

## Appendix I: Technical Specification

1 GENERAL

**Contents**

1.1	Standard Specifications and Technical Guides .....	3
1.2	Drawings.....	3
1.3	Programmes and Schedules.....	3
1.4	Materials Supplied .....	3
1.5	Access and Works on Private Property .....	3
1.6	Notification of Affected Parties.....	3
1.7	Developer’s Amenities and Establishment .....	4
1.8	Temporary Services.....	4
1.9	Normal Working Hours .....	4
1.10	Dust and Noise .....	4
1.11	Code of Practice for Working in the Road.....	5
1.12	Waahi Tapu/Historic Significance .....	5

**ADDITIONAL CLAUSES TO BE ADDED BY THE  
DEVELOPER**

## **1 GENERAL**

### **1.1 Standard Specifications and Technical Guides**

The Development Works shall be executed in conformity with those New Zealand and other relevant Standards, and Technical Guides including NZTA publications, current at the time of tendering.

The documents, which specifically apply to this contract, are listed in the relevant sections of the Specification. When there is conflict between this Specification and a standard specification this Specification shall take precedence.

Unless otherwise stated in this document or shown on the drawings, construction details shall be in accordance with the Whanganui District Council Land Development and Subdivision Engineering Supplement Document – Appendix I November 2012.

### **1.2 Drawings**

The Drawings show the nature and extent of the works and shall be read in conjunction with the Resource Consent Decision report. Written dimensions and levels on the Drawings shall be taken in all cases in preference to measurements by scale.

### **1.3 Programmes and Schedules**

Developer to add.

### **1.4 Materials Supplied**

Developer to add.

### **1.5 Access and Works on Private Property**

Except for access to the Site, and any other property which has been specifically arranged by the Authorised Officer and is detailed in the Contract Documents, the Developer shall make its own arrangements for whatever access it requires to carry out the Development Works, and shall obtain all necessary authorities for such access.

The Developer shall particularly ensure that any agreements relating to private property are in writing and are honoured in full, and that adequate arrangements are made for temporary pedestrian and vehicular access to properties.

The Developer shall ensure that the construction access shall be of a condition to ensure that no debris is deposited onto adjacent roads from the site during the construction period. Should clean-up work be required the developer shall be responsible for all costs both directly and indirectly involved in the clean-up.

### **1.6 Notification of Affected Parties**

Where it is proposed to interrupt a service to enable the Development Works to be carried out, the consent of the controlling authority or operator shall be obtained and all persons

affected shall be notified in advance of the nature and duration of the interruption, by public or individual notice. This process shall include the notification of interruption of both pedestrian and vehicular access to properties.

Where access to private property is to be hindered by the Developer's operations, the Developer shall advise the affected parties of the disruption at least 48 hours ahead of any disruption occurring.

## 1.7 Developer's Amenities and Establishment

The Developer shall be responsible for the provision of all amenities, for its workers and for the construction of the works, and shall make whatever arrangements are necessary for locating its establishment.

The Developer shall provide details of the management of the following:

- a) Site access.
- b) Fuel storage.
- c) Hazardous substance storage.
- d) Construction plant storage.
- e) Parking arrangements for contractor/developer vehicles.
- f) Site office and ablution facilities.
- g) Other provisions as notified by the Whanganui District Council.

## 1.8 Temporary Services

The Developer shall be totally responsible for the supply of temporary services for both its own staff and its Sub-developers and shall make its own arrangements for all services, such as electricity, telephone, water supply and sewage disposal, which it may require and shall pay all associated costs and charges.

## 1.9 Normal Working Hours

The Whanganui District Council may restrict the hours of work. The normal hours of work shall be 7:30am to 6:00pm Monday to Saturday.

## 1.10 Dust and Noise

The Developer shall at all times and entirely at its own Cost take such measures as removal of debris, brooming or watering to prevent dust, sand, blowing about and causing a nuisance either on or off the Site.

All noise shall be kept to a minimum. All vehicles and earthmoving equipment shall be muffled to the manufacturer's recommendations. All pumping and other equipment shall be

appropriately muffled, including as may be necessary muffling additional to that fitted as standard by the manufacturer or supplier, particularly if it is to be operated outside of normal working hours.

Noise shall be assessed, and the Developer shall control noise, by reference to NZS 6803 'Acoustics – Construction Noise'.

### **1.11 Code of Practice for Working in the Road**

Unless the Contract Documents specifically state to the contrary, the Developer shall comply in all respects with the National Code of Practise for Utility Operators' Access to Transport Corridors(10 November 2011), more commonly known as "The Code". Where there is any ambiguity, lack of clarity, or conflict between the Contract Documents and the Code the Developer shall seek the Authorised Representative's explanation and instruction in accordance with Clause 2.7.4 of the General Conditions of Contract.

### **1.12 Waahi Tapu/Historic Significance**

In the event that any Waahi Tapu, Koiwi or any other objects which may be of Maori or historic significance are uncovered or disturbed during the course of this contract, the Developer shall immediately cease work in that location and inform the Authorised Representative.

The Authorised Representative will inform the Whanganui District Council and arrange contact with the appropriate organisations or tangata whenua. Work in that location shall not recommence until the appropriate course of action has been agreed. The Developer shall secure the Site, erect fences and signs and maintain security until such time as work may recommence. Work shall only recommence upon the written instruction of the Authorised Representative and only in accordance with any conditions which may be attached to that instruction.

Compliance with Waahi Tapu, historical or archaeological contingencies will be a Variation.

**2 EARTHWORKS****Contents**

2.1	Scope .....	7
2.2	Standards .....	7
2.3	Definition of Terms .....	7
2.4	Quality of Filling Material.....	8
2.4.1	Mixing of Soils Types.....	8
2.5	Construction Procedures .....	8
2.5.1	Survey and Setting Out.....	8
2.5.2	Temporary Fencing .....	9
2.5.3	Undercutting for Roads/Streetworks .....	9
2.5.4	Construction Batters .....	9
2.5.5	Benching .....	9
2.5.6	Drains .....	9
2.5.7	Slips.....	10
2.6	Temporary Drainage and Erosion Control.....	10
2.7	Fill Construction .....	10
2.7.1	General.....	10
2.7.2	Layer thickness.....	11
2.7.3	Compaction .....	11
2.7.4	Frequency of Testing.....	11
2.8	Road/Streetworks Subgrade Construction .....	12
2.8.1	Road/Streetworks Subgrade Filling.....	12
2.8.2	Trimming and Rolling.....	12
2.8.3	Surface Finishing Tolerances .....	13
2.8.4	Subgrade Uniformity Testing .....	13
2.8.5	Surface Water Channels .....	13
2.9	Revegetation .....	13

## **2 EARTHWORKS**

### **2.1 Scope**

This Specification covers the construction of the earthworks and is applicable to soils containing less than 20% by weight of particles coarser than 37.5mm. Soils containing more than 20% by weight of particles coarser than 37.5mm cannot be tested using AS1289 - Methods of Testing Soils for Engineering Purposes. Earthworks include:-

- (a) the clearing and removal of all obstacles within the limits of the earthworks
- (b) the excavation of all cuts, including excavation below the final subgrade or foundation surface
- (c) the excavation of borrow areas, benches and surface drainage facilities
- (d) the carting of the excavated material to fill or waste
- (e) construction of the fills and road/street works subgrade
- (f) shaping, trimming, grassing, and maintaining of the works.

### **2.2 Standards**

Earthworks shall comply with the requirements of NZS4431 Code of Practice for Earthworks for Residential Development and the following clauses.

Other Standard Specifications quoted in this Technical Specification are:

- AS1289 : Method of Testing Soils for Engineering Purposes.
- AS3798 : Guidelines for Earthworks for Commercial and Residential Developments

### **2.3 Definition of Terms**

#### **Bulk Fill**

Is all that material placed in the fill, from the ground surface after stripping or undercutting, up to a level 1.0m below the final subgrade surface for roads/street works construction and 500mm below formation level for building platform construction.

#### **Borrow**

Is fill material imported to the site.

#### **Cut**

Is excavation below existing ground level.

## **Rock**

Is any igneous, sedimentary, or metamorphic stone which is solidly bonded or cemented together and which occurs in masses, ledges, seams or layers. For the purpose of this definition, 'rock' shall also include material containing more than 50% by volume of rock boulders greater than one quarter of a cubic metre in volume.

## **Slip**

Is material dislodged by the forces of nature from outside the cut batter limits or from the fill slope shown on the drawings.

## **Subgrade for Roads/Street works**

Is defined as that layer of material in the top 1.0m of the construction measured down from the final subgrade surface. This may be fill or undisturbed material.

## **Topsoil**

Topsoil is defined as that layer of material immediately below the ground surface, comprising vegetation, turf and humus or other organic matter.

## **2.4 Quality of Filling Material**

### **2.4.1 Mixing of Soils Types**

Where the material being excavated includes 'cut to fill' material and 'cut to waste' material, the excavation shall be carried out in such a manner as to avoid mixing of the materials insofar as is practicable with the type of plant being used.

Material that is excavated to waste without the approval of the Authorised Representative shall be replaced with suitable material.

## **2.5 Construction Procedures**

### **2.5.1 Survey and Setting Out**

The Developer shall employ a registered surveyor to set out the works.

For roads/street works construction the Developer shall establish batter pegs at a fixed offset from the centreline.

The subgrade, formation and basecourse levels shall be set out using lift pegs, being stakes not smaller than 50mm x 35mm in section.

The lift pegs shall be installed at a maximum spacing of 20 metres on straights and 10 metres along sections where the super elevation changes.

The lift pegs shall be marked with the offset distance, subgrade surface level and finished basecourse level.



### **2.5.2 Temporary Fencing**

Temporary fencing shall be erected and maintained until permanent fencing is constructed or until the end of the contract at locations indicated in the documents and wherever existing fencing is dismantled unless the Authorised Representative approves otherwise in writing.

### **2.5.3 Undercutting for Roads/Street works**

All cuts, unless specifically excluded, shall be undercut to ensure continuity in the construction of the subgrade layers.

Where excavation is partly or completely in rock, it shall be undercut to approximately 400mm below the final subgrade surface.

The depth of the undercut in other materials will be specified by the Authorised Representative when the material at the foundation level has been exposed and evaluated.

On completion of the undercut, the surface shall be shaped, trimmed and compacted so as not to hold water. The compaction shall be as specified in Clause 2.7.

### **2.5.4 Construction Batters**

Cut batters shall not be grader trimmed to a smooth surface but all loose rocks or other materials which appear likely to fall at a later stage shall be removed as the cut proceeds.

Fill batters shall be adequately compacted as the filling proceeds.

All batters shall be left with a texture which will help establishing of vegetation.

### **2.5.5 Benching**

Any portion of the ground whose slope is steeper than three horizontal to one vertical shall be benched before filling is placed on it, unless otherwise directed by the Authorised Representative.

Each bench shall be constructed to a width adequate to permit suitable construction equipment to operate on it. The base of the benches shall be sloped inwards at a slope of 12 horizontal to 1 vertical. The longitudinal profile of each bench shall be graded to ensure adequate drainage.

### **2.5.6 Drains**

Drains shall be excavated with an even and true grade to outlets so that water will not stand in any part.

### 2.5.7 Slips

Material from slips shall be removed and used in fills or dumped as directed by the Authorised Representative. Slips which occur prior to completion of subgrade trimming at the location of the slip shall be considered as earthworks cut to waste or fill as appropriate.

The area affected by the slip shall be shaped, trimmed and repaired as directed by the Authorised Representative.

## 2.6 Temporary Drainage and Erosion Control

The developer must provide a detailed Sediment and Erosion control plan prior to the commencement of any works on site. The plan shall be of a standard acceptable to both the Horizons Regional Council and Whanganui District Council It shall addresses all potential sediment and erosion controls necessary throughout the entire construction period. The plan shall be amended where necessary to reflect the changing conditions of the site.

The control of surface drainage shall be undertaken early in the work so as to maintain the natural water drainage facilities and limit the introduction of water into the earthworks.

Adequate provision shall also be made for the control of waterborne soils.

Additional temporary surface drainage works shall be carried out during construction as required to safeguard the integrity of the works.

The earthworks shall be carried out in such a manner that their surfaces have at all times sufficient fall to shed water and prevent ponding.

## 2.7 Fill Construction

### 2.7.1 General

Fill material shall be placed in layers of uniform thickness.

The movement of all construction vehicles and other traffic shall be evenly distributed over the full width of the filling area, so as not to damage or overstress the construction.

If material which has already been placed in the fill becomes wet and unsuitable because of the Developer's neglect to leave the surface in the compacted state, then that material shall either be :

- (i) excavated to waste and replaced with suitable material
- (ii) retreated as directed by the Authorised Representative.

### 2.7.2 Layer thickness

The maximum loose thickness of each layer of fill before compaction shall be 250mm unless field trials show, to the satisfaction of the Authorised Representative, that the specified compaction is obtained with thicker layers.

The maximum particle size of the fill material shall not exceed two thirds of the compacted layer thickness.

### 2.7.3 Compaction

#### Granular Material

For granular fill material, compaction of each layer shall continue until the whole layer has attained a dense condition. Water shall be added as necessary to aid compaction.

Wetting of material which has become too dry for use in the fill shall be carried out with sprinkling equipment of a type which ensures uniform and controlled distribution of water. After wetting, the material shall be mixed to ensure a uniform distribution of moisture throughout the layer.

The degree of compaction of each layer shall be controlled by its relative density. The density index shall be determined in accordance with AS 1289 test methods based on the maximum and minimum dry densities of the fill.

A minimum value of 80 is required.

#### Non granular Material

Compaction of cohesive soils shall be controlled by the air voids content of the soil and its shear strength measured by a shear vane test.

The acceptable criteria shall be a maximum air voids content of 10% and a minimum shear strength of 150 kPa.

### 2.7.4 Frequency of Testing

The frequency of field density tests shall comply with Table 8.1 of AS 3798 Guidelines for Earthworks for Commercial and Residential Developments. Table 8.1 is reproduced below.

**Table 8.1**

**Frequency of Field Density Tests**

Type of Earthworks	Frequency of tests (see Note 2)
Type 1 Large scale operations	1 test per layer per material type per 2500m <sup>2</sup> .

(greater than 1500m <sup>2</sup> e.g. subdivisions, large industrial lots, road embankments)	<p>or</p> <p>1 test per 500m<sup>3</sup> distributed reasonably evenly throughout full depth and area;</p> <p>or</p> <p>3 tests per lot</p>
	Whichever requires the most tests
Type 2 Small scale operations (e.g. individual residential lots)	<p>1 test per layer per 1000m<sup>2</sup>;</p> <p>or</p> <p>1 test per 200m<sup>3</sup> distributed reasonably evenly throughout full depth and area;</p> <p>or</p> <p>1 test per residential lot per layer</p>
	Whichever requires the most tests
Type 3 Concentrated operations less than 500m <sup>2</sup> (e.g. back filling of small farm dams, gullies and similar)	<p>1 test per layer per 500m<sup>2</sup>;</p> <p>or</p> <p>1 test per 100m<sup>3</sup> distributed reasonably evenly throughout full depth and area;</p> <p>or</p> <p>3 tests per visit</p>
	Whichever requires the most tests
Type 4 Confined operations (e.g. filling behind structures (see Note 4))	1 test per 2 layers per 50m <sup>2</sup>
Trenches	1 test per 2 layers per 40 linear metres

## 2.8 Road/Street works Subgrade Construction

### 2.8.1 Road/Street works Subgrade Filling

The subgrade layer shall be constructed over adjoining cut and fill sections in one operation so as to provide continuous construction over the joining line between cut and fill.

The maximum particle size of material used in the subgrade shall be in accordance with Section 2.7.

### 2.8.2 Trimming and Rolling

The entire surface of the subgrade shall be made firm, uniform, and smooth by blading, grading and rolling. Rolling associated with the surface finishing shall be the same as that which would produce the compaction specified for the particular material in Clause 2.7.

The use of construction traffic on the finished subgrade shall be controlled so as not to damage the complete work.

### **2.8.3 Surface Finishing Tolerances**

The surface of the subgrade shall be finished so that all points are within 15mm from a 3m straight edge laid parallel to the centreline of the road and from a cross-section camber board placed at right angles to the centreline.

The reduced level of any point shall be within the limits of zero above to 20mm below the designed or nominated level.

### **2.8.4 Subgrade Uniformity Testing**

Benkelman beam or other subgrade testing shall also be carried out as described in the Pavement Construction Specification.

### **2.8.5 Surface Water Channels**

Surface water channels shall be uniformly graded so that they will not hold water and shall be neatly and evenly trimmed to allow unimpeded flow.

All outlets shall be clear of made ground or as otherwise described in the documents.

## **2.9 Revegetation**

Shaping and topsoiling and grassing shall be carried out in accordance with Section 12 of this Specification.

### 3 TRENCH EXCAVATION

#### Contents

3.1	General.....	15
3.1.1	Site Clearing.....	15
3.1.2	Concrete Areas.....	15
3.1.3	Excavation Support.....	15
3.2	Trench Excavation (including for Manholes) .....	15
3.2.1	Alignment and Level .....	15
3.2.2	Trench Width/Embedment Zone Dimensions .....	15
3.2.3	Unsuitable Foundations .....	17
3.2.4	Trench Openings .....	17
3.3	Dewatering .....	18
3.3.1	General.....	18
3.3.2	Continuous Wellpointing.....	19
3.4	Excavated Material .....	19
3.4.1	Deposition.....	19
3.4.2	Disposal.....	19

### **3 TRENCH EXCAVATION**

#### **3.1 General**

##### **3.1.1 Site Clearing**

The area to be disturbed by excavation shall be cleared of all obstructions, except those specifically required to remain. All cleared material shall be removed from the site, except for turf, topsoil and any granular material (e.g. salvaged basecourse) which is to be used for reinstatement. Any material intended for reuse, including excavated material stockpiled for backfilling in accordance with clauses 4.2 and 4.5 shall be stored in locations that have been approved in advance by the Authorised Representative. If suitable locations are not available on site, the Developer shall arrange for alternate storage sites at his own expense.

##### **3.1.2 Concrete Areas**

In concreted areas, the Developer shall carefully cut the concrete to the required width. Excavation shall be confined to this area.

##### **3.1.3 Excavation Support**

The Developer shall anticipate slips or subsidence of trench walls which may damage pavements or existing services or structures and shall take all necessary steps to protect the pavements or services or structures in the vicinity of the construction (e.g. power poles adjacent to excavation may need staying or restraining during the passage of excavation).

The Developer shall be responsible for making good and for repairing any damage caused by ground movement associated with excavation or any other activities. This shall not be a Variation.

#### **3.2 Trench Excavation (including for Manholes)**

##### **3.2.1 Alignment and Level**

Trenches shall be excavated true to line and grade. The bottom of the trench shall be trimmed to the correct levels and grades to receive bedding material.

##### **3.2.2 Trench Width/Embedment Zone Dimensions**

Trench widths shall be kept to the minimum that is safely possible. The design has been based on trench support being provided with a Rollbox or similar trench support system. No payment will be made for any extra reinstatement or service relocation that results from using a trench support system (or no trench support system at all) that results in wider excavations being required.

Schedule quantities derived from trench widths shall be based on dimensions defined below. Where the ground conditions are such that these trench widths cannot be maintained (e.g. poor ground conditions result in a trench wall breakout) the Developer may, by agreement with the Authorised Representative, vary the actual trench width and subsequent amounts of backfill and/or surface restoration work required.

The trench width shall be limited as follows:

- (i) **For flexible pipe lines** from the base of the trench to the top of the overlay.

The trench width within the embedment zone shall be as specified within AS/NZS 2566.2 TABLE 4.2 for Flexible Pipelines and in strict accordance with the pipe manufacturer's recommendations. The trench width within the embedment zone shall not exceed these dimensions without the prior written approval of the Authorised Representative.

The following table is derived from AS/NZS 2566.2 Table 4.2:

EMBEDMENT ZONE DIMENSIONS FOR FLEXIBLE PIPE LINES				
Nominal Diameter mm	Bedding Depth ( $l_b$ ) mm	Horizontal distance between spring line and trench wall ( $l_c$ ) mm	Overlay Depth ( $l_o$ ) mm	Trench width (B) mm
100	75	100	100	310
150 – 225	100	150	150	460 – 550
300 – 375	100	200	150	715 – 800
475 – 575	150	300	150	1100 - 1230

- (ii) **For concrete pipelines** from the base of the trench to the top of the overlay material:

The trench width within the embedment zone shall be as follows:

- The horizontal distance between pipe spring line and trench wall shall be 0.3 metres for pipes up to and including DN1200 and  $0.2xD$  for DN1350 pipes and larger where D is the pipe external diameter.
- The overlay depth shall be 0.3 metres.

The trench width within the embedment zone shall not exceed these dimensions without the prior written approval of the Authorised Representative.



- (iii) From the top of the pipe overlay material to the surface.

Where the pipeline is to be laid within a sealed carriageway or verge, the trench width shall be limited where applicable to remain within the sealed carriageway or verge and further restricted to protect adjacent services or structures. Where this provision cannot be complied with, the Developer shall minimise disturbance and shall comply with the requirements of this Specification for Site Management.

For trenches requiring shoring, trench width above the overlay zone shall be limited to the embedment width plus 0.5 metres. Where no shoring is required, trench width shall be limited to the embedment width unless otherwise agreed with the Authorised Representative.

### 3.2.3 Unsuitable Foundations

The Developer shall test the trench floor for soft spots using a method approved by the Authorised Representative. These tests shall be carried out prior to the placement of the bedding material and at not less than one test per pipe length. Areas of unsuitable foundation shall be over excavated and refilled with compacted granular fill to the standard required for bedding. Sand shall only be used where the in-situ material is sand or the trench will permanently be above the water table. All such work shall have the prior approval of the Authorised Representative.

The Developer shall carry out his operation in such a manner as to avoid damage to, or deterioration of, the formation of the excavation. Any void, which results from such over-excavation below formation, shall be refilled in the same manner. Filling of any over excavated areas shall not be a Variation.

### 3.2.4 Trench Openings

The maximum length of trench open prior to backfilling, or otherwise causing local disruptions to vehicles or people, shall not exceed 50 metres unless the Authorised Representative's written agreement to a longer length has been obtained. The Authorised Representative may, in particular circumstances, instruct the Developer to limit his operations to some shorter lengths of open trench.

Any section of trench once opened, shall be backfilled, restored and maintained to a standard that permits vehicular (including cyclists) and pedestrian traffic to use that section, within the following time periods from commencement of construction:

- (iv) within two days for
- street intersections
  - entrances to private property
  - entrances to business premises
- (v) within five days for
- sealed carriageways

berms and footpaths

- (vi) within 15 days for all other areas

Complete restoration, including sealing where required, shall immediately follow these periods and shall be completed within the times included within the National Code of Practice for Utility Operators access to Transport Corridors(10<sup>th</sup> November 2011) unless otherwise agreed with the Authorised Representative.

The Authorised Representative may, in particular circumstances, instruct the Developer to complete all works within any nominated section, including final restoration, in time periods shorter than those specified above.

### **3.3 Dewatering**

#### **3.3.1 General**

General dewatering, excluding continuous well pointing, is to be allowed for within the pipe laying activities.

The Developer shall state at the commencement of the Contract the method to be used for controlling water in the trench or dewatering and this shall be to the approval of the Authorised Representative.

The Developer shall not allow water to accumulate in any part of the work. Where possible, trenches shall be completely dewatered before any bedding is placed or any pipes are laid. The trench (including the bedding) shall be kept free from water until the pipeline has been constructed according to the Specification and the trench backfilled.

Where this is not possible, or where the Developer elects and the Authorised Representative approves, the Developer may work in a trench with some water. The use of permeable material in the trench as a means of controlling the water could allow migration of material from the trench floor or wall into the bedding. Where this is a possibility, the material shall be enclosed within a geotextile that ensures that this migration cannot occur.

The Developer is reminded that ground settlement may take place under buildings if water tables are lowered and maintained at a low level for prolonged periods. The Developer shall make good any damage or settlement caused to buildings, roads, pipelines or other structures.

The Developer shall make adequate provision to trap silt, sand and other matter in suspension before discharging water into existing sewers or drainage channels. Water shall be discharged in a manner that prevents damage to the existing drainage system or landforms. The Developer shall remove any material deposited in these existing sewers or drainage channels.

### **3.3.2 Continuous well pointing**

Continuous well pointing shall only be used where, in the opinion of the Authorised Representative, the trench cannot be satisfactorily dewatered by the use of sumps and dewatering pumps.

Where well pointing plant is to be used in a residential area it shall be sufficiently silenced to meet the noise requirements given in Section 1.10.

The Developer shall supply, install, operate, maintain and remove such approved well pointing equipment.

## **3.4 Excavated Material**

### **3.4.1 Deposition**

Excavated material intended for backfilling shall be placed sufficiently distant from the trench to ensure that the shoring and/or excavation wall is not rendered unstable due to surcharge. No spoil or materials shall be placed against any fence, power pole, tree or other structure without the consent in writing of its owner.

Particular care shall be taken to ensure that material is not deposited in a manner that will result in damage to any surface feature either during deposition or subsequent removal of material for use or disposal. Any feature so damaged shall be repaired at the Developer's expense.

### **3.4.2 Disposal**

All excavated material not suitable for backfill and all surplus material shall be removed from the Site and disposed of in a safe and legal manner. The Developer shall pay any tip fees required.

## 4 PIPELINE CONSTRUCTION - DRAINAGE

### Contents

4.1	Pipe Materials .....	21
4.1.1	Specification .....	21
4.1.2	Quality Assurance.....	21
4.1.3	Guarantee .....	21
4.2	Pipe Embedment .....	21
4.3	Laying and Jointing of Pipes .....	23
4.4	Connections to Pipes.....	23
4.5	Backfill Materials.....	24
4.6	Fill Beneath Road Carriageways and Footpaths .....	24
4.7	Fill Compaction .....	25
4.7.1	General.....	25
4.7.2	Layer thickness.....	25
4.7.3	Compaction .....	25
4.7.4	Frequency of Testing .....	26
4.8	Pipeline Testing .....	27
4.8.1	General.....	27
4.8.2	Concrete Pipelines.....	28
4.8.3	PVC and PE Non-pressure Pipelines.....	31
4.8.4	Other Pipe Materials .....	33
4.8.5	Alternative Procedure .....	33
4.9	Abandoned Pipes and Manholes .....	34

## **4 PIPELINE CONSTRUCTION - DRAINAGE**

### **4.1 Pipe Materials**

#### **4.1.1 Specification**

Pipes for general construction shall be one of the following as indicated on the Drawings or as otherwise approved. Unless stated otherwise, pipe diameters shown on the Drawings are the nominal bores.

- (i) Reinforced rubber-ring-jointed spun concrete pipes (Class 2 unless otherwise noted) complying with AS/NZS 4058.
- (ii) Humes Titan Roller Compacted concrete pipes (RCP) that have each passed the factory hydrostatic test.
- (iii) PVC-U pipes and fittings (SN 4 unless otherwise noted) with rubber ring joints complying with AS/NZS 1260 for foul sewers and AS 1254 for stormwater sewers.
- (iv) Stormboss pipe complying with AS/NZS 5065 (with prior approval from the Authorised Representative).

Rubber rings shall comply with AS 1646.

PVC-U pipes and fittings shall be used in all areas where sewer connections are required to be made to the constructed pipeline unless otherwise noted on the Drawings.

#### **4.1.2 Quality Assurance**

Pipes shall be manufactured only in a plant where a written quality plan is being implemented at the time of pipe manufacture. This quality plan shall be forwarded to the Authorised Representative immediately on request.

#### **4.1.3 Guarantee**

The service life of all installed pipelines is expected to be a minimum of 50 years. If requested by the Authorised Representative, the Developer shall supply written confirmation from the pipe manufacturer that their pipe satisfies this performance requirement.

### **4.2 Pipe Embedment**

Unless otherwise noted, pipes shall be embedded and supported in accordance with:

For concrete pipes: Support type H2, AS/NZS 3725.

For PVC and PE pipes: AS/NZS 2566.2 with the embedment material compacted to a minimum relative compaction of Density Index 70%.

Bedding material shall in the first instance be selected from within the trench excavation.

Selection shall include the separation, stockpiling, loading and transportation of suitable material from one part of the Site to another if this is necessary. Unless otherwise noted, the grading shall be as described in Table 6 of AS/NZS 3725 for concrete pipes and as described in Table G.1 of AS/NZS 2566.2 for PVC pipes, except as may be modified in writing by the Authorised Representative. The Developer shall carry out grading tests to verify the required grading is complied with at all times and shall, if requested, submit the results demonstrating this to the Authorised Representative.

**AS/NZS/AS 3725 TABLE 6 and AS/NZS 2566.2 TABLE G1**

**GRADING LIMITS FOR ACCEPTABLE EMBEDMENT MATERIALS**

Sieve size, mm	Mass of sample passing, per cent
19.0	100
2.36	50 to 100
0.6	20 to 90
0.3	10 to 60
0.15	0 to 25
0.075	0 to 10

If the Developer demonstrates to the Authorised Representative that suitable bedding material cannot be obtained from selection on-site, and the Authorised Representative agrees, then the Developer shall supply imported material for use as bedding.

Sand shall only be used for pipe embedment with the approval of the Authorised Representative.

Where the Developer chooses to use a bedding material of grading that could allow migration of material from the trench floor or wall into the bedding, the bedding shall be enclosed within a geotextile that ensures that this migration cannot occur.

Special attention shall be given, during installation of pipes, to compaction of the material under and around pipes to ensure that the required degree of support and soil/pipe interaction is achieved.

The Developer shall test the compaction of the bed and haunch zone material at least once every 10 metres of trench using a method appropriate to the material and approved by the Authorised Representative. A record of all tests shall be made and shall be forwarded to the Authorised Representative weekly. The record shall clearly show the plan location and depth of tests. Failures shall be recorded and remedial work noted.

### 4.3 Laying and Jointing of Pipes

PVC and PE pipe shall be laid in accordance with the manufacturer's recommendations and with AS/NZS 2566.2. The Developer shall ensure that every pipe spigot to be inserted into a socket has a witness mark on the pipe so that the distance between the mark and the end of the pipe is 10mm less than the socket depth.

Concrete pipes shall be laid in accordance with the manufacturer's recommendations and with AS/NZS 3725.

PE pipe jointing of pipe shall be undertaken by appropriately certified personnel using manufacturer's-approved equipment. The Developer shall confirm in writing with the Authorised Representative that the proposed methodology including equipment to be used meets with the pipe manufacturer's approval.

Bedding shall be trimmed to level and shaped before the pipe is laid. Concrete pipe is not to be bearing on its collar.

Pipes shall be laid and jointed strictly in accordance with the manufacturer's recommendations, in straight lines, beginning at the lower end of the line (unless agreed otherwise with the Authorised Representative), and each joint shall be completed before another pipe is laid. All pipe manufacturing codes and class markings shall be laid facing upwards. All spigot witness marks shall show just clear of the following collar. Pipes shall be connected to structures as detailed on the drawings. The open end of the pipeline shall be closed off and protected when the Developer is not on site or work is otherwise not in progress on that section of the works.

Pipelines shall be constructed to the following tolerances, unless otherwise directed by the Authorised Representative:

- (a) the departure from the specified level of any point on the pipeline shall not exceed 20mm.
- (b) the departure from the specified grade of any section of the pipeline shall not exceed 0.1%
- (c) reverse fall at any point in the pipeline shall not be permitted.
- (d) the horizontal departure from the specified position of any point on the pipeline shall not exceed 50mm.

If a laser beam device is to be used for setting out, a self-checking procedure shall be used to check the beam setting every 50 metres.

### 4.4 Connections to Pipes

Where existing laterals are to be connected into the pipeline the connections shall be made as detailed in the Whanganui District Council Land Development and Subdivision Engineering Supplement to NZS 4404 Only factory made adapters and fittings shall be

used unless the prior approval of the Authorised Representative has been obtained for an alternative procedure.

Connections to new pipelines smaller than 300mm shall be by means of factory-made “Y” junctions. Saddles shall not be used.

Connections that are made directly to the pipeline shall be made with factory-made saddles. These are to be secured with epoxy and banded to the pipe with stainless steel bands. Penetrations through the concrete pipe wall shall be made with a concrete hole saw. Breaking out the hole in the concrete pipe by hammering is not permitted.

The Developer shall record the position of all junctions by measurement from the centre of the manhole covers immediately adjacent to the connection. Such information shall be included on the ‘As Built’ Drawings.

#### **4.5 Backfill Materials**

Excavated material shall be used for backfilling except where otherwise noted on the drawings or where directed by the Authorised Representative or when it is unsuitable. This suitable material shall be selected and placed in such a manner that it is not contaminated with other material. Excavated material from one area shall be used for filling in other areas if it is suitable for that area but not suitable for the area from where it was excavated. This work shall include the selection, separation, stockpiling, loading and transportation of suitable backfilling material from one part of the Site to another, for example from under a carriageway to a grassed area.

Unsuitable material shall be that which is assessed by the Authorised Representative as not being suitable to be placed and compacted after pre-treatment comprising the following or equivalent:

- (a) selection from the bulk excavation at any part of the Site, and/or
- (b) air drying by wind rowing or equivalent methods, and/or
- (c) wetting by controlled application and mixing in of water.

The Developer shall inform the Authorised Representative when the material excavated is considered to be unsuitable for backfill. Unsuitable material shall be removed from Site and in the first instance replaced by suitable material from elsewhere on the Site. If sufficient suitable material is not available on the Site and the Authorised Representative agrees with this assessment, the Developer shall supply imported suitable backfill. If suitable material is not available due to the Developer having removed suitable material from the Site then the shortfall shall be made good at the Developer’s own expense.

#### **4.6 Fill Beneath Road Carriageways and Footpaths**

Selected fill shall extend to the underside of the basecourse layer under road carriageways and the underside of the basecourse or sand layer under footpaths.



## **4.7 Fill Compaction**

### **4.7.1 General**

Fill adjacent to pipes shall be placed and compacted by hand or hand held equipment in accordance with the pipe manufacturer's recommendations to 300mm over the crown of the pipe. Backfill placed from 300mm over the top of the pipe to the underside of the surface layer may be machine compacted. Particular care shall be taken to work within the pipe manufacturer's recommendations when using a compaction wheel.

Backfilling around manholes and other structures shall be undertaken in such a manner as to avoid uneven loading or damage.

Where the excavations have been supported and the supports are to be removed, these where practicable, shall be withdrawn progressively as backfilling proceeds in such a manner as to minimise the danger of collapse. All voids formed behind the supports shall be carefully filled and compacted.

### **4.7.2 Layer thickness**

The maximum loose thickness of each layer of fill before compaction shall be 250mm unless field trials show, to the satisfaction of the Authorised Representative, that the specified compaction is obtained with thicker layers.

The maximum particle size of the fill material shall not exceed two thirds of the compacted layer thickness.

All backfill shall be thoroughly compacted in layers of uniform thickness.

### **4.7.3 Compaction**

#### **Granular Material**

For granular fill material, compaction of each layer shall continue until the whole layer has attained a dense condition. Water shall be added as necessary to aid compaction.

Wetting of material which has become too dry for use in the fill shall be carried out with sprinkling equipment of a type which ensures uniform and controlled distribution of water. After wetting, the material shall be mixed to ensure a uniform distribution of moisture throughout the layer.

The degree of compaction of each layer shall be controlled by its relative density, as per AS/NZS 2566:2002

### Non granular Material

Compaction of cohesive soils shall be controlled by the air voids content of the soil and its shear strength measured by a shear vane test.

The acceptable criteria shall be a maximum air voids content of 10% and a minimum shear strength of 150 kPa.

#### 4.7.4 Frequency of Testing

Trench testing shall include a testing regime as outlined below or equivalent:

- (a) For trenches in berms, testing is required at a rate of at least one test per layer of backfill per 15 metres of trench, with a minimum of two tests. Field density tests shall be carried out as noted in the table below.
- (b) For trenches in carriageways or under footpaths, testing is required at a rate of at least one test per layer of backfill per 5 metres of trench with a minimum of two tests;
- (c) Where the excavated area around manholes or other structures is greater than 0.5m<sup>2</sup> and less than 5m<sup>2</sup>, one test per backfill layer is required. For larger excavations, one test per 5 m<sup>2</sup> must be carried out.
- (d) It is important to note that more testing may be necessary to ensure that the required compaction standards are met. It is the responsibility of the Developer to ensure that no settlement occurs;
- (e) All test locations must be uniformly spaced in the pavement; and
- (f) Subject to satisfactory test results the above frequency of testing may be reduced with the prior agreement of the Authorised Representative.

The testing programme must include direct measurement of field density. The frequency of field density tests shall comply with Table 8.1 of AS 3798 Guidelines for Earthworks for Commercial and Residential Developments. Table 8.1 is reproduced in part below.

**AS3798 Table 8.1**

#### Frequency of Field Density Tests

Type of Earthworks	Frequency of tests (see Note 2)
Type 4 Confined operations (e.g. filling behind structures (see Note 4))	1 test per 2 layers per 50m <sup>2</sup>
Trenches	1 field density test per 2 layers per 40 linear metres

For indirect tests, the Scala Penetrometer or Clegg Hammer may be used. If the Scala Penetrometer is used the results must be correlated with the results of field density tests.

The Clegg hammer can be used for testing of general fill and base layers but not for the upper base layer of carriageways.

Compaction must not be less than that necessary to achieve the following at all depths of any backfill.

**Table 1: Compaction Testing**

	<b>Carriageway</b>	<b>Footpath</b>	<b>Berm</b>
Base	98% MDD	CIV 25	NA
Sub-base	CIV 35	CIV 25	NA
Deeper Fill	CIV 25	CIV 10	CIV 10

**Note:** Clegg hammer tests only indicate the compaction of the lift last laid of any backfill layer. These compaction tests must be carried out on every lift of each tested backfill layer to be assured of proper compaction of all of the backfill.

In the case of sand a lesser compaction requirement may be approved by the Corridor Manager if it can be clearly shown that the compaction is at least as much as the undisturbed sand in the adjoining ground.

The results of tests taken must be recorded and made available to the Corridor Manager.

## 4.8 Pipeline Testing

Where conflicts exist between NZS4404:2010 appendix C and the Technical Specification section 4.8, the Whanganui District Council Development Engineer shall determine which will take precedence.

### 4.8.1 General

On completion of construction and prior to testing, internal surfaces of sewers and manholes shall be thoroughly cleansed to remove all deleterious matter, without such matter being passed forward into existing sewers or watercourses.

The Developer shall test and CCTV inspect all completed pipelines of nominal diameter 900mm and less in accordance with 4.8.2, 4.8.3 or 4.8.4 below. Larger diameter pipelines shall be subject to a visual inspection.

The Authorised Representative shall be notified 24 hours prior to testing being carried out. A record of all tests shall be made and shall be forwarded to the Authorised Representative within 24 hours of test completion.

Pressure or vacuum testing shall be restricted to single pipeline lengths between but not including manholes. Concurrent testing of consecutive pipeline lengths shall not be permitted.

Where the water table is above the invert of the pipe, the test pressure or head required shall be increased by the distance between the pipe invert and the water table level.

A test report for each length of pipeline shall be provided. The report shall include:

- (i) Full details of the pipeline tested. Where the pipeline is below the water table, include the location of the water table.
- (ii) Any leaks detected and repairs made.
- (iii) Where testing is carried out in accordance with 4.8.2, 4.8.3 or 4.8.4 below, the initial and final test pressure and the time interval.
- (iv) Reference to the test method.
- (v) Whether the pipeline was acceptable.
- (vi) Inspection reports and video tape and DVD copies of all inspections.

#### 4.8.2 Concrete Pipelines

Concrete pipelines shall be tested in accordance with the CPAA publication *Field Testing of Concrete Pipelines and Joints*. The most reliable test in a laid concrete pipeline is a hydrostatic test but where it is more convenient a low-pressure air test may be applicable. The low-pressure air test can provide the criteria for acceptance of a pipeline but not for its rejection. The following excerpts are from the CPAA publication.

##### 1. Hydrostatic Test

**(a) Test criteria:** The pipe when tested under a minimum head of 1.2m and a maximum head of 6m shall not show any leakage in excess of 0.5 litres per hour per linear metre per metre of nominal internal diameter. The minimum and maximum heads specified shall be measured above the internal crown of the pipe.

**(b) Preparation and Procedure:** By fitting temporary bulkheads the test can be applied to the completed pipeline or progressively to sections as laid. Depending on the grade some pipelines must be tested in stages otherwise maximum head could be exceeded. All bulkheads must be suitably strutted and restrained, and plugs must be similarly fitted at any inlet/outlet connections.

Whenever possible testing should be carried out from manhole to manhole. Short branch drains connected to a pipeline between manholes should be tested as one system with the main pipeline. Long branches and manholes should be separately tested.

For the purpose of filling the line and obtaining the required 1.2m head above the crown at the high point (or higher if the water table is above the pipe invert; see

note above) of the test section, a water entry point must be provided through the temporary bulkhead. It is suggested that a flexible hose be attached to this fitting.

To obtain the correct head level and also to enable the leakage rate to be simply estimated, a drum or container should be attached to this hose. The drum which should be calibrated by marking with a litre scale is then supported so that the top mark of the scale is at 1.2 metres (or higher if the water table is above the pipe invert; see note above) above the crown of the pipe. This is the reference mark and by noting the time and rate of fall an estimate of the leakage rate can be quickly obtained.

When filling there must be provision for air to bleed out or escape from high points. After filling the water level will initially fall due to:

- (i) Absorption into the pipe wall;
- (ii) Air which is trapped at joints needs time to escape.

Allowance should be made for this by adding water to maintain some head on the pipe for an appropriate stabilising period before the measuring time commences. This stabilising time will depend on factors such as the age of the pipes, their moisture condition, the ambient conditions, etc. it will be of the order of 24 hours. Whilst the aim is to commence the test proper as soon as possible, the appropriate period will best be determined by conferring with the pipe suppliers.

At the end of the stabilising period the head of water is adjusted back to the correct level. The loss of water over a period of 30 minutes is then measured by adding water and noting the quantity required to maintain the correct water level. The average quantity added should not exceed the equivalent leakage rate as specified under the above test criteria.

**(c) Test Assessment:** Water loss in excess of the specified rate may be due to a defect. The line should be inspected and if a defect is detected by visible signs of leakage then remedial action is to be taken.

If no defect is found then it may be that the stabilising period was insufficient and after a further waiting period the test may be re-run with the Authorised Representative's approval.

## 2. Air Test

The section of line to be tested should be flushed and cleaned. This serves to clean out any debris and wet the pipe.

Isolate the section of line to be tested by means of inflatable stoppers or other suitable test plugs. The ends of all branches, laterals, tees or wyes to be included in the test, should be plugged to prevent possible blowout due to internal pressure. One of the plugs should have an inlet valve for connection to a source of air under pressure.

Prior to setting up the air test, ensure that ground water is not leaking into the isolated section of the line.

Connect the air hose to the inlet tap and a portable air control source. The air equipment should consist of necessary valves and pressure gauges to control the rate at which air flows into the test section and to enable monitoring of the air pressure within the test section. Also, the testing apparatus should be equipped with a pressure relief device to prevent the possibility of loading the test section with the full capacity of the compressor.

Add air slowly to the test section until the pressure is just over 1000mm of water. Regulate the air supply to maintain the pressure between 1000 & 1100 mm head whilst checking all plugs, bulkheads and fittings, with soap solution if necessary, to ensure there is no stray leakage. This period, which should be a minimum of two minutes, also allows the air temperature to stabilise with the temperature of the pipe walls.

After the stabilisation period ensure that the pressure is just above 1000mm head. Commence measuring time as the pressure falls to 1000mm and note the time taken for it to drop another 200mm to 800mm head. For the pipe to pass the test this time should not be less than the holding time given in the table below appropriate to the diameter and length of line under test.

If the pipeline fails the test the cause of the failure must be detected by audible or visual means and rectified and the test repeated. If no defect can be detected the developer shall either:

- (i) Apply water to the pipeline internally and/or externally and then repeat the air test.
- (ii) Apply a hydrostatic test to prove that the pipeline is sound.

**TABLE OF AIR TEST HOLDING TIMES (MINS-SECS)  
FOR AN AVERAGE APPLIED PRESSURE OF 900mm HEAD  
i.e. FALLING FROM 1000mm HEAD TO 800mm HEAD**

PIPE DIAM (MM)	LENGTH OF TEST SECTION (METRES)											
	15	20	25	30	35	40	50	60	70	80	90	100
150	0-13	0-17	0-22	0-25	0-30	0-35	0-45	0-50	1-00	1-10	1-20	1-30
225	0-30	0-40	0-50	1-00	1-10	1-20	1-40	2-00	2-10	2-10	2-10	2-10
300	0-50	1-10	1-30	1-40	2-00	2-20	3-00	3-00	3-00	3-00	3-00	3-00
375	1-20	1-50	2-20	2-40	3-10	3-40	3-40	3-40	3-40	3-40	3-40	3-40
450	2-00	2-30	3-10	3-50	4-20	4-20	4-20	4-20	4-20	4-20	4-20	4-20
525	2-40	3-30	4-20	5-10	5-10	5-10	5-10	5-10	5-10	5-10	5-10	5-10
600	3-30	4-30	5-50	5-50	5-50	5-50	5-50	5-50	5-50	5-50	5-50	5-50
750	5-20	7-10	7-10	7-10	7-10	7-10	7-10	7-10	7-10	7-10	7-10	7-10
900	7-40	8-50	8-50	8-50	8-50	8-50	8-50	8-50	8-50	8-50	8-50	8-50
1050	10-10	10-10	10-10	10-10	10-10	10-10	10-10	10-10	10-10	10-10	10-10	10-10
1200	11-40	11-40	11-40	11-40	11-40	11-40	11-40	11-40	11-40	11-40	11-40	11-40

#### 4.8.3 PVC and PE Non-pressure Pipelines

PVC and PE pipelines shall be tested in accordance with AS/NZS 2566.2 Appendix N. The following is based on this standard.

##### 1. Air Test

The test length of pipeline should be restricted to pipeline sections between maintenance holes (the most convenient places for inserting test plugs or fixing temporary bulkheads). The method should not be used for test lengths in excess of 250m and for pipe diameters larger than 1500mm.

The procedure for low-pressure air testing of large diameter pipelines is potentially hazardous because of the very large forces to be resisted by temporary plugs or bulkheads and the serious consequences of accidental bulkhead blow-out. A relief valve, with a 50 kPa maximum setting must be installed on all pressurizing equipment.

The procedure shall be as follows:

- (i) Pump in air slowly until a pressure of 25 to 30 kPa is reached. Where the pipeline is below the water table this pressure shall be increased to achieve a differential pressure of 25 kPa. In no circumstances should the actual pressure exceed 50 kPa.
- (ii) Maintain the pressure for at least 3.0 min.
- (iii) Where no leaks are detected, shut off the air supply.

- (iv) With the air supply shut off, monitor the pressure for the time intervals given in the table below.

The test length shall be acceptable, where the pressure drops by 7 kPa, or less, over the required (tabulated) test period.

Where the pipeline fails the test, check for leaks, repair any defects, then repeat Steps a) to d).

**LOW PRESSURE AIR AND VACUUM TESTS – MINIMUM TIME INTERVALS  
FOR 7 kPa PRESSURE CHANGE IN PIPELINE  
(Table 6.1 AS/NZS 2566.2)**

DN	Minimum time (minutes)	Maximum length for minimum time to apply (metres)	Test Length (metres)				
			50	100	150	200	250
			Minimum test duration (minutes)				
80	1.5	231	1.5	1.5	1.5	1.5	1.6
100	2	185	2	2	2	2	3
150	3	123	3	3	3	5	6
225	4	82	4	5	8	10	13
300	6	62	6	9	14	18	23
375	7	49	7	14	22	29	36
450	9	41	10	21	31	41	52
525	10	35	14	28	42	56	70
600	11	31	18	37	55	73	92
675	13	27	23	46	70	93	116
750	14	25	29	57	86	115	143

NOTE: The time interval may be reduced for a proportionate reduction in the allowable pressure drop. Where there is no detectable change in pressure after 1 hour of testing, the section under test shall be deemed acceptable.

## 2. Vacuum Test

The test length should be restricted to lengths between access chambers but, unlike the low-pressure air test, there are no specific limits on length or diameter as safety requirements are more easily met. Maintenance structures of impermeable materials may also be tested by this method using the minimum times shown in column 2 of the above table.

The procedures shall be as follows:



- (i) Apply a vacuum until a (negative) pressure of 25 kPa to 30 kPa is achieved.
- (ii) Maintain the vacuum for at least 3.0 min.
- (iii) Where no leaks are detected, isolate the test section from the vacuum pump.
- (iv) With the test section isolated from the vacuum pump, monitor the pressure for the time intervals given in the table above.

The test length shall be acceptable where the vacuum drops by 7 kPa, or less, over the test period.

Where the pipeline fails the test, reapply the vacuum and check for leaks. Pouring water over joints and fittings will improve the possibility of leaks detectable by auditory methods. Repair leaks detected and then repeat Steps a) to d).

### **3. Hydrostatic Test**

The procedure shall be as follows:

- (i) The test pressure shall be not less than 20 kPa, or 20 kPa above the ground water pressure at the pipe soffit at its highest point, whichever is the greater, and not exceed 60 kPa at the lowest point of the section.
- (ii) Steeply graded pipelines shall be tested in stages where the maximum pressure, as stated above, will be exceeded if the whole section is tested in one length.
- (iii) The pressure shall be maintained for at least 2 hours by adding measured volumes of water where necessary.
- (iv) Any visible leaks detected shall be repaired and the pipeline shall be retested.

The test length shall be acceptable, where the addition of make-up water does not exceed 0.5 litres/hour per metre length per metre diameter.

#### **4.8.4 Other Pipe Materials**

Pipelines shall be tested in accordance with the manufacturer's recommendations and the relevant New Zealand or agreed alternative Standard.

#### **4.8.5 Alternative Procedure**

Where the completed pipeline is connected into existing private connections in a way which the Developer believes makes testing in accordance with the appropriate method above impractical, and the Authorised Representative agrees with this assessment, the Authorised Representative may waive this testing

requirement. If the testing requirement is waived, an inspection programme shall be carried out in accordance with the following quality management procedure:

- (i) Prior to any work that will not be tested in accordance with either 4.8.2 or 4.8.3 above being carried out, the Developer shall submit to the Authorised Representative a quality management plan that shall include, but shall not be limited to:
  - the particular pipe joint system(s) to be used
  - the procedure(s) which shall be used for making joints in the pipework, including connection to existing pipes
  - the name and qualifications of the person(s) who will carry out the jointing work
  - the procedure for inspecting the work, including at what stage (i.e. during or after jointing) inspection is to be carried out
  - the procedure for recording that the jointing work and the inspection(s) have been carried out in accordance with the quality plan requirements.
- (ii) The Authorised Representative shall approve inspection rather than testing for individual sections of pipeline (between manholes) separately and shall give approval only on receipt of a satisfactory quality plan for the particular section. This approval by the Authorised Representative shall not transfer any liability for the quality of the Works from the Developer who shall remain totally responsible for the Works.
- (iii) Records of jointing work and inspections shall be forwarded to the Authorised Representative within 24 hours of the work being carried out.

#### **4.9 Abandoned Pipes and Manholes**

Abandoned pipes and manholes shall be removed, sealed off, or filled as noted on the Drawings. Where it is noted that an abandoned manhole shall be filled, the cover and frame shall be removed and the manhole chamber broken down, and removed from site, to a minimum of 1m below the surrounding ground level. The floor of the chamber shall be broken through to allow drainage out of the chamber and the reduced chamber shall be filled with compacted sand. Abandoned pipes shall be filled with lean-mix pumice concrete. There shall be no voids left in the pipe following the filling work.

The Developer shall submit his proposed filling methodology to the Authorised Representative prior to carrying out the work.

**5 PIPELINE CONSTRUCTION – WATER SUPPLY**

**Contents**

5.1 Materials ..... 36

5.2 Public Health ..... 36

5.3 Public Notifications / Water Shut-Off ..... 37

5.4 Temporary Connections ..... 37

5.5 Pipe Embedment ..... 37

5.6 Pipe Laying - Water ..... 38

5.7 Spiral Welded Pipe ..... 39

5.8 Installation of Valves ..... 39

5.9 Installation of Fire Hydrants ..... 39

5.10 Installation of Valve and Hydrant Boxes ..... 40

5.11 Trace Wire ..... 40

    5.11.1 General ..... 40

    5.11.2 Jointing Procedure ..... 40

    5.11.3 Trace Wire Jointing Tools and Equipment ..... 40

5.12 Thrust Blocks and Anchors ..... 40

5.13 Backfill Materials ..... 41

5.14 Fill ..... 41

    5.14.1 Layer thickness ..... 42

    5.14.2 Compaction ..... 42

    5.14.3 Frequency of Testing ..... 43

5.15 Connections (Standard Details) ..... 44

5.16 Disinfection and Flushing ..... 45

5.17 Testing ..... 45

**5 PIPELINE CONSTRUCTION – WATER SUPPLY**

**Where conflicts exist between NZS4404:2010 and the Technical Specification the Whanganui District Council Development Engineer shall determine which will take precedence**

**5.1 Materials**

During the course of the Contract, the Developer will have occasion to remove from service items such as old pipe, tobies, valves, hydrants and streetware etc. These materials remain the property of the Principal and shall be returned to Whanganui Infrastructure who will direct where they are to be stockpiled.

**5.2 Public Health**

It is essential for the protection of Public Health that special attention is given to diseases which are communicable by water.

All Developers’ personnel (excluding specific Sealing or Concrete Crews), who work on this contract, shall undergo the following programme of testing and/or vaccination before (and if required during) the contract. This testing and vaccination programme shall be undertaken at the Developer’s expense.

Before commencing employment under the contract, employees carrying out work, shall be tested for **Hepatitis A**.

The following testing and vaccination regime shall be adhered to:

Hepatitis A:	<p>A blood test shall be taken to assess the presence of antibodies.</p> <p>If antibodies are detected, no vaccination is required.</p> <p>If antibodies are <b>NOT</b> detected, vaccination shall be carried out, using (2 dose) Havrix.</p> <p><b>Retests shall be completed every 12 months.</b></p>
--------------	--

No Developer’s staff employed on other sites involving work in or on any river, drain, or sewer, shall be allowed to carry out work on the laying of the water main, unless permanently transferring to it after undergoing the above tests and vaccinations.

No tools or clothing used on any work in or on any river, drain or sewer shall be used for work on this contract without first being decontaminated in a manner approved by the Authorised Representative. Any excavator used for this contract shall also be decontaminated in a manner approved by the Authorised Representative.

Any vehicle used in the course of this contract as a service vehicle shall not be used for any other works except under this contract, unless that vehicle has been fully decontaminated in a manner approved by the Authorised Representative.

Any of the Developer's staff employed on this contract with diarrhoea shall stay away from work until they have been clear of symptoms for at least 24 hours. Given the possibility of infections without symptoms, it is important that personal hygiene, especially hand washing, is complied with.

**A Doctors' Certificate for each of the Developers and Sub-Developers personnel, documenting tests, results and vaccinations, shall be provided prior to commencement of physical works.**

**Installation or materials handling, shall only be carried out by personnel who comply with all these requirements.**

### **5.3 Public Notifications / Water Shut-Off**

The Developer shall notify all **domestic** consumers, with a copy to the Authorised Representative, **24 hours** (1 day) minimum before each Water Shut-off, of the affected consumers, time and duration of shut-off.

The Developer shall notify all **commercial** (non-domestic, including schools) consumers, with a copy to the Authorised Representative, **72 hours** (3 days) minimum before each Water Shut-off, of the affected consumers, time and duration of shut-off.

Notifications shall be hand delivered to letter boxes and one full copy faxed or delivered to Whanganui Infrastructure and the New Zealand Fire Service, using the 'Water Shut-off Notification'.

Whanganui District Council will supply to the Developer an electronic copy of their Water Shut-off Notification form.

### **5.4 Temporary Connections**

The cost of providing any temporary water supply that may be required during the course of the contract to ensure water is available to residential or commercial consumers shall be the responsibility of the Developer.

### **5.5 Pipe Embedment**

Bedding material for the steel and PVC mains shall in the first instance be selected from within the trench excavation. Selection shall include the separation, stockpiling, loading and transportation of suitable material from one part of the Site to another if this is necessary. If the Developer demonstrates to the Authorised Representative that suitable bedding material cannot be obtained from selection on-site, and the Authorised Representative agrees, then the Developer shall supply imported material for use as bedding.

Bedding shall be trimmed to level and shaped before each pipe is laid, so that the pipe is not bearing on its collar.

Where noted on the drawings or directed by the Authorised Representative, the embedment material grading shall be as described in the table below:

**AS/NZS 2566.2 TABLE G1**

**GRADING LIMITS FOR ACCEPTABLE EMBEDMENT MATERIALS**

Sieve size, mm	Mass of sample passing, per cent
19.0	100
2.36	50 to 100
0.6	20 to 90
0.3	10 to 60
0.15	0 to 25
0.075	0 to 10

Unless otherwise noted bedding dimensions for steel, PVC and PE pipes shall be in accordance with the requirements of AS/NZS 2566.2.

## 5.6 Pipe Laying - Water

PVC and PE pipe shall be laid in accordance with the manufacturer's recommendations and with AS/NZS 2566.2. The pipe shall be laid with the manufacturer's codes and class markings along the top of the pipe. The Developer shall ensure that every PVC pipe spigot to be inserted into a socket has a witness mark on the pipe so that the distance between the mark and the end of the pipe is 10mm less than the socket depth.

Special attention shall be given, during installation of pipes, to compaction of the material under and around pipes to ensure that the required degree of support and soil/pipe interaction is achieved.

Steel pipe shall be laid in accordance with the manufacturers recommendations.

Pipe laying depths shall as shown on the drawings or as directed by the Authorised Representative.

e.g.    Service Mains (DN 100-200) 900mm cover  
          Riders (DN 50)                    600mm cover  
          Connections                        as per standard diagram

Road crossings

900mm minimum

### 5.7 Spiral Welded Pipe

Welding shall only be carried out by one of the nominated sub developers.

Prior to any welding taking place, the Developer shall inspect and repair any defects (concrete lining, steel pipe or wrapping) in each 10m length of concrete lined spiral welded steel pipe.

The welding process (includes preparation, Resmax jointing, double welds, priming and approved wrapping) shall be carried out using welders certified to NZS 4711:1984, with Amendment 1986.

**All welders shall provide copies of current Welding Certification before work commences**

The Developer shall supply all materials required to repair defects and successfully join each pipe (using Resamax), double welds, primer and wrapping (using Polyken components).

### 5.8 Installation of Valves

Valves preferably should not be installed in the carriageway and shall generally be installed next to other fittings such as tees or bends. Where the valve is fitted to the branch of a tee, it will generally be flanged however spigot ended valves connected to adjoining pipes with gibaults may be an acceptable alternative. Spigot ended valves shall be secured to anchor blocks conservatively sized to resist any unequal hydraulic thrust forces arising from the operation of the valve.

Where valves are to be bolted to tees, flanges etc. only approved stainless steel bolts and nuts shall be used.

Valves on bulk mains shall be installed inside an 1800mm diameter manhole as detailed in the drawings. Manhole risers shall comply with NZS 3107. The maximum permitted installed out of plumb shall be 25mm of horizontal deviation in 1m of vertical riser. The Developer shall make up the height between the manhole lid and the finished surface level using concrete riser rings. The manhole frame and cover shall be set in concrete so as to finish flush with the finished surface level.

### 5.9 Installation of Fire Hydrants

The preferred location for hydrants is in the berm rather than the carriageway, and they should be installed to avoid driveways.

Hydrant risers shall be used, or the watermain laid deeper where necessary to ensure the top of the spindle is between 50 and 200mm below the fire hydrant lid.

## 5.10 Installation of Valve and Hydrant Boxes

The base shall be well compacted and properly levelled prior to installation of the concrete surrounds. The edge of the excavation shall be saw cut to provide a neat clean edge for reinstatement. The hydrant boxes shall be installed with the main. The valve boxes shall be installed across the main. The box and surrounds shall be installed so that no traffic load on the surface box can be reflected onto the pipe or fittings. The frame shall be fixed to the top concrete riser with Epar or similar approved material approved by the Authorised Representative. Fire hydrant lids shall be painted golden yellow in accordance with TNZ M/7-Y

## 5.11 Trace Wire

### 5.11.1 General

Trace wire (1.5mm conductor, coloured blue) shall be laid directly on top of all plastic water pipes, including service connections. Each end of the trace wire shall be bared, jointed with proprietary connectors and taped with PVC (or similar) to form a continuous line. It shall be secured to valves at each end. Trace wire is not required for concrete lined steel pipelines.

### 5.11.2 Jointing Procedure

- (a) Cut bent or dirty ends of trace wire off with pliers.
- (b) Remove blue insulation from trace wire with stripping tool ('1.5' – the 3rd position from right).
- (c) Insert trace wire into each end of blue connector and hold firmly.
- (d) Place one end of connector in the 1.5 groove (outer end) of crimping tool. Squeeze handles together to full close position.
- (e) Repeat squeeze action to other end of connector.
- (f) Gently heat the 'heat shrink' at each end of the connector until a seal is made onto the trace wire insulation. Be careful not to overheat and damage the 'heat shrink connector'.

### 5.11.3 Trace Wire Jointing Tools and Equipment

The Developer shall supply all appropriate jointing tools and equipment necessary to connect or join the trace wire.

## 5.12 Thrust Blocks and Anchors

Concrete thrust and anchor blocks shall be constructed in accordance with the requirements of NZS 4404:2004 page 203 and are to be installed at all bends, junctions and reducers for pipes of 50mm diameter and greater. Welded concrete lined steel pipes do not require thrust blocks unless specified.



All materials required for the construction of the anchor and thrust blocks are to be supplied by the Developer. The concrete work shall be in accordance with NZS 3109 – Concrete Construction.

The inner face of the block shall not be of a lesser thickness than the diameter of the fittings, and shall be constructed so as not to impair access to the bolts on the fittings. Concrete shall have a minimum compressive strength of 17.5 MPa at 28 days.

The pipe and fitting are not to be totally encased in concrete. A protective membrane shall be provided between the pipe and the concrete anchor and thrust blocks.

### **5.13 Backfill Materials**

Excavated material shall be used for backfilling except where otherwise noted on the drawings or where directed by the Authorised Representative or when it is unsuitable. This suitable material shall be selected and placed in such a manner that it is not contaminated with other material. Excavated material from one area shall be used for filling in other areas if it is suitable for that area but not suitable for the area from where it was excavated. This work shall include the selection, separation, stockpiling, loading and transportation of suitable backfilling material from one part of the Site to another, for example from under a carriageway to a grassed area.

Unsuitable material shall be that which is assessed by the Authorised Representative as not being suitable to be placed and compacted after pre-treatment comprising the following or equivalent:

- (a) selection from the bulk excavation at any part of the Site, and/or
- (b) air drying by wind rowing or equivalent methods, and/or
- (c) wetting by controlled application and mixing in of water.

The Developer shall inform the Authorised Representative when the material excavated is considered to be unsuitable for backfill. Unsuitable material shall be removed from Site and in the first instance replaced by suitable material from elsewhere on the Site. If sufficient suitable material is not available on the Site and the Authorised Representative agrees with this assessment, the Developer shall supply imported suitable backfill. If suitable material is not available due to the Developer having removed suitable material from the Site then the shortfall shall be made good at the Developer's own expense.

### **5.14 Fill**

#### **Fill Beneath Road Carriageways and Footpaths**

Selected fill shall extend to the underside of the basecourse layer under road carriageways and the underside of the basecourse or sand layer under footpaths.

#### **Fill Compaction**

Filling material shall be deposited in layers not exceeding 200mm loose thickness and then fully compacted to form a stable backfill.

Fill adjacent to pipes shall be placed and compacted by hand or hand held equipment in accordance with the pipe manufacturer's recommendations to 300mm over the crown of the pipe. Backfill placed from 300mm over the top of the pipe to the underside of the surface layer may be machine compacted. Particular care shall be taken to work within the pipe manufacturer's recommendations when using a compaction wheel.

Backfilling around manholes and other structure shall be undertaken in such a manner as to avoid uneven loading or damage.

Where the excavations have been supported and the supports are to be removed, these where practicable, shall be withdrawn progressively as backfilling proceeds in such a manner as to minimise the danger of collapse. All voids formed behind the supports shall be carefully filled and compacted.

#### **5.14.1 Layer thickness**

The maximum loose thickness of each layer of fill before compaction shall be 200mm unless field trials show, to the satisfaction of the Authorised Representative, that the specified compaction is obtained with thicker layers.

The maximum particle size of the fill material shall not exceed two thirds of the compacted layer thickness.

All backfill shall be thoroughly compacted in layers of uniform thickness.

#### **5.14.2 Compaction**

##### **Granular Material**

For granular fill material, compaction of each layer shall continue until the whole layer has attained a dense condition. Water shall be added as necessary to aid compaction.

Wetting of material which has become too dry for use in the fill shall be carried out with sprinkling equipment of a type which ensures uniform and controlled distribution of water. After wetting, the material shall be mixed to ensure a uniform distribution of moisture throughout the layer.

The degree of compaction of each layer shall be controlled by its relative density, as per AS/NZS 2566:2002

##### **Non granular Material**

Compaction of cohesive soils shall be controlled by the air voids content of the soil and its shear strength measured by a shear vane test.

The acceptable criteria shall be a maximum air voids content of 10% and a minimum shear strength of 150 kPa.

**5.14.3 Frequency of Testing**

Trench testing shall include a testing regime as outlined below or equivalent:

- (a) For trenches in berms, testing is required at a rate of at least one test per layer of backfill per 15 metres of trench, with a minimum of two tests. Field density tests shall be carried out as noted in the above table.
- (b) For trenches in carriageways or under footpaths, testing is required at a rate of at least one test per layer of backfill per 5 metres of trench with a minimum of two tests;
- (c) Where the excavated area around manholes or other structures is greater than 0.5m<sup>2</sup> and less than 5m<sup>2</sup>, one test per backfill layer is required. For larger excavations, one test per 5 m<sup>2</sup> must be carried out.
- (d) It is important to note that more testing may be necessary to ensure that the required compaction standards are met. It is the responsibility of the Utility Operator to ensure that no settlement occurs;
- (e) All test locations must be uniformly spaced in the pavement; and
- (f) Subject to satisfactory test results the above frequency of testing may be reduced with the prior agreement of the Corridor Manager.

The testing programme must include direct measurement of field density. The frequency of field density tests shall comply with Table 8.1 of AS 3798 Guidelines for Earthworks for Commercial and Residential Developments. Table 8.1 is reproduced in part below.

**AS3798 Table 8.1**

**Frequency of Field Density Tests**

Type of Earthworks	Frequency of tests (see Note 2)
Type 4 Confined operations (e.g. filling behind structures (see Note 4))	1 test per 2 layers per 50m <sup>2</sup>
Trenches	1 field density test per 2 layers per 40 linear metres

For indirect tests, the Scala Penetrometer or Clegg Hammer may be used. If the Scala Penetrometer is used the results must be correlated with the results of field density tests.

The Clegg hammer can be used for testing of general fill and base layers but not for the upper base layer of carriageways.

Compaction must not be less than that necessary to achieve the following at all depths of any backfill.

**Table 1: Compaction Testing**

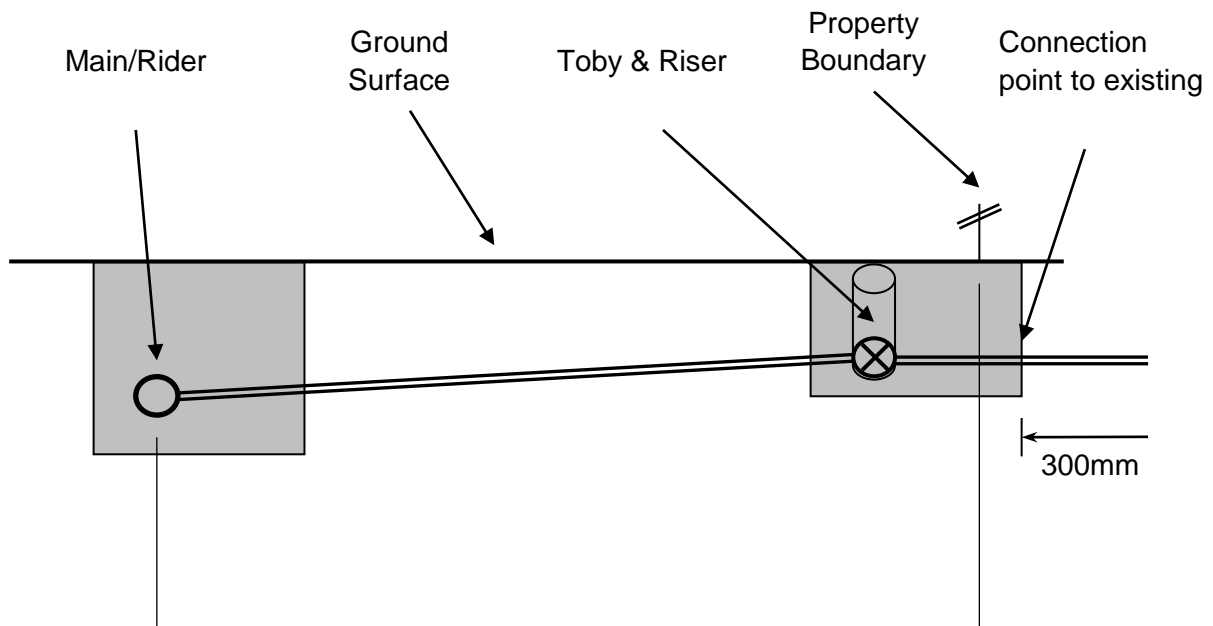
	<b>Carriageway</b>	<b>Footpath</b>	<b>Berm</b>
Base	98% MDD	CIV 25	NA
Sub-base	CIV 35	CIV 25	NA
Deeper Fill	CIV 25	CIV 15	CIV 10

**Note:** Clegg hammer tests only indicate the compaction of the lift last laid of any backfill layer. These compaction tests must be carried out on every lift of each tested backfill layer to be assured of proper compaction of all of the backfill.

In the case of sand a lesser compaction requirement may be approved by the Corridor Manager if it can be clearly shown that the compaction is at least as much as the undisturbed sand in the adjoining ground.

The results of tests taken must be recorded and made available to the Corridor Manager.

**5.15 Connections (Standard Details)**



## 5.16 Disinfection and Flushing

The pipeline is to be thoroughly flushed, pressure tested, disinfected using dissolved HTH or liquid sodium hypochlorite and left pressurised prior to commissioning.

Sufficient chemical should be applied to achieve a free available chlorine (FAC) concentration of between 10 and 100mg/litre. The FAC at the end of the disinfection period shall not be less than 10mg/litre. If the concentration is less than this the pipeline shall be flushed and the disinfection process repeated. Liquid disinfection agent shall be used in this situation.

The amount of chlorine agent to be added is calculated from the formula:

$$\text{Target chlorine concentration (grams/m}^3\text{)} = \frac{\text{weight of available chlorine (gm)}}{\text{volume of pipeline (m}^3\text{)}}$$

Where:

Weight of available chlorine = weight of chlorine chemical (grams) x % of available chlorine

Volume of the pipeline = length (m) x (diameter (m))<sup>2</sup> x 0.785 (m<sup>3</sup>)

And diameter (m) = pipe diameter (mm)/1,000

## 5.17 Testing

Prior to testing, the Developer shall flush the complete pipeline out with clean water. The Authorised Representative's representative shall be notified by the Developer a minimum of 24 hours prior to any test being carried out.

### Pressure Testing Procedure – Water

The reticulation shall withstand a pressure of 1400kpa measured at the lowest point of the section under test or 1.5 times the working pressure at any point in the system, whichever is greater.

The pressure shall be maintained for a period of 15 minutes. After 15 minutes the pressure drop shall not exceed 10% of test pressure.

Pressure test shall be carried out in the presence of the Authorised Representative of Council.

The Developer shall repair any leakage found.

## 6 MANHOLES AND SUMPS

### Contents

6.1	Manholes.....	47
6.1.1	Definitions.....	47
6.1.2	Manhole Risers.....	47
6.1.3	Droppers.....	47
6.1.4	Manhole Frames and Covers.....	48
6.1.5	Benching .....	48
6.1.6	Pipe Penetrations .....	48
6.1.7	Joints Adjacent to Structures .....	48
6.2	Manhole Testing .....	48
6.3	Sumps .....	49
6.3.1	Definitions.....	49
6.4	Backfilling and Compaction.....	49

## **6 MANHOLES AND SUMPS**

### **6.1 Manholes**

#### **6.1.1 Definitions**

- (i) Standard manholes: These shall be constructed where changes in direction, level, pipe diameter or gradient are required at the manhole, or at junctions, or on long straight lengths of pipeline.
- (ii) Drop Manholes: These shall be constructed where the invert of the incoming sewer is at a height of 350mm or more above the highest level of benching.
- (iii) Crossover Manholes: These are constructed where two pipes cross each other at a conflicting level. Normally the smaller pipe shall pass through the manhole intact with the larger pipe being open and having an inverted siphon formed in the manhole benching to enable flow beneath the crossing pipe.
- (iv) Riser Manholes: Riser manholes shall generally consist of a standard manhole without a base mounted on the large diameter pipe.
- (v) Diversion Manholes: These are constructed to divert low flow from existing combined sewers to new sanitary sewers.

#### **6.1.2 Manhole Risers**

Manholes shall be constructed from circular, precast reinforced concrete riser sections with a nominal internal diameter of 1050mm for pipes less than 900mm in diameter except as otherwise specified on the Drawings. Manhole risers shall comply with AS/NZS 4058 Precast concrete pipes (pressure and non-pressure). The maximum permitted installed out of plumb shall be 25mm of horizontal deviation in 1m of vertical riser.

All manholes having a depth, measured from the cover level to the soffit of the main pipe, in excess of 1m shall be provided with step irons evenly spaced at nominal 300mm vertical intervals. The lowest iron or rung shall be not more than 450mm above the benching and the highest not more than 600mm below the top surface of the manhole cover. Step irons shall be 225mm 'Aymroo' or approved equivalent complying with NZS/AS 1657.

#### **6.1.3 Droppers**

Any sanitary sewer discharging at a height of 350mm or more above the highest level of benching, laterals included, shall have drop inlets constructed to direct incoming flows to floor channels.

#### **6.1.4 Manhole Frames and Covers**

The Developer shall make up the height between the manhole roof slab or precast lid and the finished ground or roadway level using concrete riser rings. The manhole frame and cover shall be set in concrete so as to finish flush with the finished ground or roadway level. The concrete shall be finished in a way that allows the final ground surface covering to be brought close to the cover frame. Unless otherwise noted on the drawings, manholes shall be fitted with heavy-duty cast iron spigot frames and covers complying with Class C AS 3996 'Access covers and frames'.

#### **6.1.5 Benching**

Benching shall be concrete rendered to a smooth finish and shall slope towards the channel. Particular care shall be taken to create smooth transitions at bends and junctions.

#### **6.1.6 Pipe Penetrations**

Pipe penetrations shall be formed by drilling holes around the line of cut before knocking the section out.

The diameter of the hole cut out shall be a maximum of 100mm greater than the outside diameter of the pipe and all such junctions of pipe to manhole shall be concrete sealed with haunching around the pipe outside the manhole and flush finished inside. PVC pipes into Manholes shall be glued and gritted to provide waterproofing seal with the epoxy.

All manhole sections with hair cracks or other damage as a result of cutting, or any other reason, will be condemned and shall be replaced.

#### **6.1.7 Joints Adjacent to Structures**

A flexible joint shall be provided in accordance with drawing CM-WDC-004 and CM-WDC-016. PVC shorts into Manholes shall be glued and gritted to provide a waterproof seal to the epoxy.

### **6.2 Manhole Testing**

All chambers shall be water tested. For the application of the water test, the pipes connected to the chamber shall be sealed with watertight plugs and the chamber filled with water to within 150mm of lid level. The water shall be allowed to stand for at least 30 minutes after filling, during which time all exterior surfaces shall be checked for any leakage, and shall then be "topped up" to the initial level.

The amount of water leakage from the chamber under test shall not exceed 1/300 of the volume of the chamber during the period of 30 minutes.



Where the Developer believes that water testing is inappropriate or unnecessary, and the Authorised Representative agrees with the assessment, the Authorised Representative may waive this testing requirement. If the testing requirement is waived, an inspection programme shall be carried out in accordance with the following quality management procedure:

- (a) Prior to any work that will not be water tested being carried out, the Developer shall submit to the Authorised Representative a quality plan that shall include, but not be limited to:
  - the jointing systems and general construction approach
  - the procedure(s) which shall be used for making joints between components and for connecting in pipes
  - the name and qualifications of the person(s) who will carry out the work
  - the procedure for inspecting the work, including at what stage (i.e. during or after jointing) inspection is to be carried out
  - the procedure for recording that the work and the inspection(s) have been carried out in accordance with the quality plan requirements.
- (b) The Authorised Representative shall approve inspection rather than testing for individual manholes separately and shall give his approval only on receipt of a satisfactory quality plan. This approval by the Authorised Representative shall not transfer any liability for the quality of the Works from the Developer who shall remain totally responsible for the Works.
- (c) Records of construction work and inspections shall be forwarded to the Authorised Representative within 24 hours of the work being carried out.

## **6.3 Sumps**

### **6.3.1 Definitions**

- (i) Standard open-back sumps: These shall be constructed where shown on the drawings in accordance with the standard detail shown on Drawing CM-WDC-005. If precast sumps are to be retrofitted into existing kerb and channel new concrete kerb and channel shall be constructed for a length of 500mm either side of the sump.
- (ii) Sumps shall be precast concrete sumps as detailed on the drawings. ('Humes' or similar approved sump catchpit).
- (iii) Sump grates shall be 'Humes' or similar approved grates and frame as shown on the Plans.

## **6.4 Backfilling and Compaction**

Backfilling and compaction around manholes and sumps shall be done in a manner which avoids uneven loading or damage.

Where the excavations have been supported and the supports are to be removed, these where practicable, shall be withdrawn progressively as backfilling proceeds in such a manner as to minimise the danger of collapse. All voids formed behind the supports shall be carefully filled and compacted.

Where the excavated area is greater than 0.5m<sup>2</sup> and less than 5m<sup>2</sup>, one test per backfill layer is required. For larger excavations, one test per 5m<sup>2</sup> must be carried out. Refer to Section 3.

**7 CONCRETE WORK**

**Contents**

7.1 Materials ..... 52  
7.2 Construction ..... 52  
7.3 Inspection ..... 52  
7.4 Surface Finishes ..... 53

## **7 CONCRETE WORK**

### **7.1 Materials**

Except where modified by this Specification, concrete shall comply with the requirements of NZS 3109, for the grades of concrete shown on the Drawings. Where not otherwise stated, concrete shall be Ordinary Grade with a specified strength of 20MPa.

Cement shall be fresh ordinary Portland cement, complying with NZS 3122. Aggregate shall comply with NZS 3121, with coarse aggregate having a nominal maximum size of 19.0mm. If requested, samples and test certificates for concrete materials shall be made available to the Authorised Representative prior to placing concrete.

### **7.2 Construction**

Except where modified by this Specification, construction shall comply with the requirements of NZS 3109 'Concrete Construction'. The Developer shall provide adequate formwork and employ effective methods of placing, compacting, protecting and curing all concrete. Formwork shall be sufficiently sized and tight to prevent loss of mortar material from the concrete and to maintain the correct position, shape and dimensions of the finished work. Formwork shall be so constructed as to be removable from the cast concrete without shock or damage.

Concrete shall be protected from drying and the effect of early loading by methods that ensure cracking and distortion are minimized.

Reinforcement shall be firmly supported in position and secured against displacement. Laps and joists in reinforcement shall be made only where unavoidable and at the position agreed by the Authorised Representative.

Concrete shall not be placed if any substance which might adversely affect the steel or concrete chemically or reduce the bond is present on the reinforcement

### **7.3 Inspection**

Concrete construction shall require inspection by the Authorised Representative and shall be reported for inspection when all formwork is in position and reinforcement is placed and tied. Prior to concrete being placed in any section of the work the Developer shall give 24-hour notice to the Authorised Representative.

## 7.4 Surface Finishes

Surfaces shall be finished in accordance with NZS 3114 'Specification for Concrete Surface Finishes' to the quality set out below:

(a) Surfaces exposed to view above ground level or in contact with water or sewage:

Formed surfaces	F3
Unformed surfaces generally	U2
Pump well benching	U3
Footpaths and vehicle crossings	U5
Kerb and channel	U3

(b) Surfaces not exposed to view, nor in contact with water or sewage:

Formed surfaces	F1
Unformed surfaces	U1

## 8 PAVEMENT CONSTRUCTION

### Contents

8.1	General.....	55
8.1.1	Survey and Setting Out.....	55
8.2	Subgrade Strength .....	55
8.3	Sub-base .....	56
8.4	Basecourse.....	56
8.4.1	Aggregate.....	56
8.4.2	Pavement Construction Using Shellrock Basecourse .....	57
8.4.3	Maintenance of Basecourse .....	57
8.5	Pavement Surface Finish & Tolerances.....	58
8.5.1	Deflection Testing.....	58
8.5.2	Surface Roughness .....	58
8.6	Subsequent Surfacing .....	59
8.7	Inspection and Testing.....	59

## **8 PAVEMENT CONSTRUCTION**

### **8.1 General**

Pavement construction shall be carried out to the alignments, depths and standards detailed in the approved drawings and with the specified materials so as to provide the intended design life.

All pavement layers shall be constructed in accordance with TNZ B/2 Specification and the following.

#### **8.1.1 Survey and Setting Out**

The Developer shall employ a registered surveyor to set out the works.

For roads/street works construction the Developer shall establish batter pegs at a fixed offset from the centreline.

The subgrade, formation and basecourse levels shall be set out using lift pegs, being stakes not smaller than 50mm x 35mm in section.

The lift pegs shall be installed a maximum spacing of 20 metres on straights and 10 metres along sections where the superelevation changes.

The lift pegs shall be marked with the offset distance, subgrade surface level and finished basecourse level.

### **8.2 Subgrade Strength**

Where the extent of cut or fill for the project is too great to make subgrade CBR testing feasible at the design stage, it may be done on completion of earthworks when subgrade levels have been exposed. Even in cases where the subgrade has been tested as part of the design, its condition shall be reviewed on exposure during construction and the pavement design reviewed and pavement thicknesses adjusted accordingly.

The following lists the minimum testing the Developer shall undertake to confirm the subgrade suitability:

- Field Insitu CBR tests shall be undertaken every 75m, with a minimum of 3, one located at each end of the subdivision and one midway between each end.
- Laboratory soaked CBR tests carried out on the fill material prior to starting the fill operation and on completion a test undertaken every 75m along the subgrade.
- Benkelman Beam Testing (in accordance with TNZ T/1 specification) shall be carried out on the trimmed subgrade surface. Tests shall be undertaken in both wheel paths of each lane at intervals of 10 metres. The standard of uniformity which shall be achieved is a coefficient of variation (standard deviation divided by the mean) of 0.4 or less.

This Benkelman beaming shall not be undertaken for at least 24 hours following rain.

Prior to the placement of any pavement layers the Developer shall advise Council's Representative of the results of this testing and any review, along with any consequent adjustments to pavement layer thicknesses.

The Developer shall also give Council's Representative an opportunity to inspect the subgrade prior to the placement of the pavement layers.

Any identified wet spots in the subgrade shall be drained to the pavement drains or subsoil drains. Where the wet area is below the level of the under-channel drain, it shall be drained using approved filter drainpipes connected to the nearest stormwater system. Between the date the subgrade is completed and the application of the first sub-base or basecourse layer, the subgrade shall be maintained true to grade and cross section. Should pot-holes or ravelling develop in the subgrade, the area so affected shall be scarified and clean metal added and recompacted.

### **8.3 Sub-base**

The sub-base aggregate shall comply with the following

- Be free of non-mineral matter
- Grading
  - o 100% by mass passing the 75mm standard sieve
  - o At least 45% by mass passing the 19mm sieve
  - o No more than 70% by mass passing the 9.5mm sieve
  - o No more than 15% by mass passing the 300 micron sieve
- Broken faces, no requirement
- Have a soaked CBR value greater than 30 with a sand equivalent greater than 40, or less than 10% by weight passing the 425 micron sieve.

### **8.4 Basecourse**

#### **8.4.1 Aggregate**

All basecourse shall comply with TNZ M/4 specification.

Prior to the delivery of any basecourse to the site the Developer shall supply a test result to the Authorised Representative to verify that the basecourse source is currently meeting all requirements of that Specification.

Once basecourse construction commences, the Developer shall arrange for the sampling and testing of the basecourse grading, sand equivalent, and percentage of broken faces to confirm compliance with TNZ M/4. If shellrock is used the clay index shall also be tested, regardless of the result of the sand equivalent test. These samples shall be taken from the truck discharge point on site



The frequency of these tests shall be the greater of either two tests per site or one test per 200m<sup>3</sup> of basecourse.

#### **8.4.2 Pavement Construction Using Shellrock Basecourse**

Construction of Shellrock pavements require techniques which do not apply to normal basecourse aggregates complying with NRB Specification M/4.

If Shellrock basecourse is used the following clauses shall apply and shall take precedence over TNZ Specification B/02.

Shellrock pavements shall be full depth AP40. Subbase shall not be used.

Shellrock shall be laid on the prepared surface in layers not exceeding 100mm loose thickness. The material shall be placed over the full pavement width from the time the first loads are placed and the final pavement profile shall be maintained as the pavement depth is built up.

Primary compaction shall be carried out using steel wheel and vibratory rollers. Finishing compaction shall be achieved using steel wheel and pneumatic tyred rollers. This compaction plant shall comply with clause 6.3 of NRB B/2:1985.

If during final compaction particles begin to adhere to steel wheel rollers where the material has been watered to aid compaction, rolling using steel rollers shall cease and final compaction shall be achieved using self propelled rubber tyred rollers.

The final layer shall result in a compacted surface approximately 10mm higher than the required finished level.

The final level shall be achieved by cutting off the surplus material.

Instability in the basecourse shall be remedied by either scarification of the affected area and recompaction, or digging out the unstable material, blending it with additional shellrock and recompacting it.

The finished surface shall be allowed to mature for at least 24 hours with running course applied.

The running course shall be reject grade 5 sealing chip.

#### **8.4.3 Maintenance of Basecourse**

The finished aggregate surface shall be maintained at all times true to grade and cross section by placement of a "running course", watering as required, trimming, rolling and taking appropriate measures to ensure the even distribution of traffic. Every precaution shall be taken to ensure that the surface of the basecourse does not pot-hole, ravel, rut or become uneven, but should any of these conditions become apparent, the surface shall be patched with replacement complying aggregate and completely scarified and recompacted. The basecourse shall be

maintained to the specified standards until covered with the impermeable surfacing layer.

## 8.5 Pavement Surface Finish & Tolerances

### 8.5.1 Deflection Testing

Prior to placing the surfacing layer deflections shall be tested by the Benkelman beam method (TNZ T/1). A reading 250mm from the test point shall also be recorded to determine the bowl ratio below.

At least 95 % of all tests shall comply with the standards specified in the following table, with no test greater than 10 % beyond that specified.

Readings shall be taken in both wheel paths of each lane and at a maximum interval of 10 m.

Hierarchy	Chip Seal		Thin AC or other mix	
	Maximum Deflection (d <sub>0</sub> )	Minimum bowl ratio (d <sub>250</sub> /d <sub>0</sub> )	Maximum Deflection (d <sub>0</sub> )	Minimum bowl ratio (d <sub>250</sub> /d <sub>0</sub> )
Cul-de-sac	2.0mm	N/A	1.6mm	0.54
Minor residential	2.0mm	N/A	1.6mm	0.54
Sub-Collector	1.6mm	N/A	1.0mm	0.65
Industrial Road	1.2mm	N/A	0.7mm	0.7
Industrial Service Lane	1.2mm	N/A	1.0mm	0.65
Collector Road	1.2mm	N/A	1.0mm	0.65
Arterial Road	1.0mm	N/A	0.7mm	0.70

**Table: Benkelman Beam deflections**

### 8.5.2 Surface Roughness

Further to Clauses 7.7 (Surface Shape) and 7.8 (Surface Finish) of TNZ B/2 Specification.

The finished surface shall achieve an average NAASRA roughness value shown below.

The roughness readings are to be recorded at 20m intervals and in each lane.

<b>Surfacing Type</b>	<b>Maximum average roughness NAASRA count/km</b>	<b>Maximum of any one reading NAASRA count/km</b>
Chip Seal	70	100
Thin AC or other mix	50	85

**Table: NAASRA Roughness maximum readings**

## **8.6 Subsequent Surfacing**

The subsequent surfacing can be either a chip seal in accordance with Council's specification "Subdivisions: Two Coat First Coat Sealing" or thin asphalt in accordance with Council's specification "Subdivisions: Thin Asphaltic Surfacing".

However, as a minimum, the head of any cul-de-sacs shall be surfaced with asphalt as above.

## **8.7 Inspection and Testing**

Further to the testing requirements in TNZ B/2 specification clauses 7.5 and 7.6 and the clauses above.

When the Developer is satisfied that all required test results, (including the results of any retesting of required remedial works), indicate that the pavement is suitable for surfacing he shall give Council's Representative at least 48 hours to inspect the surface for acceptance prior to the application of that surfacing.

**9 CHIP SEALING**

**Contents**

9.1 Materials ..... 61

    9.1.1 Sealing Chip ..... 61

    9.1.2 Bitumen ..... 61

9.2 Two Coat First Coat Sealing ..... 61

    9.2.1 General..... 61

    9.2.2 Flushing/Bleeding ..... 62

    9.2.3 Sealing Chip Retention ..... 62

    9.2.4 Remedial Repairs ..... 62

    9.2.5 Basis of Payment..... 62

9.3 Second Coat Sealing ..... 62

    9.3.1 General..... 62

    9.3.2 Flushing/Bleeding ..... 62

    9.3.3 Sealing Chip Retention ..... 62

    9.3.4 Remedial Repairs ..... 63

    9.3.5 Basis of Payment..... 63

## **9 CHIP SEALING**

### **9.1 Materials**

#### **9.1.1 Sealing Chip**

Sealing chip shall comply with the TNZ M/6 Specification

Prior to the delivery of any sealing chip to the site the Developer shall supply the Authorised Representative with a test result for the chip size(s) proposed to verify that the chip source is currently meeting all requirements of TNZ M/6.

During sealing construction, the Developer shall arrange for the sampling and testing of chip samples for each grade of chip used to verify that the chip size, shape and cleanliness comply with TNZ M/6.

The frequency of these tests shall be one test per chip size per 800 lineal metres of subdivision or part thereof.

The Developer shall give the Authorised Representative at least 48 hours' notice that sealing work is proposed. At that time, the Developer shall nominate his seal design and proposed bitumen application rates and submit these to the Authorised Representative for comment.

Council's Representative will carry out a preseal inspection on the day of sealing. The Developer shall ensure all loose material is removed prior to the inspection. Commencement of the first coat sealing is subject to the inspection and approval of the Authorised Representative.

#### **9.1.2 Bitumen**

Bitumen shall comply with TNZ Specification M/1. The Developer shall arrange for the sampling of bitumen. These sample tins shall be provided to the Authorised Representative on the day of sealing, and be named with site name, type and proportions of diluents and sealing date.

### **9.2 Two Coat First Coat Sealing**

#### **9.2.1 General**

The outcome of the sealing is to provide:

- Waterproofing of the pavement layers
- Even surface texture.

First coat sealing shall be two coat using 180/200 penetration grade cutback bitumen and grades 4 and 6 sealing chip unless instructed otherwise by the Authorised Representative. Sealing shall be in accordance with TNZ P/3

Specification, as modified below, and the 2005 publication 'Chipsealing in New Zealand'.

#### **9.2.2 Flushing/Bleeding**

The finished seal surface shall not show any signs of flushing or bleeding. Flushing and bleeding shall be as defined in Clause 13 of TNZ C/1 General Maintenance Specification.

#### **9.2.3 Sealing Chip Retention**

The chip retention requirement shall be as defined in Clause 28 of the TNZ P/3 Specification.

#### **9.2.4 Remedial Repairs**

If required, remedial repairs to the seal coat shall be as specified in Clause 28.4 of TNZ P/3 Specification.

#### **9.2.5 Basis of Payment**

Clause 29 of TNZ P/3 Basis of Payment shall not apply to this work.

### **9.3 Second Coat Sealing**

#### **9.3.1 General**

Second coat sealing shall be carried out in accordance with TNZ Specification P/4, as modified below, and the 2005 publication Chipsealing in New Zealand.

The second seal coat shall be applied between 12 and 18 months after the first coat.

Second coat sealing shall be single coat using 180/200 penetration grade cutback bitumen and grade 4 sealing chip unless instructed otherwise by the Authorised Representative.

#### **9.3.2 Flushing/Bleeding**

The finished seal surface shall not show any signs of flushing or bleeding. Flushing and bleeding shall be as defined in Clause 13 of TNZ C/1 Specification.

#### **9.3.3 Sealing Chip Retention**

The chip retention requirement shall be as defined in Clause 25.1 of the TNZ P/4 Specification.

**9.3.4 Remedial Repairs**

If required, remedial repairs to the seal coat shall be as specified in Clause 25.3 and 25.4 of TNZ P/4 Specification.

**9.3.5 Basis of Payment**

Clause 26 of TNZ P/4, Basis of Payment shall not apply to this work.

## 10 THIN ASPHALTIC SURFACING

### Contents

10.1	General.....	65
10.2	Production .....	65
10.3	Construction .....	65
10.3.1	Membrane seal.....	65
10.3.2	Asphalt .....	66
10.3.3	Paving Plan .....	66
10.3.4	Construction of Ramps .....	66
10.4	End Result.....	66
10.4.1	Flushing/Bleeding .....	66



## **10 THIN ASPHALTIC SURFACING**

### **10.1 General**

This section sets out the requirements for constructing thin asphaltic concrete surfacings.

### **10.2 Production**

The Developer shall nominate the job-mix formula (JMF) showing the types and proportions of the mineral aggregates, and proposed binder to manufacture the thin asphalt surfacing.

Before laying the asphalt the Developer shall submit test results that clearly demonstrate that the proposed JMF complies with the requirements of this Section. In particular the Developer shall provide the following information for each JMF.

(a) graphs of bitumen content versus:

bulk density (t/m<sup>3</sup>)

air voids (%)

VMA (%)

stability (kN)

flow (mm)

(b) the bitumen film thickness

### **10.3 Construction**

#### **10.3.1 Membrane seal**

To ensure waterproofing of the basecourse a membrane seal shall be applied over the full extent of the basecourse surface prior to the application of the asphalt surfacing.

This membrane seal shall consist of an application of bitumen at between 1.1 and 1.5 l/m<sup>2</sup> residual rate, followed by grade 4 sealing chip.

The bitumen cut back shall be as for a first coat seal. The chip cover shall be at least 80% where the road is to be trafficked, and it shall be allowed to 'cure' for at least two weeks prior to the application of the asphalt.

The chip shall comply with TNZ M/6 specification.

Any loose chip shall be removed prior to the application of the asphaltic concrete surfacing.

### **10.3.2 Asphalt**

The asphalt to be used shall be Mix 10, using bitumen of penetration grade 80/100 and complying with TNZ M/10:2005 specification. The Developer shall sample and test this to provide evidence of compliance.

Quality Assurance requirements for the asphalt shall be in accordance with TNZ Q/2 specification.

The depth of asphalt shall be 30mm.

The construction of the asphalt including finished surface tolerances shall be in accordance with TNZ P/9P specification.

To achieve the requirements of table 5.3 of TNZ M/10 specification, rolling with an 8 - 10 tonne steel wheel finishing roller is likely to be required.

### **10.3.3 Paving Plan**

Further to clause 6.2 of TNZ P/9P, the Developer shall provide a paving plan of the site, showing the location of each proposed paver run and all joints for agreement with the Authorised Representative. The paving construction shall then be carried out according to this agreed plan.

### **10.3.4 Construction of Ramps**

Where the asphalt is to join an existing sealed or asphalt surface this must be ramped transversely (using asphalt concrete) down onto the existing pavements over a length of 4 metres, so the transition from the existing surface to the new surface is smooth and continuous. The ramps must be milled so a clean vertical joint is provided.

## **10.4 End Result**

### **10.4.1 Flushing/Bleeding**

The finished asphalt surface shall not show any signs of flushing or bleeding. Flushing and bleeding shall be as defined in Clause 13 of TNZ C/1 Specification.

## 11 KERB AND CHANNEL, FOOTPATH AND VEHICLE CROSSING CONSTRUCTION

### Contents

11.1	Scope .....	68
11.2	Generally .....	68
11.3	Materials .....	68
11.4	Concrete Construction .....	68
11.5	Kerb and Channel.....	68
11.5.1	Forming the Kerb and Channel.....	68
11.5.2	Concrete Strength .....	68
11.5.3	Position and Alignment .....	68
11.5.4	Inspection and Testing.....	69
11.5.5	Surface Finish and Tolerances .....	69
11.6	Footpath and Vehicle Crossing.....	69
11.6.1	Materials .....	69
11.6.2	Dimensions.....	69
11.6.3	Position and Alignment .....	70
11.6.4	Excavation .....	70
11.6.5	Subgrade.....	70
11.6.6	Undercutting and Replacement .....	70
11.6.7	Fill.....	70
11.6.8	Foundations.....	70
11.6.9	Joints .....	71
11.6.10	Inspection and Testing .....	71
11.6.11	Surface Finish and Tolerances.....	71
11.6.12	Mobility Crossing Ramps.....	72

## **11 KERB AND CHANNEL, FOOTPATH AND VEHICLE CROSSING CONSTRUCTION**

### **11.1 Scope**

This specification covers the construction of kerb and channel, new concrete footpath and the renewal or replacement of sections of concrete footpath, and vehicle crossings.

### **11.2 Generally**

Construction shall generally be in accordance with the requirements of NZS 4404 Land Development and Subdivision Engineering.

### **11.3 Materials**

Concrete shall be ready mixed concrete complying with NZS 3104: Specification for Concrete Production. Concrete shall have a minimum 28 day strength of 20 MPa.

### **11.4 Concrete Construction**

Construction shall be in accordance with NZS 3109: Concrete Construction.

### **11.5 Kerb and Channel**

#### **11.5.1 Forming the Kerb and Channel**

The base on which the kerb and channel is laid shall be 100mm of basecourse compacted to the same density and frequency as the road basecourse.

A concrete extrusion machine of approved design and performance shall be used for constructing the kerb and channel.

Concrete used shall be of such consistency that after extrusion it will maintain the kerb shape without support. The extrusion machine shall be operated to produce a well compacted mass of concrete free from surface pitting.

The dimensions of the kerb profile and the kerb base shall be as per Whanganui District Council standard drawing.

#### **11.5.2 Concrete Strength**

Concrete shall be of not less than 20MPa, 28 day strength.

This shall be cured for at least 7 days during dry weather.

#### **11.5.3 Position and Alignment**

All curves both horizontal and vertical shall be tangential to straights and the lines and levels of kerbs shall be such as to give the finished kerbs smooth lines free of kinks and angles.

#### 11.5.4 Inspection and Testing

At least 24 hours prior to the pouring of any concrete the Developer shall give Council's Representative an opportunity to inspect the prepared base.

The prepared base shall have a minimum CIV of 35 and shall be tested at 5m intervals.

If requested by Council's Representative the Developer shall provide test results to verify that the concrete being used meets the strength requirements.

#### 11.5.5 Surface Finish and Tolerances

The exposed faces of the kerb and channel shall present a smooth, uniform appearance free from honey-combing or other blemishes to at least U3 standard in terms of NZS 3114.

Construction joints shall be placed in all unreinforced kerb and channel at 3 metre centres.

Workmanship standards shall be such that, on straights, kerbing shall not deviate from a straight line by more than 6 mm in any length of 3 m. Similar standards shall apply to the gradient line.

The completed kerb and channel shall not pond water.

### 11.6 Footpath and Vehicle Crossing

#### 11.6.1 Materials

All footpaths and vehicle crossings shall be constructed in concrete.

#### 11.6.2 Dimensions

##### Width

Footpaths shall be 1.5m wide unless otherwise specified on the Drawings.

Crossing dimensions shall be in accordance with Whanganui District Council standard drawings.

##### Thickness

Concrete footpaths shall be 75mm thick except at vehicle crossings where footpath sections shall be 100mm thick across private crossings, 150mm thick across right-of-way crossings, and 200mm thick across commercial crossings.

### **11.6.3 Position and Alignment**

The longitudinal and vertical alignment of the footpath shall follow that of the adjacent kerb, the footpath shall be constructed to provide a 3% cross fall sloping toward the kerb top.

Berm cross fall shall be 4% sloping toward the kerb top.

Crossing dimensions shall be as per Whanganui District Council standard drawings.

### **11.6.4 Excavation**

Excavation for the footpath shall include the removal and disposal of grass, vegetation, topsoil, roots, basecourse, asphalt, concrete and any other unsuitable material down to formation level.

### **11.6.5 Subgrade**

Suitable subgrade shall be free of organic material and have a CBR of not less than 7.

Suitable subgrade shall have a Scala Penetrometer reading of not less than 4 blows per 100mm.

The Developer shall carry out Scala Penetrometer tests at intervals not greater than 15m, with a minimum of one test per section, or as agreed with the Authorised Representative.

### **11.6.6 Undercutting and Replacement**

The Developer shall advise the Authorised Representative where the subgrade is unsuitable for the construction of the concrete footpath. The Authorised Representative may instruct the Developer to undertake remedial measures which may include compaction or undercutting and replacement of the subgrade materials to achieve suitable subgrade as specified.

### **11.6.7 Fill**

Where the existing ground level is below the formation level and where unsuitable material is excavated and removed, the Developer shall place and compact suitable clean fill material (as approved by the Authorised Representative) to achieve the suitable subgrade as specified. Demolished footpath material shall not be used as fill.

### **11.6.8 Foundations**

Footpaths shall be formed over not less than 100mm of compacted fill. Crossings shall be formed over not less than 150 mm of compacted basecourse. The

formation is to be thoroughly compacted by rolling before any concrete is placed. Porous areas shall be blinded with sand prior to placing concrete. Testing shall be CIV at no less than 15m as per Table 1 Section 5.

The foundation shall be evenly trimmed to a cross fall of 1 in 50.

### **11.6.9 Joints**

The concrete paths shall be laid with construction joints at intervals of not greater than 3m. If paths are constructed by continuous pour techniques, clean, true, well-oiled 5mm thick steel strips at least 40mm deep shall be inserted at 3m intervals to facilitate controlled cracking. These shall be carefully removed after the concrete has set. Alternatively, the joints may be cut by means of a concrete cutting saw. In this case the cutting shall be carried out not more than 48 hours after pouring and shall be to a depth of 40mm. These joints may also be typically tooled into the concrete when the concrete is still plastic.

Construction joints are also to be placed at each side of vehicle crossings where they meet the line of the footpath.

If the footpath is to tie into an existing path, this shall be completed with a clean straight join and be constructed to the tolerances noted below.

Saw cutting of the existing path may be necessary to achieve this.

Joints shall be constructed at right angles to the edge of the path unless otherwise shown on the Drawings or instructed by the Authorised Representative and shall be straight and true.

### **11.6.10 Inspection and Testing**

At least 24 hours prior to the pouring of any concrete the Developer shall give Council's Representative an opportunity to inspect the formwork and prepared base.

If requested by Council's Representative the Developer shall provide test results to verify that the concrete being used meets the strength requirements.

### **11.6.11 Surface Finish and Tolerances**

Footpaths and vehicle crossings shall be finished to an even non-skid brush surface to finish U5 in terms of NZS 3114.

The surface of all footpaths and vehicle crossings shall not deviate by more than 6 mm from a 3 m straight edge at any point and no abrupt changes in line or level shall occur.

No footpath or vehicle crossing shall pond water.

### **11.6.12 Mobility Crossing Ramps**

Any required crossings shall also be constructed to the same requirements as for footpaths.

Mobility Crossing Ramp Crossings shall be constructed at all road intersections, as shown on the WDC Standard Drawings or as instructed by the Authorised Representative.



## 12 BERM CONSTRUCTION, TOPSOIL AND GRASSING

### CONTENTS

12.1	Scope .....	74
12.2	Topsoil.....	74
12.2.1	Quality .....	74
12.2.2	Respreading Of Topsoil .....	74
12.3	Grassing.....	74
12.3.1	Conventional Seeding.....	74
12.3.2	Fertiliser And Grass Mixtures.....	75
12.3.3	Hydroseeding .....	75
12.4	Maintenance Of Topsoiled And Grassed Areas .....	76
12.5	Landscaping .....	76

## **12 BERM CONSTRUCTION, TOPSOIL AND GRASSING**

### **12.1 Scope**

This section of the Specification covers the supply, and spreading of topsoil, landscaping and grassing as part of berm construction and site restoration on completion at the work site, borrow and disposal sites.

### **12.2 Topsoil**

#### **12.2.1 Quality**

Material removed from the work areas shall be replaced with imported topsoil to achieve the requirements of this Section of the Specification.

Topsoil is defined as that layer of material immediately below the ground surface, comprising vegetation, turf and humus or other organic material.

Topsoil shall be of good quality and free of weeds, stones and other foreign matter. 100% of the material shall pass a 9.5mm sieve.

#### **12.2.2 Respreading Of Topsoil**

Topsoil respreading shall not commence in any area of the site without the consent of the Authorised Representative.

The topsoil from the stockpile shall be spread evenly over fill batters and cut batters flatter than 1 ½ H to 1 V and other working areas as the Authorised Representative may direct.

The minimum depth of topsoil shall be 100 mm the topsoil in berms shall be graded to the footpath edge and shall be 15mm above the footpath edge to allow for compaction.

Following respreading and where required the topsoil shall be broken up into fine material by discing or rotary hoeing. All topsoil, where safely possible shall then be graded, trimmed and lightly compacted.

Compaction shall be by light roller and or normal machinery movements when lacing the topsoil. The finished surface shall be uniform and free of wheel ruts.

### **12.3 Grassing**

#### **12.3.1 Conventional Seeding**

Areas to be topsoiled and grassed shall be sown by conventional seeding methods.

As soon as possible after sections of the earthworks are completed, the Developer shall grass the areas as specified. However grassing shall only be undertaken when the seasons or weather conditions permit.

The Developer shall be responsible for achieving good strikes of grass and clover and shall repeat showings where necessary to meet this requirement. A sward coverage of not less than 90% shall be achieved prior to acceptance by Council.

The surface to be grassed shall be trimmed and where possible worked to provide a suitable bed for sowing.

### 12.3.2 Fertiliser and Grass Mixtures

- (i) Fertiliser shall be three parts of superphosphate to one part of sulphate of ammonia and applied at the rate of 60 grams per square metre.
- (ii) Grass mixtures and spreading rates shall be a blend of three fine turf rye grasses except that the Authorised Representative may approve alternative mixtures submitted for approval by the Developer if he is satisfied that the alternative mixtures will produce suitable grass swards appropriate to the locality.

### 12.3.3 Hydroseeding

All cut and fill slopes except as provided in Clause 3.2 shall be seeded by the hydroseed method using the seed mix and fertilisers specified below (or similar as approved by the Authorised Representative).

Mulch shall be newsprint (or equivalent) applied at a minimum rate of 1250 kg/ha weight and the adhesive shall be PVA (or equivalent) applied at a minimum rate of 100 l/ha. In any case the rates shall be those approved by the Authorised Representative as appropriate for the steepness of the slope and the weather conditions prevailing at the time.

<u>Seed Mix</u>	
Italian Rye Grass	35 kg per hectare
Perennial Rye Grass	15 kg per hectare
Brown Top	5 kg per hectare
Yorkshire Fog	8 kg per hectare
Rye Corn	9 kg per hectare
2 parts White and Suckling Clover 70/30	8 kg per hectare
Lotus Maku	2 kg per hectare
Rd Clover	6 kg per hectare
Subterranean Clover	<u>2 kg per hectare</u>
	90 kg per hectare

Fertilisers

12:10:10 NPK

600 kg per hectare

The above application rates are based on the Developer being able to achieve a reasonable adherence of seed to the steep cut faces. The Authorised Representative may approve alternative rates which prove to be better suited for the steepness of the face and the prevailing weather conditions at the time.

Hydroseeding shall not be carried out during a period of heavy rainfall, prior to anticipated heavy rain or during prolonged dry weather.

**12.4 Maintenance of Topsoiled and Grassed Areas**

The Developer shall be responsible for maintaining all topsoiled and grassed areas until a strong, stable covering of grass has been established. Berms shall be maintained free of weeds and depressions and be mown for the duration of the Defects Liability Period.

Any erosion channels occurring from water run off on sloping areas shall be repaired by spreading of additional topsoil material and, if necessary regrassing, all at the expense of the Developer.

**12.5 Landscaping**

Any landscaping within the public road reserve shall be in accordance with Part 7 of NZS 4404. Any existing surface features such as trees, shrubs, bushes, gardens, fences, hedges, buildings of any kind, pavements, road markings, services which are removed or damaged by the Developer in the course of his activities shall be immediately repaired, replaced or reinstated to a standard not inferior to that which existed prior to commencement of work.