. Fertilizer *		
a) Vegetation of Slopes / Drains	Organic or inorganic similar to Lawn Starter: Scott's Turf Builder Starter; Andersons 18:24:12 Turf Starter; Yard Mustang Starter Fertilizer; Garnulock 2	As per Manufacturers recommendations
b) Landscape Planting	Proprietary pellets like 'Kokei' pellets; Slow release granules: Scott's Osmocote; Ultra Coat; Complete Grow; Organic Slow Release; Organic Linker XTRA; Neutrog Rapid Raiser; Dynamic Lifter.	As per Manufacturers recommendations

Material	Type	Minimum Application Rate
5. Wetting Agent*	'Aquasoil' or similar	1 litre/1000 litres of mix water
6. Organic Fibre Mat *	'Sta-firma' (light grade) or similar	
7. Mulch	Certified Large size hardwood mulch	100mm thick
Material shall be as listed or equivalent as approved by HC.		

15.5 Seeding

15.5.1 Seeding & Preparation

- Seed into a well-prepared, weed-free seedbed.
- Lightly rake and firm the surface to ensure good seed-to-soil contact.
- Maintain consistent moisture during establishment.
- Ensure a turf starter fertilizer is incorporated into the seed bed.

15.5.2 Turf

Turf (instant turf rolls) or grass sods should consist of dense, well-rooted, vigorous growth turf with 25mm of approved topsoil attached. The sods should be free of noxious weeds, soil pests and diseases. The sods are to be cut by an approved sod cutter in long lengths of uniform width of not less than 300mm and are to be in a sound unbroken condition.

The turf species, regardless of Construction Drawing requirements, shall be Couch or Kikuyu.

Grass species in available turf mixes preferred in the Hilltops LGA are:

1. Kikuyu over sown with Annual Rye.

Or

2. Couch over sown with Annual Rye.

All areas should be scarified and then topsoiled in accordance with Section 15.5.1 above prior to the placement of turf. Laying of turf should be scheduled so that each section is rolled or tramped immediately after it has been laid to obtain a key with the underlying soil. Each row of turf should be butted hard against each other so that there are no gaps and the outside edge should be left staggered to form an uneven edge when strip turving is not proposed.

Turf must be placed so stormwater sheet flow is not concentrated and does not cause erosion. To promote stormwater sheet flow runoff from the adjoining surface, turf must be set down to match the level of the adjoining area, or alternatively, the areas adjacent to the turf shall be graded to match the surface of the new turf.

Turf laid adjacent to concrete works shall be laid flush with the surface of the concrete. Excessive surface level differences between the turf and adjacent concrete will not be accepted. Turf shall be removed, topsoil regraded, and turf re-laid as directed by Council's Representative.

On batters, it is essential that the turf sections be laid along the contour, while in drains, turf sections should be laid across the drain at right angles to the direction of flow. The turf should be anchored with wire netting and pinned with rabbit bows on steep sites or drains to ensure stability in accordance with Council's Engineering Guideline Specification - Standard Drawings.

If the soil profile is hard, making penetration of rabbit bows/wire staples difficult, lengths of reinforcing mesh, cut to size, should be used. It is essential that these bows, or rods, pin the netting hard against the grass sods. It is preferable to shorten the bows, etc to achieve this than to have the bows flatten out where penetration to the depth of the bows cannot be achieved. Removal of netting and bows is required after establishment were later maintenance, such as mowing, will be carried out.

Other points on laying turf are:

- Ensure that the area for turf laying is well prepared, weed-free and the finished height of the turf roll soil will be level with finished level of pathways/K&G.
- Lightly rake and level the surface to ensure good turf to-soil contact.
- Ensure a turf starter fertilizer is incorporated into the seed bed.
- Fill any gaps between the turf with topsoil
- Lightly roll the turf after laying
- Maintain consistent moisture during establishment.

Turf should be watered regularly for at least a week after it has been laid to ensure maximum rate of establishment. Afterwards, watering should be carried out as necessary for the duration of the work and subsequent maintenance period.

Dead and/or damaged turf will not be accepted and is to be replaced immediately.

15.6 Compliance

15.6.1 Compliance Inspections

Compliance with this part of the Specification will be confirmed upon site observation by Council's Representative. This action of site observation shall constitute a **HOLD POINT**.

HOLD POINT

All required seeding and or turfing as part of the works shall be confirmed by site inspection.

PROCESS HELD: Revegetation including seeding and or turfing.

15.6.2 Non-Complying Work

Where surface restoration and finishing of surface works are observed by Council's Representative to not comply with this or any section of the Specification, the Service Provider will be instructed verbally or in writing of the non-compliance. The non-complying item(s) must be rectified prior to the final inspection.

15.7 Service Providers Responsibility for Site Security

The Service Provider is responsible for the theft or vandalism of any surface treatment up to the following milestones:

- Final inspection where the surface treatment is located on existing public land, road reserve or other Council maintained land; and/or
- Registration of the linen plan in the case of land being dedicated to Council.

16 Traffic Signs, Pavement Marking and Road Safety Barriers

16.1 General

This section of the Specification covers the supply and installation of traffic signs, pavement markings and other pavement delineation, permanent traffic and pedestrian control devices and permanent safety barriers. This section of the Specification does not include traffic signals. Traffic signals are subject to TfNSW approvals, specifications and installation compliance.

16.2 Supply and Installation

All traffic signs, pavement markings and permanent traffic and pedestrian control devices shall be supplied and installed in accordance with current requirements of TfNSW QA specifications, TfNSW supplements to Australian Standards, technical guidelines, technical directions and where not covered by TfNSW documents, then in accordance with AS 1742 - Manual of uniform traffic control devices suite of standards.

Where signs, pavement markings and permanent traffic and pedestrian control devices shown on the approved drawings conflict with the requirements of TfNSW and/or AS 1742 suite of standards, Council's Representative shall be requested to confirm what measures are required.

Where traffic signs, pavement markings and permanent traffic and pedestrian control devices for a particular situation are required by TfNSW and/or AS 1742 suite of standards and there is no requirement shown on the drawings, then Council's Representative may direct the Service Provider to install appropriate measures.

This Specification is for the:

- a) Supply and erection of the Regulatory, Warning, Guide, Information and Direction signs as described in AS 1742, AS 1743 and AS 1744.
- b) Supply and erection of sign support structures to support the signs.
- c) Adjustment of existing signs and sign support structures.

16.2.1 Reference Documents

Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated. Where not otherwise specified in the relevant Hilltops Council (HC) Construction Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the HC Construction Specifications at the time of the Works approval.

- a) Hilltops Council (HC) Specifications
 - C201 - Control of Traffic.
 - C212 - Clearing and Grubbing
 - C271 - Concrete Works.
- b) Australian Standards References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS.
 - AS 1163 Structural steel hollow sections

- AS 1214 Hot-dip galvanised coatings on threaded fasteners.
 - AS 1250 The use of steel in structures (SAA Steel Structures Code).
 - AS 1379 The specification and manufacture of concrete.
 - AS/NZS 1554.1 Welding of steel structures
 - AS/NZS 1580.602.2 Measurement of specular gloss of non-metallic paint films at 20o, 60o and 85o
 - AS 1580.108.2 - Dry film thickness - Paint inspection gauge.
 - AS 1734 – Aluminium and aluminium alloys - flat sheet, coiled sheet and plate.
 - AS 1742 Manual of uniform traffic control devices.
 - AS 1743 Road Signs – Specifications.
 - AS 1744 Forms of letters and numerals for road signs.
 - AS 1866 Aluminium and aluminium alloys - extruded rod, bar, solid and hollow shapes.
 - AS 2700 Colour standards for general purposes.
 - AS 3678 - Structural steel - hot-rolled plates, floor plates and slabs.
 - AS 3679.1 Structural steel - hot-rolled bars and sections
 - AS/NZS 4680 - Hot-dip galvanised (zinc) coatings on fabricated ferrous articles.
- c) HC Standard Drawings Applicable to this Section
- G003 - Street Name Plate Details.

HC Standard Drawings shall take precedence over ALL other drawings related to the Works.

Where any HC Standard Drawings conflicts with this Specification, the requirements of this Specification shall take precedence. Proposals to deviate from this Specification shall constitute a **HOLD POINT**.

HOLD POINT

All proposed deviations from the approved design drawings, HC Standard Drawings, this Specification or the documents referenced within it, shall be submitted for approval to the HC Representative with supporting evidence at least five (5) working days prior to the work being undertaken.

PROCESS HELD: The lot or element affected by the proposed deviation.

16.2.1.1 Provision for Traffic

The Constructor shall provide for traffic control in accordance Section 4 – Traffic Management while undertaking the work and shall organise the work to avoid or minimise delays and inconvenience to traffic.

Where a sign is erected before its intended use by traffic and is visible to traffic, the face of the sign shall be completely and securely wrapped in porous cloth sheeting or other opaque covering material.

16.3 Materials

16.3.1 General

The Constructor shall supply documentary evidence, satisfactory to the HC Representative, that all materials and parts proposed for use comply with the requirements of the appropriate Australian Standard(s) and/or HC Standard Drawing G003.

Details of the signs and sign support structures to be provided as part of the Works shall be as shown on the approved design drawings.

The dimensions, legend and background for each sign shall be in accordance with this Specification and the approved design drawings.

16.3.2 Sign Blanks

Sign blanks shall be 1.6mm thick aluminium sheet alloy. The aluminium alloy shall be Type 5251 or Type 5052 and Temper H38 or Temper H36 in accordance with AS 1734.

Sign blanks shall be free of cracks, tears and other surface blemishes and the edges shall be true and smooth. The dimensions of the sign blank shall be within plus or minus 1.5mm of the dimensions specified and the finished sign shall be flat within a maximum allowable bow of 0.5% of the maximum dimension of the sign blank in any direction.

Sign blanks shall be one (1) piece except where the sign is of such a size as to require more than one full sheet of aluminium in which case a multipiece sign shall be allowed.

A multipiece sign shall be made up of the minimum number of pieces practical and sheets of the multipiece sign shall be butted together with a maximum gap of 1mm at any point along the joint.

All joints shall be covered by a backing strip. The backing strip shall be riveted to each sheet with rivets, coloured to match the background material on the face of the sign, at a spacing not exceeding 200mm. Backing strips shall be of the same material and colour as used for the sign blank and shall have a minimum width of 50mm over the full length of the joint.

The aluminium extrusion used for mounting may be used as the backing strip for horizontal joints where it complies with the spacing requirements.

The face of each sign blank shall be chemically cleaned and etched or mechanically abraded. Where the sign blank is to receive a paint background, the face shall be spray painted with a compatible etch primer.

The back of each sign blank shall be uncoated and the surface finish shall be rendered dull and non-reflective either by mechanical or chemical means and shall be free of scratches and blemishes.

Signs shall be supplied with square holes or aluminium extrusion backing for mounting purposes, at the centre spacings as shown on the approved design drawings.

16.3.2.1 Aluminium Extrusion Backing

The signs shall include special aluminium extruded sections for mounting purposes. The aluminium shall be Type 6063-T5 in accordance with AS 1866.

The aluminium extrusion shall be fixed at the centre spacings as shown on the design plans and shall be riveted to the sign blank with correctly coloured rivets at a spacing not exceeding 200mm.

16.3.2.2 Retro-Reflective Material for Background and Legend

Retro-reflective material shall conform in colour and class to the requirements of AS 1743 for Class 1, Class 2 and Class 2A materials.

16.3.2.3 Non-Reflective Background Material

- a) Background Paint Background paint shall be an approved long life industrial quality, two compound polyurethane paint. The paint shall exhibit high standards of adhesion, abrasion resistance, resistance to weathering and colour fastness under widely varying conditions of exposure. The paint shall be compatible with the etch primer used on the sign blank.

The paint shall be applied using conventional air spray application to give a uniform cover free of blemishes. A minimum dry film thickness of 38 microns is required when tested in accordance with AS 1580.108.2.

Exact colorimetric values are set out in AS 2700.

- (i) For matt coatings, the gloss level, determined by AS/NZS 1580.602.2, using an 85° head, shall be neither less than 12% of gloss nor more than 15% of gloss.
 - (ii) For gloss coatings, the gloss level, determined by AS/NZS 1580.602.2 using a 20° head shall be neither less than 85% of gloss nor more than 95% of gloss.
- b) Background Sheet Material

Adhesive cast vinyl sheet material may be used in place of background paint. The material shall be of uniform density and compatible with the material used for the legend both in application and durability.

The colours and gloss levels shall be uniform and conform to the requirements of Section 16.3.2.3.

16.3.3 Non-Reflective Material For Legend

- a) Legend Screening Ink

Screening ink shall be a high quality, full gloss, non-fade, non-bleed and scratch resistant type of ink compatible with the material to which it is applied. Screening ink shall have durability at least equal to the material to which the screening ink is applied.

- b) Legend Sheet Material

Adhesive cast vinyl sheet material may be used in place of screening ink. The material shall be of uniform density and compatible with the material used for the background both in application and durability.

c) Colours and Finish

The requirements of Clause 16.02.07(a) shall also apply to non-reflective materials for legends but additional colours complying with AS 2700 may be specified.

16.3.4 Rivets

Each rivet shall consist of a domed head and shank made of aluminium alloy and a steel mandrel which is discarded after securing the rivet.

A paint coating shall be applied to the domed head so that when the rivet is in position it will show the same colour as the material to which it is attached.

The paint shall be an alkyd enamel, which shall be applied after an appropriate treatment of the shank of the rivet to ensure long lasting adhesion.

16.3.5 Reference Markings

All signs supplied and erected shall be clearly and permanently stamped or engraved with an identification coding. The coding shall appear in ciphers of height neither less than 6mm nor more than 10mm on the rear of the sign and shall be carried out in such a manner that the front face of the sign is not damaged.

For rectangular signs, the coding shall appear as near as practicable to the bottom rear left hand corner. For other shaped signs, the coding shall be positioned on or below the horizontal centre line and as near as practicable to the left hand rear edge.

Manufacturers shall include coding information in the following format:

- Manufacturer's Name.
- Month and Year of Manufacture.
- Manufacturer and Class of Retroreflective Material.

16.3.6 Sign Support Structures

a) General

Sign support structures shall be fabricated from steel sections which shall comply with the requirements of AS 1163, AS 3678 and AS 3679.1.

Signs support structures shall be standard round galvanised posts of 50, 65 or 80 mm nominal bore or purpose-designed steel structures as shown on the approved design drawings and manufactured in accordance with the requirements of AS 1250.

Splices in members shall be restricted to a maximum of one splice per member.

Splices shall be full penetration butt welds.

All welding shall be in accordance with the requirements of AS 1554.1, Category GP.

b) Protective Treatment

Except for standard galvanised posts, all steel components including brackets shall be protected by hot-dip galvanising after all fabrication processes are completed.

The steel components shall be finished by the hot-dip galvanising process in accordance with AS/NZS 4680 to provide an average minimum coating thickness of 85 microns and a bright finished surface free from white rust and stains.

Bolts, nuts and washers and brackets shall be galvanised in accordance with AS 1214.

Splices in standard galvanised posts shall be painted by using an organic zinc-rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680.

Scratched and slightly damaged surfaces of galvanised coatings shall be renovated by using an organic zinc-rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680. This method of renovation shall be restricted to areas not exceeding 2500mm² on any one structure. Any structure with totally-damaged coating areas exceeding 2500mm² shall be regalvanised by the Constructor.

The cost of regalvanising such damaged coating areas shall be borne by the Constructor.

c) Attachment of Signs

Posts and other components shall be provided with the required sign attachment holes or fittings to suit the typical attachment systems as shown on the approved design drawings. Sign panels shall be attached to each supporting member at each extrusion section or bolthole in the sign panel.

The Constructor shall submit details of the proposed attachment systems for the approval of the HC Representative (refer Hold Point).

16.3.7 Setting Out

The proximity of the work zone to traffic shall be assessed. Where applicable Traffic Management Procedures shall be developed, installed and administered in accordance with the sites TGS where applicable.

The location of signs shall be as shown on the approved design drawings. The Constructor shall set out the work to ensure that all signs and support structures are placed in accordance with the approved design drawings.

Road warning/Regulatory/Guidance Signs shall be erected at a deflection of 5 degrees off/away of the normal to the Centreline of existing/proposed Road (square = 90 Degrees, requirement here is 95 degrees) to minimise head light glare/head light bounce back to driver.

Signs shall not to straddle table drains or guardrail and limit/hinder future maintenance activity.

On curved alignments, the angle of placement should be determined by the course of approaching traffic rather than the orientation of the road at the point where the sign is located.

The Constructor shall set out the proposed location and alignment of each sign support structure (refer Hold Point in Section 16.3.9).

Work on the foundations of the sign support structure shall not commence until the HC Representative has inspected and approved the location and alignment of the sign support structure (refer Hold Point in Section 16.3.9).

16.3.8 Clearing

Any trees and undergrowth within three (3) metres of the sign support structure and along a driver's line of sight to the front of the sign shall be cleared and removed. The Constructor shall be responsible for assessing whether all approvals are in place for the removal of vegetation for this purpose. Vegetation removal shall be undertaken in accordance with Section 5 Site Clearing and Bulk Earthworks.

16.3.9 Sign Structure Footings

The footings for a simple pipe support or the footings for each post of a purpose designed sign support structure shall be constructed in accordance with the approved design drawings. In the absence of suitable detail in the approved design drawings, street name plates and other small signs shall be installed in accordance with HC Standard Drawing G003.

The use of Oz-Posts, or equivalent, shall be submitted for the consideration of the HC Representative.

All relevant Dial Before You Dig (DBYD) checks and procedures shall be undertaken prior to excavation for the installation of sign support structures. It is the Constructor's responsibility to adequately locate and protect all services and assets.

The footings shall be neatly excavated to the depth and width shown on the approved design drawings. The material shall be disposed of at a licensed waste facility.

When anchor bolt assemblies are specified, they shall be accurately placed and firmly supported. Anchor bolt assemblies shall be provided with levelling nuts under the sign structure base-plates to allow adjustment of the structure after installation.

Steel reinforcement shall be placed as shown on the approved design drawings. Concrete in the footings of sign support structures shall comply with Section 10 – Minor Concrete Works and have a minimum compressive strength at 28 days of 20MPa for pipe support footings and 32MPa for purpose-designed support footings. Reinforcement shall be installed in accordance with the approved design drawings.

HOLD POINT

The following details shall be submitted to the HC Representative at least five (5) working days prior to the proposed installation of signage:

- Sign supplier and the proposed sign type.
- Details associated with the Sign support structures where applicable.
- Traffic management arrangements, where applicable.
- Sign set out.

PROCESS HELD: Excavation of Footings and Erection of Signs.

16.3.10 Erection

All components shall be accurately positioned and supported during erection.

The top of each pipe support post shall extend sufficiently beyond the upper extrusion section or bolt holes on the sign panels to enable attachment of the signs. The top of each post shall be below the top edge of the sign panel.

For pipe support multi-post installations, the tops of the posts shall be at the same level except where sign shape or the arrangement of sign panels dictates otherwise.

During erection, sign panels shall be suitably supported and braced and the sign face protected from damage.

Signs damaged during erection shall be repaired to a standard equivalent to the original sign or replaced by the Constructor at the Constructor's cost.

Galvanised coatings on purpose-designed support structures which are scratched or slightly damaged during erection shall be renovated by using an organic zinc-rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Appendix E of AS/NZS 4680. This method of renovation shall be restricted to areas not exceeding 2500mm² on any one (1) structure. Any structure with totally-damaged coating areas exceeding 2500mm² shall be regalvanised.

The cost of regalvanising such damaged coating areas shall be borne by the Constructor.

16.4 Adjustment of Existing Signs and Support Structures

16.4.1 General

Where shown on the approved design drawings and where directed by the HC Representative, the Constructor shall adjust existing sign panels and sign support structures. The work shall include minor adjustments of existing sign panels and/or sign support structures or the work may extend to the dismantling of signs and sign support structures, relocation or replacement of sign support structures including footings and re-erection of signs including all fittings.

Where signs are removed, the impact of the removal of the sign shall be considered and addressed in the traffic management arrangements applicable to the Works site.

16.5 Limits and Tolerances

16.5.1 Summary of Limits and Tolerances

The limits and tolerances applicable to the various clauses in this Specification are summarised in Table 33.

Table 33: Summary of Limits and Tolerances

Item	Activity	Limits/Tolerances
1.	Sign Blanks	
	a) Dimensions	± 1.50mm
	b) Bow	< 0.5% of maximum dimension

Item	Activity	Limits/Tolerances
	c) Butt Gap in Multipiece sign	< 1mm
	d) Rivett spacing in back strip	200mm
	e) Back strip width	> 50mm
2.	Extrusion Backing	
	a) Rivet Spacing	<200 mm
3.	Background Paint	
	a) For matt coatings, gloss level	> 12% and < 15%
	b) For gloss coatings, gloss level	> 85% and < 95%
4.	Reference Marking	
	a) Height of Coding	> 6mm and < 10mm
5.	Sign Support Structures	
	a) Protective Treatment thickness	> 85 microns
	b) Paint coating over Splices in standard galvanised posts	> 85 microns
	c) Damaged Surface of galvanised surfaces:	
	(i) Coating with zinc rich paint Area	< 2500mm ²
	(ii) Regalvanise Area	> 2500mm ²
6.	Clearing	
	a) Trees and Undergrowth to be cleared	< 3m from sign support structure
7.	Concrete in Foundations of Sign Support Structures	
	a) Strength (pipe support footings)	> 20 MPa at 28 days
	b) Strength (purpose-designed support footings)	> 32 MPa at 28 days

16.5.2 Street Name Signs

Street/road name signs shall be supplied and installed by Council in accordance with AS 1742. All road names shall be gazetted or approved by Geographical Names Board as per the NSW Address Policy and facilitated by Council. Confirmation of road names, correct spelling and road type i.e. Street, Avenue, Close, etc shall be obtained by Council to inform the approved drawings. The cost associated with the ordering and erection of street name signs shall be borne by the developer/service provider.

Confirmation of wording for other Council signs shall be obtained from Council's Representative and shown on construction drawings for approval by Council. The technical characteristics of signs shall be in accordance with Council's Engineering Guideline Specification - Standard Drawings and Australian Standards. No advertising of manufacturer's name shall be permitted unless prior written approval is provided by Council's Representative.

16.5.3 Lettering

The letter used on the street name signs shall be as detailed in Council's Engineering Guideline Specification - Standard Drawings. Use road type abbreviations as shown in Table 34, where not specified on the approved engineering drawings or Standard Drawings:

Table 34: Road Type Abbreviations

Type	Abbreviation	Type	Abbreviation	Type	Abbreviation
Alley	ALY	Crescent	CR	Parade	PDE
Arcade	ARC	Drive	DR	Parkway	PWY
Avenue	AVE	Esplanade	ESP	Place, Plaza	PL
Boulevard	BVD	Expressway	EXP	Promenade	Prom
Brace, Brae	BR	Freeway	FWY	Quay	QY
Chase	CH	Gardens	GDNS	Road	RD
Circle, Circlet	CIR	Glen	GL	Square	SQ
Circuit	CCT	Grove	GR	Street	ST
Close	CL	Highway	HWY	Terrace	TCE
Corner	CNR	Junction	JNC	Walk	WK
Court	CT	Lane	LA	Way	WY

16.5.4 Other Signs

Where shown on the drawings or directed by Council's Representative other signs may be required. Other signs shall be installed in accordance with the relevant Australian Standards. Where details of the type and size of other signs are not specified on the approved drawings the Service Provider shall provide details of the proposed signs to Council's Representative for approval prior to ordering and installation of the signs.

16.6 Colour of Signs

Council will specify the colour of signs required as shown in Australian Standards Council's Signage Manual. Commonly used in this local government area combination generally include but are not limited to the following:

Table 35: Colour of Signs

Sign Type	Letter Colour	Background Colour
Town/Village name	Black	White
Tourist information	White	Brown
Community services, facilities and farm names	White	Blue

16.6.1 Installation of Signs

Signs shall be installed in accordance with Council's Engineering Guideline Specification - Standard Drawings.

Details of the proposed post holders are to be provided to Council's Representative for acceptance prior to installation.

Signs erected within the verge shall provide 2.2m minimum vertical clearance to the underside of the sign (or the lowest mounted sign in an assembly of signs) in rural areas, or 2.5m minimum vertical clearance within the verge (footway area/nature strip/path) in urban areas, from the finished ground level; and 300mm minimum lateral clearance behind face of kerb, or 600mm minimum behind the edge of guidepost line. See also Council's Engineering Guideline - Standard Drawings.

16.6.2 Guide posting

16.6.2.1 Scope

This Specification is for the setting out, supply of all materials and erection of guideposts at the locations shown on the approved design drawings or as directed by the HC Representative in areas where street lighting is not provided.

16.6.2.2 Reference Documents

Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

Where not otherwise specified in the relevant Hilltops Council (HC) Construction Specifications or the approved design drawings, the Constructor shall use the latest

versions of the Reference documentation, including amendments and supplements, listed in the HC Construction Specifications at the time of the Works approval.

- a) Hilltops Council (HC) Specifications
 - Section 4 – Traffic Management.
- b) Australian Standards
 - References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS.
 - AS 1742.2-2009 - Manual of uniform traffic control devices. Part 2: Traffic control for general use.
 - AS 1906.2-2007 - Retroreflective materials and devices for road traffic control purposes. Part 2 - Retroreflective devices (non-pavement application).
- c) Transport for NSW (TfNSW) Specifications
 - TfNSW QA Specification 3412 – Supply of Guideposts

16.6.2.3 Materials

- a) Proprietary Posts Guideposts shall be a proprietary metallic or flexible (driveable or non-driveable) post must comply with the TfNSW QA Specification 3412. Timber guideposts are not acceptable.

Where a proprietary metallic or flexible guidepost is proposed, the Constructor shall supply details of the proposed guidepost as required by the current version of TfNSW QA Specification 3412. This shall include the manufacturer's recommended installation procedure, technical specifications and test certificates for consideration by the HC Representative. The test certification shall address post strength, flexibility, impact and heat resistance and durability. The HC Representative's approval of the submitted details and acceptance of the nominated guidepost type and supplier is required prior to delivery or inclusion in the works.

- b) Delineators Proposed delineators must conform with the specifications of TfNSW QA Specification 3412.

16.6.3 Construction

16.6.3.1 General

The Constructor shall at all times conform to the requirements of Section 4 – Traffic Management.

Where the shoulder is in embankment or at natural surface level, the guideposts shall be placed near the outer edge of the shoulder and at a uniform distance, minimum 1m, from the pavement edge line. Where the shoulder is located in a cutting, the guideposts shall be placed on the road pavement side of the table drain, and a minimum 1m from the pavement edge line, in such a manner as not to impede the flow of water in the drain. If doubt around the correct positioning occurs, reference to AS 1742.2 shall be made.

Guideposts shall be erected at the locations shown on the approved design drawings.

Underground services laid in proximity to the guideposts shall be located prior to erection of posts and all care shall be taken not to damage such services.

16.6.3.2 Erection of Guideposts

Guideposts shall be set vertically in the ground to a depth in accordance with TfNSW QA Specification 3412 or as recommended by the manufacturer. In order to offset shoulder irregularities, this depth shall be varied so as to give uniform display of guideposts to a height of approximately 1000mm above ground level, with the tops evenly graded. Each guidepost shall be erected with the 100mm axis at right angles to the centre line of the road.

Guideposts may be driven in accordance with the manufacturer's recommended installation procedure. Where driving is not recommended, guideposts are to be installed in natural ground inside excavated holes which are subsequently backfilled and compacted with the excavated material around the guideposts.

Backfilling shall be compacted in layers of depth not more than 150mm for the full depth of the guide posts up to ground level. The density of the compacted backfilling shall not be less than that of the adjacent undisturbed ground. Guideposts shall be firm in the ground to the satisfaction of the HC Representative.

Proprietary guideposts, when installed in the ground in accordance with the recommendations of the manufacturer, shall resist overturning, twisting and displacement from wind and impact forces.

All necessary steps shall be taken to prevent people and stock from stepping into the post holes during the erection of the guideposts. The nominated position of the guideposts shall be installed within the following tolerances:

- Within 3° of vertical.
- Within 25mm of the nominated height (nominally 1000mm).
- Within 200mm of the longitudinal design spacing.
- Within 100mm of the transverse design position.

16.6.3.3 Delineators

Delineators must be affixed to the guidepost conforming to the requirements of TfNSW QA Specification 3412. In the case of proprietary posts, the delineators shall be fastened to the post in such a manner that they are not dislodged or rendered inactive under vehicular impact.

The delineators shall be so arranged that drivers approaching from either direction will see only red delineators on their left side and white delineators on their right side.

16.7 Pavement Markings

All pavement markings on roads, including lines, diagonals, chevrons, symbols and words, shall be installed in accordance with TfNSW QA Specification R141 Pavement Marking, QA Specification R145 Pavement Marking (Performance Based), as required, and other applicable TfNSW specifications and publications.

Permanent pavement markings shall be set out (by a Surveyor for development works) and applied in white reflectorised thermoplastic paint; or 2 coats white reflectorised waterborne road marking paint on most Council-controlled rural roads or urban roads with a low traffic volume (typical annual daily traffic (ADT) volume ≤ 400), unless otherwise directed by Council's Representative, except for (C3) parking restriction lines, which shall be yellow - see below and the Pavement Marking Schedule in Council's Engineering Guideline Specification - Standard Drawings.

Any decision by Council's Representative to alter the above requirements for white reflectorised thermoplastic paint or white reflectorised waterborne road marking paint will be based on the road surface treatment (new or existing; sprayed bituminous, asphalt or concrete surface), road hierarchy and traffic volume and the condition, material and type of existing pavement markings, where applicable. In the case of Council's pavement marking or road renewal program, budgetary considerations shall also apply in confirming the type of pavement marking to be adopted.

All yellow (C3) parking restriction pavement marking lines on roads shall be applied in yellow reflectorised thermoplastic paint, unless otherwise directed by Council's Representative.

Retroreflective Raised Pavement Markers (RRPMs) shall be provided with all longitudinal pavement line marking on roads (except alongside yellow (C3) parking restriction lines) unless otherwise approved by Council's Representative. Pavement markers to be in accordance with AS 1906.3 - Retroreflective materials and devices for road traffic control purposes - Raised pavement markers (retroreflective and non-retroreflective) and TfNSW QA Specification R142 Raised Pavement Markers and other applicable TfNSW publications.

All pavement markings on shared paths and bicycle paths, including longitudinal and transverse lines and symbols), shall be applied in white reflectorised road marking paint unless otherwise shown in Council's Engineering Guideline Specification - Standard Drawings, or unless otherwise directed by Council's Representative.

The Service Provider shall be responsible for the maintenance and replacement, if necessary, of raised pavement markers and all pavement markings until the expiry date of the defects liability period. Unless pavement markings are being travelled over by the Service Provider's construction vehicles, the Service Provider's liability in this regard does not include damage through normal wear and tear.

All spillages shall be immediately cleaned up by the Service Provider. The Service Provider shall incur the costs of any restoration work required, in the opinion of Council's Representative to restore the surface to its original state.

All temporary and obsolete pavement markings shall be removed by milling (thermoplastic paint) or sand blasting (waterborne paint) the wearing course. Where required by Council's Representative, an appropriately specified single seal shall be applied in accordance with Section 12 - Bituminous Sealing of this Specification.

16.8 Road Safety Barriers

16.8.1 Road Safety Barriers

Road Safety Barriers shall be supplied and installed to comply with the requirements of TfNSW QA Specification R132 Safety Barrier Systems. The following clarification shall be applied when using TfNSW QA Specification R132 Safety Barrier Systems:

- Superintendent or Principal shall mean Council's Representative.
- Project Quality Plan is not required.
- Documentation required in Annexure R132/D shall be provided when requested by Council's Representative.
- Referenced documentation shall be current at the date of the preconstruction site meeting.

- Hold points shall not be applicable unless requested by Council's Representative.
- All materials are to be supplied by the Service Provider.
- Basis of measurement and payment does not form part of this Specification.
- Location of safety barrier shall be as shown on the approved drawings.
- Waste resulting from installation of safety barriers shall be removed from the site by the Service Provider.
- Setting out shall be sufficient to construct the safety barrier to the alignment as designed.
- Traffic Control is to be provided in accordance with Section 4 - Traffic Management of this Specification.

Mowing strips, a minimum of 300mm wide (depending on the safety barrier type) and 100mm thick on 100mm compacted gravel with jointing type and locations appropriate for the purpose is required.

Rub rails or safety railings are to be provided to the rear of the safety barrier where there is an adjoining pedestrian or shared path system.

16.8.2 Road Pedestrian Barrier Fencing

Road Pedestrian Fencing is to be designed to withstand vehicle impacts whilst channelling pedestrians to safe road crossing locations.

Road Pedestrian Fencing is the only pedestrian fencing type recommended by Transport for NSW for use on the NSW classified road network, and may be installed along the roadside verge or in the median of roads with posted speed zones of up to 80km/h.

Pedestrian Fencing can also be used to protect pedestrians from hazards such as steep drop-offs and large open drains on local roads.

- Features and design considerations are: Variants of Type 1 or Type 5 pedestrian fence to be considered.
- Designed to withstand low and moderate speed vehicle impact loads
- Channels pedestrians to safe crossing locations
- The orientation of the balustrades facilitates line-of-sight for passing motorists and pedestrians
- Either surface finished in hot dip galvanised or powder-coated black.

16.9 Compliance

16.9.1 Compliance Inspections and Documentation

Compliance with this section of the Specification will be confirmed upon site observation by Council's Representative. This action of site observation shall constitute a **HOLD POINT**.

HOLD POINT

All traffic signs, pavement markings, guideposts, permanent traffic control devices and safety barriers installed and/or removed as part of the works shall be confirmed by site inspection.

PROCESS HELD: Traffic signs, pavement markings, guideposts, permanent traffic control devices and safety barriers installed.

All traffic signs, pavement markings, permanent traffic control devices and safety barriers installed and/or removed as part of the works shall be shown on the work-as-executed drawings. This action of review shall constitute a **HOLD POINT**.

HOLD POINT

All traffic signs, pavement markings, guideposts, permanent traffic control devices and safety barriers installed and/or removed as part of the works shall be shown on the work-as-executed drawings.

PROCESS HELD: Review of Works as Executed Drawings.

Safety barrier installations shall be confirmed in writing by the installation service provider, certifying that their installation conforms to the approved drawings and manufacturer's specifications and requirements.

16.9.2 Non-complying Work

Where traffic signs, pavement markings, permanent traffic control devices and safety barriers are observed by Council's Representative to not comply with this or any section of this Specification, the Service Provider shall be instructed verbally or in writing of the non-compliance. The non-complying item(s) shall be required to be rectified prior to the final inspection.

17 Water Main Construction

17.1 General

17.1.1 Scope

This Specification is for the construction of:

- a) Mains up to diameter DN600 nominal size.

This Specification EXCLUDES the construction activities for:

- a) Reservoirs, including repainting of reservoirs.
- b) Treatment Plants.
- c) Dams.
- d) Pump Stations.
- e) Headworks.
- f) Dosing plants.

The Constructor shall carry out the work and supply materials meeting the requirements of the reference documents except as otherwise specified herein.

17.2 Definitions

The Works – Defined as follows:

- Developer Infrastructure Works - work includes subdivisions and any public infrastructure work associated with an approved Development in the Hilltops Council local government area requiring a Subdivision Works Certificate.
- Contracted Works – infrastructure work undertaken by a Principal Service provider or subservice provider formally appointed by Hilltops Council and supervised by Hilltops Council.
- Internal Works - infrastructure work undertaken by Hilltops Council's day labour workforce.

Constructor – Defined as the organisation responsible for construction of the Works and the Principal Service provider as defined in the *Work Health and Safety Act 2011*.

Hilltops Council Representative – Defined as follows:

- Developer Infrastructure Works – Nominated Hilltops Council officer(s) for the approved Development.
- For Contracted Works – the Superintendent.
- For Internal Works – Hilltops Council Asset Owner

Constructor's Representative – Defined as follows:

- Contracted Works – the Principal Service provider's nominated representative as per the relevant contract.
- Internal Works – Hilltops Council officer responsible for delivery.

Developer's Representative– Defined as the person or organisation appointed by the Developer to administer the Constructor responsible for the delivery of Developer Infrastructure Works.

17.3 Witness and Hold Points

A 'witness point' shall mean a point in the construction or verification process at which an activity is to be observed by Council. Forty-eight (48) hours' notice is required to be given by the Service Provider for a witness point.

A 'hold point' shall mean a point in the construction or verification process beyond which the work may not proceed without the authorisation of Council. Forty-eight (48) hours' notice is required to be given by the Service provider for hold point, except for hold points to be carried out at Manufacturer's premises, which require five (5) days' notice, or where specific as longer elsewhere in this Specification.

Hold and Witness points are to be scheduled for normal working hours of Councils personnel. If personnel are required at other times, then Council may require the Service Provider to pay for the overtime costs of the personnel.

Council may, without penalty, convert hold points to witness points on a temporary or permanent basis.

Table 36: Hold and Witness Points for Contract

Activity	Stage of Work Requiring Inspection or Test	H or W Point
General	Construction Program supplied	H
	Traffic Guidance System	H
	Site Safety Management Plan	H
	Construction Environmental Management Plan	H
	Warranties and Certificates of compliance	H
	Detailed Design submission and approval	H
Environmental Protection	Site Protection measures	H
	Site clearing and access construction	H
	Preparation of foundation for structures	H
	Backfill around structures and test results	
Pipeline Construction	Pipeline Foundation Embedment	H
	Construction Trench stops, bulkheads prior to Backfill	H
	Pipeline alignment	H

Activity	Stage of Work Requiring Inspection or Test	H or W Point
	Pier construction	H
	Thrust boring / Directional drilling	H
	Hydrostatic testing	H
	Backfill compaction testing	W
Roadwork	Approval from Council for work in road reserve	H
	Approval from R&MS for work in road reserve	H
WAE Drawings	Submission of WAE Drawings	H
Inspection	Completion	W
	Work as Executed documents	H

17.4 Reference Documents

The requirements of this Specification and Drawings shall prevail over any provisions in Standard Technical Specifications and Standard Drawings that are inconsistent with this Specification and Drawings, but only to the extent of any such inconsistency. Where such an inconsistency exists, the Service provider is to outline the inconsistency and the document taken as correct.

The Service provider will undertake the work in accordance with the most recent Australian Standards and Specifications which include, but are not limited to, the following:

- Water Supply Code of Australia (WASA)
- The Water Services Specification (WS-Spec) WSA 03-2002 - Water Supply Code of Australia.
- WSAA drawing for Water Reticulation
- Councils Engineering Guidelines Design and Construction specifications
- Councils Engineering Guidelines Standard Drawings
- Australian Standards
 - AS 1289.5.4.1 - Compaction control test – Dry density ratio, moisture variation and moisture ratio.
 - AS 1289.5.6.1 - Density Index Method for a Cohesionless Material.
 - AS 1432 - AS 1449 - Copper tubes for plumbing, gas fitting and drainage applications. Wrought alloy steels – Stainless and heat-resisting steel plate, sheet and strip.

- AS/NZS 1477 - PVC pipes and fittings for pressure applications.
- AS 1579 - Arc welded steel pipes and fittings for water and waste water.
- AS/NZS 1594 - Hot-rolled steel flat products.
- AS 1646 - Elastomeric seals for waterworks purposes
- AS 2032 Code of practice for installation of PVC pipe systems
- AS 2033 - Installation of polyethylene pipe systems
- AS 2129 - Flanges for pipes, valves and fittings.
- AS/NZS 2280 - Ductile iron pressure pipes and fittings.
- AS 2419.2 - Fire hydrant installations – fire hydrant valves.
- AS/NZS 2566.1 - Buried flexible pipelines – Structural design.
- AS/NZS 2566.2 - Buried Flexible pipelines – Installation.
- AS 2638 - Sluice valves for waterworks purposes
- AS 3578 - Cast iron non-return valves for general purposes
- AS 3681 - Guidelines for the Application of polyethylene sleeving to Ductile Iron pipelines and fittings.
- AS 3862 - External fusion-bonded epoxy coating for steel pipes.
- AS 3952 - Water supply –Spring hydrant valve for waterworks purposes.
- AS 3996 - Metal access covers, road grates and frames.
- AS 4087 - Metallic flanges for waterworks purposes.
- AS/NZS 4129 - Fittings for polyethylene (PE) pipes for pressure applications.
- AS/NZS 4130 - Polyethylene (PE) pipes for pressure applications.
- AS/NZS 4158 - Thermal-bonded polymeric coatings on valves and fittings for water supply purposes.
- AS/NZS 4321 - Fusion bonded medium density polyethylene coating & lining for pipes and fittings.
- AS/NZS 4441 - Orientated PVC (PVC-O) pipes for pressure applications.
- AS/NZS 4680 - Hot-dipped galvanised (zinc) coatings on fabricated ferrous articles.
- AS/NZS 4765 - Modified PVC (PVC-M) pipes for pressure applications.
- AS 4794 - (c) Non-return valves – Swing check and tilting disc.
- NSW Workcover - Excavation Work Code of Practice

The Service provider must comply with relevant WHS and environmental management legislation as well as any additional requirements as required by the relevant consent authority. This may include additional controls and documentation such as traffic control plans and/or a Review of Environmental Factors etc if required by the consent authority.

A Water Supply Works Approval will be issued under Section 13 of the Local Government (General) Regulation 2005 once the following items have been completed.

17.5 Design Approval

Detailed designs to undertake the Water Supply Works are to be completed in accordance with Councils Engineering Guidelines and have been approved by Hilltops Council. Where designs are not completed in accordance with this document, Hilltops Council will request changes to be made. If this occurs, updated designs with the incorporated changes must be provided to Hilltops Council for approval prior to a Water Supply Works Approval being issued.

Where any Hilltops Councils Standard Drawings conflicts with this Specification, the requirements of this Specification shall take precedence.

Proposals to deviate from this Specification shall constitute a **HOLD POINT**.

HOLD POINT

All proposed deviations from the approved design drawings, Hilltops Councils Standard Drawings, this Specification or the documents referenced within it, shall be submitted for approval to the Hilltops Council Representative with supporting evidence at least five (5) working days prior to the work being undertaken.

PROCESS HELD: The lot or element affected by the proposed deviation.

Detailed engineering drawings are required for any structures such as reservoirs, pumping stations and Pressure Reducing Valve pits proposed for construction in conjunction with water supply works. Also included but not limited to are thrust block designs for elbows and stop valves.

17.6 Agreements

The Service Provider shall provide Hilltops Council

- Written agreements for permission for the construction of the pipelines by other authorities such as water, road and rail authorities as required by the design.
- Signed easement agreements where the pipeline is to be constructed in private property and/or in other authority managed lands.

The Developer shall be responsible for ensuring their engaged service provider meets all relevant legislative requirements and have suitable insurance such as Public Liability Insurance and Workers Compensation Insurance.

The Service provider shall keep the site of the works clean and tidy at all times and pay continuous attention to the removal of litter, waste materials, garbage and refuse. Under no circumstances shall the Service provider dispose of any material or goods, construction debris, rubbish or like material on or around the site. All such materials shall be removed from the site regularly and disposed of by the Service provider at its own expense.

The Service provider shall make the site available to inspection by Hilltops staff at all times. Hilltops Council have set hold and witness points that the Service provider must

adhere to as noted below in Section 17.3. Notification of achieving hold and witness points is required at least 48 hours prior on business days.

17.7 Dilapidation Report

Prior to commencement of any work on Site the Service Provider shall prepare dilapidation report which includes a detailed video and photographic pre-construction record of all areas, which will be affected by construction including stockpile areas, storage areas and access tracks. Details shall include but not be limited to ground surfaces, natural vegetation, gardens, improved surfaces (including roads, driveways and other pavements), services (including kerbs and gutters, drains, pits, power poles) and structures (including buildings, retaining walls, fences). Special attention is to be given to all improvements within 5 metres of the pipeline routes, including gutters and driveways.

17.8 Format

Video: Video shall be in digital format on a USB or accessible via cloud storage and include appropriate commentary. The date of the videoing is to be displayed on the screen at all times.

The commentary shall be clear and audible and shall include the nature of improvements and comments on any defects highlighted on video.

Photographs: Photographs are to be presented in digital format on USB or accessible via cloud storage. Date of photography shall be displayed in photos.

Complete the video/photographic records and submit copies to the Principal's Authorised Person prior to commencing work on the site.

17.9 Updating of Record

Add to the video/photographic records as work proceeds if additional areas will be affected by construction activity and the condition has not been previously recorded or if site conditions change.

Provide a record of damage and defects to improvements in the vicinity of the works prior to all construction activities. This record will be used in the resolution of disputes between property owners and the Service Provider or Principal and accordingly should be comprehensive in its coverage of the areas affected by construction activities.

17.10 Site Office, Facilities & Services

The Service Provider is to arrange for all power, water supply, sanitary, telephone and other services required for construction purposes as required. The Service Provider is to make their own arrangement for the project site office, stockpile, plant items and components storage. Site storage requirements explained in Section 6.7 below.

17.11 Setting Out of Works

The datum used is AHD. Council has provided the existing pipeline alignment for sections of pipes to be replaced. Subject to approval by Council's technical staff, the Service Provider is required to design and construct the final pipeline alignment taking account of the Service provider's DBYD enquiries, council assets and construction methodology for any work carried out.

17.12 Incident Management

The Service Provider is to manage all incidents in a manner, which conforms to the requirements of relevant legislation and minimises the adverse effects of the incidents.

Before commencing any work under the Contract, provide to Council an Incident Management Plan that shall include but not be limited to:

- A statement of accountabilities.
- Risk identification and assessment.
- Incident prevention.
- Incident response procedures.

Identify personnel responsible for the implementation of the Incident Management Plan who shall notify each incident to Council immediately it occurs and manage the incident in accordance with the management plan.

“Incidents” shall include, but are not limited to, those events causing or with the potential to cause a threat to or impact upon:

- Health and safety of any persons.
- The environment.
- Public or private property.
- Community infrastructure including water supply, sewerage, electricity, gas, telephone, rail, road, footpaths.
- Prosecution or fines by a regulatory authority.
- Requirements for urgent action under legislation.

17.13 Existing Services

All relevant services are to be located by the service provide to confirm all utilities shown on the design drawings. This includes undertaking a Dial Before You Dig (DBYD) and contacting Council to determine approximate locations where not included in DBYD locations. Where services are in close proximity to the proposed construction works, on site location is required.

The service provider is to also make themselves aware of but not limited to:

- Road features such as back of kerb, edge of bitumen and driveways and paths
- Fence and lot boundaries
- Significant trees to be either protected or removed
- Existing valve or pit locations
- Existing pit locations for other utilities

All services shall be located and marked out on the ground without causing permanent damage to the surface. The use of paints or other marking materials, which cannot be readily removed, is strictly prohibited. Positive identification of buried fibre optic, gas, potable water and power transmission infrastructure shall be required by pot holing prior to any works commencing. Pot holing shall also be required at all locations identified by the Service Provider as being of high risk. If any investigations result in delays, all open excavations shall be made safe, by backfilling, plating or otherwise, as appropriate.

Minimum clearances to Council's existing water supply and sewer reticulation mains shall be to the Water Services Association of Australia (WSAA) Water and Sewer Design Codes of Australia standards or Council's minimum clearance standards, whichever is greater.

The following Council conditions including minimum horizontal and vertical clearances to water and sewer assets have been compiled to assist utility providers with clearances required to Council's assets.

17.14 Materials

17.14.1 General

The Constructor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this Specification.

The Constructor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

All materials shall be tested in accordance with AS/NZS 4020 to determine their suitability to be in contact with drinking water.

17.15 Unplasticised, Modified and Orientated PVC (uPVC, PVC M, PVC-O)

Unplasticised PVC (uPVC), modified PVC (PVC-M) and orientated PVC (PVC O) pipes and fittings for mains and suction pipes shall comply with AS/NZS 1477, AS/NZS 4765 and AS/NZS 4441, shall be suitable for use with rubber ring (elastomeric) seal, complying with AS 1646, joints and shall be of the class and size as shown on the approved design drawings.

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS 2032 and AS/NZS 2566.1.

Pipes and fittings are to be handled and stored protected from sunlight as per the manufacturer's recommendations. The Constructor shall provide protection for the pipes and fittings from ultraviolet light and damage. The Constructor shall take account of the time for storage and type of shelter.

17.16 Ductile Iron Pipe and Fittings

Ductile Iron pipes and fittings shall comply with AS/NZS 2280 and shall be of the class, size and lining, as shown on the approved design drawings, and installed in accordance with AS/NZS 2566.1. Jointing shall be with rubber rings (elastomeric), complying with AS 1646, to the class and type as shown on the approved design drawings.

Flanges shall be to AS 2129 and AS 4087 with a minimum allowable operating pressure class of PN16 or to the class and size shown on the approved design drawings. Bolts and nuts for flanged joints below ground shall be Grade 316 stainless steel, unless shown otherwise on the approved design drawings. Grade 316 stainless steel bolts and nuts shall have a liberal application of Nickel Anti seize prior to assembly.

Where corrosive environments have been identified, all pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS 3681 unless specified otherwise to be coated and lined. All fittings shall be fusion-bonded coated, in accordance with AS/NZS 4321, or wrapped. The Constructor shall wrap all

unprotected joints in the trench with a petrolatum tape system approved by the Hilltops Council Representative.

17.17 Steel Pipes and Fittings

Steel pipelines and fittings shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining and coating as shown on the approved design drawings.

The Constructor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Hilltops Council Representative.

The jointing system shall be rubber ring (elastomeric), complying with AS 1646, unless shown otherwise on the approved design drawings.

The Constructor shall not lay continuously welded steel pipelines parallel to, when in close proximity, high voltage power lines.

17.18 Copper Pipe and Fittings

Copper tube and fittings shall comply with AS 1432 and shall be of the size and type as shown on the approved design drawings. The installation and commissioning shall comply with AS 4809.

Copper services shall have a minimum size of DN25 with a 1.4mm wall thickness. The Constructor shall install copper tube, capillary and compression fittings, insulated from ferrous mains, as shown on the approved design drawings. Where DN20 water meters are to be fitted the service shall be reduced to DN20 prior to the meter.

17.19 Polyethylene (PE)

Polyethylene (PE) pipe shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size as shown on the approved design drawings and installed in accordance with AS 2033.

Jointing shall be by butt thermal fusion or by electrofusion couplings. The use of compression fittings is not permitted. Fittings up to 110mm shall comply with AS/NZS 4129.

Fittings from 110mm to 600mm shall be ductile iron in accordance with AS/NZS 2280 and coated internally and externally in polyethylene in accordance with AS/NZS 4129.

The Constructor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the approved design drawings.

17.20 Valves and Hydrants

17.20.1 General

The Constructor shall ensure that the valves and hydrants supplied are compatible with the pipework such that proper sealing is provided between the pipe flanges and the valve. The concrete lining in pipework shall not be chipped away or reduced to provide clearance from the working parts of valves.

The Constructor shall ensure that the valves and hydrants are installed so as to facilitate maintenance and repair. The Constructor shall take into account the manufacturer's recommendations, the requirements shown on the approved design drawings, the type of connection, lubrication of connecting bolts, and the location of valves within valve chambers or type of backfill material.

The type of external protection of buried valves and hydrants shall be fusion bonded medium density polyethylene coating to AS 3862 and AS/NZS 4321 or thermal-bonded polymeric coating to AS/NZS 4158. Flanges shall comply with AS 2129 and AS 4087 and shall be of the class and size shown on the approved design drawings.

17.20.2 Stop Valves

Stop valves shall comply with the following:

- a) Stop valves shall be resilient seated valves manufactured in accordance with AS 2638. The valves shall be flanged, where permitted by Hilltops Council, unless shown otherwise on the approved design drawings.
- b) Ball valves shall be flanged, where permitted by Hilltops Council, unless shown otherwise on the approved design drawings.
- c) Butterfly valves shall comply with AS 4795. The valve shall be double flanged unless shown otherwise on the approved design drawings.
- d) Knife Gate valves shall comply with AS 6401. The valve shall be flanged where permitted by Hilltops Council unless shown otherwise on the approved design drawings.
- e) Scour valve assemblies shall be as shown on the approved design drawings.
- f) The direction of closing for all stop valves and scour valves shall be in as per note below.

NOTE : For design drawings shall indicate stop valves and scour valves closing orientation are to be for the following reticulation areas:

- Young – Anticlockwise closing (ACC)
- Boorowa – Anticlockwise closing (ACC)
- Harden – Clockwise closing (CC) (includes Jugiong, Galong, Kingsvale, Prunevale and Wombat)

Excluding ball valves and butterfly valves (unless fitted with a gear box).

- g) All valves shall have a minimum pressure rating of PN16 and resilient sealed.

Valves shall be operated by a removable key. The Constructor shall size “Tee Key” valve operators and hand wheels to operate the valves under all operating conditions throughout their full range with no greater than 180 Newtons applied to the ends of the key bar or the rim of the wheel. Valves greater than DN375 shall be fitted with an appropriate gearbox.

Hand wheels, where specified, shall display an embossed or engraved arrow, together with “open” and/or “close” corresponding to the valve operation.

The top of valve key shall be between 100mm and 300mm below finished surface level and installed as shown in Hilltops Council Standard Drawing SD 1104. If necessary, this shall be achieved by the use of an extension spindle of height to suite.

All valves and hydrants are to be covered by approved surface boxes.

Clearance between the top of a valve or hydrant, and the underside of the surface box is to be between 80mm and 150mm.

Where pipe cover exceeds 450mm hydrant tees with risers are required.

The surface box shall be supported on bricks, concrete blocks, or PVC pipe founded above the pipe bedding. Surface box supports must not be allowed to rest on the water main. Fill material under surface boxes shall be compacted in layers not exceeding 150mm to reduce the amount of settlement.

Hydrants are to be located along each reticulation water main at a maximum spacing of 60 metres in residential areas and 160 metres in rural residential areas. This may be altered slightly with the consent of Hilltops Council nominated manager to ensure the hydrant is away from driveways or other obstructions, or to enable it to be located at a high or low point of the main. Additional hydrants shall be installed at the end of all dead-end mains, at road intersections or significant changes in direction, and at high and low points where required for maintenance and flushing.

17.20.3 Existing Stop Valves and Hydrants

Where the project is utilising existing water mains, the level of hydrant and stop valve surface boxes should be adjusted to suit new surface levels.

17.21 Air Valves

Air valves shall be of the double air valve type with integral isolating valve of minimum size DN80 and shall be installed as shown in Hilltops Council Standard Drawing SD1104. Air valves shall be installed such that they can be maintained without affecting supply. The direction of closing for air valve isolators shall be in a clockwise direction.

17.22 Non-Return Valves

Non-return valves shall resilient seated swing check type to AS 3578 or AS 4794 of cast iron or steel body, cover and an EPDM coated disc. The leaf shall swing clear and provide an unobstructed waterway. Lifting lugs shall be provided for >DN250. Wafer style non-return valves shall not be used. The body cover shall be located and sized to allow the valve flap to be removed and the seat to be inspected without removing the valve body.

17.23 Spring Hydrants

Spring hydrant bodies shall be manufactured in accordance with AS 3952 and installed in accordance with AS 2419.2 except as varied below. The top of spring hydrants shall be between 100mm and 200mm below finished surface level as shown in Hilltops Council Standard Drawing SD1104. If necessary, this shall be achieved by the use of hydrant risers of a height to suite. Spring hydrants shall be protected internally and externally with fusion-bonded coating in accordance with AS/NZS 4158.

17.24 Pressure Reducing Valves

Pressure reducing valves shall be of the type as shown on the approved design drawings. Pressure reducing valves shall be installed with restrained isolating valves, bypass arrangement and dismantling joints to facilitate maintenance.

17.25 Pipeline Construction

17.25.1 General

The Constructor shall implement traffic control measures in accordance with Section 4 Traffic Management when working within or adjacent to a public road reserve. The Constructor shall not change the pipeline alignment without prior approval from the

Hilltops Council Representative. The Constructor shall provide full details, of any proposed changes to the pipeline alignment. This action constitutes a **HOLD POINT**.

HOLD POINT

Submission to the Hilltops Council Representative of evidence supporting the proposal to deviate from the pipeline alignment by more than the tolerances shown in Section 17.26. The alternative pipeline alignment shall be adequately described with the hold point for approval.

PROCESS HELD: Placement of section or lot of affected pipeline.

17.26 Location

The location of the mains, sizes of mains, types of chambers and covers and the classes of pipes shall be as shown on the approved design drawings. The pipelines shall be laid to grades and locations shown on the approved design drawings and to tolerances shown in Table 37. The Constructor shall confirm the locations immediately prior to construction.

Table 37: Tolerances

Description	Horizontal	Vertical
Water Main	± 100mm lateral displacement from alignment	± 50mm [^]
Appurtenances & Structures	± 200mm lateral displacement from design position or alignment	± 50mm [*]
Property Services	± 100mm lateral displacement from alignment	± 50mm [*]
Water Meters	± 100mm lateral displacement from design position or alignment	As required depending on ground surface level
Structures and Fixtures at or above Ground Level	-	+ 5mm in trafficable areas [#]
Trench Dimensions	+ 150mm wider than the design trench width	+ 0mm and - 50mm from the design level of the floor of the excavation.

Description	Horizontal	Vertical
* Provided minimum clearance and cover requirements are achieved.		
# Trafficable areas including sealed pavements, footpaths, cycle ways, driveways or other critical areas within public places.		
^ Pipelines to be constructed with continuously rising grade between design low and design high points.		

17.27 Utility Clearances and Cover Requirements

Table 38: Utility Clearances from Water and Sewer

	Main Size	Gas		Telecommunication		Electrical	
		Minimum Clearance (mm)		Minimum Clearance (mm)		Minimum Clearance (mm)	
	& (mm)	H	V	H	V	H	V
WATER	≤ 200	300	150	300	150	500	300
	>200≤450	600	150	600	300	1000	300
	>450	1000	500	1000	500	1000	500

17.28 Cover Requirements

If not stated elsewhere, the following cover requirements shall be adopted and in accordance with Hilltops Councils Standard Drawings W series. The depths may need to be increased on larger diameter mains to accommodate larger fittings in accordance with Hilltops Councils Standard Drawings W series. Where located in classified road carriageways or railway corridors, cover shall be as approved by the respective Roads Authority or Rail Authority.

- DICL water pipeline in carriageways – minimum 700mm cover.
- DICL and PVC water pipeline in non-trafficable locations - minimum 450mm cover.
- Services under 50mm in carriage ways - minimum 700mm cover.
- Services under 50mm in non-trafficable locations – minimum 450mm cover.
- For services 50mm or larger use relevant cover for water pipelines.

Water service connections that cross roadways are to be placed in a conduit. Conduits shall be under bored in existing roads. Conduits shall be 100 mm PVC pipe of at least storm water quality (AS 1254).

Conduits shall have 700 mm cover under roads and are to extend 300 mm beyond the back of the kerb.

Where no kerb is to be installed the conduit shall be installed 450 mm below the invert of the table drain and extend 1000 mm beyond the drain. The conduit shall be installed so that it faces the boundary of 2 lots to enable 2 water services to be laid in the same conduit.

17.29 Interconnection

Once all required documentation is received and approved, Hilltops Council Water staff will provide a connection point for construction. Hilltops Council will undertake works required to connect to the existing live water mains.

Such work will be at the expense of the Developer (development works) and charged at actual cost.

Irrespective of development or mains works for Council, the starting point shall normally consist of a flanged stop valve of the same class and size as the existing main. The works service provider/service provider shall not, in any circumstances operate the stop valve or use water from the connection point as this presents a contamination risk to Hilltops Councils reticulation system.

17.30 Variation to Designs

Where a variation to the design is proposed, approval of Hilltops Council is to be obtained in writing prior to construction occurring. Unapproved variations may need to be rectified at the Developer's and/or Service provider's cost.

17.30.1 Mains in Cul-de-Sacs

Where the cul-de-sac incorporates a pathway to an adjacent street or ends in a park, the water main is to extend through the pathway or park so that a dead-end is not created in the main. Where a pathway or park is not provided, the main is to be returned at the end of the cul-de-sac to form a loop main which should conform to the following criteria:

1. The loop is to be totally on the footway, apart from the one road crossing required to reconnect with the main.
2. The loop is to incorporate a minimum of 3 separate service tapping's, each separated by at least one block frontage.
3. A hydrant is to be provided within the loop approximately equidistant from loop back point.
4. The loop is to cross the road perpendicular and at the start of the neck at the Cul-de-sac.
5. Changes in direction of the main shall be achieved through the installation of deflection fittings supported by appropriately designed thrust blocks and by deflections at pipe collars within the manufacturer's tolerance guidelines.

17.31 Work in Roadways

The Service Provider is to comply with all applicable traffic laws, regulations and requirements of Hilltops Council and Roads and Maritime Services regarding road closures and work to be carried out within roadways.

Prepare a Traffic Guidance System (TGS) including site risk assessment prior to construction within roadways in accordance with the current Traffic Control at Work Sites

Manual (RMS, 2020) and include in the CEMP for approval by Hilltops Council. Submit a copy to Council Authorised Person. Comply with the approved Plan.

A Section 138 (locally referred to a Works within Road Reserve) permit application will be required to be submitted 4 weeks prior to works commencement. This permit covers any works within the road reserve including footpath/verge zones. A copy of the TGS plus relevant Public liability insurance policy certificates of those performing the works including traffic management is to accompany the application.

A free corridor shall be provided along all footpaths and person access ways of minimum width one metre.

Roads must be left clean at the end of every working day. Where excavated material is trucked onto adjacent areas at any time it shall be removed immediately so that road pavements are kept safe and trafficable. Roads shall, where necessary, be swept with a vacuum sweeper to remove all of this material.

Additionally, any works about street trees that may impact its root zone or canopy will also need Council consent prior to works commencing.

17.32 Cover Over Pipelines

The minimum depth of cover to be provided for mains shall be in accordance with Hilltops Council Standard Drawings SD1102 and SD1103.

Lesser cover may be provided where special protection of the pipelines has been shown on the approved design drawings or directed by the Hilltops Council Representative.

Greater cover may be provided where special situations occur, where there is conflict with other services or to meet grading requirements.

The maximum desired cover shall be 1000mm.

17.33 Crossings

Where a pipeline crosses any road, creek or involves features shown on the approved design drawings, under the control of any Authority, the Constructor shall carry out the work in accordance with the requirements of that Authority. The Constructor shall provide written notification to the relevant Authority of the intention to carry out the work, pay the appropriate fees and provide written approval from the Authority to the Hilltops Council Representative and/or Developer's Representative (for Developer Infrastructure Works) prior to commencement of the work.

For local and regional roads, the Constructor is to obtain a Works within Road Reserve Permit from Hilltops Council and undertake all work in accordance with Trench backfilling details in Standard drawing SD1103 and the issued Works with Road Reserve Permit.

Where the road is a classified road, (i.e.: State or National Highway), the Constructor shall obtain a ROL from the Transport for New South Wales, pay the appropriate fees and provide a copy of the ROL to the Hilltops Council Representative prior to commencement of the work. This action constitutes a **HOLD POINT**.

HOLD POINT

Written approval from the relevant Authorities of the intention to carry out the work shall be provided to the Hilltops Council Representative and/or Developer's Representative (for Developer Infrastructure Works).

PROCESS HELD: Commencement of pipeline crossing work.

Where shown on the approved design drawings, the Constructor shall use trenchless methods for the installation of the pipelines in accordance with Section 20 – Trenchless Conduit Installation. The installation of the pipelines by open trenching shall not be permitted over the lengths designated for trenchless installation.

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing. Where the carrier pipe is proposed to be PVC or similar, precautions need to be taken to prevent damage from excessive heat during curing of the grout.

17.34 Earthworks

The Constructor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the approved design drawings within the specified tolerances. The Constructor shall comply with all requirements of Hilltops Council including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners.

All excavations shall be undertaken in accordance with the NSW WorkCover Excavation Work Code of Practice. The Constructor shall leave a clear space of 1000mm minimum between the edge of the zone of influence of any excavation. No excavated materials shall be stockpiled against the walls of any building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling.

At the completion of work each day, the Constructor shall install appropriate safety fencing along the edges of open excavations and any other measures to ensure the public are isolated and protected from open excavations. The Constructor shall provide fenced walkways and vehicular crossways across trenches to maintain access from the carriageway to individual properties or within individual properties and advise all affected residents beforehand. All such installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

The Constructor shall locate, protect and repair, as necessary, all services affected by the Works at the Constructor's expense.

The Constructor shall carry out erosion and sedimentation control at all construction work sites in accordance with Section 3 – General Matters.

The Constructor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open.

17.35 Minimum Trench Width for Pipelines

The minimum clear width of trench (inside internal faces of timbering or sheet piling, if used) to a height of 150mm above the top of the pipe shall be in accordance with the dimensions shown on Hilltops Councils Standard Drawing SD1103.

Where the approved design drawings provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum and the restoration undertaken in accordance with Section 7 Utility Services Installation, Road Opening and Utility Restoration. The wearing course on road surfaces shall be saw cut to avoid damage to the adjacent roadway. The Constructor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

17.36 Excavation Depth

The Constructor shall excavate trenches to 75mm below the underside of the pipe barrel and socket or coupling except for mains, or as otherwise shown on the approved design drawings. An additional 50mm shall be added to the depth of bedding material in rock (i.e.: total depth of bedding = 125mm).

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of barrel with chases provided for joints and wrapping.

17.37 Support of Excavation

The Constructor shall adequately support all excavations to Statutory requirements including the NSW WorkCover Excavation Work Code of Practice. Records documenting compliance with this Code, and other Statutory requirements shall be kept on the Works site.

17.38 Trench Floor Preparation and Bedding

The trench floor shall be prepared in a manner which prevents differential settlement. The floor shall be inspected for rock outcrops, soft spots or loose areas. Where issues are identified the areas shall be either reworked or over excavated and replaced with a cohesive material uniform with the remainder of the trench. Reworked and excavated section of the trench floor shall be compacted to at least the equivalent of the surrounding natural ground.

When the preparation of the trench floor has been completed, the Constructor shall obtain the Hilltops Council Representative's approval prior to commencing the placement of bedding, pipe laying and jointing. Reworked areas shall be identified along with the treatment undertaken. This action constitutes a **HOLD POINT**.

HOLD POINT

The floor of the trench shall be inspected by the HC Representative. Where applicable, supporting documentation verifying conformance shall be made available from the Constructor to the HC Representative either prior to or during the inspection.

PROCESS HELD: Placement of bedding material.

Bedding material shall be Processed Aggregate that meets the following material specification requirements:

- Grading shall fall within the specified limits shown in Table 39.
- Wet strength shall be greater than 80kN.
- Wet strength / dry strength variation shall not exceed 35%.

Table 39: Grading of Bedding Material for Pipes

Sieve Size (mm)	% of Mass Passing
9.5	100
6.7	85-100
2.36	0-20
0.075	0-2

Alternative sources, complying with AS/NZS 2566.1, may be nominated for approval by the Hilltops Council Representative. Use of an alternative source of material shall constitute a **HOLD POINT**.

HOLD POINT

Alternative sources of bedding material can be nominated by the Constructor for the Hilltops Councils Representative's approval, with conformance records demonstrating compliance with AS/NZS 2566.1, at least five (5) working days prior to placement.

PROCESS HELD: Placement of bedding material.

17.39 Shared Trenching

17.39.1 Footways

Shared trenching will not be permitted.

17.40 Laying and Jointing of Pipes

Unless detailed otherwise in this Specification, the Constructor shall install pipes in accordance with AS 2032, AS 2033, AS/NZS 2566.2 or as appropriate.

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Constructor and, if required by the Hilltops Council Representative, the Constructor shall suspend each one in a sling to enable the Hilltops Council Representative to inspect it.

The Constructor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter (including run off) entering sections of pipeline which are left uncompleted overnight or unattended during rainfall.

The Constructor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports shall be removed prior to completion of backfilling.

Joints in pipelines shall be flexible, rubber ring (elastomeric) joints, either roll on or skid type or, where shown on the approved design plans, mechanical joints, either fixed flange or bolted gland type.

For pipes with rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Constructor shall make the joint such that the witness mark shall, at no point, be more than 1mm from the end of the socket.

Pipes may be cut as needed to suit closing lengths, to remove damaged pipe or fittings or to remove sockets, if necessary, when jointing a socketed fitting.

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine-toothed handsaw and mitre box. For field cuts of ductile iron or steel, the Constructor shall ensure that firefighting equipment, in working order, is on the Works site prior to the field cuts being made. If the Constructor proposes to use a petrol-engine pipe cutter in an excavation, the Constructor shall ensure that a safe atmosphere is maintained in the excavation at all times. Cuts in the trench shall be checked for plumb, cuts above ground are to be conducted to ensure plumb and checked afterwards.

The Constructor shall chamfer the ends of any pipes cut in the field to the manufacturer's written instructions.

Where pipes are cut in the field, the Constructor shall make a witness mark on the pipe using a felt-tip marking pen at the length specified by the manufacturer from the end of the pipe. The Constructor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Constructor shall refer to the socket manufacturer for the correct marking depth.

Where PVC/PE pipes are to be joined to ductile iron pipes, the joints shall be made by inserting a PVC/PE spigot into a ductile iron socket. Ductile iron spigots shall not be joined to PVC/PE sockets. Alternatively, multi-fit mechanical couplings or flanged adaptor couplings may be used to join pipes of different materials.

If the Constructor encounters asbestos associated with the installation of the pipeline, work shall cease and the Hilltops Council Representative and Developer's Representative (for Developer Infrastructure Works) shall be notified immediately. Constructor's and/or their nominated sub-service providers are not permitted to deliberately expose or remove asbestos material.

Only appropriately trained personnel shall be permitted to work with asbestos materials and where cutting and disposal of asbestos cement pipes is required, the Constructor shall conform with all relevant WHS requirements.

Flexibly jointed pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Constructor shall comply with the manufacturer's written recommendations in respect of maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

The Constructor shall lay pipes on continuously rising grades from design low point (e.g. scour valve) to design high point (e.g. air release valve or hydrant), notwithstanding any minor irregularities in the ground surface.

Green detectable marking tape shall be laid along the line of mains constructed from material other than Ductile Iron Cement Lined pipe. The tape is to be positioned at either the interface between the bedding material and the backfill material, or 150mm above the top of the service when the backfill material is the same as the bedding material. It shall be laid in a manner to create a continuous connection between valves and/or hydrants. Strip the end of the tape to expose its conducting wires and connect bare wires to a nut or bolt of a valve or hydrant to form an electrical connection of the wire to the valve or hydrant.

17.41 Clearances

Minimum clearance requirements between water mains and other utility services shown in Table 40.

Table 40: Minimum Clearances Between Pipe Barrels

Proposed utility service	Minimum horizontal clearance between pipe barrels		
	Existing water main size		Minimum vertical clearance between pipe barrels mm
	≤ DN 200	>DN 200	
Water mains	500	600	500
Electricity conduits and cables	1000	1000	1000
Gas mains	500	600	500
Telecommunication conduits and cables	500	600	500

Proposed utility service	Minimum horizontal clearance between pipe barrels		
	Existing water main size		Minimum vertical clearance between pipe barrels mm
Fibre Optic Cable	4000	4000	2000
Drains	500	600	500
Sewers	500	500	500
Kerbs	500	600	500

NOTES:

1. Vertical clearances apply when water mains cross one another and utility services, except in the case of sewers when a vertical separation shall always be maintained, even when the water main and sewer are parallel. The water main shall always be located above the sewer to minimize the possibility of backflow contamination in the event of main break. In the case of no other alternative and the main must cross under the sewer or drain the main will be sleeved and seal from possible contamination in the event of a main break.
2. Clearances from kerbs shall be measured from the outside of the barrel of the water main to the nearest point of the kerb.
3. If a relocation of any service is required the Service provider will bear the cost of such relocation. All damages caused by the Service provider to existing services shall be rectified by the Service provider at no cost to the Principal. The Service provider shall mark up on an appropriate work-as-executed drawing all existing and relocated services.

17.42 Trench Stops

Where a pipe is laid on bedding at a grade of 5% to 14%, the Constructor shall construct, as below, trench stops consisting of bags filled with cement stabilised sand and sealed, or concrete bulk heads. Refer Hilltops Council Standard Drawing SD 1103 Series Trench/Embedment. Trench stops shall be installed and spaced as prescribed by Hilltops Council Standard Drawing SD 1103 Series Trench/Embedment or as shown in the approved design drawings.

- a) At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300mm below finished surface level, or up to a maximum 1 metre above the pipe obvert (whichever is the lesser).
- b) The bags shall be placed around and above the pipe, as in (a) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.

Spacing requirements are detailed in Table 41.

Table 41: Trench Stops Spacing

Type	Grade (%)	Horizontal Spacing (m)
Trench Stop	10	10x Depth to Invert
Concrete Bulkhead for all water mains at grades of 15% or greater	15	6x Depth to Invert
	20	5x Depth to Invert
	25	4x Depth to Invert
	33	3x Depth to Invert
	50	2x Depth to Invert

Adequate trench drainage is required to prevent trench scouring and subsidence due to high permeability of the bedding and trench fill.

17.43 Concrete Bulkheads

Where a pipe is installed at a grade of 15% and to 29%, the Constructor shall construct concrete bulkheads. Where a pipe is installed at a grade of 30% to 50%, the Constructor shall construct concrete bulkheads integral with concrete encasement. Where a pipe is installed at a grade of 50% and over, the Constructor shall install the pipe in accordance with the approved design drawings. Bulkheads shall be of 20MPa concrete in accordance with Hilltops Council Standard Drawing SD1103, Section 10 - Minor Concrete Works, and 150mm minimum thickness as follows.

- Where concrete bedding or encasement to pipe is required, the 150mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150mm. The bulkhead shall extend to within 300mm below finished surface level, or up to a minimum 1 metre above the pipe obvert (whichever is the lesser).
- Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150mm for the full width of trench.
- A 75mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10mm to 20mm in size within 150mm in all directions upstream and above the invert of the drain hole beyond which another 150mm thick surround of gravel 2mm to 10mm in size shall be placed.

Concrete bulkheads shall be installed and spaced as prescribed by Hilltops Council Standard Drawing W1209 or as shown in the approved design drawings.

WITNESS POINT

The Constructor shall notify the Hilltops Council Representative at least two (2) days prior to the placement of concrete for concrete bulkheads for inspection and approval by the Hilltops Council Representative.

PROCESS HELD: Placement of Concrete.

17.44 Valve and Hydrant Chambers

The Constructor shall construct around each valve and hydrant a chamber of the type and to the details shown on the approved design drawings. Where no details are provided, Hilltops Council Standard Drawing W1302 shall be complied with for valves and Hilltops Council Standard Drawing SD1104 shall be complied with for hydrant chambers. Plastic chambers shall not be used in roadways.

The concrete shall comply with Section 10 Minor Concrete Works. Valve and hydrant chamber covers shall be manufactured from coloured materials (where required) and not painted after installation. Colours to be in accordance with Table 42.

Table 42: Valve and Hydrant Chamber Cover Colours

Colour	Designation
Yellow	Potable Water
Red	Closed Valve Zone Boundary
White	Dedicated Rising Mains
Lilac	Reuse Water
Black/Grey	Wastewater

Where the type of valve chamber is such that the body, or part of the body, of the valve is to be backfilled before the valve chamber is constructed, the Constructor shall either wrap the valve using Denso or approved equivalent applied in accordance with the manufacturer's guidelines.

17.45 Chamber Covers and Frames

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4mm radius.

Tolerances for the dimensions on the COVER shall be - 5mm + NIL. Tolerances for the dimensions on the FRAME shall be - 5mm + 5mm.

Covers shall be seated as shown on the approved design drawings.

Covers shall be finished flush with the surface in road pavements, footpaths and other paved surfaces. Elsewhere, covers shall be finished 50mm above the surface of the ground, in a manner designed to avoid as far as possible, the entry of surface water.

Cast iron covers and frames shall be manufactured in accordance with AS 3996 and shall be installed and filled with concrete, as necessary, in accordance with the manufacturer's written requirements.

The Constructor shall take care to avoid lateral movement, cracking and subsidence when installing plastic covers and frames.

Covers to be type "Class D" where located within trafficable areas (including asphalt, bitumen seal, concrete, nature strip) and "Class B" for non-trafficable areas.

17.46 Locations and Service Connections

Water mains are to be located on the footway in accordance with the footway allocations referred to in this specification and shall extend to the extremity of the development or the project.

The Council Representative may give approval for infrastructure to be located in areas other than road reserves provided an easement is created. The developer should transfer to Council any water easements provided in the subdivision and execute a transfer and grant of easement in favour of Council pursuant to Section 88B of the Conveyancing Act 1919, as amended. The minimum width of water easements shall be 3.0m for reticulation mains and 5.0m for trunk mains.

The Council Representative may require water mains to be located on both sides of the road in commercial/industrial areas, in areas likely to have high or medium density housing, at the boundaries between pressure zones and on highly trafficked roads.

Water mains are to be provided for the full extent of the development to facilitate the systematic and orderly expansion of Council's infrastructure

The standard residential water service connection size is 25mm. All services will be laid at 90 degrees to the Water Supply Works so as to give an indication where the service lies relative to the location of the water meter.

All services that are connected to the Water Supply Works with an operating pressure GREATER than 90 metres head (900kpa) are to include a pressure reducing device prior to the meter. The pressure reducing device must be in accordance with Hilltops Councils OR Goldenfields Water's preferred device depending on the owner of the main being tapped.

17.47 Service Connections

The Constructor shall provide service connections in accordance with the approved design drawings. Where no detail is provided, service connections to be in accordance with Hilltops Council Standard Drawings SD1102.

The Constructor shall leave the water main exposed for a distance of half a metre either side of the service connection to enable the necessary inspections by the Hilltops Council Representative prior to backfilling by the Constructor.

Water services should be single service drawn copper pipe or polyethylene in accordance with Section 17.18 and 17.19. Services that are connected to mains with an operating pressure greater than 140 metres head (1400kpa) are to be installed using copper tube which conforms with AS 4020 Grade “B” specifications.

Services are to be a minimum of DN25 with 1.4mm thickness copper or DN32 PE100 PN16. Fittings at joints, branches and bends are to be brass or copper capillary fittings or of a type approved by Hilltops Council. Ball valves and elbows are to be of brass and a type approved by Hilltops Council. Flared fittings will not be acceptable.

In industrial and commercial areas, services under the carriageway are to be laid in approved conduit. The minimum conduit pipe shall be 100mm, PN9 UPVC.

In residential areas, services under the carriageway are to be laid in approved conduit. The minimum conduit pipe shall be 100mm, PN9 UPVC. Conduits may be laid for future proposed services; however, the service is not to be connected to the water main. Service connections shall have a minimum cover of 500mm under carriageways and 300mm in footways.

The service line must include the tapping band, copper piping, union connector, elbow, CIM valve (lockable isolation valve and nipple as specified in Engineering Guidelines Standard Drawings).

All service lines are to be risen to a height which will allow meters are to be installed 350mm above the finished ground level.

Joints of service connections are to be kept to the minimum required.

Joints are not to be made in any service pipes under roads or within 2 metres of the shoulder of the road.

Water services are to be laid at right angles to the road centreline and parallel to the radius on curves and in cul-de-sac ends.

The services are to have a minimum cover in accordance with Hilltops Engineering Guidelines Part 3 Standard Drawings SD 1102 Series – Service Details.

The service is to terminate inside each lot in accordance with Hilltops Engineering Guidelines Part 3 Standard Drawings SD 1102 Series – Service Details.

The minimum distance between two (2) adjacent tapping bands is 600mm for uPVC and PE mains unless specified differently by the pipe manufacturer. Tapping into pipes pulled on/for curves/bends should be discouraged.

All maincocks are to be located in the footway/verge area.

In Industrial/Commercial areas services under carriageways should be laid in approved conduit pipes. The minimum conduit pipe shall be 100mm. PN 9, uPVC pipe is required as a conduit.

In residential areas services under carriageways should be laid in approved conduit pipes. The minimum conduit pipe for copper services shall be 50mm. PN9, uPVC pipe is required as a conduit.

Conduits may be laid for future proposed services; however, the service is not to be connected to the water main.

Fire service to be contained within lot served.

The minimum size of a water service in both residential and industrial / commercial areas is 25 mm ID with a 20mm service to be provided for residential service and 25mm

service to provide for industrial / commercial areas in accordance with HC Standard Drawings.

For areas set aside for recreation, a 32mm service with a 20mm meter is to be provided.

However, firefighting requirements and other considerations may warrant a larger service size. The Designer is responsible for nominating the correct size water service.

The size of service required shall be determined in accordance with the National Construction Code – Volume 3 Plumbing Code of Australia and AS/NZS 3500 to ensure adequate flow and pressure is provided to each property.

The size of water services serving multiple dwellings, flats or units will vary as detailed in Table 43.

Table 43: Minimum Size of Water Service

Class of Building	No. of dwellings	Service Size (mm)	Maximum Length (m)
Class 1 Single Dwelling House	1	20	130
Class 1&2 Excluding Single Dwelling House	1	25	100
	2	25	100
	3-5	32	100
	6-10	40	100
	11-16	50	100

Notes: Classes are defined in the National Construction Code of Australia Volume One Limitations of Method:

4. *Total length as measured from the water main to the last branch offtake is not to exceed the total length as stated above.*
5. *Height of the highest fixture above the water main is not to exceed 4m, where the minimum mains pressure is 15m (150 Kpa).*

Fire Services

The minimum size of a water service in both residential and industrial / commercial areas is a 20mm ID service to be provided for residential service and 25mm ID service to provide for industrial / commercial areas in accordance with HC Standard Drawings.

For areas set aside for recreation, a 32mm service with a 20mm meter is to be provided.

However, firefighting requirements and other considerations may warrant a larger service size. The Designer is responsible for nominating the correct size water service.

The size of service required shall be determined in accordance with the National Construction Code – Volume 3 Plumbing Code of Australia and AS/NZS 3500 to ensure adequate flow and pressure is provided to each property.

The size of water services serving multiple dwellings, flats or units will vary as detailed in Table 44.

Table 44: Minimum Size of Water Service

Class of Building	No. of Dwellings	Service Size (mm)	Maximum Length (m)
Class 1 Single Dwelling House	1	25	130
Class 1&2 Excluding Single Dwelling House	1	25	100
	2	25	100
	3-5	32	100
	6-10	40	100
	11-16	50	100

Notes: Classes are defined in the National Construction Code of Australia Volume One Limitations of Method:

- 1. Total length as measured from the water main to the last branch offtake is not to exceed the total length as stated above.*
- 2. Height of the highest fixture above the water main is not to exceed 4m, where the minimum mains pressure is 15m (150 Kpa).*

Fire Services

- 1. Where a development comprises of a multi-dwelling complex, the Council watermain shall be constructed conformant with Fire and Rescue NSW guidelines.*
- 2. Where there is a non-residential development, the developer shall provide Council with a design for the internal fire services that is compliant with the relevant Australian Standards and regulations.*

Fire services should not be designed to allow direct pumping out of the council main unless the developer demonstrates that on-site storages tanks are a non-viable option for the fire service.

- 1. Where development comprises of a multi-dwelling complex, the Council watermain shall be constructed conformant with Fire and Rescue NSW guidelines.*
- 2. Where there is a non-residential development, the developer shall provide Council with a design for the internal fire services that is compliant with the relevant Australian Standards and regulations.*

Fire services should not be designed to allow direct pumping out of the council main unless the developer demonstrates that on-site storages tanks are a non-viable option for the fire service.

Hilltops Council will supply and install water meters once applicable fees have been paid and upon registration of the subdivision for Developer Infrastructure Works.

Tapping bands approved by the manufacturer for use on the specific type of pipe are to be used for all service connections (readytap connectors or equivalent are acceptable). The minimum distance between two adjacent tapping bands should be 600mm. Thin

brass type tapping bands without rubber backing will not be permitted. Stainless steel type tapping bands are preferred.

17.48 Thrust and Anchor Blocks

Thrust and anchor blocks shall be installed at the locations shown in the approved design drawings in accordance with Hilltops Council Standard Drawings SD1103. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur.

The Constructor shall provide permanent thrust blocks in accordance with Hilltops Council Standard Drawings SD1103 such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area.

The Constructor shall provide permanent anchor blocks (e.g. at end caps) in accordance with the approved design drawings or Hilltops Council Standard Drawing SD1103. Where no detail is provided, the proposed position and dimensions of the anchor block shall be referred to the Hilltops Council Representative.

HOLD POINT

The Constructor shall notify the Hilltops Council Representative at least two (2) days prior to the placement of concrete of any thrust blocks and/or anchor blocks for inspection and approval by the Hilltops Council Representative.

PROCESS HELD: Placement of Concrete.

The Constructor shall provide temporary anchorages adequate to restrain the pipe when under test.

The Constructor shall obtain the approval of Hilltops Council for the type and use of restrained joints as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning.

Stop valves on mains of 150mm diameter or greater are to be fixed to a thrust block.

All thrust blocks are to be poured in place. Trench walls are to be trimmed to provide good bearing area and concrete is to have a minimum compressive strength of 20 MPa.

When forming and pouring thrust blocks:

- Valves and fittings must not be buried in concrete.
- All joints shall be kept clear of concrete.
- A protective barrier is to be maintained between the concrete and any fitting (i.e. polythene membrane).

The Developer /service provider shall be responsible for any failure of the pipeline that may be due to inadequate restraint in accordance with the Hilltops Council Standard Drawings for Water - Trench/ Embedment.

SD 1103: Concrete Blocks

SD 1103: Gate Valves & Vertical Bends

SD 1103: Restrained Joint System, DN 100 to DN 375 DI Mains

17.49 Concrete Encasement

Where pipes have less than 450mm of cover above the top of the pipe barrel, or were directed by the Hilltops Council Representative, they shall be encased in concrete. Concrete shall be 20MPa complying with Section 10 Minor Concrete Works and have the following minimum dimensions:

- a) For trenches in other than rock: 150mm minimum under, on both sides and on top of the pipe barrel.
- b) For trenches in rock: 75mm minimum under the pipe barrel, 150mm on top of the pipe barrel and for the full width of trench excavated.

In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12mm thick shall be formed in the concrete encasement at the face of each socket or at one (1) face of each coupling.

Reinforcement in concrete encasement shall be as shown on the approved design drawings.

17.50 Wrapping of Pipelines

Sleeving / wrapping is only required where it is envisaged that a corrosive environment may exist (i.e. isolation for electrical installations, sullage lines etc). Application of polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions or as directed by the Hilltops Council Representative. The Constructor shall take due care not to damage the sleeving / wrapping during its application or during the backfilling of the trench.

17.51 Corrosion Protection of Steel Bolts and Nuts

All bolts and nuts used in below ground applications shall be Grade 316 stainless steel bolts and nuts, with a liberal application of Nickel Anti-seize applied prior to assembly. For above ground applications, hot-dipped galvanised bolts and nuts may be used.

17.52 Connection to Existing Pipes

Connections to existing pipes shall be undertaken by Hilltops Council. A request for a connection to Hilltops Council mains shall be directed to the Hilltops Council Representative. The timing of the connection shall be determined by Hilltops Council in consultation with the Constructor.

17.53 Pipeline Testing and Restoration

17.53.1 Pressure Testing

The Constructor shall pressure test mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. This action constitutes a **HOLD POINT**. Testing shall be undertaken and recorded in accordance with Annexure 17A and shall be submitted as evidence of lot or section conformance.

HOLD POINT

Inspection of pressure testing including the Constructor's requirement to nominate test method(s) to the Hilltops Council for approval at least two (2) working days prior to undertaking the test.

PROCESS HELD: Undertaking pressure test of lot or section.

Suitable connection points shall be included to allow for pressure testing and disinfection of pipelines to occur. This is typically hydrants placed at the start and end of the development or suitable 25mm connection points. The determination of requirements will be made during the design review, approval phase and construction phase in consultation with Hilltops Council.

Test all pipelines to requirements of AS 2566.2 to detect and repair leakages and defects in the pipeline including joints, thrust and anchor blocks.

Use potable water for the tests.

Carry out initial testing before the commencement of roadworks and pits.

Carry out testing when conditions will permit the detection of any leaks.

Test pipelines in sections as soon as practicable after each section has been laid, jointed and backfilled, provided that:

- Pipe cannot be commissioned until the whole of the section has been successfully pressure tested.
- The pressure testing does not commence earlier than seven (7) days after the last concrete thrust or anchor block in the section has been cast.
- The section is a length of pipeline which can be effectively isolated for testing.

Pipelines shall be tested in sections approved by the Hilltops Council Representative as soon as practicable after each section has been laid, jointed and backfilled, provided that:

- a) Some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Hilltops Council Representative; and
- b) The pressure testing shall not be commenced earlier than five (5) working days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this Clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g.: by means of main stop valves.

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Hilltops Council Representative.

During pressure testing, all field joints, which have not been backfilled, shall be clean, dry and accessible for inspection.

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one (1) side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, the Constructor shall clean it to the satisfaction of the HC Representative and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves / hydrants / services. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

17.53.2 Test Heads

Hydrostatically test all pipelines to the following pressures:

The hydrostatic test pressure, which shall be applied to each section of the pipeline, shall be a minimum 1200kPa or 1.5 times the standard operating pressure, whichever is the greater. The test pressure however, shall not exceed the pipe or fitting design pressure. A test shall be regarded as satisfactory if:

- There is no failure of any thrust block, pipe, fitting, joint or any other component.
- There is no visible leakage.
- The measured loss rate does not exceed the accepted maximum.

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one (1) side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, the Constructor shall clean it to the satisfaction of the Hilltops Council Representative and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves / hydrants / services. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

The Constructor shall maintain the specified test pressure as long as required by the HC Representative while the Constructor examines the whole section. In any case, the specified test pressure shall be maintained for not less than 2 hours. For the purpose of determining the actual leakage losses, the Constructor shall use the Constant Pressure Test (Water Loss Method) in accordance with AS 2566.2 by carefully measuring and recording the quantity of water added in order to maintain the pressure during the period of testing.

Note: This test method is applicable only to ductile iron, PVC and steel pipelines. For PE pipelines, the test method outlined in AS 2566.2 - Appendix M5 shall be adopted.

The pressure testing of a section shall be considered to be satisfactory if:

- a) There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
- b) There is no visible leakage; and
- c) The measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:

- $Q1 = (0.14 \times D \times L \times H) / 1,000,000$

where:

- $Q1$ = permissible leakage rate (litres per hour)
- D = internal diameter of pipe (mm)
- L = length of main tested (m)
- H = average test head (m)

- d) Unless otherwise specified by the Hilltops Council Representative adopt a maximum test length of 1 kilometre.

Any failure, defect, visible leakage or excessive leakage rate which is detected during the pressure testing of the pipeline or during the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works, shall be made good by the Constructor at the Constructor's expense.

Final water inspections are to be carried out immediately prior to final practical inspection, to ensure all water infrastructure is compliant.

17.53.3 Flushing and Disinfection of Pipelines

All water mains shall be pressure tested, flushed, disinfected and flushed again prior to handover to Hilltops Council operation. The Service provider is required to submit a plan detailing the amount, source and method of disposal of all water volumes used prior to handover. If there is any possibility that damage to the environment will occur as a result of any high chlorine discharge, then a neutralising agent shall be applied. All temporary connections to the water main for the purposes of pressure testing, disinfection and flushing, shall at all times be equipped with appropriate backflow prevention devices.

The service provider is required to submit a detailed disinfection procedure based on WSA-03. The procedure should cover both bacteriological and chemical testing based on WSA-03. In summary for disinfection this requires the pipeline to be flushed and then sterilized by filling the Water Supply Works with between 5 and 10 mg/L of chlorine. After 24 hours water samples are taken, and the chlorine residual must be greater than 2.5 mg/l.

All testing records including amount of water used, flows, pressure, test results, field observations and any other relevant information shall be captured using an ITP (Inspection and Test Plan). All testing and sampling are to be witnessed by a Hilltops staff representative and require a minimum forty-eight (48) hours' notice period. This action constitutes a **HOLD POINT**.

HOLD POINT

Inspection of pressure testing including the Constructor's requirement to nominate test method(s) to the Hilltops Council for approval at least two (2) working days prior to undertaking the test.

PROCESS HELD: Undertaking pressure test of lot or section

17.53.4 Defective Pipes

If the pipeline or part thereof gives an unsatisfactory test or non-conforming performance, submit a proposal to rectify or relay the pipeline. Re-test the pipeline as specified above. Continue repairing and testing until the pipeline passes the test.

17.53.5 Cost of Supply of Test Water

The service provider /service provider can extract water required for testing from adjacent hydrants. All work, fittings, hoses, signs, barriers and other components required to supply the water is to be provided by the service provider.

17.54 Backfill and Compaction

After laying and jointing of a pipeline has been completed, the Constructor shall present the laid and jointed pipes for inspection by the Hilltops Council Representative prior to the commencement of trench backfilling. This action constitutes a **HOLD POINT**. The Hilltops Council Representative's approval of the laid and jointed pipes is required prior to the release of the hold point.

HOLD POINT

Inspection by the HILLTOPS COUNCIL Representative of the laid and jointed pipes at least two (2) working days prior to backfilling.

PROCESS HELD: Backfilling of lot or section of laid and jointed pipes.

Material for the side support and overlay of the pipe shall comply with the requirements for pipe bedding specified in Clause 17.38. The material shall be compacted in layers of not more than 150mm to 95% of the standard maximum dry density as determined by AS 1289.5.4.1 for cohesive materials. The extent of the bedding material within the trench shall be determined in accordance with Hilltops Council Standard Drawing SD1103.

The Constructor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150mm thick as follows:

- a) Where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be:
 - (i) Backfilled with Select Material to the underside of the pavement. Alternative materials, including excavated materials, or stabilised sand may be nominated to the Hilltops Council Representative.
 - (ii) Backfilled with road base and sub-base material in accordance with C242 – Flexible Pavements.
 - (iii) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a Density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials or 98% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1 for cohesive materials.

The Constructor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe. Vibratory compaction should be avoided in close proximity to the pipe and associated connections and infrastructure.

The Constructor shall carry out compaction tests 75mm to 100mm below the level being tested.

When backfilling, detectable marker tape must be installed 300mm above the pipe and be easily accessible to allow attachment of pipe detection equipment at valve pits.

In some locations the pipe may need to be encased in concrete, e.g. under creeks. In such cases the pipe must have the concrete carefully poured around it, and the concrete allowed to cure before being put into use. Where the pipeline crosses roads the relevant Local Council may require stabilised sand to be used as backfill material. The relevant Local Council will need to be contacted to determine this requirement.

Native material may be used for bedding providing the material is tested and 100% of the test material pass through a 19mm sieve and 75% + or – 25% pass through a 2.36mm sieve. If native material is used for back fill, the material must be free of all vegetation. If testing fails suitable material is to be imported. Compaction in 150mm layers is required on backfilling to the full trench depth to achieve at least 95%.

See Table 45 for location of compaction tests.

Table 45: Location and Number of Compaction Tests for Backfill

Length of Construction	Number of Tests	Location of Test
0-5km	3	Start, Middle, End
>5km	At least 3	Start, End, every 2.5km

Records of compaction test must be submitted with the Works As Executed documentation.

17.55 Valve and Hydrant Marking

The Constructor shall clearly mark the position of each stop valve, scour valve, air valve and hydrant on completion of backfilling in a manner and position in accordance with HILLTOPS COUNCIL Standard Drawing SD1104 and/or as approved by the HILLTOPS COUNCIL Representative.

The markings shall be abbreviated as follows:

- SV – Stop Valve
- SCV - Scour Valve
- H – Hydrant
- W – Water Main or Water Service
- AV – Air Valve

The Constructor shall provide formed kerb impressions for each valve and hydrant, with lettering to be 75mm high and 15mm wide and placed on top of the kerb with reflective white paint with glass beads. Alternatively, in areas where kerb is existing, a stainless steel kerb marker disc with a central hole for a mushroom head nail or peg to secure the disc to the top of the kerb may be used. The face of the disc shall be stamped or engraved with letters to identify the adjacent service/fitting.

Where there is no kerb, or as otherwise directed by the Hilltops Council Representative, the Constructor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting in accordance with Hilltops Council Standard Drawing SD1104. The distance to the valve or hydrant in metres, to an accuracy of 0.1m and the size of the main, shall be permanently marked or stamped on the plate with legible numbers a minimum 12mm high and Red or Black in colour. The top number gives the distance (in metres) from the plate to the hydrant, and the bottom number gives the size (in mm) of the water main.

The post shall conform to the following requirements:

- a) The post shall be of sufficient length to be set firmly in place under saturated ground conditions.
- b) When installed, the post shall project 1000mm above the ground, provided that where tall grass or crops are likely to obscure the post, its height above the ground shall be increased to 1500mm.
- c) The post shall be metal, with blue powder coating for reticulation mains or white powder coating for rising mains and trunk mains.

For hydrants, the Constructor shall affix blue two-way reflective raised pavement markers to the centreline of road pavement.

17.56 Restoration of Surfaces

The Constructor shall make good at their cost all fencing, roads, footpaths and surfaces generally, which may be disturbed by operations of the Constructor. The Constructor shall restore all work sites and areas adjacent thereto to a condition, standard and finish equivalent to that which existed prior to the works commencing.

Where restoration to an equivalent condition, standard and finish is not reasonably practical, the Constructor is required to consult with the relevant property owner, statutory agency or land custodian to agree on a suitable alternate that is in general

terms functionally equivalent and to the satisfaction of the relevant parties. (E.g.: a uniquely patterned concrete driveway could be replaced by a 'plain' finish concrete driveway if agreed by the property owner).

The Constructor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works, applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works. The Constructor shall maintain pavements in accordance with Section 7 Utility Services Installation.

In other than roadways, the Constructor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works in order that the surface of the completed trench may then conform to the adjacent surface. Surplus material shall be removed and disposed of, to areas arranged by the Constructor.

Where dry weather conditions have persisted after the original backfilling, including during the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works, the Constructor shall take all necessary steps to consolidate the trench before removing surplus materials from the Works site.

In locations where, in the opinion of the Hilltops Council Representative, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Hilltops Council Representative in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Constructor shall maintain the backfill and adjacent ground until the expiry of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works.

Excess excavated material shall be disposed of to a Licenced waste facility authorised to accept the waste, unless:

- a) The excavated material meets the definition of "Virgin Excavated Natural Material" (VENM) as defined in the NSW Protection of Environment Operations Act 1997 (POEO Act); or
- b) The excavated material meets the requirements of "The Excavated Natural Material Order 2014" (ENM) issued under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014;

and,

- a) The excess excavated material is tested and disposed of in accordance with the requirements of the relevant classification (VENM or ENM);
- b) The Constructor (or Principal) obtains all necessary approvals for disposal to a destination other than a Licenced waste facility. This is to include written authority from the owner of the land where the material is to be placed that they approve acceptance.

Restore cleared areas by replacing the pre-existing topsoil and seed the disturbed area to promote regrowth.

Where a complaint of unsatisfactory restoration has been received and agreed with by the Council, the service provider shall rectify such defect within ten (10) working days of the complaint being received and provide written acknowledgement from the relevant property owner that the restoration is satisfactory. If the Service Provider fails to rectify unsatisfactory restoration, Council may rectify any unsatisfactory restoration work on behalf of the Service Provider and deduct the cost from moneys otherwise due to the Service provider.

All restored surfaces and improvements shall be maintained in a satisfactory condition until the return of the post completion undertaken, notwithstanding that any deterioration, and the need for their maintenance, may or may not be due to defects which become apparent or arise from events which occur during the post-completion period.

Where, within public or private property, the Constructor shall level trenches at the time of backfilling or otherwise as directed by the Hilltops Council Representative. The Constructor shall make good any subsequent settlement, as required by placing additional fill.

The Constructor shall immediately restore any damaged or disturbed private property and services. Should the Constructor elect to tunnel under paving, kerb and gutter or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces. The Constructor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works.

The Constructor shall provide notice to affected property owners of any pending work. Written notification shall be delivered to all affected property owners as per the minimum time frames for notification shown in Table 46.

Table 46: Notification Timeframes

Properties Affected	Minimum Timeframe for Notification
1	24 hours
Up to 25	5 working days
Greater than 25	10 working days

17.57 Work-As-Executed Documents

The Service provider (developer or service provider shall provide 'Works As Executed' drawings showing the correct location of all key features including but not limited to pipes, valves, hydrant points and other fittings, pipe bends and take offs, inlet and outlet structures, pits, profile of earth works, runs of pipe work, etc. The information produced by the final survey should be sufficient to accurately locate all works both above and below ground. The Works as Executed drawings are to be provided in accordance with Councils requirements for WAE detailed in Appendix A of this construction specification.

17.58 Easements

Where construction did not occur in the road reserve, easements shall be created in favour of Hilltops Council over any public water infrastructure located in private property. The width of the easement shall normally be 3 metres for pipes up to 450 mm diameter laid in properties within the urban boundaries as determined by Hilltops Council. In non-urban areas easements shall be 6 metres wide.

For larger diameter pipes and other special circumstances see the design section 1 of this Engineering guideline.

17.59 Final Inspection

It is the Developer's/service providers responsibility to request the Hilltops Council staff (in writing) to conduct an onsite inspection to confirm that any outstanding items and subsequent defects are satisfactorily completed. A staff member will attend site within 5 days of receiving and inspection request.

17.60 Return of Defects Liability Bond

Upon the successful completion of the above requirements the Defects Liability Bond (or remainder thereof) after the defects period has ended, will be returned/refunded to the Developer.

CONSTRUCTION SPECIFICATION FOR CIVIL WORKS
C401 - WATER RETICULATION

ANNEXURE C401A – PRESSURE TESTING

MSF-180 – Water and Wastewater Test Sheet – Pressure Main Hydrostatic Test Result

PRESSURE MAIN HYDROSTATIC TEST RESULT SHEET - FOR PVC, DICL, GRP & STEEL PIPE SYSTEMS (Not Suitable for PE)

Testing Method to be in accordance with Australian Standards - Compressed Air Testing SHALL NOT be permitted for pressure pipe.

Works Title / Street Name / Locality: _____									
Line No / Pipeline Description: _____					Diameter: _____			Pipe Material: _____	
Date of Test: _____ Test pressure Required (k Pa) (at top of pipe – allow for elevation at bottom of pipe)# : _____									
Downstream Chainage and Fitting (e.g. SV at Ch 0)	Upstream Chainage and Fitting (e.g. EC at Ch 600)	L Length of Main Under Test (m)	D Pipe Diameter (mm)	H Test Pressure (m)	Q Allowable Make-up Water (l/hr)	Test Duration (hrs)	Difference in vertical elevation of test section (m)	Testing Result – Did the pipeline meet the specification requirements? ☐ YES ☐ NO Record quantity of make-up water added	Comments (e.g. re-test required) Complete another test result sheet if re-test required.

Name of Witness: _____ Signed by Witness: _____

Reference : AS/NZS 2566.2:2002, Buried flexible pipelines – Part 2: Installation, The hydrostatic test pressure at any point in the pipeline shall be (a) not less than the design pressure; and (b) not more than 1.25 times the PN of the lowest rated component in the system) shall be applied to the section under test.

The test length shall be acceptable where (a) there is no failure of any thrust block, pipe, fitting, joint or any other pipeline component; (b) there is no visible leakage; and (c) the quantity of make-up water necessary to maintain the test pressure shall comply with the following equation:

$$Q = \frac{0.14 \times D \times L \times H}{1,000,000}$$

Where, Q = Allowable Make-up Water, (L/h)

D = nominal pipe diameter, (mm)

L = length of the test length, (m)

H = average test pressure, (m). (note: 1m = 10kPa) or (120m = 1,200kPa)

Note: The make-up water is not a leakage allowance, but it is an allowance to cover the effects of the test head forcing small quantities of entrapped air into solution. Normally the test should last for a minimum of 2hrs and be concluded within 5hrs to 8hrs. The make-up water requirement should reduce with time as air goes into solution.

AS/NZS 2032:2006, Installation of PVC Pipe Systems - two pressure measuring instruments to be used. Where the joints are accessible for inspection and there is no evidence of leaks of the test water after at least 15 minutes, the section is deemed to have passed. Where the joints are not accessible for inspection and the loss of water is less than that calculated as the maximum allowable loss (Q), the section is deemed to have passed the test. # Subtract 10kPa from the pressure input for each 1m that the test rig is above the bottom of the pipe.

Figure 8: Water and Wastewater Test Sheet - Pressure Main Hydrostatic Test Result

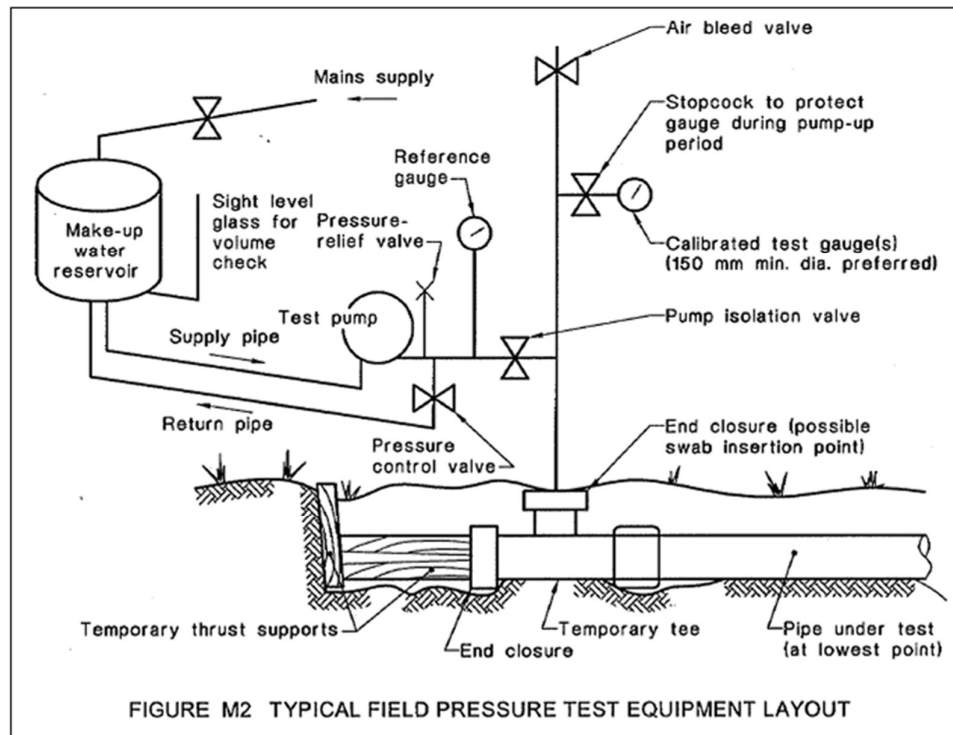


Figure 9: Typical Field Pressure Test Equipment Schematic Layout

18 Sewer Construction

18.1 General

This Specification is for construction of:

- a) Gravitation sewers up to DN600 nominal size.
- b) Common Effluent sewers, both gravity and pressurised.
- c) Rising mains up to DN600 nominal size.
- d) Standard appurtenances such as maintenance holes, maintenance shafts and property connection sewers.

This Specification excludes the construction activities for:

- a) Treatment plants.
- b) Headworks.
- c) Dosing plant.
- d) Work controlled by others, including overflow management.

The Service provider Constructor shall carry out the work and supply materials meeting the requirements of the reference documents except as otherwise specified herein.

For the purposes of this Specification, 'access chambers' are referred to as "maintenance holes".

18.2 Definitions

The Works – Defined as follows:

- Developer Infrastructure Works - work includes subdivisions and any public infrastructure work associated with an approved Development in the Hilltops Council local government area requiring a construction certificate.
- Contracted Works – infrastructure work undertaken by a Principal Service provider or subservice provider formally appointed by Hilltops Council and supervised by Hilltops Council.
- Internal Works - infrastructure work undertaken by Hilltops Council 's day labour workforce. Constructor – Defined as the organisation responsible for construction of the Works and the Principal Service provider as defined in the Work Health and Safety Act 2011. Hilltops Council Representative – Defined as follows:
 - Developer Infrastructure Works – Nominated Hilltops Council officer(s) for the approved Development.
 - For Contracted Works – the Superintendent.
- For Internal Works – Hilltops Council Asset Owner Constructor's Representative – Defined as follows:
 - Contracted Works – the Principal Service provider's nominated representative as per the relevant contract.
 - Internal Works – Hilltops Council officer responsible for delivery.

- Developer’s Representative – Defined as the person or organisation appointed by the Developer to administer the Constructor responsible for the delivery of Developer Infrastructure Works.

18.3 Reference Documents

Documents referenced in this Specification are listed below whilst being cited in the text in the abbreviated form or code indicated. The Constructor shall possess, or have access to, the documents required to comply with this Specification.

Where not otherwise specified in the relevant Hilltops Council Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the Specifications at the time of the Works approval.

Where parallel sections or equivalent clauses to the reference SEWERAGE CODE OF AUSTRALIA is called up as part of this Specification, these references are identified by part and section numbers and enclosed in brackets thus (WSA Edition, Part, Section). Sewerage Code

a) Hilltops Council Specifications

- Section 3 – General Matters (including Control of Erosion and Sedimentation).
- Section 4 – Traffic Management.
- Section 7 – Utility Services Installation, Road Opening and Utility Services
- Section 10 – Minor Concrete Works
- Section 19 – Trenchless Conduit Installation.

b) Australian Standards References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS.

- AS/NZS 1111 - ISO metric hexagon commercial bolts and screws.
- AS/NZS 1112 - ISO metric hexagon nuts, including thin nuts, slotted nuts, and castle nuts.
- AS 1152 - Specification for test sieves.
- AS/NZS 1260 - PVC pipes and fittings for drain, waste and vent applications.
- AS 1272 - Unsintered PTFE tape for thread sealing applications.
- AS 1289.5.4.1 - Compaction control test – Dry density ratio, moisture variation and moisture ratio.
- AS 1289.5.6.1 - Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material.
- AS 1349 - Bourdon tube pressure and vacuum gauges.
- AS 1444 - Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties.
- AS 1449 - Wrought alloy steels – Stainless and heat-resisting steel plate, sheet and strip. AS/NZS 1477 - PVC pipes and fittings for pressure applications.
- AS 1565 - Copper and copper alloys – Ingots and castings.

- AS 1579 - Arc welded steel pipes and fittings for water and wastewater.
 - AS/NZS 1594 - Hot-rolled steel flat products.
 - AS 627.4 - Metal finishing – Preparation and pre-treatment of surfaces-Abrasive blast cleaning.
 - AS 1646 - Elastomeric seals for waterworks purposes.
 - AS 1657 - Fixed Platforms, walkways, stairways and ladders – Design, construction and installation.
 - AS 2032 - Code of practice for installation of uPVC pipe systems.
 - AS 2033 - Installation of polyethylene pipe systems.
 - AS/NZS 2280 - Ductile iron pressure pipes and fittings.
 - AS 2528 - Bolts, stud bolts and nuts for flanges and other high and low temperature applications.
 - AS/NZS 2566.1 - Buried flexible pipelines – Structural design.
 - AS 2837 - Wrought alloy steels – Stainless steel bars and semi-finished products.
 - AS 3578 - Cast iron non-return valves for general purposes.
 - AS 3681 - Guidelines for the application of polyethylene sleeving to ductile iron pipelines and fittings.
 - AS 3972 - Portland and blended cements.
 - AS 3996 - Metal access covers, road grates and frames.
 - AS 4058 - Precast concrete pipes (pressure and non-pressure).
 - AS 4087 - Metallic flanges for waterworks purposes.
 - AS/NZS 4129 - Fittings for polyethylene (PE) pipes for pressure applications.
 - AS/NZS 4130 - Polyethylene (PE) pipes for pressure applications.
 - AS 4198 - Precast concrete access chambers for sewerage applications (Read 'maintenance hole' for 'access chamber').
 - AS/NZS 4321 - Fusion-bonded medium-density polyethylene coating and lining for pipes and fittings.
 - AS/NZS 4441 - Orientated PVC (PVC-O) pipes for pressure applications.
 - AS/NZS 4680 - Hot-dip galvanised (zinc) coatings on fabricated ferrous articles.
 - AS/NZS 4765(Int) - Modified PVC (PVC-M) pipes for pressure applications.
 - AS 4794 - Non-return valves – Swing check and tilting disc.
 - AS/NZS 5065 - Polyethylene and Polypropylene Pipes and fittings for drainage and sewerage application.
- c) Hilltops Council Standard Drawings Applicable to this Section
- S1201 - Trench/Embedment – Embedment and Trench Backfill Typical Arrangement.

- S1202 - Trench/Embedment – Standard Embedment for Flexible and Rigid Pipes.
- S1206 - Trench/Embedment – Trench Drainage Bulkheads, Trench Stops and Mass Concrete Piers.
- S1300 - Maintenance Holes – Pipe Diameter $\leq$ DN300 Precast Types P1 and P2.
- S1308 - Maintenance Holes – Typical Manhole Cover Arrangement.
- W1205 - Trench/Embedment – Concrete Thrust Block Details - Sheet 1 of 2.
- W1206 - Trench/Embedment – Concrete Thrust Block Details - Sheet 2 of 2.
- W1207 - Trench/Embedment – Thrust and Anchor Block Details – Gate Valves and Vertical Bends.

d) Other Publications

- Hilltops Council Engineering Guideline Part 1 Design. Minimum Standards for Subdivisions and Developments.
- NSW Workcover Excavation Work Code of Practice.
- National Construction Code (NCC) 2016 - Volume 3 - Plumbing Code of Australia.
- PWD Safety Guidelines for fixed ladders, stairways, platforms and walkways for use in sewerage treatment works, pumping stations and maintenance holes.

Hilltops Council Standard Drawings shall take precedence over ALL other drawings related to the Works.

Where any Hilltops Council Standard Drawings conflicts with this Specification, the requirements of this Specification shall take precedence. Proposals to deviate from this Specification shall constitute a **HOLD POINT**.

HOLD POINT

All proposed deviations from the approved design drawings, Hilltops Council Standard Drawings, this Specification or the documents referenced within it, shall be submitted for approval to the Hilltops Council Representative with supporting evidence at least five (5) working days prior to the work being undertaken.

PROCESS HELD: The lot or element affected by the proposed deviation.

18.4 General

The Constructor shall comply with the requirements of the manufacturer's recommendations regarding the handling, transport and storage of materials and as further specified in this Specification.

The Constructor shall not use damaged or defective materials, including coatings and linings, outside the manufacturer's recommended limits.

All gravity reticulation pipes shall be rubber ring (elastomeric), complying with AS 1646, jointed to the type, size and class as shown on the approved design drawings.

18.5 Unplasticised AND Modified PVC (UPVC and PVC-M) Pipe And Fittings

Unplasticised PVC (uPVC) pipes and fittings for gravity systems shall comply with AS/NZS 1260, shall be suitable for rubber rings (elastomeric) joints and shall be of the class SN8 RRJ 3m lengths and size as shown on the approved design drawings.

Unplasticised PVC (uPVC), modified PVC (PVC-M) and orientated PVC (PVC-O) pipes and fittings for mains and suction pipes shall comply with AS/NZS 1477, AS/NZS 4765 and AS/NZS4441, shall be suitable for use with rubber ring (elastomeric) seal, complying with AS 1646, joints and shall be of the class and size as shown on the approved design drawings.

PVC pipes and fittings for mains and suction pipes shall be installed in accordance with AS 2032 and AS/NZS 2566.1.

Pipes and fittings are to be handled and stored protected from sunlight. The Constructor shall provide protection for the pipes and fittings from ultraviolet light and damage. The Constructor shall take account of the time for storage and type of shelter.

18.6 Polyethylene (PE) Pipe and Fittings

Polyethylene pipe shall comply with AS/NZS 4129 and AS/NZS 4130 and shall be of the class and size shown on the approved design drawings and installed in accordance with AS 2033.

Jointing shall be by butt thermal fusion or by electrofusion couplings, Compression fittings are not permitted.

The Constructor shall provide pipe of the appropriate external diameter consistent with the required internal diameter shown on the approved design drawings.

18.7 Polypropylene (PP) Pipe and Fittings

Polypropylene pipe shall comply with AS/NZS 5065 and AS/NZS 4130 and shall be of the class SN10 RRJ 3m lengths and size shown on the approved design drawings and installed in accordance with AS 2033 and AS/NZS 2566.2.

18.8 Ductile Iron (DI) Pipe and Fittings

Ductile iron (DI) pipes and fittings shall comply with AS/NZS 2280 and shall be of the class, size and lining, as shown on the approved design drawings, and installed in accordance with AS/NZS 2566.1. Jointing shall be with rubber rings (elastomeric) to the class and type as shown on the approved design drawings.

Flanges shall be to AS 2129 and AS 4087 with a minimum allowable operating pressure class of PN16 or to the class and size shown on the approved design drawings. Bolts and nuts for flanged joints below ground shall be Grade 316 stainless steel, unless shown otherwise on the approved design drawings. Grade 316 stainless steel bolts and nuts shall have a liberal application of Nickel Anti seize prior to assembly.

Where corrosive environments have been identified, all pipework shall be sleeved externally with polyethylene sleeving in accordance with the requirements of AS 3681

unless specified otherwise to be coated and lined. All fittings shall be fusion-bonded coated, in accordance with AS/NZS 4321, or wrapped. The Constructor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the Hilltops Council Representative.

18.9 Steel Pipeline

Steel pipelines and fittings shall comply with AS 1579 and AS/NZS 1594 and shall be of the class, size, lining and coating as shown on the approved design drawings. The Constructor shall wrap all unprotected joints in the trench with a petrolatum tape system approved by the HILLTOPS COUNCIL Representative. The jointing system shall be rubber ring (elastomeric), complying with AS 1646, unless shown otherwise on the approved design drawings.

18.10 Preformed Maintenance Holes (MH)

Precast concrete maintenance hole components shall comply with AS 4198 and Hilltops Council Engineering Guideline Section 3 Part B Standard Drawing SD1204.

18.11 Preformed Maintenance Shafts (Ms) and Terminal Maintenance Shafts (TMS) Including Cover

Precast concrete maintenance shaft and terminal maintenance shaft components shall comply with AS 4198 and the approved design drawings.

18.12 Maintenance Hole Covers and Frames

Concrete maintenance hole covers and frames shall comply with AS 4198 and shall be of the size and class as shown on HILLTOPS COUNCIL Engineering Guideline Part 3 Volume B Standard Drawing S1204 and shall have two lifting points.

18.13 Steelwork

Structural steelwork, including ladders, brackets and covers, complying with AS 1657, shall be abrasive blast cleaned to AS 1627.4, Class 2.5 and hot dip galvanised to AS/NZS 4680. The Constructor shall supply and install step irons for maintenance holes as shown on HILLTOPS COUNCIL Engineering Guideline Section 3 Part B Standard Drawing S1204 and whenever the depth to the invert is greater than 1.2m deep. Flanges Corrosion Protection Standard Corrosion Protection Joints Standard Concrete Corrosion Protection Step Irons

19 Pipeline Construction

19.1 General

The Constructor shall implement traffic control measures in accordance with C201 - Control of Traffic when working within or adjacent to a public road reserve. The alignment of the pipeline as shown on the approved design drawings shall not be changed without the prior approval of the Hilltops Council Representative. Proposals to deviate from the approved alignment shall constitute a **HOLD POINT**.

HOLD POINT

The Constructor shall submit all details and justification of any proposed changes to the pipeline alignment for approval to the HILLTOPS COUNCIL Representative at least five (5) working days prior to the work being undertaken.

PROCESS HELD: The lot or element affected by the proposed deviation

19.2 Location

The location of the sewers, maintenance holes, sizes and grades of sewers, the types of maintenance holes and maintenance hole covers, and the classes of pipes shall be as shown on the approved design drawings. The Constructor shall confirm the locations immediately prior to construction.

The Constructor shall commence laying of pipelines at the lower end of the line unless directed otherwise by the HILLTOPS COUNCIL Representative. The Constructor shall lay pipelines to grades and locations shown on the approved design drawings.

Unless shown otherwise on the approved design drawings, the horizontal alignment of all sewer mains located within lots adjacent to stormwater pipes shall be laid with a minimum of 0.5m separation between the outside of the sewer main joint and the outside of the stormwater pipe joint.

Where sewer of different diameters intersects and/or join, the maximum depth of the smaller pipe is to be such that the pipe obverts are at the same level. It's prohibited to build over or adjacent to Hilltops Council owned sewers. This is to ensure prevention to damage of the sewer asset.

19.3 Cover Over Pipelines

The minimum depth of cover to be provided over pipelines shall be in accordance with Hilltops Council Engineering Guidelines Part 3 Volume B Standard Drawing SD1203.

Lesser cover may be permitted where special protection of the pipelines has been shown on the approved design drawings or directed by the Hilltops Council Representative.

Greater cover may be provided where special situations occur, such as conflict with other services or to meet grading requirements.

19.4 Crossings

Where a pipeline crosses any road, creek or involves features shown on the approved design drawings, under the control of any Authority, the Constructor shall carry out the work in accordance with the requirements of that Authority. The Constructor shall provide written notification to the relevant Authority of the intention to carry out the work, pay the appropriate fees and provide written approval from the Authority to the Hilltops Council Representative and/or Developer's Representative (for Developer Infrastructure Works) prior to commencement of the work.

For local and regional roads, the Constructor is to obtain a Work with Road Permit from Hilltops Council and undertake all work in accordance with Section 7 Utility Services Installation, Road Openings and Utility Restorations.

Where the road is a classified road, (i.e.: State or National Highway), the Constructor shall obtain a ROL from Transport for New South Wales (TfNSWG0), pay the appropriate fees and provide a copy of the ROL to the Hilltops Council Representative prior to commencement of the work. This constitutes a **HOLD POINT** where applicable.

HOLD POINT

Written approval from the relevant Authorities of the intention to carry out the work shall be provided to the Hilltops Council Representative and/or Developer's Representative (for Developer Infrastructure Works).

PROCESS HELD: Commencement of pipeline crossing work.

Where shown on the approved design drawings, the Constructor shall use trenchless methods for the installation of the sewer mains in accordance with Section 20 – Trenchless Conduit Installation. The installation of the sewer main by open trenching shall not be permitted over the lengths designated for trenchless installation.

19.5 Earthworks

The Constructor shall carry out all excavations for structures and pipelines to the lines, grades and forms shown on the approved design drawings, or as directed by the Hilltops Council Representative, within the specified tolerances. The Constructor shall comply with all requirements of the appropriate Authority including having regard for drainage, dewatering, silt control, noise abatement, proximity to existing buildings and generally for the amenity of adjacent owners.

All excavations shall be undertaken in accordance with the NSW Excavation Work Code of Practice. The Constructor shall leave a clear space of 1000mm minimum between the edge of the zone of influence of any excavation. No excavated materials shall be stockpiled against the walls of any building or fence. Topsoil from excavations shall be stockpiled separately and utilised to restore the surface after backfilling.

At the completion of work each day, the Constructor shall install appropriate safety fencing along the edges of open excavations and any other measures to ensure the

public are isolated and protected from open excavations. The Constructor shall provide fenced walkways and vehicular crossways across trenches to maintain access at all times from carriageway to individual properties or within individual properties and advise beforehand all affected residents. All such installations shall be of adequate size and strength and shall be illuminated to prevent accidents.

The Constructor shall locate, protect and repair, as necessary, all services affected by the work at the Constructor's expense.

The Constructor shall carry out erosion and sedimentation control at all construction sites in accordance with Section 3 - General Matters (includes Control of Erosion and Sedimentation).

The Constructor shall take account of safety issues and possible wet weather effects to limit the extent of excavation left open.

19.6 Minimum Trench Width for Pipelines

The minimum clear width of trench shall be determined as shown on HILLTOPS COUNCIL Engineering Guidelines Part 3 Volume B Standard Drawing SD1203.

Where the approved design drawings provide for a trench to be excavated across a paved surface, the width of the trench shall be kept to a minimum and the restoration undertaken in accordance with Section 7 - Utility Services Installation, Road Openings and Utility Restorations.

The wearing course on road surfaces shall be saw cut to avoid damage to the adjacent roadway.

The Constructor shall widen the trench where necessary for the installation of valves and fittings and protective coating systems.

19.7 Maximum Trench Width

For gravitation sewers or rising mains of pipe materials other than PVC or PE, no restriction shall be placed on the maximum width of trench due to the structural strength of the pipe provided the depth to invert of the pipe does not exceed the depths shown in column (ii) of Table 47. The Hilltops Council Representative and/or Developer's Representative (for Developer Infrastructure Works may, however, restrict the width of trench due to local conditions. The Hilltops Council Representative and/or Developer's Representative (for Developer Infrastructure Works shall not restrict the width of trench to less than as shown in column (iii) of Table 47.

Where the depth to invert exceeds that shown in column (ii) of Table 47 below, the maximum width of trench (outside timbering or sheet piling, if used) to a height of 150mm above the top of the pipe shall be as shown in column (iii) of Table 47.

Table 47: Maximum Trench Widths

Nominal Size of Pipe (mm) (i)	Maximum Depth to Invert, Unlimited Width Trench (m) (ii)	Maximum Trench Width (mm), Depths Greater than in Column (ii) (iii)
150	8.0	750
225	6.5	825

Nominal Size of Pipe (mm) (i)	Maximum Depth to Invert, Unlimited Width Trench (m) (ii)	Maximum Trench Width (mm), Depths Greater than in Column (ii) (iii)
300	5.5	900
375	4.5	975
400	4.5	975
450	4.5	1050
525	4.0	1125
600	4.0	1200

For gravitation sewers or rising mains of PVC/PE pipe the maximum width of trench from the trench base to a height of 150mm above the top of the pipe shall be the outside diameter of the pipe barrel plus 400mm. However, in timbered or travelling box excavated trenches, the width of trench when measured to the outside of the support used may be increased to a maximum of 580mm plus the outside diameter of the pipe barrel.

The Constructor shall supply a method statement of any special construction control, where shown on the approved design drawings, for the approval of the Hilltops Council Representative and/or Developer's Representative (for Developer Infrastructure Works).

19.8 Excavation Depth

The Constructor shall excavate trenches to 75mm below the underside of the pipe barrel and socket or coupling or as otherwise shown on the approved design drawings. An additional 50mm shall be added to the depth of bedding material in rock (i.e.: total depth of bedding =125mm).

The excavation shall be carried out such as to ensure solid and uniform support for each pipe over the whole length of the barrel with chases provided for joints and wrapping.

19.9 Support of Excavation

The Constructor shall adequately support all excavations in accordance with the requirements of the NSW WorkCover Excavation Code of Practice. Records documenting compliance with this Code, and other Statutory requirements shall be kept on the Works site.

The Constructor shall ensure that timber is left in place where its removal may endanger structures in the vicinity of the excavation.

19.10 Trench Floor Preparation and Pipe Bedding

The trench floor shall be prepared in a manner which prevents differential settlement. The floor shall be inspected for rock outcrops, soft spots or loose areas. Where issues are identified the areas shall be either reworked or over excavated and replaced with a cohesive material uniform with the remainder of the trench. Reworked and excavated

section of the trench floor shall be compacted to at least the equivalent of the surrounding natural ground.

When excavation and preparation of the trench has been completed the Constructor shall obtain the Hilltops Council Representative's approval prior to commencing the placement of bedding, pipe laying and jointing. Reworked areas shall be identified along with the treatment undertaken. This action constitutes a **HOLD POINT**.

HOLD POINT

The floor of the trench shall be inspected by the Hilltops Council Representative. Where applicable, supporting documentation verifying conformance shall be made available from the Constructor to the Hilltops Council Representative either prior to or during the inspection.

PROCESS HELD: Placement of bedding material.

Pipes for gravitation sewers and rising mains (excluding PVC/PE pipes), shall be bedded on non-cohesive material. Pipe bedding shall consist of a non-cohesive Processed Aggregate bedding material, having a minimum thickness of 75mm below the barrel and socket of the pipe and its grading shall meet the material specification requirements shown in Table 5:

- Grading shall fall within the specified limits shown in Table 48.
- Wet strength shall be greater than 80kN.
- Wet strength / dry strength variation shall not exceed 35%.

Table 48: Grading of Bedding Material for Pipes

Sieve Size (mm)	% of Mass Passing
9.5	100
6.7	85-100
2.36	0-20
0.075	0-2

Alternative sources, complying with AS/NZS 2566.1, may be nominated for approval by the HILLTOPS COUNCIL Representative. Use of an alternative source of material shall constitute a **HOLD POINT**.

HOLD POINT

Alternative sources of bedding material can be nominated by the Constructor for the HILLTOPS COUNCIL Representative's approval, with conformance records demonstrating compliance with AS/NZS 2566.1, at least five (5) working days prior to placement.

PROCESS HELD: Placement of bedding material.

For PVC/PE pipes, irrespective of foundation, the material to be used for pipe bedding (underlay a minimum of 100mm below the underside of the pipe barrel and socket, side support and overlay to a minimum depth of 150mm above the top of the pipe) as shown in Hilltops Council Engineering Guideline Section 3 Part B Standard Drawing SD 1203 shall be in non-cohesive granular material, either crushed, natural or blended, and its grading shall fall within limits shown in Table 48.

The maximum acceptable grade for all gravitation sewers is 10%. Where sewer mains are laid at grades of 5% to 10%, these mains shall be constructed with trench stops or concrete bulkheads in accordance with Section 19.15 and 19.16.

19.11 Laying and Jointing of Pipes

Unless detailed otherwise in this Specification, the Constructor shall install pipes in accordance with AS 2032, AS 2033, AS/NZS 2566.1 or AS 3690 as appropriate.

Before being laid, all pipes, fittings, valves, and materials to be used shall be cleaned and examined by the Constructor and, if required by the Developer's Representative or the Hilltops Council Representative, the Constructor shall suspend each one in a sling to enable the Certifying Engineer to inspect it. If directed by the Hilltops Council Representative and/or Developer's Representative (for Developer Infrastructure Works), the Constructor shall oil valves and repack valve glands.

The Constructor shall ensure that the interior of the pipeline is clean and free from obstructions. Plugs shall be used to prevent foreign matter entering sections of pipeline which are left uncompleted overnight.

The Constructor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. The Constructor shall remove any temporary supports prior to completion of backfilling.

Except where solvent cement joints are needed to make up or install fittings, joints in pipelines shall be flexible, rubber ring (elastomeric) joints (either roll-on rubber ring (elastomeric) or skid type) or, where shown on the approved design drawings, mechanical joints (either fixed flange or bolted gland type).

For pipes with roll-on rubber ring (elastomeric) joints, spigots and sockets shall be clean and dry. The Constructor, after making the joint, shall check that the rubber ring (elastomeric) has rolled in evenly, and, if not, the Constructor shall withdraw the pipe and remake the joint.

For pipes with skid type rubber ring (elastomeric) joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. The Constructor shall

make the joint such that the witness mark shall, at no point, be more than 1mm from the end of the socket.

Pipes may be cut as needed to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary, when jointing a socketed fitting.

For field cuts, a mechanical pipe cutter shall be used, except that PVC/PE pipes may be cut using a power saw or a fine-toothed handsaw and mitre box. For field cuts of ductile iron or steel, the Constructor shall ensure that fire-fighting equipment, in working order, is on the Works site prior to the field cuts being made. If the Constructor proposes to use a petrol-engine pipe cutter in an excavation, the Constructor shall ensure that a safe atmosphere is maintained in the excavation at all times. Cuts in the trench shall be checked for plumb, cuts above ground are to be conducted to ensure plumb and checked afterwards.

The Constructor shall prepare the ends of any pipes cut in the field to the manufacturer's written instructions.

Where pipes are cut in the field, the Constructor shall make a witness mark on the pipe at the length specified by the manufacturer from the end of the pipe. The Constructor shall not use PVC/PE pipes with scored witness marks. Where the same manufacturer does not make spigots and sockets, the Constructor shall refer to the socket manufacturer for the correct marking depth.

Where PVC pipes are to be joined to pipes of another material, the joints shall be made as follows:

- a) For jointing PVC/PE spigot to VC socket or PVC/PE socket to VC spigot, the Constructor shall use a PVC/PE adaptor shall be used. The joints in both instances shall be made using a ring conforming to AS 1646.
- b) For jointing PVC/PE spigot to ductile iron socket, the Constructor shall use a rubber ring (elastomeric) joint with an adaptor coupling. Ductile iron spigots shall not be joined to PVC/PE sockets.

If the Constructor encounters asbestos cement pipes, work shall cease and the Developer's Representative and the Hilltops Council Representative shall be notified immediately. Constructor's and/or their nominated sub-service providers are not permitted to deliberately expose or remove asbestos material.

Only appropriately trained personnel shall be permitted to work with asbestos materials and where cutting and disposal of asbestos cement pipes is required, the Constructor shall conform with all relevant WHS requirements.

Gravitation pipelines shall be constructed to the following tolerances:

- a) The maximum horizontal deviations to either side from the design axis of a pipeline shall be 50mm for all sizes of pipes.
- b) The invert level shall not deviate from the design grade line by more than 10mm.
- c) Shall not be less than the minimum design grade to achieve self-cleansing flows.

Gravity sewer mains shall not have any deflection at joints, any horizontal or vertical deflection shall be made at manholes. Only flexibly jointed rising mains shall be permitted to have deflection at joints, such pipelines with gradual changes in alignment or grade shall be laid with the joint being deflected after it has been made. The Constructor shall comply with the manufacturer's written recommendations in respect of

maximum deflection for each joint provided that no joint shall be deflected to such an extent as to impair its effectiveness.

The Constructor shall lay pipes for rising mains on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.

Beige or cream detectable identification tape to AS/NZS 2648.1 shall be laid along the line of the rising main, positioned at either the interface between the bedding material and the backfill material, or 150mm above the top of the service when the backfill material is the same as the bedding material.

Prior to backfilling and compaction operations, the Constructor shall undertake ovality tests of all pipelines for any abnormalities in pipe shape and rectify any unsatisfactory sections found to the satisfaction of the Hilltops Council Representative. The test results shall be made available to the Hilltops Council Representative. This action constitutes a **WITNESS POINT**. The Hilltops Council Representative shall advise at the time of notification by the Constructor whether the option to inspect the test results is required.

WITNESS POINT

Constructor to submit ovality test results to the HILLTOPS COUNCIL Representative at least two (2) working days prior to backfilling of any trenches.

PROCESS HELD: Backfilling of trenches.

19.12 Connections to Maintenance Holes and Structures

The Constructor shall connect pipelines to maintenance holes, structures or embedded concrete by means of 600mm long pipes such that two (2) flexible joints are provided, the first joint being at or within 150mm of the face of the structure. Where flexible joints cannot be made with cut pipes, the Constructor shall select pipes from the various lengths provided in order to make the second joint within 300mm of the position shown on the approved design drawings.

The Constructor may vary slightly the positions of maintenance holes shown on the approved design drawings, subject to approval from the Hilltops Council Representative prior to construction, to suit changes such as erection of structures, growth of flora and installation of services. The positioning of a maintenance hole shall be such as to comply with WHS requirements for access by maintenance staff, providing a proper working area around the top and access into the hole. Once the final position of a maintenance hole has been established, construction shall be subject to the following requirements:

- a) For deviations from the design levels of maintenance holes as shown on the approved design drawings or as directed by the Hilltops Council Representative during construction, the following tolerances shall apply:
 - (i) Where the difference in levels between the inlet pipe and the outlet pipe in a maintenance hole is 100mm or less:

Pipe	Tolerance
Inlet	- nil; + 10mm
Outlet	- 10 mm; nil

(ii) Where the difference in levels, as above, is greater than 100mm:

Pipe	Tolerance
Inlet	-10mm; + 10 mm
Outlet	-10mm; +10mm

Allowable lateral deviations from the final design position of maintenance holes shall be +/- 300 mm.

Hilltops Council shall complete all necessary work on “live” maintenance holes (i.e.: access to the sewer system that is currently in service and new connections to live sewers) unless shown otherwise on the approved design drawings. The Constructor shall liaise with Hilltops Council to avoid disruption, delays and possible conflict. (NB: If approved by the Hilltops Council Representative, work can be undertaken by the Constructor under supervision by the Hilltops Council Representative or nominated Hilltops Council Officer).

19.13 Junctions and Property Connection Sewers

The Constructor shall provide junctions for dead ends and property connection sewers or risers to properties to serve existing and future dwellings in accordance with this Specification and the approved design drawings. Such junctions shall be inserted along pipelines in locations shown on the approved design drawings or directed by the Hilltops Council Representative.

Where not shown on the approved design drawings, junctions shall be provided at a depth no deeper than 1.5m as follows (NB: construction of the vertical shaft is not to be undertaken in cases where it would preclude gravity sewer servicing of the entire lot):

- For existing dwellings, at the most practical point not outside the property boundary to facilitate the connection, considering existing sewage outlets. Separate connections shall be provided for dual occupancies.
- For vacant blocks, at the most practical point not outside the property boundary to facilitate the connection, considering topography and likely positioning of sewage outlets.

Junctions for risers shall be encased in 20MPa concrete up to 300mm in accordance with Section 10 Minor C2 Concrete Works.

Except where concrete encasement is directed by the Hilltops Council Representative, the Constructor shall sand compact backfill around risers to the top of the socket or coupling on the highest branch off the riser, for the full width of trench and for a minimum distance of 500mm upstream and downstream of the riser. Compaction density shall be as for the requirements for the trench pipeline.

All property connection sewers and junctions shall have a minimum diameter of 150mm and have a screwed access cap. Property connection sewers shall have a maximum length of 10m.

19.14 Marking of Junctions and Property Connection Sewers

The Constructor shall clearly mark the position of each riser, junction or end of a property connection sewer on completion of backfilling. The marking shall be made by one of the following methods, but the location of the mark or peg shall be consistent with the method(s) in use by Hilltops Council and to the approval of the Hilltops Council Representative.

- a) Where the position of a riser, junction or the end of a property connection sewer is at a substantial boundary fence or structure located on the boundary, a neatly stencilled letter "J" 50mm high shall be painted thereon. Underground identification tape, as specified hereafter, shall finish flush with the existing ground surface as close to the boundary fence or structure as possible.
- b) Elsewhere, the Constructor shall drive into the ground, a red survey peg, 75mm x 50mm x 600mm long at that position, and left flush with the surface of the surrounding ground. The Constructor shall connect the peg to an underground identification tape as specified hereafter.
- c) As an alternative to providing a red survey peg, the vertical riser can be constructed. The sewer riser is to be marked red, solvent capped, protected from vandalism and easily identifiable for future internal property connection.
- d) The Constructor shall tie the identification tape to the junction or end of the property connection sewer and hold the tape in a vertical position during backfilling. The Constructor shall spike the top end of the tape by the junction peg immediately upon completion of backfilling.
- e) Beige or cream detectable marking tape shall be laid along the line of all mains. The tape is to be positioned at either the interface between the bedding material and the backfill material, or 150mm above the top of the service when the backfill material is the same as the bedding material.

19.15 Trench Stops

Where a sewer or rising main is laid on bedding at a grade of 5% to 14%, the Constructor shall construct, as below, trench stops consisting of bags filled with cement stabilised sand and sealed, or concrete bulk heads. Trench stops shall be installed as prescribed by Hilltops Council Engineering Guidelines Part 3 Volume B Standard Drawing SD 1203 or as shown in the approved design drawings.

- a) At the socket side of the joint nearest to the position of a stop required in accordance with the formula hereinafter, a recess 100mm deep to suit the width of bag shall be excavated into the bottom of the trench across its full width and into both sidewalls and extend to within 300mm below finished surface level, or up to a maximum 1 metre above the pipe obvert (whichever is the lesser).
- b) The bags shall be placed around and above the pipe, as in (a) above, so as to give close contact with the pipe and to fill the entire space between the excavated recess and the pipe. Bags shall not be placed onto sand bedding.

19.16 Concrete Bulkheads

Where a sewer rising main is installed at a grade of 15% and up to 29%, the Constructor shall construct concrete bulkheads. Where a sewer rising main is installed at a grade 30% to 50%, the Constructor shall construct concrete bulkheads integral with concrete encasement. Where a pipe is installed at a grade of 50% and over, the Constructor shall install the pipe in accordance with the approved design drawings. Bulkheads shall be of 20MPa concrete as prescribed by Hilltops Council Standard Drawing SD1206, Section 10 Minor Concrete Works, and 150mm minimum thickness as follows:

- a) Where concrete bedding or encasement to pipe is required, the 150mm thick bulkhead shall be cast integral with the concrete bedding or encasement across the width of trench and shall be keyed into both sidewalls a minimum of 150mm. The bulkhead shall extend to within 300mm below finished surface level, or up to a minimum 1 metre above the pipe obvert (whichever is the lesser).
- b) Where other bedding, or no bedding, is applicable, the bulkhead shall also be keyed into the bottom of the trench 150mm for the full width of trench.
- c) A 75mm nominal diameter drain hole shall be provided in the concrete bulkhead immediately above the top of the encasement bedding or foundation and crushed rock or gravel shall be placed in and at the upstream end of the drain hole to act as a filter. The gravel shall be 10 to 20mm in size within 150mm in all directions upstream and above the invert of the drain hole beyond which another 150mm thick surround of gravel 2 to 10mm in size shall be placed.

WITNESS POINT

The Constructor shall notify the Hilltops Council Representative at least two (2) days prior to the placement of concrete for concrete bulkheads for inspection and approval by the Hilltops Council Representative.

PROCESS HELD: Placement of Concrete

Concrete bulkheads shall be installed and spaced as shown in the approved design drawings.

19.17 Thrust and Anchor Blocks for Rising Mains

The Constructor shall construct thrust and anchor blocks were shown on the approved design drawings to the dimensions depicted in Hilltops Council Engineering Guideline Part 3 Volume B SD1103 or as otherwise directed by the Hilltops Council Representative. The blocks shall be provided at valves, flexibly jointed bends, tees, enlargers and reducers or any other point where unbalanced forces resulting from internal pressures will occur.

The Constructor shall provide permanent thrust blocks of 25MPa concrete in accordance with Hilltops Council Engineering Guideline Part 3 Volume B SD1103, such that the thrust blocks bear against undisturbed material normal to the direction of thrust resulting from internal pressures over the bearing area not less than that directed by the Hilltops Council Representative.

The Constructor shall provide permanent anchor blocks of 25MPa concrete in accordance with Hilltops Council Engineering Guideline Part 3 Volume B SD1103. Where no detail is provided, the proposed position and dimensions of the anchor block shall be referred to the Hilltops Council Representative.

WITNESS POINT

The Constructor shall notify the Hilltops Council Representative at least two (2) days prior to the placement of concrete of any thrust blocks and/or anchor b Section 7 Utility Services Installation, Road Opening and Utility Services

locks for inspection and approval by the Hilltops Council Representative. Spacing Location Thrust Blocks Anchor Blocks Witness Point

PROCESS HELD: Placement of Concrete

The Constructor shall provide temporary anchorages adequate to restrain the pipe when under test.

The Constructor shall obtain the approval of the Hilltops Council Representative for the type and use of restrained joints, as an alternative to thrust blocks, in the case of congested service corridors and urgent commissioning

19.18 Rising Main Fittings

The Constructor shall install rising mains, air release valves and inspection pipes were shown on the approved design drawings or directed by the Hilltops Council Representative. All rising mains shall be topped with an appropriate identification tape.

The Constructor shall provide marking plates bearing the letters "AV" for air valves, "SCV" for scour pipes, "SV" for stop valves and "SRM" for sewage rising main at changes of direction, road crossings and at such chainages that the location of the main is marked, at least once each 100m, as specified hereinafter.

In urban areas, the Constructor shall provide formed kerb impressions for each fitting and road crossing, with lettering to be 75mm high and 15mm wide and placed on top of the kerb with reflective white paint with glass beads. Alternatively, in areas where kerb is existing, a stainless-steel kerb marker disc with a central hole for a mushroom head nail or peg to secure the disc to the top of the kerb may be used. The face of the disc shall be stamped or engraved with letters to identify the adjacent service/fitting.

Where a valve or fitting is at a distance greater than 10m from any existing wall, fence or post to which the notice plate could be conveniently fixed, the Constructor shall provide and set in the ground a post with the relevant marking plate fixed at the top of the post, facing the fitting. The distance to the fitting in metres, to an accuracy of 0.1m, and the

size of the main shall be permanently marked or stamped on the plate with legible numbers a minimum 12mm high. The top number gives the distance (in metres) from the plate to the hydrant, and the bottom number gives the size (in millimetres) of the sewer main.

The post shall conform to the following requirements:

- a) The post shall be of sufficient length to be set firmly in place under saturated ground conditions.
- b) When installed, the post shall project 1000mm above the ground, provided that where tall grass or crops are likely to obscure the post, or were directed by the Hilltops Council Representative, its height above the ground shall be increased to 1500mm.
- c) The post shall be metal with yellow powder coating.

19.19 Concrete Encasement

The Constructor shall encase in concrete pipes in gravity sewers or rising mains, as shown on the approved design drawings, with less than the specified cover above the top of the pipe barrel, or were directed by the Hilltops Council Representative. Concrete shall be 20MPa in accordance with Section 10 Minor Concrete Works and have the following minimum dimensions:

- a) For trenches in other than rock: 150mm minimum under, on both sides and on top of the pipe barrel.
- b) For Trenches in rock: 100mm minimum under the pipe barrel, 150mm on top of the pipe barrel and for the full width of trench excavated.

In trenches of other than rock or fissured rock, a contraction joint consisting of a layer of bituminous felt 12mm thick shall be formed in the concrete encasement at the face of each socket or at one (1) face of each coupling.

Reinforcement in concrete encasement shall be as shown on the approved design drawings.

19.20 Wrapping of Pipelines

Where shown on the approved design drawings or directed by the Hilltops Council Representative, the Constructor shall enclose a pipeline or a section thereof, in lay flat polyethylene sleeving where corrosive soils exist.

The materials to be used shall be high impact resistance polyethylene sleeving of minimum thickness 0.2mm polyethylene film, approved by the Hilltops Council Representative, and 50mm wide plastic adhesive tape.

The width of the sleeving when flat shall be in accordance with the pipe manufacturer's written recommendations for the size and type of the pipeline which is to be encased. Precautions shall be taken so that exposure to direct sunlight does not exceed 48 hours.

Where necessary to distinguish pipes within close proximity, pipelines shall be identified by colour sleeving, green in colour, or an appropriate identification tape.

Application of the polyethylene sleeving and plastic adhesive tape shall be in accordance with the pipe manufacturer's written instructions. The Constructor shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving overlapped for a minimum of

250mm at each field joint, and the ends of each length of sleeving shall be held in position with at least three (3) circumferential turns of adhesive tape.

As the polyethylene sleeve material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately one (1) metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes.

The Constructor shall hand wrap valves, hydrants and irregular shaped fittings and joints using flat polyethylene sheets secured with plastic adhesive tape, or other suitable material, to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of sleeving.

The Constructor shall rectify any damage done to the polyethylene tubing before, during or after backfilling of the trench.

19.21 Corrosion Protection of Steel Bolts and Nuts

The Constructor shall wrap all galvanised steel bolts and nuts, used for installation below ground, of flanges, bolted gland joints, mechanical joints, tapping bands using a tape consisting of Denso or approved equivalent applied in accordance with the manufacturer's recommendations. Bolts and nuts shall be dry, clean and free from rust immediately before wrapping.

19.22 Cast-In-Situ Maintenance Holes

For all maintenance holes concrete work, the Constructor shall comply with Section 10 Minor Concrete Works in relation to the supply and placement of concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection except as specified below.

Cement used in all concrete shall be Type SR to AS 3972. The Constructor may use fly ash additive to a maximum 20%. Cement used shall be no older than three (3) months since manufacture.

The minimum cement content shall be 360 kg/m³ of concrete and the water/cement ratio of the mix shall not be greater than 0.50 by mass.

19.23 Covers and Frames

Covers and frames shall not be warped or twisted. Surfaces shall be finished such that there are no abrupt irregularities and gradual irregularities shall not exceed 3mm. Unformed surfaces shall be finished to produce a surface that is dense, uniform and free from blemishes. Exposed edges shall have a minimum 4mm radius. Covers and frames shall not be delivered to the Works site before satisfactory documentary evidence has been submitted to the Hilltops Council Representative that quality tests have been carried out. This action constitutes a **HOLD POINT**.

HOLD POINT

Constructor to submit documentary evidence of the quality tests for covers and frames to the Developer's Representative for approval.

PROCESS HELD: Delivery of covers and frames to the Works site.

Tolerances for the dimensions on the COVER shall be - 3mm + NIL.

Tolerances for the dimensions on the FRAME shall be -3mm +3mm.

Maintenance hole covers shall be seated on a layer of bitumen-impregnated fibreboard, having a cross-section of 25 x 25mm. Alternatively another seating material of a cross-section and composition approved by the Hilltops Council Representative may be used.

Maintenance hole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces of any type. Elsewhere, covers shall be finished 25mm above the surface of the ground where not shown otherwise on the approved design drawings, or such other level as directed by the Hilltops Council Representative, in a manner designed to avoid as far as possible, the entry of surface water.

In locations were shown on the approved design drawings or directed by the Hilltops Council Representative, the Constructor shall install a ductile iron cover and frame instead of the standard concrete maintenance hole cover. Where shown on the approved design drawings, the Constructor shall install bolt down frames and covers in areas subjected to 1 in 100-year flooding. Ductile iron covers and frames shall be manufactured in accordance with AS 3996, and shall be installed as necessary, in accordance with the manufacturer's written requirements.

19.24 Preformed Maintenance Hole and Maintenance Shaft Systems

If approved by the Hilltops Council Representative, preformed systems, complying with the approved design drawings, if any, otherwise complying with AS 3518, AS 3571 or AS 4198 may be used in lieu of cast in-situ systems. Preformed system components shall not be delivered to the Works site before satisfactory documentary evidence has been submitted to the Hilltops Council Representative that quality tests have been carried out. This action constitutes a **HOLD POINT**.

HOLD POINT

Constructor to submit documentary evidence of the quality tests for preformed maintenance hole and maintenance shaft systems to the HILLTOPS COUNCIL Representative for approval.

PROCESS HELD: Delivery of preformed maintenance hole and maintenance shaft systems to the Works site

The Constructor shall supply components that make a watertight system and have a satisfactory surface finish.

Generally, preformed maintenance holes shall be made up in accordance with the Hilltops Council Engineering Guideline Part 3 Volume B SD 1204, with components consisting of a base section, shaft sections of section lengths such as to minimise the number of joints required, a cone section, cover and frame. Make-up Rings may be used between cone sections and frames to make up height differentials. The vertical distance from the top of the surround and the first step is to be 600mm.

Generally, preformed maintenance shafts shall be made up components consisting of a base section, shaft sections of section lengths such as to minimise the number of joints required, cover and frame.

The installation of all preformed components shall be in accordance with the manufacturers' recommended procedures and requirements.

Backfill for all preformed maintenance holes and maintenance shafts shall be placed and compacted evenly around the maintenance hole to a level 300mm above the top of the highest incoming pipe and for the full width of the excavation. Where, necessary, the Constructor shall import and compact non-cohesive granular material as shown in Hilltops Council Engineering Guideline Part 3 Volume B SD 1204.

19.25 Pipeline Testing and Restoration

19.25.1 General

The Constructor shall subject all sewers and maintenance holes to an initial test as soon as practicable after construction and before backfilling is commenced. An acceptance test shall be carried out before the issue of the Practical Completion Certificate or issue of the Subdivision Certificate for Developer Infrastructure Works and not earlier than one (1) month after completion of construction of all sewers and maintenance holes in a section. Sewers or maintenance holes failing any test, shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained.

All lines shall be clear and free from soil, slurry, liquids and other foreign substances at the time of initial and acceptance testing.

19.25.2 Initial Test of Gravitation Sewers

The Constructor shall make the initial testing of gravitation sewers with compressed air. Before the initial test is performed, all pipelaying on the section shall be completed, and backfill shall be compacted to the level of the centre of the pipe barrel and Hilltops Council Representative notified. This action constitutes a **WITNESS POINT**. The Hilltops Council Representative shall advise at the time of notification by the Constructor whether the option to inspect the initial testing is required.

WITNESS POINT

The Constructor shall notify the HILLTOPS COUNCIL Representative that all pipelaying on the section is completed, backfilled and compacted to the level of the centre of the pipe barrel.

PROCESS HELD: The initial test of gravitation sewers.

The initial test may be carried out before risers and/or property connection sewers are constructed so that the main line can be backfilled. However, the Constructor shall carry out an initial test on the risers and property connection sewers as soon as they are completed.

Where the Hilltops Council Representative approves the construction of pipelines in other than full lengths between maintenance holes, each length of pipeline shall be tested before backfilling together with the downstream portion of the maintenance hole length under construction.

The Constructor shall rectify any fault detected and obtain a satisfactory test before the remainder of backfill is placed.

The Constructor shall undertake ovality testing as follows:

- a) All sewers to DN300 shall be tested to determine any excessive ovality using a proving tool approved by the Hilltops Council Representative. Ovality testing shall be undertaken after all earthworks associated with the Works are complete and no sooner than 28 days after backfilling of trenches has been completed. Sewer pipes having excessive ovality shall be replaced and the line retested.
- b) The proving tool shall be rigid and non-adjustable having an effective length of not less than its nominal diameter. The minimum diameter at any point along the length shall be as indicated in Table 49.

Table 49: Minimum Sewer Pipe Prover Diameter

Nominal Size (DN)	Minimum Prover Diameter(mm) UPVC Pipe
100	99.7
150	142.6
225	222.9
300	280.8

- c) The proving tool shall be fabricated from steel and have pulling rings at each end. The prover shall be marked to indicate the nominal pipe size and the prover outside diameter.
- d) Maximum Allowable Deflection = 3% of Mean Outside Diameter. The testing shall require a “prover” to be pulled through each section of the pipeline by hand winching to demonstrate that the maximum allowable deflection is not exceeded in accordance with Annexure C402A.

19.25.3 Initial Test of Maintenance Holes

After the maintenance holes have been constructed (including benching, fitting of the converter slab, surround frame and cover) and all backfill operations are complete, they shall all be tested.

Where designs contain both precast and in-situ concrete maintenance holes, each type shall be viewed as separate populations, with the above criteria applying to each population separately within the Works. If any of the sample holes fail the initial test, then all maintenance holes within the Works shall be tested.

The hydrostatic test shall be made by plugging all pipe openings in the walls and, filling the maintenance hole with water to the lowest point on the top of the maintenance hole cover surround. The plugs shall be positioned in the pipes as near as practicable to the internal face of the maintenance hole.

After allowing 30 minutes for absorption loss, refill the maintenance hole and measure the loss of water during the following 30 minutes.

The test on the manhole will be considered satisfactory provided the water lost is less than 3 mm depth in the top section of the manhole for each 1 m depth of maintenance hole.

The depth of the manhole is to be taken from the bottom of the manhole cover recess in the cover surround to the invert of the outlet from the manhole.

The plug should be fitted with a suitable release for emptying the manhole on satisfactory completion of the test.

19.25.4 Acceptance Test of Gravitation Sewers and Maintenance Holes

The Constructor shall make the acceptance test on all components in the section of the sewer in the same manner as the initial test. The submission, to the Hilltops Council Representative, of satisfactory test results constitutes a **HOLD POINT**.

HOLD POINT

Constructor to submit documentary evidence of the satisfactory test results for the section of sewer to the Hilltops Council Representative for approval. Approval is required prior to release of the hold point.

PROCESS HELD: Acceptance of the test results Hold Point

The Hilltops Council Representative may permit hydrostatic testing as an alternative to compressed air testing for acceptance of gravitation pipelines.

The Hilltops Council Representative may reject any pipeline or maintenance hole in which there is visible or detectable leakage.

19.25.5 Testing Gravity Mains with Compressed Air

The Constructor shall supply and keep all necessary equipment in a condition acceptable to the Hilltops Council Representative.

The Constructor shall test pressure gauges prior to use by static water column.

Compressed air shall be supplied by a compressor of the rotary vane type capable of supplying at least 1m³/minute at 35kPa. The air shall be fed through a pressure reducing valve capable of reducing pressure from that supplied to 35kPa $\pm$ 4kPa. The air shall then pass through an airtight line fitted with a pressure gauge reading from 0 to 50kPa, a pressure relief valve that shall be set to blow off at 35kPa $\pm$ 4kPa and a gate valve to the pipeline to be tested.

The method of setting up and carrying out the test shall be in accordance with AS 2566.2 as follows:

- a) Insert a blank plug at one end and a disc with air-hose connection at the other end of the line. Care shall be taken to ensure that the force due to pressure on the disc is not taken by pipe joints but is taken by struts bearing on the disc or on the end pipe in the line. Test lengths shall be limited to single pipe runs between maintenance holes.
- b) Couple test equipment to line under test and compressor or airline.
- c) Slowly increase the air pressure in the line from 0 to 28kPa (over one (1) minute approximately). Where the pipeline is below the water table this pressure shall be increased to achieve a differential pressure of 25kPa. In no circumstances shall the actual pressure exceed 50kPa.
- d) Hold air pressure at 28kPa for three (3) minutes for stabilising temperature.
- e) Close gate valve to shut off air supply to test equipment.
- f) Measure the time it takes for the pressure to drop from 25kPa to 18kPa. If this time is less than that permitted or if the line cannot be pressurised to 28kPa, then the test is unsatisfactory and the pipeline shall be checked for leaks.
- g) To check pipelines for leaks:
- h) Open the gate valve from the air supply sufficiently to maintain a pressure of 14kPa to 23kPa in the pipeline.
- i) Move along the pipeline coating it with detergent solution. Bubbles will indicate a point of leakage. Special attention should be paid to joints, discs and horns of junctions.
- j) If leaks are detected, they shall be repaired to the satisfaction of the Hilltops Council Representative.
- k) Re-test as above until the time taken for the pressure to drop is greater than that shown below.

19.25.6 Allowable Pressure Drop Times

The time taken for the pressure to drop from 25kPa to 18kPa shall be greater than the durations shown in Table 50.

Table 50: Minimum Installed Sewer Gravity Mains Test Durations

Nominal Size (DN)	Test Length (metres)		
	50	100	150
	Minimum Test Duration (minutes)		
150 or smaller	3	3	3
225	4	5	8
300	6	9	14
375	7	14	22
450	10	21	31
525	14	28	42
600	18	37	55

Pressure drop times which are less than these may indicate leakage or excessive air permeability through unsaturated pipe walls with some materials. Vitrified clay pipes, in particular, suffer from excessive air permeability under dry summer conditions. When this occurs, pipes shall be thoroughly saturated with water before testing or a hydrostatic test applied.

Saturation with Water In any case, where the allowable pressure drop time cannot be attained and there are no visible leaks, the Constructor shall apply a hydrostatic test.

19.25.7 Hydrostatic Testing of Gravity Mains

The Constructor shall carry out the hydrostatic test by connecting to the pipeline or section thereof under test, a pipe or hose terminating in a 150mm diameter container not less than 100mm deep. All other open ends of the pipeline shall be plugged.

Pipe Connection The pipeline under test, and the pipe or hose with container, shall be filled with water until the free surface is level with the top of the container, when that container is suspended in accordance with the requirements set out below.

- a) The test container shall be suspended at a level such that the test head applied to the pipeline is as follows:
 - (i) For initial test when no property connection sewers or risers are constructed – a minimum head of 2m above the pipe invert at the upstream end of the line under test, or

- (ii) For initial test where property connection sewers and/or risers are constructed – a minimum head of 2m above the highest invert in the line under test, including its risers and property connection sewers.
- b) For acceptance test, a minimum head of 2m above the highest invert in the line under test, including its risers and property connection sewers, or above the free-standing level of groundwater in the vicinity whichever is the higher.
- c) Such other lesser head, at the Hilltops Council Representative's discretion, may direct.

The Constructor shall determine, at the Constructor's expense, the free-standing level of groundwater, by a method acceptable to the Hilltops Council Representative.

After allowing an interval of 2 hours for absorption, any fall of the free water surface shall be made good by adding extra water to the container. The Constructor shall measure the fall in water level during ten (10) minutes thereafter.

The pipeline will be regarded as satisfactory if there are no visible leaks, and if the fall in water level is not more than 25mm for each standard test length of the pipeline under test including property connection sewers and/or risers.

A standard test length in metres is defined as 1370m divided by the effective diameter of the pipeline in millimetres. Where the pipeline under test is all of the same size, the effective diameter shall be the nominal size of that pipeline. Where the pipeline under test has property connection sewers and/or risers of smaller nominal size than the main sewer line, then the effective diameter shall be calculated as the product of the length and the nominal size of the larger pipe added to the product of the length and the nominal size of the smaller pipe; this sum shall be divided by the total length of pipeline under test; the result shall be the effective diameter.

19.25.8 Visual Inspection and Measurement of Infiltration

Whenever, in the case of acceptance testing, the pipeline is subjected to a significant head of groundwater (i.e. 1500mm or more above the soffit of the sewer main provided that groundwater is at least 150mm above any property connection sewer included in the test), the tests previously prescribed may be dispensed with in favour of visual inspection and measurement of infiltration.

In such circumstances, the Constructor shall propose full details of the method by which the infiltration is to be measured.

If the Hilltops Council Representative, at the Hilltops Council Representative's discretion, approves of an inspection and infiltration test being performed for the purposes of acceptance, the Hilltops Council Representative shall determine, the duration over which infiltration is to be measured. The rate of infiltration shall not exceed that determined by the following formula:

Where: $Q.I. = 0.65 (L_1 d_1 h_1 + L_2 d_2 h_2 + L_n d_n h_n) + H_a$

Q.I. = rate of infiltration (litres/hour).

L = length of pipe (m).

d = nominal size of pipe(m).

- h = average head of groundwater over the invert level of the pipe in the section under test.
- Ha = head of groundwater above the invert level of the outlet pipe of the maintenance hole when the maintenance hole is included in the infiltration test

The Constructor shall determine the head of groundwater, at the Constructor's expense, by a method approved by the Hilltops Council Representative.

19.25.9 Testing of Rising Mains

The Constructor shall pressure test rising mains to detect leakage and defects in the pipeline including joints, thrust and anchor blocks. No testing should be commenced until all utility services (e.g. electricity, telecommunications, gas) have been installed in the area. The submission, to the Hilltops Council Representative of satisfactory test results constitutes a **HOLD POINT**.

HOLD POINT

Constructor to submit documentary evidence of the test results for the rising mains to the HILLTOPS COUNCIL Representative for approval.

PROCESS HELD: Acceptance of the test results.

Pipelines shall be tested in sections approved by the Hilltops Council Representative as soon as practicable after each section has been laid, jointed and backfilled, provided that:

- a) If so specified or if the Constructor so desires, some or all of the pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested to the satisfaction of the Hilltops Council Representative; and
- b) The pressure testing shall not be commenced earlier than seven (7) days after the last concrete thrust or anchor block in the section has been cast.

For the purpose of this clause, a section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g.: by means of main stop valves.

Pressure testing shall not be carried out during wet weather unless otherwise approved by the Hilltops Council Representative.

During pressure testing, all field joints which have not been backfilled shall be clean, dry and accessible.

During the pressure testing of a pipeline, each stop valve shall sustain at least once, the full test pressure on one (1) side of the valve in closed position with no pressure on the other side for at least 15 minutes.

Before testing a pipeline section, the Constructor shall clean it to the satisfaction of the Hilltops Council Representative and fill it slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves. In order to achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.

The hydrostatic test pressure which shall be applied to each section of the pipeline shall be equivalent to the pressure rating of the pipe specified.

The Constructor shall maintain the specified test pressure as long as required by the Hilltops Council Representative while the Constructor examines the whole section. In any case, the specified test pressure shall be maintained for not less than two (2) hours. For the purpose of determining the actual leakage losses, the Constructor shall use the Constant Pressure Test (Water Loss Method) in accordance with AS 2566.2 by carefully measuring and recording the quantity of water added in order to maintain the pressure during the period of testing.

Note: This test method is applicable only to ductile iron, PVC and steel pipelines. For PE pipelines, the test method outlined in AS 2566.2 - Appendix M5 shall be adopted.

The pressure testing of a section shall be considered to be satisfactory if:

- a) There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component.
- b) There is no visible leakage; and
- c) The measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:

$$Q1 = (0.14 \times D \times L \times H) / 1,000,000$$

where:

Q1 = permissible leakage rate (litres per hour)

D = internal diameter of pipe (mm)

L = length of main tested (m)

H = average test head (m)

- d) Unless otherwise specified by the Hilltops Council Representative, adopt a maximum test length of 1km.

Any failure, defect, visible leakage and/or excessive leakage rate, which is detected during the pressure testing of the pipeline during the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works, shall be rectified by the Developer/Constructor at the Developers/Constructor's expense.

19.25.10 Backfill and Compaction

After laying and jointing of a pipeline has been completed the Constructor shall present the laid and jointed pipes for inspection by the Hilltops Council Representative prior to commencement of trench backfilling. This action constitutes a **WITNESS POINT**.

WITNESS POINT

The Constructor shall notify the HILLTOPS COUNCIL Representative that laying and jointing of a pipeline has been completed and is ready for inspection.

PROCESS HELD: Commencement of trench backfilling.

Backfill shall not be placed until the Hilltops Council Representative has given approval.

Material for the side support and overlay of the pipe shall be as for pipe bedding specified in Clause 19.9. The material shall be compacted in layers of not more than 150mm to 95% of the standard maximum dry density of the material used when determined in accordance with AS 1289.5.4.1.

The Constructor shall backfill the remainder of the excavation and compact the backfill in layers of not more than 150mm thick as follows:

- a) Where the trench is within a roadway, proposed roadway, or footpath area, the remainder of the trench shall be:
 - (i) Backfilled with a non-cohesive granular material, with a grading falling generally within the limits shown in Table 5, and compacted to Density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials
 - 1. Below 0.5m of the road surface
 - 2. In the road reserve, but excluding the road pavement
 - (ii) Backfilled with excavated material and compacted to 100% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1, to within 0.5m of the road surface, but excluding the pavement layers.
 - (iii) Backfilled with road base and sub-base material in accordance with Section 8 Flexible Pavement Construction.
- b) Elsewhere, unless stated otherwise, the remainder of the trench shall be backfilled with ordinary excavated backfill material. Where suitable material is not available, granular material may be used for the full depth of backfilling. The material shall be compacted to a density Index of 70 when determined in accordance with AS 1289.5.6.1 for cohesionless materials or 98% of the standard maximum dry density of the material when determined in accordance with AS 1289.5.4.1 for cohesive materials.

The Constructor shall carry out backfilling and compaction without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

The Constructor shall carry out compaction tests 75mm to 100mm below the level being tested.

The Constructor may compact backfill by trench flooding only where:

- a) The ground and backfill material is cohesionless sand.
- b) Water for flooding has been sourced at the Works site.

- c) The process will not create mud which would be moved off the Works site by vehicles or construction plant.
- d) Additives are not used.

19.25.11 Restoration of Surfaces

The Constructor shall make good at their cost all fencing, roads, footpaths and surfaces generally, which may be disturbed by operations of the Constructor. The Constructor shall restore all work sites and areas adjacent thereto to a condition, standard and finish equivalent to that which existed prior to the works commencing.

Where restoration to an equivalent condition, standard and finish is not reasonably practical, the Constructor is required to consult with the relevant property owner, statutory agency or land custodian to agree on a suitable alternate that is in general terms functionally equivalent and to the satisfaction of the relevant parties. (For example: a uniquely patterned concrete driveway could be replaced by a 'plain' finish concrete driveway if agreed by the property owner).

The Constructor shall maintain all restored surfaces in the condition to which they are restored until the expiry of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works applicable to those surfaces, notwithstanding that any deterioration of the restored surfaces, and the need for their maintenance may or may not be due to defects which become apparent or arise from events which occur during the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works. The Constructor shall maintain pavements with crushed igneous rock, gravel or other suitable material allowing for consolidation and shall then restore them to a condition equivalent to that of the original pavement.

Immediately the backfilling of a trench excavated through a pavement has been completed, the Constructor shall temporarily restore the pavement. Where the trench crosses bitumen or concrete pavement, the surface is to be protected from deterioration. A pre-mixed asphaltic material may be used for such temporary restoration. The Constructor shall maintain the temporary restoration until final restoration is carried out. Final restoration of the pavement shall be carried out to restore the pavement and its sub-base to no less than the original condition. Final restoration may include, if required by the Hilltops Council Representative, the removal of temporary restoration.

In other than roadways, the Constructor shall place the backfill sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works in order that the surface of the completed trench may then conform with the adjacent surface. Surplus material shall be removed and disposed of, to areas arranged by the Constructor. Where dry weather conditions have persisted after the original backfilling, including during the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works, the Constructor shall take all necessary steps to consolidate the trench before removing surplus materials from the Works site.

In locations where, in the opinion of the Hilltops Council Representative, surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench to the satisfaction of the Hilltops Council Representative in such a way as to avoid future erosion of the backfill and adjacent ground surfaces. The Constructor shall maintain the backfill and adjacent ground until the expiry of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works.

Excess excavated material shall be disposed of to a Licenced waste facility authorised to accept the waste, unless:

- a) The excavated material meets the definition of “Virgin Excavated Natural Material” (VENM) as defined in the NSW Protection of Environment Operations Act 1997 (POEO Act); or
- b) The excavated material meets the requirements of “The Excavated Natural Material Order 2014” (ENM) issued under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014;

and

- a) The excess excavated material is tested and disposed of in accordance with the requirements of the relevant classification (VENM or ENM);
- b) The Constructor obtains all necessary approvals for disposal to a destination other than a Licenced waste facility. This is to include written authority from the owner of the land where the material is to be placed that they approve acceptance.

Were, within public or private property, the reasonable convenience of persons will require such, the Hilltops Council Representative may order the Constructor to level trenches at the time of backfilling. The Constructor shall make good any subsequent settlement, as required by placing additional fill.

The Constructor shall immediately restore any damaged or disturbed private property and services.

Should the Constructor elect to tunnel under paving, kerb and gutter or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces. The Constructor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works.

The Constructor shall provide notice to affected property owners of any pending work. Written notification shall be delivered to all affected property owners. The minimum timeframe for notification shall be as per the minimum time frames for notification shown in Table 51.

Table 51: Property Owner Notification Timeframe

Properties Affected	Minimum Timeframe for Notification
1	24 Hours
Up to 25	5 Working Days
Greater than 25	10 Working days

19.26 Special Requirements

19.26.1 CCTV Inspection

19.26.1.1 When is a CCTV Inspection Required

If directed by the Hilltops Council Representative, a CCTV inspection to verify the internal condition of all sewer pipe infrastructure is required to be undertaken after backfilling and after completion of all Works and passage of construction equipment above the mains (normally around the time of completion of all the sewer work).

If directed by the Hilltops Council Representative, a CCTV inspection of all sewer pipe infrastructure is required to be undertaken on or immediately prior to the expiration of the Defects Liability Period or Maintenance Bond Period for Developer Infrastructure Works.

Additional CCTV inspections are required of any remediation / repair work undertaken to the sewer infrastructure, or as directed by the Hilltops Council Representative to demonstrate that the standard of the infrastructure is acceptable.

The CCTV assessment shall also include any existing sewer infrastructure that is to be utilised within the design. The Hilltops Council Representative will advise if any repair / upgrades to the existing system are required.

19.26.1.2 What is to be Inspected

All sewer networks are to be CCTV inspected.

Pipes shall be inspected and reported on the following:

- a) Horizontal alignment
- b) Vertical alignment
- c) Cracks and defects
- d) Pipe joints
- e) Joints to manholes and other pipes
- f) Ovality

19.26.1.3 Pre-Inspection Criteria

All pipes are to be inspected upon delivery. A "No cracks policy" is to be adopted, giving the site supervisor the authority to reject any pipe with a crack when delivered.

19.26.1.4 Inspection Criteria

CCTV surveys are to be undertaken using a camera with the ability to capture footage in colour and pan and tilt 360 degrees and thus allowing to capture each of the full pipe joint.

All pipes must be free of debris and silt at the time of inspection.

The pipeline shall be assessed at the speeds as indicated in Table 52.

Table 52: Camera Speed Versus Diameter

Conduit Diameter	Allowable Camera Speed
Dia. < 200mm	0.1 m/s *
200mm ≤ Dia. < 300mm	0.15 m/s *
Dia. ≥ 300mm	0.2 m/s *
* - Or as agreed by Council	

The camera must stop perpendicular at all joints but does not need to pan 360°. However, particular attention should be paid to any infiltration at joints and connections. The camera must stop perpendicular to all cracks, defects, junctions and manholes, and pan 360 degrees.

19.26.1.5 Acceptance Criteria

The pipeline will be acceptable if the Hilltops Council Representative is satisfied that the CCTV inspection does not reveal any defects that would constitute a departure from this Specification or any other relevant Hilltops Council Specification.

Sections of the pipeline that fail the ovality test are to be excavated and the trench and embedment replaced.

Pipes that are crushed, creased, split or contain evidence of a displaced joint ring are to be replaced.

19.26.1.6 Submission

Where a CCTV inspection has been directed by the Hilltops Council Representative, the Constructor must submit both a hardcopy report and an electronic report (submitted in USB portable medium in a format suitable to Hilltops Council - as outlined below) of the CCTV inspection prior to the release of Security as per the relevant Contract or Maintenance Bond for Developer Infrastructure Works.

USB portable drive contents and format:

- Individual video files representing each section of pipe from node to node. (e.g. from MH5A to MH6A).
- Each video file is to be named appropriately to enable easy identification, utilising names as shown on the as constructed or approved design drawings. (e.g. MH5A-MH6A)
- Video file format is to be MPG format.
- Copy of pipe survey report in PDF format.

The reports must include:

- Name of asset owner.
- Name of the company performing the inspection and name of the operator
- Operator's job reference.

- d) Coding system employed.
- e) Method of inspection.
- f) Details of equipment used.
- g) Specify the date of the inspection
- h) Time of commencement of inspection.
- i) Specify location (including Street Name and number)
- j) Specify details of the reach being inspected (including line and structure numbers)
- k) Provide footage in colour
- l) Whether the maintenance structure was pre-cleaned.
- m) Precipitation at the time of inspection.
- n) Description of any measures taken to control flow during the inspection.
- o) Cover details.
- p) Details of steps and ladders.
- q) Type of node.
- r) The vertical reference point,
- s) The circumferential reference point.
- t) Video or digital image storage details.
- u) Identify all faults, features and connections in the pipeline.
- v) Clearly show chainage along the pipeline
- w) Suggest appropriate remediation measures, as required.

19.26.1.7 *If Remediation Work is Required*

Any defects identified by the inspection must be repaired or replaced in accordance with the provisions of this Specification, or as directed by the Hilltops Council Representative.

All costs associated with the CCTV inspection and rectification work shall be borne by the developer/constructor.

A follow-up CCTV assessment is required of any repaired or replaced infrastructure, to demonstrate that the remediation measures undertaken are satisfactory to the Hilltops Council Representative.

ANNEXURE C402A – PRESSURE TESTING

MSF177 - WASTEWATER TEST SHEET - Gravity Main Air Test Result

GRAVITY SEWER MAIN AIR TEST RESULT SHEET						
Testing Method to be in accordance with the Technical Specification or if not available, the Method described BELOW on this sheet.						
Works Title / Street Name: _____						
Upstream and Downstream Maintenance Hole Numbers: _____						
Pipe: Diameter: _____ Pipe Material: _____						
Date of Test	Downstream Fitting Description e.g.: Chainage, Manhole No., Stop Valve	Upstream Fitting Description e.g.: Chainage, Manhole No., Stop Valve	Time taken for pressure to drop (min)	Testing Result Did the pipeline meet the specification requirements?		Comments (e.g. re-test required) Complete test result for re-test on this sheet.
				YES	NO	

Name of Witness: _____ Signed by Witness: _____

Method: Hold air pressure at 28kPa for 3 minutes for stabilising temperature. Close gate valve to shut off air supply to test equipment. Measure the time it takes for the pressure to drop from 25 kPa to 18 kPa. If this time is less than that permitted or if the line cannot be pressurised to 28 kPa, then the test is unsatisfactory and the pipeline shall be checked for leaks.

Allowable pressure drop times: 150mm pipe = 2 minutes, 225mm pipe = 4 minutes, 300mm pipe = 6 minutes, 375mm pipe = 8 minutes.

Figure 10: Wastewater Test Sheet - Gravity Main Air Test Result

MSF-179 - WASTEWATER TEST SHEET – Pipeline Ovality Test Result

PIPELINE OVALITY TEST RESULT SHEET					
Testing Method to be in accordance with the Technical Specification					
Works Title: _____					
Line No / Pipeline Description (Dia / Pipe Material): _____					
Date	Downstream Fitting Description e.g. Chainage, Manhole No.	Upstream Fitting Description e.g. Chainage, Manhole No.	Testing Result – Did the pipeline meet the specification requirements?		Comments (e.g. re-test required) Complete test result for re-test on this sheet.
			YES	NO	

Name of Witness: _____ Signed by Witness: _____

Figure 11: Wastewater Test Sheet - Pipeline Ovality Test Result

20 Trenchless Conduit Installation

20.1 General

20.1.1 Scope

This Specification covers the installation of any type of drainage or service conduit where trenchless techniques are to be used. Trenchless techniques minimise interference with existing features, facilities or traffic. These techniques may be by either jacking, ramming, bursting, thrust or auger boring, micro-tunnelling, directional drilling or other suitable technique as appropriate for the particular installation.

This Specification section should be read in conjunction with:

- Section 6 Stormwater Drainage Construction
- Section 10 Minor Concrete Works
- Section 11 Major Concrete Works
- Section 7 Road Openings.
- Section 17 Water Reticulation.
- Section 18 Sewerage System.

The work to be executed under this Specification consists of supply of the conduit, installation and all necessary ancillary work, whether such work is temporary or permanent, as shown on the approved design drawings.

The conduit and all aspects of the work shall meet the performance requirements detailed in this Specification.

20.2 Definitions

Some of the trenchless techniques available are described below in accordance with the International Society for Trenchless Technology Glossary of trenchless terms:

- a) Jacking - A system of directly installing pipes behind a shield machine by hydraulic jacking from a drive shaft such that the pipes form a continuous string in the ground.
- b) Ramming - A non-steerable system of forming a bore by driving a steel casing, usually open-ended, using a percussive hammer from a drive pit. The soil may be removed from an open-ended casing by auguring, jetting or compressed air. In appropriate ground conditions a closed casing may be used.
- c) Bursting - A technique for breaking the existing pipe by brittle fracture, using force from within, applied mechanically, the remains being forced into the surrounding ground. At the same time a new pipe, of the same or larger diameter, is drawn in behind the bursting tool. The pipe bursting device may be based on a pneumatic impact Moling tool to exert diverted forward thrust to the radial bursting effect required, or by a hydraulic device inserted into the pipe and expanded to exert direct radial force.
- d) Thrust Boring - A method of forming a pilot bore by driving a closed pipe or head from a thrust pit into the soil which is displaced. Some small diameter models have steering capability achieved by a slanted pilot-head face and electronic monitoring, generally in conjunction with a locator. Back reaming may be used to enlarge the pilot bore.

- e) Auger Boring - A technique for forming a bore from a drive pit to a reception pit, by means of a rotating cutting head. Spoil is removed back to the drive shaft by helically wound auger flights rotating in a steel casing. The equipment may have limited steering capability.
- f) Micro-tunnelling - Steerable remote control pipe jacking to install pipes of internal diameter.
- g) Directional Drilling - A steerable system for the installation of pipes, conduits and cables in a shallow arc using a surface launched drilling rig. Traditionally the term applies to large scale crossings in which a fluid filled pilot bore is drilled without rotating the drill string, and this is then enlarged by a wash over pipe and back reamer to the size required for the product pipe. The required deviation during pilot boring is provided by the positioning of a bent sub. Tracking of the drill string is achieved by the use of a downhole survey tool.
- h) Encasement Pipe – Installed using trenchless methods to provide initial support to the excavated bore, prior to installation of the carrier pipe. The casing pipe may also be installed to provide additional protection to the carrier pipe.
- i) Carrier Pipe – A permanent pipe installed inside a casing pipe.
- j) Jacking Pipe – A pipe specifically designs and manufactured for the purpose of being jacked into its final position.

The Works – Defined as follows:

- Developer Infrastructure Works - work includes subdivisions and any public infrastructure work associated with an approved Development in the HC local government area requiring a construction certificate.
- Contracted Works – infrastructure work undertaken by a Principal Service provider or subservice provider formally appointed by HC and supervised by HC.
- Internal Works - infrastructure work undertaken by HC 's day labour workforce.

Constructor – Defined as the organisation responsible for construction of the Works and the Principal Service provider as defined in the Work Health and Safety Act 2011.

Hilltops Council Representative – Defined as follows:

- Developer Infrastructure Works – Nominated Hilltops Council officer(s) for the approved Development.
- For Contracted Works – the Superintendent.
- For Internal Works – Hilltops Council Asset Owner

Constructor's Representative – Defined as follows:

- Contracted Works – the Principal Service provider's nominated representative as per the relevant contract.
- Internal Works – Hilltops Council officer responsible for delivery.

Developer's Representative– Defined as the person or organisation appointed by the Developer to administer the Constructor responsible for the delivery of Developer Infrastructure Works.

20.3 Reference Documents

Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

Where not otherwise specified in the relevant Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the Specifications at the time of the Works approval.

a) Hilltops Council (HC) Specifications

- Section 6 Stormwater Drainage Construction
- Section 10 Minor Concrete Works
- Section 11 Major Concrete Works
- Section 15 Restoration and Finishing of Surfaces.
- Section 17 – Water Reticulation.
- Section 18 – Sewerage System.
- Section 19 Pipeline Construction
- Section 20 Trenchless Conduit installation.

b) Australian Standards

- References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS.
- AS 3725 - Loads on buried concrete pipes.
- AS 4058 - Precast concrete pipes (pressure and non-pressure).

c) Other Standards

- DIN 16869 Design/Construction of Via Ferratas.
- DIN 19565-1 Pipes and Fittings of Glass Fibre Reinforced Plastics (UP GF) for Buried Sewers and Drains.
- DIN 54815-1 - Pipes made of Filled Polyester Resin Moulding Materials.
- DIN EN14636-1 - Plastic Piping Systems for Non-Pressure Drainage and Sewerage – Polyester Resin Concrete (PRC) – Part 1: Pipes and Fittings with Flexible Joints.

d) Other Publications

- CPAA - Concrete Pipe Association of Australia.
- Pipe Jacking, Design Guidelines.
- Concrete Pipe Jacking, Technical Bulletin.
- ISTT - International Society for Trenchless Technology (Represented in Australia by the Australasian Society for Trenchless Technology) Glossary of Trenchless Terms

20.4 Methodology

The Constructor shall submit a clear and detailed methodology for the execution of the trenchless conduit installation. This detailed methodology shall be included in the Constructor's Method Statement.

The Method Statement shall adequately address the following items as a minimum requirement:

- a) General description of method and sequence of operation.
- b) Specialist sub-service providers and specialist equipment to be utilised.
- c) Conduit type and specification, including compliance with relevant Australian Standard.
- d) Jointing type and specification, including location, attachment and type of pipe spiders.
- e) Grout type, if required, methodology and equipment for grout injection.
- f) Mechanical description of any motorised pumping, jacking, horizontal boring, directional drilling or mining equipment intended for use.
- g) Existing underground utility services:
 - Treatment at conflict locations;
 - Protection of services in zone of influence; and
 - Continual service location by radio locator and visual location via vacuum excavation is required, where possible.
- h) Survey equipment and methods.
- i) Direction of installation of conduit.
- j) Size, depth and position of temporary access pits required.
- k) Location of temporary spoil site for driller's mud and nature of haulage equipment. (Note: the temporary spoil site will require environmental approval from the relevant authority).
- l) Programmed daily working hours and duration for the operation.
- m) Strategy for dealing with noise pollution problems.
- n) Traffic management
- o) Dewatering.
- p) Environment and sedimentation control.

General requirements and design guidelines for jacking precast concrete and other rigid pipes are given in the CPAA publications, Pipe Jacking - Design Guidelines and Concrete Pipe Jacking - Technical Bulletin.

The "Dial Before You Dig" (DBYD) service shall be contacted to obtain current locations of water, sewer, stormwater, gas, electricity and telephone services etc, during the preparation of the Method Statement.

The relevant Utility Authorities' shall be contacted to verify the location of services, during the preparation of the Method Statement.

20.5 Construction

20.5.1 Conduit

The materials used for the encasement pipe and carrier pipe are to fully comply with this Specification and the Constructor is responsible for sourcing and using the appropriate conduit for the work to the appropriate standard as detailed in Table 53.

Table 53: Conduit Type, Application, Uses and Standards

Conduit Type	Application	Uses	Standard
Concrete	Encasement Pipe or Carrier Pipe	Stormwater / Sewer	AS 4058
Ductile Iron Cement Lined (DICL)	Encasement Pipe or Carrier Pipe	Stormwater / Sewer	AS 2280
Steel	Encasement Pipe or Carrier Pipe	Stormwater / Sewer / Water Supply	AS1579
1579 Glass Reinforced Plastic (GRP)	Encasement Pipe or Carrier Pipe	Stormwater / Sewer	DIN 16869 and DIN 19565
HDPE Line Concrete	Encasement Pipe or Carrier Pipe	Stormwater / Sewer	AS 4058
Polymer Concrete	Encasement Pipe or Carrier Pipe	Stormwater / Sewer	DIN 54815-1 and DIN EN14636-1

For precast concrete pipes, the strength of the conduit shall be verified by the Constructor as adequate for the purpose utilising the methodology set out in AS 3725 with reference to AS 4058, for cracking load test parameters, and the Constructor's own determination of appropriate soil parameters. The ultimate load for the conduit is to exceed cracking load by a factor of safety of 50%.

The Constructor shall provide similar and equivalent verification if the conduit does not comprise precast reinforced concrete pipe.

The conduit shall not be installed until the Constructor has produced documentary evidence to the Hilltops Council Representative and/or the Developer's Representative (for Developer Infrastructure Works) that appropriate load testing as required by Australian Standards and this Specification has been carried out and the representative specimens have satisfied the appropriate requirements. This action constitutes a **HOLD POINT**. The approval of the Hilltops Council Representative and/or the Developer's Representative (for Developer Infrastructure Works) of the documentary evidence is required prior to the release of the hold point.

HOLD POINT

The Constructor shall provide documentary evidence to the Hilltops Council Representative and/or the Developer's Representative (for Developer Infrastructure Works) at least two (2) working days prior to the installation of the conduit, that appropriate load testing as required by Australian Standards and this Specification has been carried out and the representative specimens have satisfied the appropriate requirements.

PROCESS HELD: Installation of the conduit. Hold Point

20.6 Installation

The installation shall provide for the following performance requirements:

- a) The installation of any conduit by open trenching shall not be permitted over the length designated for trenchless techniques. (Note: Approval is required from the Hilltops Council Representative for any open trenching that may be required for the retrieval of the boring head in the case of failure).
- b) The encasement pipe shall be as detailed on the approved design drawings. For an urban carriageway, the encasement pipe shall extend 1 metre behind the back of the kerb on either side of the carriageway unless otherwise approved by the Hilltops Council Representative.
- c) The carrier pipe shall be positioned on support cradles, and the carrier pipe shall be centrally located within the encasement pipe.
- d) The line and grade of the encasement pipe and carrier pipe shall comply with the approved design drawings within the tolerances indicated on the approved design drawings or stated in Section 20.7 when not explicitly shown on the approved design drawings
- e) After installation, all joints shall be flush to the internal conduit walls and watertight.
- f) After installation of the encasement pipe and carrier pipe and prior to any grouting procedures, bulkhead walls shall be established at locations shown on the approved design drawings. Such bulkheads shall comply with Section 20.8.1.
- g) After installation and pressure testing, voiding between the encasement pipe and natural earth as well as voiding between the encasement pipe and carrier pipe shall be eliminated by grouting prior, with material and methodology of grouting described in the Method Statement. The grouting mix shall be a high flow, low shrink cementitious grout. The grouting mix is to be approved by the Hilltops Council Representative prior to the commencement of any works. The Constructor is to ensure that the grouting pressure does not exceed the buckling capacity of the empty conduit.

Where the carrier pipe is ductile iron cement lined (DICL), any length of pipe which is enclosed within the encasement pipe need not be wrapped in polyethylene tubing.

Where the carrier pipe is proposed to be PVC or similar, precautions need to be taken to prevent damage from excessive heat during curing of the grout.

The installation of the encasement pipe and carrier pipe shall not affect any adjacent building foundations and shall provide for consistent support prior to, during and after installation.

The installation of the encasement pipe and carrier pipe shall not endanger the stability or health of the root systems of trees to be retained as designated by Hilltops Council.

20.7 Tolerances

The carrier pipe shall be installed in accordance with the horizontal and vertical alignment as shown on the approved design drawings subject to the following definition of tolerances:

- a) The position of both the inlet and outlet of the carrier pipe shall be determined by a registered Surveyor and shall comply with the approved design drawings for horizontal position to a tolerance of $\pm 30\text{mm}$
- b) Vertical tolerance at the inlet/outlet of the carrier pipe where installation commences shall be $\pm 10\text{mm}$
- c) The average grade of the carrier pipe shall comply with the grade ($\pm 0.05\%$) as shown on the approved design drawings
- d) The carrier pipe alignment at all joints will be true with a tolerance of $\pm 5\text{mm}$ deflection in any direction at 1.5m from the joint.

20.8 Permanent and Temporary Pits

a) Excavation

Any permanent and/or temporary pits established for purposes of installation shall be constructed in accordance with the excavation requirements of Section 6 Stormwater Drainage of this specification.

b) Backfill

Backfilling of temporary pits shall comply with the backfilling and compaction requirements of Section 6 Stormwater Drainage of this specification

The surface of temporary pits, after backfilling, shall be restored to pre-construction condition as in accordance with Section 7 Utility Services Installations, Road Opening and Utility Restoration as part of this specification. Permanent pits or access chambers, located at the pits used for trenchless conduit installations, shall be constructed to the details as shown on the approved design drawings and in accordance with the appropriate Specification following demobilisation of the trenchless conduit installation equipment.

Backfill and compaction around permanent pits or access chambers shall be in accordance with the requirements of Section 6 Stormwater Drainage of this specification.

20.8.1 Bulkheads

Bulkheads shall be constructed in accordance with the approved design drawings or as nominated in the Method Statement submitted. They shall be built in reinforced concrete as detailed in the approved design drawings and fabricated to bond to the conduit so as to exclude direct grout pressure loss at the conduit/soil interface.

Bulkheads shall be constructed, and any grouting undertaken, prior to construction of adjacent conduits installed under conventional trench techniques so as to prevent undermining of the previously installed trenchless conduit.

20.8.2 Concrete Work

For all concrete work, the Constructor shall comply with Section 10 Minor Concrete Works and Section 11 Major Concrete Works of this specification in relation to the supply and placement of normal class concrete and steel reinforcement, formwork, tolerances, construction joints, curing and protection.

APPENDIX A. WORK-AS-EXECUTED DRAWINGS AND COMPLIANCE DOCUMENTATION REQUIREMENTS

Work-as-executed (WAE) drawings and related compliance documentation shall be provided to Council's Representative for approval prior to handover of works.

For development-related works, Compliance Certificate(s) and Subdivision Certificate(s) for any works shall not be issued without Council's review and acceptance of the WAE drawings and related compliance documentation, showing all information as required by this Specification and the applicable Development Consent.

A.1 Information Required on Work-as-Executed Drawings

Work-as-executed (WAE) drawings shall demonstrate that works have been constructed as shown on the approved drawings and in accordance with this Specification, to the approved line, level and specification tolerances.

WAE drawings shall be prepared and certified by a Registered Land Surveyor in the State of New South Wales or a suitably qualified Engineer. WAE drawings for internal Council works may be certified by a Council Team Leader or Engineering Surveyor or Council Project Manager.

WAE drawings shall have the following notation on each drawing set written in red and signed by the certifying Surveyor and/or Engineer:

I certify that:

1. All construction has been carried out in accordance with the attached engineering drawings and the Specification and with regard to location and level, is as shown in red ink or with variations shown in red ink thereon.
2. All drainage works are situated within drainage easements and/or reserves as shown on the Deposited Plan.
3. All construction within private land has appropriate easements, right-of-way, or like restriction over the whole of the structure.

Date: _____

Printed Name: _____

Signature: _____

WAE drawings shall be prepared using the approved Design and Construction Drawings as a base in order to identify compliance with the approved drawings and to highlight approved changes that may have been required during construction.

All WAE information shall be provided in red and shall consist of:

- A red tick on approved drawings next to level, note or label where the WAE information is the same as that on the approved drawing.
- New levels, notes or label information in red where WAE information is different from the approved drawings and the original approved information struck through in red.
- New plan and section detail lines and symbols shown in red and original approved plan and section detail lines and symbols crossed out with a series of small crosses in the case of lines or a single cross in the case of a symbol.

Additional details required to be shown on all WAE drawings include:

- All levels shall be in AHD.
- The designs must be in georeferenced in GDA co-ordinate system GDA 2020, MGA Zone 55.
- Finished levels and horizontal alignment of concrete kerb and gutter, vehicle access crossings and other concrete works.
- All traffic signs, pavement markings, permanent traffic control devices and safety barriers installed or removed as part of the works.

WAE drawings shall be submitted in an electronic and hard copy format to Council's Representative for approval. The electronic file format shall be high resolution Portable Document Format (.pdf) or other acceptable format, such as AutoCAD (.dwg), with all pages of the plan contained in a single file.

Any additional WAE information data or files for Council's internal construction projects may be added into Council's electronic document management system and referenced on the WAE drawings, or by direct transfer of WAE data into Council's Asset Management System and GIS.

ADAC - Asset Design As Constructed

A compliant version 5.0.1 ADAC XML file is required to be submitted for all works accompaniment to the As-Constructed bundle of information. The ADAC XML data is to be derived from and must align with the corresponding As-Constructed drawing(s).

On acceptance of the "As-Constructed" bundle of information, Council will undertake data format and conformance checks on the ADAC XML file to confirm the completeness and validity of the information and conformance of the details with the accompanying As-Constructed drawing(s).

Should significant anomalies, errors or missing information be identified during these checks, the ADAC XML file(s) will be returned to the provider for correction and resubmission potentially delaying the progress of the "On-Maintenance" process and asset handover.

A.2 Roadworks and Pavement As-Constructed Compliance Details

For development-related works, the Service Provider in collaboration with the Consulting Geotechnical Engineer shall prepare work-as-executed (WAE) documentation, including as-constructed Pavement Testing Report, incorporating the approved Construction Drawings showing the following (but not limited to):

- Extent of as-constructed pavement.
- Average Pavement layer thickness (i.e. from surveyed conformance levels during construction - refer below).

- Location and test identification number of test results from all relative compaction testing carried out for the works (i.e. as separated by each pavement layer tested during construction).

Finished surface levels of road pavements and elsewhere in the road reserve or proposed road reserve:

- Surveyed as-constructed pavement layer levels shall be presented in tabular (spreadsheet) format, which references the chainage and provides enough levels to define the surface of each layer. The table shall also provide the average pavement layer thickness for each road based on the difference between each adjoining pavement layer's conformance levels. The as-constructed levels referred in the table shall be taken at the top of the following pavement layers:
 - Subgrade layer.
 - Subgrade replacement layer.
 - Select material layer.
 - Sub-base layer.
 - Base course layer.
 - Finished sealed surface and/or
 - Asphalt wearing course layer.
- A plan view from the approved drawings shall be used to mark the final pavement layer thickness, as averaged from the surveyed pavement layers conformance levels (i.e. summarising each road's final averaged pavement layer thicknesses), including the following:
 - Subgrade replacement layer.
 - Select material layer.
 - Sub-base layer.
 - Base course layer.
 - Asphalt wearing course layer.
 - Any other pavement layer that may have been incorporated into the works.
- A full schedule of quantities and rates to show the full value of the works. This is required to determine the defect liability bond and also for Council to financially bring in that works value as an asset/s to Council.

A.3 Sewer and Stormwater Drainage Details

Work-as-executed (WAE) drawings, in addition to those listed in A.1 above, shall include (but not limited to) the following:

- Finished surface levels at all manhole/pits and other structures.
- Finished surface levels between manholes/pits and other structures.
- Location of finished surface levels taken labelled (e.g. top of kerb, centre of headwall, centre of grate, centre of concrete lid) stormwater pits.
- Finished invert levels for pits, other structures, pipes and box culverts – stormwater assets.

- Changes to the horizontal position of any pits, other structures, pipes and box culverts) Stormwater).
- Confirmation of the installed pipe diameter.
- Pipe material and class of pipe.
- Confirmation of the size of installed box culverts.
- Pipe or box culvert grades.
- Locations of subsurface drainage cleanouts/flush point and outlets.
- Details of overland flow path (stormwater).
- Finished invert levels, top of bank levels, base width, top width, base/wall material for open channels – stormwater.
- Manufacturer/model number of any proprietary drainage/sewer structure used.
- Confirmation and certification; stormwater drainage basin(s), wetland(s), bio-retention/detention, rainwater tank(s) and sediment basin(s), minimum volume.
- A full schedule of quantities and rates to show the full value of the works. This is required to determine the defect liability bond and also for Council to financially bring in that works value as an asset/s to Council.

A.4 Water Main Details

Work-as-executed (WAE) drawings, in addition to those listed in A.1 above, shall include (but not limited to) the following:

- Finished surface levels at all Stop valve, scour valves, air valves, hydrants and other structures.
- Finished surface levels between stop valves and hydrants and other structures.
- Changes to the horizontal position of any pipe work, pits or valves.
- Confirmation of the installed pipe diameter.
- Pipe material and class of pipe.
- Manufacturer/model number of any proprietary valves or other structures used.
- A full schedule of quantities and rates to show the full value of the works. This is required to determine the defect liability bond and also for Council to financially bring in that works value as an asset/s to Council.

A.5 Open Spaces Details

- Details of any provided playgrounds, exercise equipment, bus shelters, street trees (including root barrier/water systems), irrigation systems and turfed areas.
- A full schedule of quantities and rates to show the full value of the works. This is required to determine the defect liability bond and also for Council to financially bring in that works value as an asset/s to Council.

PUBLIC ASSET CREATION SUMMARY

Property Address:	
Development Application:	
Construction Certificate:	
Project:	
Project Work Order/s (where applicable)	

1. PUBLIC ASSET CREATION SUMMARY

Road	Name/ Number	Carriageway Width (m)	Length (m)	Tendered Cost (\$)
	Total:			
Road Reserve			Area Dedicated (m ²):	
Piped Drainage Stormwater	Pipe Size (mm)	Material	Length (m)	Tendered Cost (\$)

1. PUBLIC ASSET CREATION SUMMARY				
	Other			
	Total:			
Swale/ Bio-retention	Width (m)		Length (m)	Tendered Cost (\$)
	2			
	4			
	Other			
	Total:			
Footpath/ Cycleway	Width (m)		Length (m)	Tendered Cost (\$)
	1.2			
	1.5			
	2.5			
	Total:			
Bulk Earthworks			Tendered Cost (\$):	
Landscaping			Tendered Cost (\$):	
Water Mains	Pipe Size (mm)	Material	Length (m)	Tendered Cost (\$)
Sewer	Pipe Size (mm)	Material	Length (m)	Tendered Cost (\$):
	No. of Manholes			
Sewer Pump Station			Tendered Cost (\$):	

2. STREET TREES (PUBLIC ROADS)	
Delete whichever is not applicable:	
Street trees/ tree guards have been (or will be) planted as part of the subdivision works	
Road Name:	Trees Planted/Required:
Total:	
Tendered Cost (\$):	

Office Use Only:

Title	Name	Date	Signature
Construction Engineer			
Subdivision Technical Officer			

PREPARING WORKS AS EXECUTED DATA FOR COUNCIL SEWER & STORMWATER ASSETS

Report Guidelines

This guideline is intended to provide advice to applicants on Preparing Works as Executed Data for Council Sewer & Stormwater Assets.

What are Works as Executed Data for Council Sewer & Stormwater Assets?

Works as executed data requirement of Council sewer/stormwater assets consists of a Works As Executed (WAE) plan (dwg file), a spreadsheet and a closed circuit television (CCTV) report which is to be prepared to enable Council to update records and note variations to Council sewer/stormwater assets.

What are Works as Executed Data for Council Sewer & Stormwater Assets required?

Works as executed data for Council sewer/stormwater assets is required following development works which modify Council's sewer & stormwater assets or create new sewer/stormwater assets that will be handed over to Council's care and control. Generally, this is imposed as a condition of development consent.

Technical Requirements for Works as Executed Data for Council Sewer and or Stormwater Assets

The Works as Executed Data is to be provided by a registered surveyor and should comply with the following:

1. Level of accuracy:

- X, Y coordinates (Easting; Northing) shall be +/-0.05m
- X, Y (Easting; Northing) to GDA 2020 Map Grid of Australia Zone 55.
- Reduced level heights shall be +/-0.01m
- Reduced levels shall be in terms of Australian Height Datum (AHD)

2. Appropriate Formats

- Spreadsheet (.xls)
- WAE electronic plan – drawing (.dwg AutoCAD 2009 or earlier version)
- CCTV report / footage DVD (.mpeg)
- Manholes/Pits:
 - Pit # (available from Council)
 - Y coordinate (Northing)
 - X coordinate (Easting)
 - Installation date
 - Pipe Type
 - Pit Material
 - Grate RL (Stormwater)
 - Pit depth and invert RL
 - Lintel details (stormwater)

- Pit Inflow type (stormwater)
- Pipes
 - From (upstream) Pit #
 - To (downstream) Pit #
 - Upstream invert level
 - Downstream invert level
 - Installation date
 - Pipe type
 - Pipe length
 - Pipe material
 - Pipe diameter
 - Construction type
 - Joint type

WAE Plan

A registered survey is to electronically amend the approved 'design plan' to reflect the Works as Executed information. In this respect the electronic copy of the drawing file should contain the Works as Executed information on a separate drawing layer.

The WAE plan is to provide the following information:

- The reduced levels (AHD) of all pit and pipe attributes should be listed in the following order:
 - Pit lid level (for stormwater - road gully pit levels to be taken at centre of grate in the gutter junction pits)
 - Centre of manhole/pit – reduced level of the invert of the pit
 - Thereafter, each inlet pipe invert in a clockwise direction from the outlet (Stormwater)
- Coordinates of all surface features and changes of horizontal alignment (bends) must be shown (refer Datum heading for coordinate system);
- All pipe sizes, classes, material and grades

In relation to formalised overland flow paths:

- The position (coordinates for start and finish points and changes of direction) of formalised overland flow paths
- The reduced levels at appropriate intervals over the length of any formalised overland flow paths including top and bottom of any retaining structures.

Other general requires of reporting

All reports are to meet the following standards:

- Include an executive summary;
- Be professionally prepared; and
- Provide details and qualifications of author.