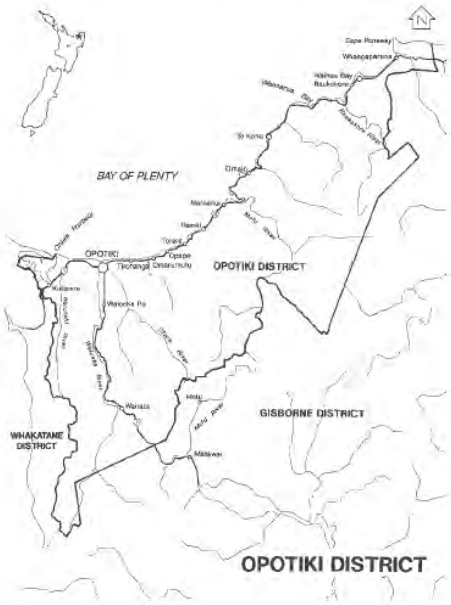
Opotiki District Council

Version 1.0
August 2000
Amended September 2001

Code of Practice - Subdivision and Development



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August 2000

This "Code of Practice – Subdivision and Development" was adopted by Council Resolution No. 59 at an Ordinary Meeting of the Opotiki District Council held on August 22, 2000
Minor Typographical Errors Amended September 2001

SCHEDULE OF AMENDMENTS

Issue No. _____

Organisations and individuals holding copies of this "Code of Practice – Subdivision and Development" are requested to note any changes required and to forward any amendments to Opotiki District Council for the attention of the Engineering Secretary.

Amendment No.		Date	Entered by
1	Standard Drawing R28 – Change to Note 2.	24/03/03	EZ Newell – Eng Sec

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APPENDICES

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Section 1.0

General Requirements

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SECTION 1.0 - GENERAL REQUIREMENTS

1.1 DEFINITIONS

In this Standard, unless inconsistent with the context, the following definitions shall apply:

'Bulk Earthworks' means any earthworks operations involving movement of more than 200 cubic metres volume of material.

'Carriageway' means any portion of a road used by motor vehicles.

'Cleanfill' means material consisting of natural components, such as clay, soil and rock and such other materials such as concrete, brick or demolition produces (excluding asphalt), which are free of combustible and organic materials, free of voids and which are not subject to biological or chemical breakdown and shall not be capable of leaching chemicals or toxins into the environment.

'Council' means the Opotiki District Council.

'Developer's or Subdivider's Representative' shall be a Registered Engineer, registered surveyor, experienced in subdivisional engineering, appointed by the subdivider to represent him in all technical matters connected with the subdivision.

'Drainage' means sanitary drainage and/or stormwater drainage and includes pipes, open drains and sewerage treatment plants, and "drain" has a corresponding meaning.

'Earthworks' means any alteration to the contours, including the excavation and backfilling or recompaction of existing natural ground and the stripping of vegetation and topsoil.

'Engineer' means the Engineering and Services Manager of the Opotiki District Council or any other officer or other person appointed by the Council to control engineering work of the Council.

'Footpath' means so much of any road as is laid out or constructed by authority of the Council primarily for pedestrians; and may include the edging, kerbing and channelling thereof.

'Ground' is a general term used to describe the material in the vicinity of the surface of the earth whether soil or rock.

'Land Drainage System' refers to the flow of surface and ground water but concentrates mainly on peak surface discharges and their regulation under urban conditions.

'Owner' in relation to any land or interest therein, includes an owner thereof, whether beneficially or as trustee, and his/her agent or attorney, and a mortgagee acting in exercise of power of sale; and also includes the Crown, the Public Trustee, and any person, local authority, board, or other body or authority however designated, constituted or appointed, having power to dispose of the land or interest therein by way of sale, and may include the owner's representative.

'Subdividing Owner' means the owner of the land to be subdivided, until allotments are sold.

'Post Construction Settlement' means the settlement of the ground surface which takes place after completion of the construction of the earthworks.

'Primary Design Flow' is the estimated stormwater runoff selected to provide a reasonable degree of protection to the surrounding land. In most cases, this flow will be piped or contained within relatively narrow confines under public control and be protected by a reserve or easement.

'Private Road' means any roadway, place, or arcade laid out within the district on private land by the owner there of but intended for the use of the public generally.

'Private Way' means any way or passage whatsoever over private land within the district, the right to use which is confined or intended to be confined to certain persons or classes of persons, and which is not thrown open or intended to be open to the use of the public generally.

'RMA 1991' means Resource Management Act 1991.

'Road' or *'Street'* means any area under the control of the Opotiki District Council and includes State Highways, whether formed or unformed. It includes carriageways, berms and other grassed areas, footpaths and pedestrian accessways, and is the total area from boundary to boundary, customarily referred to as 'road reserve'.

'Sanitary Drainage' means drainage primarily for the reception and discharge of pollutants and wastewater.

'Secondary Flow Path' refers to the path taken by stormwater runoff in excess of the primary design flow and should be capable of producing a reasonable degree of protection to the surrounding buildings.

A freeboard above the second flow level is required when determining allowable floor levels. This is to cater for flood surface undulation, tolerance for flow estimation methods, and for possible failure of the primary system.

'Shall' indicates a requirement that is to be adopted in order to comply with the Standard, while the words *'should'* or *'may'* indicate a recommended practice.

'Soil' means the heterogeneous aggregation of particles comprising either peat, clays, silts, sands, gravels, crushed and re-oriented rock fragments, or a mixture of any of the above. The term excludes rock that is intact rock masses whether highly jointed or not.

'Cohesionless Soil' means a non-plastic soil (sand, gravel) where the strength is derived primarily from cohesion between the soil particles.

'Soft Soil' means cohesive soil having a low shear strength (less than 25 kPa).

'Loose Soil' means cohesive soil (having a Standard Penetration resistance of less than 10 blows per 300 mm). Also refers to uncompacted or poorly compacted fill.

'Soils Engineer' means a person who is currently entitled to practice as a Registered Engineer and has experience in soils engineering acceptable to the Council;; or such other person as the Council may specifically approve as being competent.

'Stable Ground' means grounds existing in a state which can be shown by a Soils Engineer is unlikely to settle, slip, erode or otherwise move to the detriment of superimposed buildings, services, roads or property generally.

'Stormwater' means water or other runoff resulting from precipitation (rain, hail, snow) and does not include Trade Waste or Domestic Sewage.

'Stormwater Drainage' means a drain primarily for the reception and discharge of stormwater.

'Street' has the same meaning as *'Road'* as defined by Section 315 of the Local Government Act 1974.

'Street Classifications'

Secondary/District Arterials	Roads which are: • of strategic importance; and • a significant element in the local economy	• links between residential, commercial, industrial or recreation land use activities.

Note: generally such roads would be within urban areas but in some localities, such roads would provide alternative links between centres of population or be significant for the movement about a district, of goods or produce.

Collector Routes	Routes which are: • locally preferred between or within areas of population or activities; • complementary arterials; and • usually paved and are of road geometry aligned with operational safety standards required for the traffic volumes on each section.	• primarily suited to urban situations, yet have a place in rural areas. In rural areas, where land use activity is relatively intensive, it is necessary to provide links between local roads and arterials.
Local Roads	Roads whose primary function is property access.	All other roads servicing land use activity.

'Survey Plan' has the same meaning as in the Resource Management Act 1991.

'Trade Waste Discharge' is any liquid with or without matter in suspension or solution, that is or may be discharged from a trade premises in the course of any trade or industrial process or operation, or in the course of any activity or operation of a like nature, but does not include stormwater or domestic sewage.

'Trench' means any excavation within a road for the purpose of maintaining, locating or installing services, and excavations on grassed berms for the purpose of providing or maintaining services to residential sections except shallow excavations for the purpose of constructing vehicle crossings,

'Trenching Authority' means any Board, Corporation, government department, or any other legally constituted group of persons or person responsible for providing underground services.

'Trencher' means any person or persons responsible for actually carrying out the trenching work for or on behalf of any Trenching Authority, or privately.

'Wastewater' means water or other liquid, including waste matter, in solution or suspension discharged from a premises.

1.2 APPLICATION

1.2.1 This document forms the Opotiki District Council Code of Practice - Subdivision and Development.

In order to encourage a range of, and flexibility in, subdivision and development design while achieving adequate levels of environmental protection amenity, safety and infrastructure provision, the Opotiki District Council District Plan adopts a range of subdivision and development standards as performance levels. Various methods may be employed to satisfy these levels. However, compliance with the Council's Code of Practice - Subdivision and Development on a defined matter is deemed to satisfy the particular performance level applying to that matter.

1.2.2 This Code of Practice - Subdivision and Development has been developed as a means of compliance with the Subdivision and Development Performance Standards contained in the Opotiki District Plan.

It is essential that compatibility of design, construction and materials is achieved in order to minimise long term costs and disruption.

While allowing for the implementation or thoroughly researched and investigated innovated ideas, the aim is to ensure that the alteration or extension of infrastructure within the Opotiki district is carried out with minimum long term costs to the community.

1.2.3 All Codes and Standards referred to herein are deemed to include any subsequent amendments as well.

1.3 SUBDIVISIONAL COMPLETION REQUIREMENTS

1.3.1 Completion of Works

Council deem that subdivisional works are complete when the following conditions have been complied with:

(a) All conditions met as required by the Resource Consent.

(b) All engineering construction work required as a condition of approval has been completed to the Council's satisfaction.

(c) Certification of subdivision construction received, checked and approved by Council for all works.

(d) "As-Built" drawings received, checked and approved by the Council for all works.

(e) Satisfactory completion of the maintenance period.

1.3.2 Maintenance and Final Acceptance

The developer shall be responsible for the maintenance of the works for a period of six months, from the date on which the Council certifies in writing that the work has been completed after notification by the developer or his/her representative. Other items of work (eg silt traps) may have longer periods of maintenance as specified by Council.

Prior to final acceptance at the completion of the maintenance period, the subdivider shall have the following works carried out:

(a) Berm grass to be mown;

(b) Carriageways swept;

(c) Drainage system, including cesspits, cleaned out.

An inspection of the subdivision shall be carried out by the Council prior to the acceptance at the completion of the maintenance period. Any section of the works that does not comply with the approved plans and specifications must be rectified by the subdivider before any of the subdivision will be accepted.

1.3.3 Bonds for Uncompleted Work

Bonds for Uncompleted subdivisional works are not favoured and would normally only apply to special cases where approved by the Council. Bonds will normally be to the value of the work uncompleted plus ten percent [10%] to be retained for administration and supervision.

1.3.4 Emergency Procedure

The Council is to be informed without delay, if, during the course of construction works any situation arises whereby the security of public or private property, or the operation of any public facility is endangered. The Council may instruct the subdivider's representative to carry out such remedial measures as the Council thinks fit to remove the danger. Any work so ordered is to be done at the expense of the subdivider. If the work is not commenced within 8 hours of the issuing of the instruction, the Council may arrange for the required work to be carried out at the subdivider's expense. Should any emergency arise requiring immediate attention, the Council may carry out the work and recover the costs from the subdivider.

1.3.5 Damage

All damage to existing roads, services or private property, or disturbance of survey boundary marks due to, or caused by, any new works, shall be the liability of the subdivider. The damage must be repaired by the subdivider immediate following written instruction from the Council. If the works is not commenced within 16 working hours, then the Council may arrange for the necessary work to be carried out and charged to the subdivider. This provision includes removal of mud and debris from existing roads in the vicinity of the subdivision. A daily removal of such debris may be necessary in the interests of traffic safety.

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Section 2.0

Information and Draughting Requirements

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SECTION 2.0 - INFORMATION AND DRAUGHTING REQUIREMENTS

2.1 INFORMATION REQUIREMENTS

Information for all works and services to which this Code of Practice – Subdivision and Development applies shall be supplied in accordance with the Opotiki District Plan.

2.1.1 Information Required with Resource Consent Applications

Where applicable, the following information shall be submitted with any application for resource consent:

A description of the activity for which consent is sought.

A description of the site including details and location of existing and proposed:

(a) land uses, buildings and structures (and/or building platforms);

(b) topographical features such as vegetation, land forms, wildlife habitats, watercourses, open drains, vehicle access points;

(c) parking, access and loading areas for vehicles;

(d) earthworks;

(e) utilities such as effluent disposal, water and stormwater;

(f) the land use capability of the land as sourced from the New Zealand Land Resource Inventory worksheets with specific reference to the type of soils and the existence of peat, high water tables and the potential for erosion;

(g) If the activity is situated in natural bushland or exotic forest land an assessment of the defensible space in regard to rural fire protection.

(h) any other historic sites including archaeological sites and wahi tapu;

(i) natural hazards or hazard-prone areas identified on any planning map and other natural hazards known to exist;

(j) any designation or heritage orders that apply to the subject land;

(k) existing site contamination;

(l) legal restrictions such as easements, restrictive covenants.

A description of any management plan required for mining operations.

An assessment of environmental effects which includes an analysis of the suitability of the site for the proposed activity and management of adverse effects, having regard to, but not limited to:

(a) Topography and other physical features;

(b) Traffic volume, type and movement to the site as well as on-site movements. An assessment must include details of the width and grade of proposed vehicular accessways and proposed roads.

(c) Provision of services. An assessment must show the means, location and direction of sewage, stormwater disposal and drainage, and consider any off-site effects. Details on groundwater levels may be required to confirm compliance with the "Regional On-site Effluent Disposal Plan".

For activities exceeding a combined site coverage of 1000m^2, Council may require technical evaluations of the existing and anticipated stormwater flows and the necessity or otherwise of retention ponds or other stormwater control and/or mitigation devices.

(d) Scheduled heritage sites and the means by which the general principles and conservation processes of the International Charter for the Conservation and Restoration of Monuments and Sites (1966) and its amendments are to be met. Council may require a Conservation Plan for a heritage site as part of the Assessment of Environment Effects.

(e) The scale and staging of earthworks including quarrying/ exploration programme of restoration.

(f) Ecological impacts on waterways, wetlands, wildlife habitats and indigenous vegetation.

(g) Air emissions including an analysis of the:

- local topographic, meteorological and land use conditions:
- raw materials to be used;
- methods of waste handling and disposal;
- process plant and buildings;
- instrumentation and control systems;
- ancillary plant buildings;
- by-products handling and disposal;
- odour treatment;
- containment measures to reduce wind dispersal;
- mitigation options and monitoring;
- emergency discharge procedures and effects.

(h) Visual impact on the surrounding landscape.

- the scale of the activity;
- height, cross-sectional area, colour and texture of structures;
- distance of structures to site boundaries;

- degree of compatibility with surrounding properties;
- site location in terms of the general locality, topography, geographical features, adjoining land uses, ie landscape character, rural houses;
- proposed planting, fencing and other landscaping treatments as detailed in a submitted landscape plan;
- proposed signs;
- civil aviation requirements for height, colour and design requirements of buildings;
- lighting on site;
- the opportunity for site sharing of works and network utilities;
- the visual quality, visual absorption, visual rating of outstanding and significant landscape units;
- any earthworks necessary for the creation of building platforms, fire breaks, access should create minimum disturbance to the landform and character of the site;
- whether existing landscape features are integrated into the new activity.

Such an assessment may include the preparation of a Landscape Plan.

(i) The provisions of any relevant Management Plan under any other legislation.

(j) In assessing applications where it is likely that the activity will result in any adverse effect on the environment, the applicant shall describe, in an assessment of environmental effects, the potential effects of alternative locations or methods to that proposed. The practicality and economics of alternative options versus that proposed will be relevant when considering the assessment.

(k) Amenity values existing in the area, and in particular the ambient noise levels currently experienced, any shadowing effects, lighting, glare and vibration effects.

(l) Council may require, as part of any resource consent application, evidence from an independent and appropriately qualified acoustic engineer that the proposal will comply with the District Plan (Noise Standard). Council shall consider the noise insulation methods associated with the use of generators, fans, blowers, refrigeration equipment, forklifts, outdoor loading operations, and any activity that operates between 7:00 pm and 7:00 am.

(m) The probability of risk from the operation of the activity including the use of hazardous substances.

Plans illustrating the proposal shall include:

(a) A plan to scale, showing the location of the site, with:

- street or road name;
- street number or rural number;
- legal description;
- current valuation number

- north point; and
- scale;

(b) A site plan of the property showing:

- site boundary lengths and other dimensions in metres;
- location with distances to site boundaries, of all existing buildings which are to remain on the site, and all proposed buildings and structures (including where applicable, eaves, balconies, courts and verandahs);
- proposed use of each building;
- position of services;
- vehicle parking, access and loading;
- existing levels and contours where this is appropriate to define building platform and drainage patterns. All contours must be shown in terms of Moturiki Datum plus 100 metres;
- proposed contours;
- position of existing and proposed easements and other legal restrictions.

(c) For the subdivision of land, the following additional information is to be provided:

- Each lot shall be shown on a plan of subdivision, prepared by a registered surveyor.
- Each lot shall have a number, area (except in the case of a cross-lease, company lease or by the deposit of a unit plan), boundary dimensions and in the case of a rear lot, the net area (excluding access) as well as the total area.
- The whole of the property(ies) concerned shall be shown on the plan. Where this is not practicable, the entire block is to be shown on a scaled diagram inserted on the page.
- Proposed esplanade reserves or strips or proposed access strips.
- the sea, or of any part of the bed of a river or lake which is required under Section 235 of the 'RMA 1991' to be shown on a survey plan as land to be vested in the Crown.

A Description of the Consultation Undertaken

Council will require details of the consultation undertaken with potential adversely affected persons. In particular Council will require written confirmation that consultation has occurred with the following parties where a resource consent is required for activities described below:

Affected Party	Activity
Iwi Department of Conservation	Activities which may adversely effect a scheduled heritage feature (natural or cultural). Commercial activities on the surface of the water. Organised jet boat or personal watercraft events on the surface of the water. Clearance of vegetation along riparian margins. Activities, other than residential development and subdivision, in the coastal zone. Note: This does not preclude Council requesting consultation with these parties for subdivision and residential activities in this zone.
New Zealand Fire Service	Activities which involve the use, storage, disposal and transportation of hazardous substances.
Maritime Safety Authority Environment BOP	Placement of navigation and safety aids.
Transit New Zealand	Activities which rely on access to a State Highway.
NZ Historic Places Trust	Activities which may adversely affect a scheduled cultural heritage feature."

2.1.2 Developer's or Subdivider's Representative

The developer or subdivider shall nominate a suitably qualified and experienced representative, (hereinafter referred to in this part as the "subdivider's or developer's representative") who has suitable experience in all phases of subdivisional engineering work and the subdivider or developer shall notify Council of the name of the person so employed before any work commences.

The developer's or subdivider's representative shall be responsible for:

(a) the preparation and submission for approval of engineering plans and specifications in terms of Council's standards;

(b) supervision of the works as detailed in the approved plans and specifications; and

(c) certifying to Council upon completion of the works that the works have been carried out in accordance with the approved documents. Certification of Compliance to be in the format as shown in Appendix 1.

The subdivider's or developer's representative shall be available for a meeting on the site of the works within eight ordinary working hours of being so requested by the appropriate Council officer. While each stage of the works must be approved by officers of the Council, they will not undertake day to day supervision and the subdivider's or developer's representative shall be responsible for ensuring that the work complies with all aspects of this standard.

2.1.3 Inspections by Council

The consent holder's representative shall notify the Opotiki District Council's Engineer, telephone (07) 315-6167, fax (07) 315-7050, when the following phases of work are reached and such other phases as the Council may determine to enable inspection to be carried out:

- Prepared earthworks and subsoil drainage prior to filling
- Completed earthworks and prepared subgrade
- Commencement of drainage reticulation
- Commencement of water reticulation
- Finished basecourse
- Before the commencement of street sealing
- Pressure testing of services

Inspection will be carried out within 48 hours of notification. Work shall not proceed until inspection has been made, or alternatively until authorisation is given to proceed.

2.2 DRAUGHTING REQUIREMENTS

2.2.1 Size of Drawings

All drawings shall be prepared and submitted on sheets of the Standard ISO Type A series. Principal drawings are to be on A1 or A2 sizes as appropriate. Detailed drawings, site plans, etc may be of A3 or A4 sizes.

2.2.2 Draughting

All draughting is to confirm to NZS/AS 1100 and NZS 5902 Part 5 : 1981 or other New Zealand Standard where appropriate. In particular, the minimum height of letters is to conform to NZS/AS 1100. In order to make microfilm file copies, the linework must be no finer than 0.18mm and all lines must be of uniform density.

The symbols shown on the Standard Drawings are to be used. Other symbols are to conform to NZS/AS 100 or appropriate New Zealand Standard.

2.2.3 Scales

The following scales shall be used:

Plans		1:500 or 1:200	
Long-Section	Horizontal	1:500 or 1:200	)
	Vertical	1:100 or 1:50	) where necessary

Cross-Sections	Horizontal	1:100 or 1:50	)
	Vertical	1:100 or 1:50	) where necessary

Note: The vertical scale may be exaggerated where unavoidable.

Details:	General	1:10, 1:20, 1:50
	Roading	(eg kerb lines, cul-de-sac heads) 1:200
Scheme Plans:	Urban	1:500 to 1:100

Note: Scheme plan scales are required to conform wherever possible to the Engineering Plan Scale (ie 1:500)

Rural	To specific approval

All dimensions and levels shall be in metric measurement.

2.2.4 Orientation of Plans

(a) *Plans and Long-Sections*

The north point shall be to the top of the sheet wherever practicable. All plans and long-sections shall have the lesser distance (m) on the left hand side of the sheet. For drainage and water supply, the lesser distance of a line shall be at the downstream end of the pipe. Long-sections should be orientated as far as possible the same as the plan.

(b) *Cross-Sections*

Cross-sections shall commence at the bottom left hand corner of the sheet and proceed upwards in order of increasing traverse distance. Where the road reserve is 20m wide, it may not be possible to place two columns of sections on one sheet, in which case the sheet may be rotated 90° clockwise and the sections plotted from the "bottom" of the sheet to the "top".

The left and right kerb lines shall be determined by facing in the direction of increasing distance. for open channel flow, left and right banks shall be determined by facing in the direction of flow.

2.2.5 "As Built" Plans

"As Built" plans, in the form of transparent foils endorsed and certified correct by a registered surveyor (Refer Appendix 1C) , are to be submitted by the subdivider showing the details below:

(a) Sanitary Drainage Reticulation, including lid and invert levels of manholes and measured positions of manholes relative to boundary pegs and measurements to house junction, bends, ramps and other fittings, referred to the centre of the downstream manhole cover. The position of all house connections should also be related to a section boundary peg, and the invert levels of connections given (ground levels can be altered subsequent to utility construction).

(b) Stormwater Drainage Reticulation detailed as for (a) above.

(c) Water Reticulation including depth and position of mains, ridermains, service lines, location of hydrants, valves, tees and meter boxes relating to the nearest boundary peg. The position of all service connections is to be related to the nearest section boundary peg.

(d) Areas of filling showing the extent and depth of fill over original ground in the form of a six metre (6m) grid or by fill contours.

(e) The Registered Engineer supervising the filling shall supply a certificate that any fill has been carried out in accordance with these requirements.

(f) All alterations to be submitted engineering drawings found necessary during construction are to be approved of in writing by the Engineer.

(g) The correct street names as approved by Council.

(h) All building footprints relative to site boundaries when applicable.

(i) All private on site servicing relative to the building footprint and site boundaries.

2.2.6 Benchmarks and Standard Datum

To provide permanent reference levels, a suitable benchmark shall be placed where directed by Council, at not greater than 250m intervals. Wherever possible, benchmarks are to be located at tangent points in positions where they are unlikely to be disturbed during construction or by future maintenance.

The "As Built" plan shall show the position of benchmarks in terms of survey co-ordinates or by accurate survey and the level thereon in terms of Moturiki Datum plus 100 m.

The standard reference datum for all work shall be "Moturiki" Datum plus 100m and all levels shall be stated in terms of this datum. A statement of compliance with this clause shall be included on all drawings with levels thereon.

If existing benchmarks are disturbed during the course of the work, including the maintenance period, they shall be reinstated and relevelled at the subdivider's expense.

2.2.7 Certificate of Construction

The subdivider shall be responsible, both directly and through his/her representative, to ensure that work is carried out in accordance with this approval and sound civil engineering practice. He shall appoint an appropriately qualified person to supervise the works on his/her behalf and, upon completion, his/her representative shall certify compliance on the forms enclosed in the Appendix 1D.1.

Section 3.0

Earthworks and Land Stability

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SECTION 3.0 - EARTHWORKS AND LAND STABILITY

3.1 TECHNICAL RESPONSIBILITIES

Where any land development involves the carrying out of bulk earthworks, the assessment of slope stability, or the detailed evaluation of the suitability of natural ground for the foundations of buildings, roads, services or other works, then a soils Engineer shall be appointed to carry out the following functions:

(a) Prior to detailed planning of any development to undertake a site inspection and such investigations of sub-surface conditions as may be required.

(b) Before work commences to review the drawings and specifications defining the earthworks proposed, and submit a written report to the Engineer on foundation and stability aspects and any proposed departure from this Code and associated Standards.

(c) Before work commences and during construction to determine the extent of further specialist soils engineering services required (including investigation and geological work).

(d) Before and during construction to determine the methods and frequency of construction control tests to be carried out, determine the reliability of the testing and to evaluate the significance of test results and field inspection reports in assessing the quality of the finished work.

(e) During construction to provide regular inspection (while a daily visit might be regarded as reasonable on earthwork construction on minor projects, inspection on a near full-time basis is often necessary).

(f) On completion to submit a written report to the Engineer attending to the compliance of the earthworks with these Standards and as to the suitability of the development for building construction.

The subdivider's or developer's representative may act as the soils Engineer if he possesses suitable qualifications and experience.

The construction control testing shall be carried out by an organisation (preferably that of the soils Engineer or under his/her control) with Telarc Registration in all relevant tests. (Minor testing using Scala Penetrometer or Pilcon Vane may be exempt from this requirement).

3.2 SITE INVESTIGATIONS

3.2.1 Preliminary Site Evaluation

Prior to any detailed planning or design, the soils Engineer, as applicable, should undertake a preliminary evaluation of the general nature and character of the site in sufficient detail to determine the likely requirements for earthworks and/or the need for further investigations into the suitability of foundation conditions, and the stability of the natural ground. The preliminary evaluations should be carried out in the context of the total surroundings of the site and should not be influenced by details of land tenure, political or other boundary considerations. In simple cases, a visual appraisal may be sufficient, but in other cases, depending on the nature of the project, its locality, the scale of development proposed and individual site characteristics, particular attention may need to be given to the following matters.

3.2.2 Slope Stability

Some natural slopes exist in a state of only marginal stability and relatively minor works such as trenching, excavation for roads or building platforms, removal of scrub and vegetation or the erection of buildings, can lead to failure.

Signs of instability include (but are not limited to) cracked or hummocky surfaces, crescent shaped depressions, crooked fences, trees or power poles leaning uphill or downhill, uneven road surfaces, swamps or wet ground in elevated positions, plants such as rushes growing on a slope and water seeping from the ground.

3.2.3 Foundation Stability

A study of the general topography of the site and its surroundings may indicate areas which have previously been built-up as a result of natural ground movement or by the deliberate placing of fill material. Unless such fill has been placed and compacted under proper control, long term differential settlement could occur causing damage to super-imposed structures, roads, services or other development works.

3.2.4 Special Services

Where a soils Engineer has been appointed, then he shall submit to Council a written report setting out the particulars of any investigations carried out, including details of contours, natural features and modifications proposed thereto; and shall furnish to Council a statement of professional opinion as to the suitability of the land for its proposed use or subdivision with details of any special conditions that should be imposed. This statement is to be in the format given in Appendix 1.

3.3 STORMWATER AND SILT CONTROL

Due to the increased rate of run-off brought about by the deluge of the ground of its natural growth in mass earthworks, particular care shall be taken to control stormwater and to ensure that it is permitted free entry to stormwater culverts at all times. The developer shall be responsible for ensuring that adequate grids or similar approved traps are constructed and maintained during the construction period of the work, and until such time as the land becomes stabilised, to the satisfaction of the Engineer. Any of Council's stormwater infrastructures blocked by silt shall be thoroughly cleaned by the developer or at the developer's expense.

Erosion and sediment control to be carried out in accordance with Bay of Plenty Regional Council - Technical Report No 28 *"Erosion and Sediment Control Guidelines for Earthworks",* latest issue.

The subdivider shall ensure that all erosion/sediment/stormwater controls are installed at all times during the works and afterwards where necessary, to the satisfaction of the Engineer. The subdivider shall carry out maintenance of erosion/sediment/stormwater controls where/when necessary and as directed by the Engineer or other authority.

Developers are also reminded of the requirements of the Regional Councils with regard to excavation and the removal of ground cover. All necessary consents must be obtained prior to commencement of works.

3.4 CONSTRUCTION PROCEDURES

Before any earthworks are commenced, areas of cut and fill should be clearly defined. Where necessary, sufficient fencing or barriers should be provided around trees or other features to be protected. All site activities including clearing, storage, cutting and filling must be kept away from the root zone of trees (best defined as the extent of the canopy).

Earthworks are to be carried out, as appropriate, in accordance with the:

(a) Specification for Earthworks Construct (F/1) - Transit New Zealand

(b) NZS 4431 : 1989 *"Code of Practice for Earthfill for Residential Development"*.

3.5 EXEMPTION FROM TESTING REQUIREMENTS

There will be no exemption from testing unless approved in writing by the Engineer.

3.6 EARTHFILLS RELATED TO GROUND WATER

All developers in the urban area shall comply with the minimum level stated but not withstanding the above may be subject to additional requirements as deemed necessary by the Engineer.

3.7 PROTECTION OF PROPERTY FROM INUNDATION

In accordance with Section 106 of the Resource Management Act 1991 and Section 36 of the Building Act 1991, Council shall not grant subdivision or building consent if land or buildings can be subject to inundation, unless satisfactory means of avoidance, remedy or investigation are carried out.

New primary stormwater systems shall be capable of disposal of surface water resulting from a storm having a 10% probability of occurring annually.

Secondary flow (normally surface flow) paths and systems capable of carrying surface water resulting from a storm having a 2% probability of occurring annually (50 year return) shall be constructed to ensure that such surface water shall not enter buildings.

Low lying areas prone to inundation by a 50 year return period storm must be identified and restricted from building.

Building floor levels must be as stated in the District Plan.

3.8 ARCHAEOLOGICAL OR HISTORIC SITES

Where an archaeological or historical site is discovered during earthworks operations, all operations shall cease immediately and shall not be modified or disturbed in any way unless a modification/destruction order has been granted from the New Zealand Historic Places Trust and/or relevant Maori authority.

3.9 MANAGEMENT PLAN

Ten [10] working days prior to earthworks commences on site, a management plan is to be submitted to the Engineer indicating the measures that will be applied in the event that site and weather conditions give rise to actual or potential adverse effects of dust on adjoining properties. The management plan shall describe the measures to be applied to minimise dust, intended sources of water and named personnel to be contact in the event of dust nuisances occurring and earthworks shall not proceed until the consent holder's ability to control any dust nuisance has been demonstrated.

3.10 NOISE CONTROLS

That the starting and operation of all earthmoving equipment shall be restricted to between the hours of 6:30 am and 7:00 pm Monday to Friday and 7:30 am to 6:00 pm Saturday. No earthmoving equipment shall be operated on Sundays and public holidays.

That construction equipment on the site shall be operated in a manner that ensures that the corrected noise level (based on L_{10} measurements) as measured at the boundary of the site where the noise is created and does not exceed:

75 dBA between 7:30 am and 6:00 pm	Monday to Saturday;
60 dBA between 6:30 am and 7:30 am	Monday to Friday; and
70 dBA between 6:00 pm and 7:00 pm	Monday to Friday

(at a distance of 100 metres from the activity)

Measurement

The noise levels shall be measured and assessed in accordance with the requirements of the New Zealand Standards NZS 6801 (Methods of Measuring Noise) and NZS 6802 (Assessment of Noise in the Environment). The noise shall be measured with a sound level meter complying, at least, with the Standard ICE 651 (1979) Sound Level Meters Type 2.

More restrictive hours or noise levels maybe imposed
as a result of conditions of Resource Consent.

Section 4.0

Roading and Landscaping

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SECTION 4.0 - ROADING AND LANDSCAPING

4.1 ROADING NETWORK AND DESIGN

4.1.1 Application

Standard Drawing R 01 gives the minimum requirements in relation to various types of streets, service lanes and private ways.

Standard Drawing R 02 gives the Standard Location of Services to be installed within the berm. Street trees and landscaping requirements are in addition to the area of berm taken up by the service locations. The standard berm widths are exclusive of street tree and landscaping requirements. Such requirements are to be provided in areas of road reserve clear of all services.

Arterial, commercial and industrial roads will be subject to specific approval. *(Refer to definitions of Roads, Section 1.0).*

4.1.2 Gradients

Longitudinal Gradients

The choice of a longitudinal gradient will depend principally on the type of terrain. The volume and extent of earthworks in new subdivisions is influenced by the maximum and minimum gradients adopted. The minimum acceptable gradient will normally be 0.5%, but in exceptional conditions, a flatter minimum gradient may be necessary. Residential street gradients should not be steeper than 12.5%. On all routes likely to carry significant volumes of public transport or heavy vehicles, the maximum gradient should not be above 8%.

The Engineer may approve gradients which are greater than these maximum values. For cul-de-sacs heads, the maximum longitudinal gradient shall be 3% (to prevent surface water run off escaping from channels at vehicle crossings).

Where gradients steeper than those recommended above are unavoidable, they should be restricted to those sections of the street where the alignment is straight, and should be kept as short as possible.

4.1.3 Crossfall on Carriageway

Normal crossfall of three percent (3%) in both directions from the crown shall be developed on all standard carriageways. However, in exceptional circumstances, these may be waived with special approval, but in no case shall be less than two percent (2%) or greater than five percent (5%) from the crown coupled with a lateral shift in the crown of up to one-quarter of the road width. Where a uniform crossfall is developed from kerb to kerb, this shall not exceed two percent (2%) unless on a curve where super-elevation may be permitted.

4.1.4 Super-elevation

Super-elevation is not necessary in 50 km/h zones, or areas that, in the opinion of the Engineer, are likely to become 50 km/h zones. Super-elevation may, however, be employed where it suits boundary levels up to the allowable design maximum crossfall. However, certain main routes may in the future, have an increased speed limit. If this development is a possibility, the Engineer may require super-elevation to be constructed to a speed value nominated at the time of the

request. In any circumstances, the maximum crossfall should not exceed ten percent (10%) where uniform crossfall is developed. Super-elevation shall be calculated from NRB S2 Tables.

4.1.5 Kerb Lines

Generally, kerbs will be at the same level on both sides of the street. However, in special circumstances, the left hand and right hand kerb line may be better graded individually in conjunction with centreline levels, footpath levels and boundary levels. Under such circumstances, at a given cross-section the left hand and right hand kerbs may differ from each other in level provided the following standard design tolerances are not exceeded.

Table 1 : Maximum Difference in Kerb Lines for Different Widths of Carriageway

Width of Carriageway (m)	*Maximum Difference in Kerb Line (mm)*
7.5	140
8.0	150
8.5	160
11.0	175
13.0	200

4.1.6 Horizontal Curves

Curves in 50 km/h areas may be circular with a minimum radius of 45m on the centreline. In areas that may have a higher speed limit in the future, the Engineer may require transition curves with a specified speed value. Transition curves shall be computed in accordance with NRB S2 Tables. Widening is not required on circular curves.

4.1.7 Vertical Curves

Vertical curves shall be designed for a minimum speed value of 50 km/h and a minimum sight distance of 60m, as set out in NRB Specification S.2. In areas that may have a higher speed value in the future, the minimum speed value and sight distance shall be determined by the Engineer.

4.1.8 Slope of Berms

The normal slope of the grass berm from kerb to boundary shall be four percent (4%). This slope shall not be less than three percent (3%) nor more than ten percent (10%).

In all cases, the crossfall on the footpath shall not vary outside the limits of two percent (2%) to four percent (4%).

Where it becomes necessary to employ a berm steeper than eight percent (8%), it will be necessary to produce design gradients for individual property access to show that these may be satisfactorily negotiated by a 99 percentile car as defined in the Transport Department Design tables for clearance at sag or summit crossings.

4.1.9 Formation Width

The formation width shall be the full width of the street plus 1.2m, all batters to be in private property. Where a subdivision abuts an existing street that will require earthworks in the course of future upgrading, then provision must be made in the subdivision for 3m wide batter easements on the new subdivision sections. If a batter is not practicable, then a retaining structure shall be built to the approval of the Engineer.

4.1.10 Batters

Cut and fill batters shall not be steeper than four horizontal to one vertical or such lesser slope as may be required by the Engineer. The top edge of a fill batter or the toe of a cut batter shall be at least 600mm beyond the street boundary. Where cut and fill affects excessively large areas or in rural areas, the Engineer may approve steeper batter and cut slopes. These will only be permitted where no other practicable alternative exists.

4.1.11 Crossings

4.1.11.1 *Pram Crossings*

Crossings shall be constructed in accordance with NZS 4121 : 1985. Also see Standard Drawing R 07.

4.1.11.2 *Vehicle Crossings*

See Standard Drawings R 08, R 09 and R 10.

4.1.12 Turning Circles

Cul-de-sac heads shall be provided generally in accordance with the alternatives shown on the Standard Drawings. See Standard Drawing R 04.

A minimum traffic path turning circle of nine metres (9.0m outside radius) shall be provided.

4.1.13 Inter-visibility at Intersections

Inter-visibility at intersections shall be in accordance with the Standard Drawings R 05 and R 06. where a local residential street meets a principal street or local distributor, adequate sight distance both up and down the major route is to be provided to enable traffic to emerge safely from the side street. For a design speed of 50 km/h on the major route, this will require a clear sight distance of 75m (minimum) from the side street.

4.1.14 Grades at Intersections

Centre line grades at major intersections should be kept below three percent (3%) wherever possible. At an intersection of two streets of differing classifications, the grade of the street having the higher classification should be carried through the intersection, adjusting the grades of the lower classified street accordingly. Generally with the centre line grade of the lower classified street intersecting the crossfall of the main street, the distances from the main road centre line are as given in Table 2 below.

Table 2 : Distance from the Main Road Centre Line for Different Road Widths	
Road Width (m)	*Distance from main road centre line (m)*
13.0 11.0 8.5	3.5 3.0 2.5

4.1.15 Structural Design of Pavements

4.1.15.1 *General Requirements*

Principal and arterial roads shall be designed in accordance with Transit New Zealand Pavement Manual. All other pavements shall be designed in accordance with either of the following:

- CBR Method (CBR design curves are given on Standard Drawing R 03).
- The minimum design period shall be 20 years.
- Design Method based on achieving the deflection specified in Section 4.2.8. It is recommended that at each phase of construction (ie subgrade, sub-base, basecourse) beam readings be taken. (The deflection shall be determined using the CGRA "Rebound" with an 8.2 tonne axle load). The minimum metal depth under this method shall be no less than that obtained using a CBR value of 7.

4.1.15.2 *Submission of Test and Design Data*

The following information shall be submitted in conjunction with the engineering design drawings for approval.

- All soil test information obtained to provide a basis for pavement design, with a reference to origin of design method. Where substantial cuts and fills are anticipated, the range of CBRs are to be aligned with the Geotechnical Investigation Report.
- Copy of design calculations used to determine pavement thickness.
- If a stabilising agent is to be used, the designer shall submit a range of relevant test results, and calculations, including the percentage use of the stabilising agent and an indication of the likely CBR value to the achieved by the stabilisation.

4.1.15.3 *Minimum Depth of Metal*

The minimum compacted basecourse metal depth shall be twice the nominal maximum size of the basecourse aggregate and not less than

- 100mm for Lots 1-2
- 150mm for Lots 3-7
- 200mm for 8 Lots or more

for public roads.

4.1.15.4 *Stabilisation of Sub-base*

Where a low bearing value is obtained for the subgrade, it may be advantageous to employ a stabilised sub-base, rather than excavate to a greater depth. Specific design of a stabilised subgrade shall be to the satisfaction of the Engineer.

4.1.15.5 *Basecourse Metal*

Basecourse metal shall comply with Transit NZ Specification M4 or M5. Basecourse construction shall comply with Transit NZ Specification B2.

4.2 ROADING CONSTRUCTION

4.2.1 Subgrade Drainage

4.2.1.1 *Materials for Porous Drains*

Drainage pipes shall comply with Transit New Zealand Special F/2 minimum internal diameter 50mm approved perforated pipe. Backfill material shall be 20mm - 5mm clean drainage metal. Backfill material shall be brought up to subgrade level in all cases.

4.2.1.2 *Cuttings*

Where a road is constructed in a cutting and moisture appears on the face of the cutting, a porous drain shall be constructed at the toe of the batter and connected to the nearest cesspit downstream.

4.2.1.3 *Kerb and Channel*

In areas where soils are not free draining, a porous drain shall be constructed under both channels and connected into the downstream cesspit. The invert level of the drain shall be a minimum of 500mm below subgrade level.

4.2.1.4 *Wet Spots in Subgrade*

Any permanent wet spot in the subgrade below the line of the longitudinal field tile drains or any area undercut below the level of the longitudinal drains shall be connected to the nearest enclosed stormwater system by a suitable sized porous drain. Where the drain is located under the carriageway, perforated pipes shall be used.

4.2.1.5 *Subgrade Drainage Systems*

In some cases, in the opinion of the Engineer it may be necessary, due to the nature of the country, to lay an extensive subsoil drainage system of perforated pipes. In such a case, the material covering the pipes shall be graded upwards so that the particles cannot enter the pipes. In general, to satisfy the conditions that particles do not enter the pipe and no scour occurs in the 'filter', the ratios to be complied with are shown in Table 3 below.

Table 3 : Criteria for Backfill Material in Subsoil Drainage Systems using Perforated Pipes	
Ratio	*Value*
85 PERCENT SIZE OF FILTER MATERIAL Size of opening in pipe	2
15 PERCENT SIZE OF FILTER MATERIAL 85 percent size of protected soil	5
15 PERCENT SIZE OF FILTER MATERIAL 15 percent size of protected soil	5

It will be necessary, in most cases, to manufacture a suitable filter material to comply with the above requirements.

4.2.2 Kerbs, Channels and Cesspits

4.2.2.1 Kerb and channel as shown on the Standard Drawing R 11 shall be provided on both sides of the carriageway in all urban subdivisions. In roads with a single crossfall, kerb and channel on one side and a concrete edging strip on the other will be permitted.

Mountable kerbing as detailed on Standard Drawing R 11 or other optional profile shall be used on street islands and may be used on private accessways or where specifically approved by the Engineer.

4.2.2.2 Subgrade under Kerbing

The subgrade under kerbing and channelling shall be equivalent to the road subgrade. Where the subgrade provides insufficient drainage beneath the kerb and channel, compacted basecourse shall be placed to a minimum depth of 50mm. Similarly, where the subgrade strength is less than CBR 7, a designed compacted basecourse bedding shall be placed beneath the kerb and channel. After the kerb is poured and before any road metal is placed on the channel (road) side, suitable filling shall be done after the concrete has attached sufficient strength to accept the compactive efforts.

4.2.2.3 Construction Methods

All kerbing and channelling shall be constructed using an approved slip form or machine extruded method. Cast in situ methods against static form work shall be subject to specific approval.

4.2.2.4 *Materials*

(a) PREMIX CONCRETE

Premix concrete from approved sources may be used. Delivery dockets which shall state the certified strength of the concrete shall be produced if required by the Engineer. Premix concrete shall comply in all respects with NZS 3108 : 1983.

(b) SITE MIX CONCRETE

Site mix concrete shall comply with NZS 3108 : 1983, and shall meet the minimum strength specified on the drawings. Cement shall be kept in a damp-proof shed and lumpy cement shall not be used. Cement shall comply with NZS 3122 : 1974.

(c) PRECAST BLOCKS

Precast blocks shall not be used.

4.2.2.5 *Kerbing Standard and Tolerances*

The line of the kerb shall be perfectly straight between tangent points and on curves shall sweep round without kinks, flats or angles in a true arch to the radius shown or directed. The levels shown on the approved drawings shall be strictly adhered to except at intersections where slight adjustments will be made, if necessary, to give perfect lines throughout. Where the kerb finishes against other structures, this shall be done in a neat and tradesmanlike manner to the approval of the Engineer.

Tolerances	Horizontal straight sections Vertical curved sections	± 3mm over 5m straight edge ± 5mm from true radius line ± 5mm from design levels with no kerb section holding water.
Surface	No visual blemishes or changes in surface texture	

4.2.2.6 *Construction Machine Damage*

The greatest care shall be exercised when rolling or grading adjacent to the kerb and channel and in particular, the grader blade must not be used to hook road metal out of the channel.

No kerbing length shall have more than five percent (5%) in number of chips or otherwise this section of kerbing shall be removed and entirely repoured, eg 100m length of kerbing can only have up to 5 chips in its entire length.

All chips in channels and kerbs shall be repaired using an approved epoxy mortar system.

4.2.2.7 *Contraction Joints*

Contraction joints shall be cut by guillotine and spaced at not more than 4m centres. Cold joints in concrete more than two hours old shall be cut with a saw to provide a proper face on which to restart the extrusion.

Where kerbing and channelling is interrupted by precast elements, eg kerb returns, cesspits etc, the machine laid kerbing and concrete shall be sawn to a square face.

4.2.2.8 *Cesspits*

These shall be constructed as detailed as shown on the Standard Drawings SW 01 and SW 02. Cesspits shall be provided:

(a) at intervals of all channels in such a position that the maximum "run" of water in any channel is 100m for single carriageways and 60m for dual carriageways.

(b) at intersections, located at the uphill kerb line tangent points.

(c) at any low spot in a channel.

(d) at changes of gradients and/or direction in the channel where there could be a tendency for water to leave the channel in the absence of a cesspit.

(e) where necessary to prevent water discharging across a berm, eg from a kerbed and sealed right of way or accessway.

A double cesspit must be provided:

(a) at low points to minimise the risk of ponding due to the grating of a single cesspit becoming blocked.

(b) at the ends of cul-de-sacs.

(c) on all channels at a grade steeper than five percent (5%).

Cesspits shall be connected to the stormwater mains by a 225mm diameter pipe for single cesspits with leads less than 15m in length, otherwise 300mm diameter, and 375mm diameter pipe for double cesspits, led directly into a manhole.

Cesspits are to be of the backdrop type with gratings parallel to the kerbline as shown on the Standard Drawings.

4.2.2.9 *Testing of Cesspits and Channels*

Prior to final Acceptance by Council, the effectiveness of the channels and cesspits is to be tested by flooding the channel from a fire hydrant or tanker. Any ponding of water in the channel shall render the work unacceptable.

4.2.3 Footpaths

4.2.3.1 *General*

A concrete footpath shall be provided where required.

4.2.3.2 *Construction of Footpath*

The footpath shall be of concrete with a minimum of 28 days strength of 17.5 mPa.

The following nominal thickness shall apply:

(a) in conjunction with vertical kerb and channel 75mm thickness.

(b) in conjunction with mountable kerb and channel 115mm thickness.

(c) in conjunction with turning circles of cu-de-sacs on all kerb types 100mm thickness reinforced with HRC 665 mesh.

(d) in Industrial and Commercial Subdivision on all kerb types 150 mm thickness reinforced with HRC 665 mesh.

The footpath shall be constructed on a minimum subgrade strength of CBR 7

4.2.3.3 *Dimension of Footpath*

Footpaths shall be 1.4m wide. Where, under special circumstances, the footpath is located adjacent to the kerb, the width of the footpath shall be 1.4m measured from the back of the kerb. In certain circumstances, eg in main shopping areas, the footpath width may be increased as required by the Engineer.

The finished footpath shall conform to the following finishes and tolerances:

Tolerances	Horizontal straight sections Curved sections	± 5mm over 3m straight edge ± 10mm from true radius line
Vertical	+10mm from design levels with no section holding water.	
Surface	No visual blemishes or changes in surface texture. No cracks in surface. Minor hairline cracking associated with curing will be subject to specific inspection and approval by the Engineer. No visible signs of damage or vandalism.	

4.2.4 Crossings

4.2.4.1 *Pram Crossings*

A pram crossing as detailed on the Standard Drawing R 07 shall be provided in the kerb line at all road intersections.

Preferably the pram crossing should be located immediately "downstream" of a cesspit or at the high spot in the kerb and channel so that there is a minimum flow of water in the channel past the crossing.

4.2.5 Vehicular Crossing

A crossing as detailed on the Standard Drawings R 08, R 09 and R 10, shall be provided as follows:

(a) At the entrance to all strips to rear lots, private ways and service lanes, existing houses, heavy vehicle entrances and all frequently used entrances.

(b) Crossings shall be provided for each front lot.

There shall be three types of crossings - residential, commercial/industrial and rural.

4.2.5.1 *Residential*

The residential crossing (Standard Drawing R 08) shall be of 115mm thick unreinforced concrete 17.5mPa on a compacted subgrade. Where an existing concrete footpath is in position, then the section of footpath shall be sawcut and removed with the new concrete crossing poured from the kerb line to the boundary.

Where an existing vehicle crossing (Standard Drawing R 10) is required to be widened to meet a standard access width, then the existing vehicle crossing shall be removed and replaced to the correct width and standard.

No residential crossing shall be located no closer than 15 metres from the intersection of two kerblines at any adjacent intersection unless specific approval is granted by the Engineer. In all cases, adequate visibility must be provided.

4.2.5.2 *Commercial and Industrial*

Crossings shall be provided in all commercial and industrial areas, and as crossings to all private ways and service lanes, and shall be minimum 150mm thick concrete 20 mPa and reinforced as shown on the Standard Drawing R 09. The existing footpath and road channel is to be replaced and recast as part of the new crossing.

No commercial or industrial crossing shall be located no closer than 30 metres from the intersection of two kerblines at any adjacent intersection unless specific approval is granted by the Engineer. In all cases, adequate visibility must be provided in accordance with the Standard Drawing R 09.

4.2.5.3 *Rural*

The rural crossing shall be of two coat seal or bi-couche seal wearing surface on a compacted basecourse of 150mm thickness on subgrade, all as for normal carriageway construction.

Rural crossing shall conform to Standard Drawing R 28, R 29 and R 30.

The primary purpose of rural crossings is to protect the edge of the existing seal. The crossing must therefore be formed to cover the anticipated or (in the case of existing unsealed crossings) the existing swept vehicle path area, with the full area of vehicle exit and entry from the carriageway to the legal boundary being covered.

In situations where the legal boundary is either very close to or a considerable distance from the edge of carriageway, the minimum length of the crossing from the edge of the carriageway shall be 8.0m.

Rural crossings shall be culverted as necessary and are to have headwalls constructed.

No rural crossing shall be located no closer than 50 metres from the intersection of two carriageway edgelines at any adjacent intersection unless specific approval is granted by the Engineer. In all cases, adequate visibility must be provided in accordance with the Standard Drawings R 25.

4.2.5.4 *Visibility*

Visibility for vehicles exiting and entering vehicle entrance crossings shall comply with the safe stopping and sight distance requirements of the Standard Drawing R 25.

Vehicle crossings on State Highways shall comply with the safe stopping and sight distance requirements of Transit New Zealand.

4.2.6 Berms

After the formation, footpath, kerb and channel works have been completed, the berms shall be spread with a 75mm loose depth (65mm depth after rolling) of topsoil. The topsoil shall be graded to kerb top and footpath edges. Also refer to Section 4.2.14.11 for garden and specimen tree areas.

Berm Tolerance:	$\pm$ 20mm over 3m straight edge with no areas holding water.

4.2.7 Grassing

The subdivider shall be fully responsible for establishing grass on all berms, areas and lots disturbed by earthworks. The subdivider shall use the grass varieties as specified below.

If necessary, sprinkler systems may be required to establish a take of grass and/or prevent topsoil being wind blown. The cost of sprinkler setup and moving sprinklers to be included in the subdivider's cost.

4.2.7.1 *Cultivation and Rolling*

Before sowing, the whole area shall be broken up and thoroughly cultivated to the full depth of 150mm harrowed or raked to produce a firm seed bed with a fine tilth of 30mm deep for seeding. All rubbish, perennial weeds and stones greater in any dimension than 10mm arising from these works shall be collected and removed off-site to the contractor's tip. A dressing of agricultural lime shall be applied at the rate of 135g to the square meter of area during cultivation.

4.2.7.2 *Seed Mixture and Sowing Rate*

The seed mixture shall be certified free of all pests and diseases. The seed mixture and proportions of each variety to be used is as under:

Turf type - Perennial Rye Grass (Drought tolerant)

The total sowing rate shall be 250kg/hectare or 25g/m^2.

At the time of sowing, a compound pre-emergence fertiliser 4:12:15 NPK will be applied into the topsoil at a rate of 100kg/ha or as directed by the Engineer.

4.2.7.3 *Seed Sowing Berms*

The surface area shall be again broken up to an even depth of 30mm and 25% of the total seed quantity sown before the surface is raked to a good even tilth. The remaining 75% of that total seed quantity shall then be sown and thoroughly raked in and the berm area finished off with a light rolling.

4.2.7.4 *Failure to Establish Grass*

If, in the opinion of the Engineer, failure to establish a successful grass surface is due to the subdivider's negligence or the condition of the seed, the subdivider will be required to make the sown areas good before the work is passed.

Grass areas will only be accepted as reaching Practical Completion when germination has proved satisfactory and all weeds have been removed.

4.2.8 Carriageway Acceptance

4.2.8.1 Immediately prior to surfacing the pavement, Benkelman Beam tests shall be carried out by the subdivider and witnessed by Council. A section of road shall be accepted as complying with the deflection requirements based on the following:

- not more than 5% of the tests shall exceed the maximum as set out in Standard Drawing R 03.
- no single result shall exceed the maximum allowable by more than 50%.
- an area of excessive deflection shall not exceed $5m^2$.

4.2.8.2 If the section of road fails to achieve the above required standard of deflection, the subdivider shall carry out additional tests on the sub-base and basecourse and confirm that:

- the actual thickness of pavement agrees with the design thickness as determined by the CBR tests.
- the grading and quality parameters of metal conforms to requirements.
- the pavement is of suitable density.

Any subsequent beam or laboratory tests shall be arranged and paid for by the subdivider.

4.2.8.3 If beam readings are within 25% of design criteria and all of 4.2.8.2 have been met, Council may permit the subdivider to surface the road provided that agreement has first been reached on a suitable bond.

4.2.9 Carriageway Surfacing

4.2.9.1 Urban roads may be surfaced with 50mm of asphaltic concrete, a two stage seal coat or other approved surfacing.

4.2.9.2 The following standards shall be adhered to when surfacing roads:

Asphaltic Concrete

To TNZ M/10 and P/9 (and notes).

Bi-Couche Seal System

A two coat Bi-Couche seal system may be applied using Grade 3 and Grade 5 sealing chip. All chip shall comply with TNZ M6 specification. The design of the system shall be to the approval of the Engineer, in accordance with the TNZ Manual.

Where asphaltic concrete is to be used on a road, the final surface shall be 10mm $\pm$ 5mm proud of the lip of the channel. Prior to the application of any asphaltic concrete, the basecourse surface is to be sealed with an approved bituminous water proofing membrane. The basecourse level is to be flush with the channel for a chipseal surface.

4.2.9.3 The subdivider may, if he wishes, surface the road carriageway with interlocking paving blocks subject to specific approval from the Engineer.

4.2.10 Service Lanes

Where required and dimensioned by the resource consent, the subdivider shall provide and form a service lane to facilitate delivery of supplies. The service lane shall have a commercial/industrial vehicle crossing at the entrance, adequate stormwater disposal and kerbed both sides or alternatively concrete edging strips and central dish channel. Pavement design and surfacing to be subject to the approval of the Engineer.

The service lane may have a single crossfall.

Where the service lane crosses an existing footpath, a commercial/industrial crossing shall be installed at the subdivider's expense.

4.2.11 Private Accessways

Private ways shall be formed to the dimensions and specification as shown on the Standard Drawing R 13.

The following clauses shall also apply to urban private accessways.

4.2.11.1 *Stormwater Drainage*

Stormwater drainage shall be provided so that the maximum "run of water" does not exceed 60m with all stormwater collected and discharged to an approved system. Stormwater shall be controlled so that it does not run over the street berm or entry vehicle crossing.

4.2.11.2 *Surfacing*

Concrete, interlocking paver, asphaltic concrete or two coat chip seal surface shall be provided on the accessway in accordance with the Standard Drawings.

4.2.11.3 *Vehicular Access*

Where vehicular access is across any berm on the legal road reserve, a vehicular crossing shall be provided at the subdivider's expense in accordance with the Standard Drawing R 08.

4.2.11.4 *Street Lighting*

Where shown on the Standard Road Drawing R 01 or where an access serves more than three lots, provision must be made for installing lighting designed in accordance with NZS 6701 : 1983. A street light shall also be placed opposite the proposed accessway. The power supply may be connected to the street light circuit. The subdivider shall make a one off payment to Council to capitalise future maintenance and power costs for these lights. Also refer to clause 4.2.13.

4.2.11.5 *Private Services*

Private services shall be installed in the accessway of sufficient length and capacity to serve all properties or building sites utilising the accessway for frontage to the public road.

4.2.12 Street Signs and Roadmarking

Street name signs shall be supplied and erected in accordance with the Standard Drawing R 12.

Where a subdivider requires an alternative name plaque or subdivisional entrance feature to be installed, this shall be subject to specific approval and notwithstanding the approval the standard sign shall also be erected.

4.2.12.1 Where road marking and signs are required as an integral part of the roading function, it is the subdivider's responsibility to provide these facilities at their cost.

4.2.12.2 As part of the engineering plan approval, satisfactory design drawings of signs and road markings are to be prepared in accordance with the following documents:

(a) Manual of Traffic Signs and Markings (TNZ/MOT)
Part I : Traffic Signs : 1992 amended 1994
Part II : Markings, Edition 3 : 1994

(b) Transit New Zealand - P/12, Specification for Pavement Marking : April 1994

All road marking contractors must be a member of the New Zealand Road Markers Federation Incorporated and provide a quality assurance programme.

4.2.13 Street Lighting

The subdivider shall design and submit a street lighting proposal to the Engineer for approval. All design to be in accordance with NZS 6701 : 1983 and NZS 6705 : 1986.

Where it is deemed by the Engineer that the proposed light pole or fitting is not a common type to the district, it will be necessary for the subdivider to supply to the Council additional spare lights and poles in the event of failure or damage occurring. Also refer to clause 4.2.11.4.

Street lights are to be located at the joint property boundary position.

4.2.14 Street Landscaping

4.2.14.1 Landscaping is not a minimum requirement, however developers are encouraged to provide street trees to enhance the subdivisional environment. Standard Drawing R 24 is applicable if the developer chooses to undertake landscaping. Standard Drawing R 24 should be treated as a guideline. A flexible approach should be taken to ensure the best compromise between practicality and environmental quality.

4.2.14.2 Street planting is to enhance and strengthen the existing character and intended future character of neighbourhood areas and unify those areas into an integrated city.

4.2.14.3 The planting shall provide maximum long term benefit to the public with minimum ongoing maintenance. It must not compromise the safe use of the legal road reserve or affect its structural integrity.

4.2.14.4 *Location*

(a) TREES

Trees are generally to be planted in the front berm area between the kerb and footpath and not within the rear (services) berm or in road verges less than 1 metre in width.

The minimum separation distances shown on Standard Drawings R 05 and R 24 should be observed for tree planting. These separation distances are guidelines and may have to be increased depending on the road geometry.

(b) GARDENS

Gardens must be designed to keep maintenance to a minimum. Gardens must be located within street medians. The finished level of the soil is to be slightly raised to the centre rather than flat or sunken. The Council wishes to limit garden areas to keep maintenance costs within reasonable limits.

4.2.14.5 *Size*

The mature size of any tree or garden planting is to be assessed for each planting location and is to be in scale with the surrounding street environment and the space available. Plants should not exceed 600mm in height above the roadway when planted in the sight triangle at intersections, or other traffic or pedestrian conflict areas.

4.2.14.6 *Species Selection*

Species are to be selected with regard to overall composition, low maintenance, and longevity.

The number of species used is to be limited to ensure a unified results and species choice in street gardens is to complement the street tree planting. The following matters are to be considered for correct species selection:

- Tolerance to pollution, pruning and vandalism
- Pest and disease resistance
- Non-suckering and non-invasive root habits
- Trees should have single steps and be limbable to 2.0 metres
- Longevity (gums, pines, macrocarpas, grevillea and casuarina are not permitted).
- Shading characteristics compatible with location.
- Minimum maintenance requirements.

4.2.14.7 *Quality Control*

All plant material shall be sound, healthy, vigorous and free of any defects which may be detrimental to plant growth and development.

4.2.14.8 *Landscaping Structures*

Landscaping structures include sculptures, walls, fences, screens, bollards, entranceways, posts and the like and could be made from materials such as concrete, brick, stone, rock and timber. The design of the landscape must be considered as an integral part of the development and surroundings to fulfil both functional and aesthetic requirements. Durability and maintenance requirements must be considered.

The structures must be located so that they do not obstruct the sight lines for intersections, pedestrian crossings and signs. The separation distances must be considered together with trees and other landscaping features.

Structures must be designed to safely withstand appropriate loadings and must not be a hazard to traffic.

Entranceway structures must be located fully on private land. This policy applies mainly to arterial routes and on minor roads. Council may allow structures in the road reserve on a specific approval basis.

4.2.14.9 *Development of Street Trees and Gardens*

PLAN APPROVAL

Plans are to be submitted by the subdivider's representative at an appropriate scale (generally not less than 1:500 for tree planting and not greater than 1:100 for gardens) which detail both the botanical and common names, number proposed, size at planting, staking or other planting requirements and planting date (season). The location of services and street furniture is also to be provided. Plan approval, pre-construction, etc, are to follow the standard engineering requirements as set out in Section.

4.2.14.10 *Irrigation*

Council approval is required prior to the installation of any permanent or semi-permanent irrigation system. Island gardens shall be provided with a duct for a water connection. Developers shall apply and pay for a metered water connection for irrigation purposes.

4.2.14.11 *Topsoil Depths*

(a) GARDENS

All garden areas are to have a minimum of 400mm depth of organic topsoil free of all perennial weeds and stones greater in any dimension than 10mm.

The subgrade below the topsoil is to be free draining and shall not contain any rock or concrete materials.

The subgrade shall be loosened to a depth of 500mm to provide free drainage prior to placing the topsoil.

(b) SPECIMEN TREES

The tree pit should exceed the diameter of the root ball by 500mm and its depth by a minimum of 200mm.

The subgrade below the tree pit is to be free draining and shall not contain any rock or concrete materials.

The subgrade shall be loosened to a depth of 500mm to provide free drainage below the tree pit.

4.2.14.12 *Root Control Barrier Planter*

All specimen trees in islands in front berms of streets shall be planted in conjunction with an approved root control barrier planter.

Root control planters shall be of a proprietary structural polyethylene material or as approved by the Engineer and installed in accordance with the manufacturer's recommendations and Standard Drawing R 23.

A 100mm wide drainage metal layer shall be placed around the perimeter of the root control planter as shown on the Standard Drawing R 23.

4.2.14.13 *Maintenance Period*

The developer is responsible for the routine maintenance and replacement of the planting including deadwooding, weed control, mulching, replacing dead trees and watering for a period of 12 months. The replacement of dead trees is to be undertaken within ten days of written notification.

4.2.14.14 *Completion*

The Council does not require "as builts" of the street landscaping. The developer's representative must be satisfied that the street landscaping is in accordance with the design and must include landscaping in the Certificate of Completion.

4.2.15 Traffic Calming

This section sets out recommended standards for traffic calming features relating to local streets referenced from *"The Street Where You Live"* by M L Gladd 1995. Traffic calming is a shorter and more descriptive term than Local Area Traffic Management (or LATM) as it is known and is the introduction of changes to the street to slow down and reduce the flow of traffic and/or to divert heavy and large vehicles to roads designed to take them.

Developers are encouraged to provide these features to enhance the local environment of the streetscape.

Traffic calming has the following advantages:

- Speed reduction
- Reduction in accidents
- Streetscape improved by increasing planting areas

- Noise - reduced due to slower speed
- Quality of life - reduced noise and stress and increased streetscaping (cobbles, shrubs, trees and grass, etc) results in a better quality environment and this can be reflected in the status of the area and property values.

4.2.15.1 *What are the devices and where should they be used?*

There is a wide choice of traffic calming devices for residential streets from very mild to severe, including outright closure. Some common types are listed in Table 2.

Degree of Severity	Threshold or Peripheral	En Route Changes
1. Mild Restraints	1.1 Threshold Type B	1.4 Change of alignment
	1.2 Threshold Type C	1.5 Traffic islands in street
	1.3 Splitter islands ("fish tail" or short median)	
2. Moderate Restraints	2.1 Threshold Type A	2.2 Two lane angled slow point (with divider)
		2.3 Two lane speed hump
		2.4 Cushion (hump) to only affect narrow vehicles
		2.5 Platform, minor intersection.
		2.6 Roundabout, minor intersection.
3. Strong Restraint		3.1 Single lane slow point.
		3.2 Single lane speed hump
		3.3 Combined slow point with hump.
4. Very Strong Restraint		4.1 Diagonal closure of intersection
		4.2 Complete closure of road (at end or en route)
		4.3 Meandering restraint zone or "Woonerf" (usually with supplementary devices)

TABLE 2 - TYPES OF DEVICES FOR RESIDENTIAL STREET TRAFFIC CALMING

How "tough" a measure is needed depends on the severity of the problem, the target maximum traffic flow or speed, the needs to reduce the use of the road by through traffic and heavy vehicles, and the type of property served.

Materials and landscaping should enhance the streetscape and be both durable and easy to maintain. In general, where there is a vertical action (eg a "platform" type of restraint) and the area is reasonably large, coloured paving blocks are the preferred material. Planting of grass, shrubs and larger trees can usually be achieved on areas of road removed from the trafficable area.

4.2.15.2 *Design*

The Standard Roading Drawing R 19 indicates various traffic calming devices. All designs will be subject to the final approval of the Engineer.

4.2.15.3 *Construction*

All costs associated with construction of traffic calming devices will be borne by the subdivider.

4.2.16 Fencing

Fencing shall be required at the sides of any road, street, reserve or accessway, if in the opinion of the Council such fencing is necessary to ensure the safety of the public, or to avoid, remedy or mitigate any adverse effect on the environment.

Fences shall be required on both sides of pedestrian accessway as shown in Standard Drawing R 14.

Other fences to be erected will be specified by the Council and must be constructed in accordance with the Standard Drawings. Temporary fencing shall be erected by the subdivider to protect the general public, particularly children, from all danger areas in the subdivision. Signs shall be erected warning persons of the dangerous areas. The use of barbed wire is prohibited.

Fencing covenants in favour of Council will be required over all lots fronting land, other than roads, vested in Council.

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Section 5.0

Utilities - Stormwater and Land Drainage

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SECTION 5.0 - UTILITIES - STORMWATER AND LAND DRAINAGE

5.1 GENERAL

The stormwater system shall provide for the collection and control of all stormwater within the land being developed together with drainage from the entire catchment upstream of the proposed system. The design of the stormwater system must also take into account the effects of the proposed subdivision or development on downstream systems.

For on-site disposal, specific design and disposal details are required to ensure that satisfactory collection and disposal is possible.

5.2 PROTECTION FROM FLOODING

Compliance with the performance standards may be verified by evaluating the potential flooding risk and providing the necessary surface water control measures to satisfy the requirements.

5.2.1 Flood Risk Assessment shall take account of the characteristics of the total catchment. A search shall also be undertaken to find any relevant historical information on flooding. This could include reviewing records held by relevant bodies, discussions with the local inhabitants or appropriate field tests.

5.2.2 Evaluation shall address the following:

(a) The proximity and nature of any river, stream or water-course, and associated flood plains.

(b) The capacity of culverts or water-courses downstream of the site and the likelihood of upstream ponding resulting from under capacity, or from blockage by debris or slips.

(c) The upstream culvert and water-course conditions, and the location of the secondary flow path for flood waters in the event of blockage or under capacity.

5.2.3 Calculations based on reasonable judgement taking account of the overall site conditions, details of the drainage system, and the probable impediments to free flow, (both upstream and downstream) shall determine the expected runoff 'Q', and show that the design flood levels at the site satisfy the Performance Standards.

5.2.4 Council may consider land is adequately protected from inundation if subject to drainage easements or restrictive covenants (building line and level) covering the inundated and 'at risk' areas.

5.2.5 Secondary flow paths shall be identified and where appropriate, catered for by specific design, taking account of:

(a) The capacity of the downstream surface water system, and the risk of blockage at its intake.

(b) The necessity for a secondary intake structure and the relative flow distribution between primary and secondary intakes for the likely degree of blockage.

5.3 STORMWATER CONSENTS FROM ENVIRONMENT BOP

A general authorisation from Environment BOP exists for the discharge of clean stormwater into natural water provided that:

(a) The maximum discharge shall not exceed the flow from a 300mm pipe on a flat grade or equivalent of 80 litres per second.

(b) The suspended solids concentration of the water discharged does not exceed 150 gm^3.

(c) The water discharged is free of grease and oil and meets the Trade Waste Bylaws for discharge.

(d) The works shall be designed, constructed and maintained in such a manner so as not to cause erosion or flooding or to adversely affect any land or property owned or occupied by another person. Also refer to clause 3.3 - Stormwater and Silt Control.

(e) Clause 5.4.4 applies to Ohiwa Harbour.

Therefore, when undertaking development works within the district, Resource Consents are not required provided that the above conditions apply. Council will itself, impose such controls as it sees necessary to minimise the effects on the water and soil environment caused by the development.

For discharges outside the scope of the general authorisation Resource Consents will be required from the Environment BOP and a copy shall accompany the engineering drawings for approval.

5.4 DESIGN REQUIREMENTS

5.4.1 Performance Standard

(a) The subdivider shall provide a stormwater disposal system that is adequate to safeguard people from injury or illness and to protect property from damage caused by surface water.

(b) That a primary system capable of disposal of surface water resulting from a storm having a 10% (10 year) probability of occurring annually, shall be constructed.

(c) That a secondary flow system capable of carrying surface water resulting from a storm having a 2% (50 year) probability of occurring annually shall be constructed to ensure that such surface water shall not enter buildings.

(d) That subdivider shall provide a stormwater reticulation system for the collection and disposal of stormwater runoff from impermeable surfaces.

That surface flows on carriageways are controlled in order to enable safe and comfortable vehicle and pedestrian access across and along road reserves.

(e) That the primary disposal system for all residential development shall be in accordance with clause 5.4.5.

(f) That all stormwater reticulation and disposal systems are constructed to convey surface water to an appropriate outfall using gravity flow where possible, and in a manner which avoids the likelihood of blockages, leakage, penetration by roots, or the entry of groundwater where pipes or lined channels are used and avoids the likelihood from superimposed loads or normal ground movements.

(g) That accessible inspection chambers are provided at all changes of grade, direction and pipe size.

(h) That self-cleansing velocities are maintained within reticulation systems.

(i) That the reticulation and disposal system is designed and constructed for a function design life of 50 years.

(j) That damage to the environment both during and after the development construction phase is minimised or avoided.

(k) That a stormwater system is provided which can be economically maintained.

5.4.2 Where further subdivision, upstream of the one under consideration is provided for in the district or regional planning scheme, the Engineer will require stormwater pipelines to be constructed to the upper limits of the subdivision.

Where the proposed subdivision or development brings about the need for additional works to be undertaken downstream of the subdivision or development, the developer will be required to contribute in proportion to the catchment area of his/her subdivision or development, to the costs of the additional works.

5.4.3 Building Floor Levels

A catchment plan has been prepared by Council indicating minimum floor heights in the Opotiki area. All developments shall comply with the minimum levels stated but notwithstanding the above, may be subject to additional requirements as deemed necessary by the Engineer.

5.4.4 Stormwater Treatment

All stormwater discharges to open water courses into Ohiwa Harbour shall be subject to specific treatment and design in accordance with "*On Site Effluent Treatment Regional Plan – Environment Bay of Plenty*".

All discharges will be required to have a detention time before discharge to the waterway.

5.4.5 Residential Development Primary Disposal System

NB: While in most cases the Subdivider will not be carrying out building on the new allotments the responsibility will lie with the Subdivider to determine which system the site falls into (as outlined in 5.4.5.1 -5.4.5.4) and provide a Report to the Engineer for final approval prior to installing the necessary overflow pipes as required from the stormwater reticulation to the lot boundary as shown on the Standard Drawings.

All residential roof stormwater shall be disposed of in the following manner :

5.4.5.1 *Allotments with good free draining soils* (percolation rates >1000 mm per hour)

Properties with good ground soakage shall have porous soakage rings to dispose of all roof stormwater equating to the total volume as determined by onsite investigation (refer to Section 5.5.16) ; OR

Alternatively the soakage storage volumes in Table A maybe used.

Allotments with good ground soakage will not require any overflow or stormwater connection pipes to a Council stormwater reticulation system, if available.

5.4.5.2 *Allotments with moderate draining soils* (percolation rates 100 mm to 1000 mm per hour)

These shall have porous soakage rings equating to the total volume as determined by TABLE A with a 100 mm dia high level overflow pipe to a Council stormwater reticulation system or where this is not possible, to connect to the kerb with an approved kerb connection.

Allotments with moderate ground soakage will require a stormwater connection pipe to a Council stormwater reticulation system.

5.4.5.3 *Allotments with poor draining soils* (percolation rates less than 100mm per hour) OR *sloping sites , steeper than 15%*; 8 degrees and *OR sites of known or possibly instability* shall have sealed storage holding tank (s) equating to a total volume as determined by TABLE A with a low level (25 mm) drain *and a 100 mm dia high level overflow pipe to the Council stormwater reticulation or where this is not possible, to connect to the kerb with an approved kerb connection.

All systems in this category will be subject to the final approval of the Engineer.

* *The small drain will connect into the overflow pipe and allow the storage chamber to slowly empty over several hours. An access point to clean the drain pipe will be required to prevent blockages.*

5.4.5.4 *Allotments which do not comply with the above*

These properties due to their topography and poor draining soils cannot comply with the stormwater requirements .

Such properties shall be subject to specific design and approval from the Engineer.

Note: For all systems it will be the subdividers responsibility to access the potential for instability and or other drainage problems caused by the proposed stormwater system and if necessary seek professional geotechnical advise on which system is appropriate for the site.

Table A - Onsite Storage Volumes for Total Roof Areas.

Primary Stormwater System for Roof Areas.	
ROOF AREA (M^2)	STORAGE VOLUME (M^3)
80	0.81
100	1.00
120	1.21
140	1.41
160	1.61
180	1.81
200	2.01

Table A has been determined using a simplified triangular unit hydrograph with a base equal to 3.5 tc and a maximum height Q vs tc. Q has been calculated using the below data:

Storm Event 10 % AEP with a intensity (I) = 96 mm/hour
Time of concentration (tc) = 4 minutes
Runoff Co-efficient (c) = 0.90

5.4.5.5 Standard precast soakrings shall be installed for all ground soakage systems.

Standard sizes currently available are as follows:

Table B - Standard Precast Soakring Volumes

Size (mm)	Volume/unit (m^3)
720 (570 ID) x 760 deep	0.194
915 (765 ID) x 457 deep	0.210
1220 (1070 ID) x 305 deep	0.274

Table B in conjunction with Table A can be used to determine how many soakrings will be required for each roof area.

5.5 ESTIMATION OF SURFACE WATER RUNOFF

The following section shall be used to design the primary stormwater reticulation system for all road and impermeable surfaces together with runoff from allotments, and road reserve areas as contained within the catchment.

5.5.1 Surface water runoff for catchments up to 500 ha may be calculated using the Rational Method. For catchment areas greater than 500 ha, the Modified Rational Method is used.

5.5.2 A permissible alternative to the Modified Rational Method, for catchments larger than 500 ha is the method described in "Flood Frequency in New Zealand".

5.5.3 Rational Method

5.5.3.1 The formula to be used for catchments less than 500 ha is:

$$Q = \frac{CIA}{360}$$

where

Q = runoff in cubic metres per second (m^3/s)
C = runoff co-efficient (see Table 5)
I = rainfall intensity in mm/hr
A = area of catchment above the point being considered in hectares

5.5.4 Modified Rational Method

5.5.4.1 Where the catchment area is greater than 500 ha, the Modified Rational Formula shall be used. This formula is:

$$Q = \frac{CIASF}{360}$$

where Q, C, I, A are as defined above, and

S = the shape factor (dimensionless)
= $0.4253 + 1.266\ k - 0.3952\ k^2$

$$k = \frac{A}{100\ L^2}$$

L = straight line length to catchment head in km

and

F = the area factor (dimensionless)
= $0.6 + -.4\ e^x$

$$x = \frac{A}{7700}$$

S and F can be determined from Table 4.

Table 4 : Shape and Area Factors

k	S	A(ha)	F
0.33	.80	500	0.975
0.35	.82	800	0.96
0.40	.87	1000	0.95
0.45	.91	1500	0.93
0.50	.96	2000	0.91
0.60	1.04	3000	0.87
0.80	1.19	5000	0.81
1.00	1.30	7000	0.76
1.20	1.38	10000	0.71
1.40	1.42		
1.60	1.44		

5.5.5 Runoff Co-efficient

5.5.5.1 Values of runoff co-efficient for various land use types can be obtained from Table 5. Where an area comprises different land use types, an average runoff co-efficient shall be determined based on the areas and runoff co-efficients of the component land use type.

Table 5 : Runoff Co-efficient

Description of Surface	C
Natural Surface Types	
Bare impermeable clay with no interception channels or runoff control	0.70
Bare uncultivated soil of medium soakage	0.60
Heavy clay soil types:	
- pasture and grass cover	0.40
- bush and scrub cover	0.35
- cultivated	0.20
Medium soakage gravel, sandy and volcanic soil types:	
- pasture and grass cover	0.20
- bush and scrub cover	0.25
- cultivated	0.20
High soakage gravel, sandy and volcanic soil types:	
- pasture and grass cover	0.20
- bush and scrub cover	0.15
- cultivated	0.10
Parks, playgrounds and reserves:	
- mainly grassed	0.30
- predominantly bush	0.25
Developed Surface Types	
Steel and non-absorbent roof surfaces	0.90
Asphalt and concrete paved surfaces	0.85
Near flat and slightly absorbent roof surfaces	0.80
Stone, brick and precast concrete paving panels:	
- with sealed joints	0.80
- with open joints	0.60
Unsealed roads	0.50
Railway and unsealed yards and similar surfaces	0.35
Land Use Types	
Full roofed and/or sealed development	0.90
Industrial, commercial, shopping areas and town house developments	0.65
Residential areas in which impervious area exceeds 35% of gross area. (This includes most modern subdivisions).	0.45

Note: The runoff co-efficient C is the variable in the rational formula least able to be precisely determined and has a direct result on the estimation of the discharge. Thus care is required in selecting a value of the co-efficient. The co-efficient represents the integrated effects of infiltration, storage, evaporation, natural retention, interception, etc, which all affect the time distribution and peak rate of runoff. The factors required to determine a value for C are surface type, characteristic topography and land use.

5.5.6 Slope Correction

5.5.6.1 The values in Table 5 assume an average sloping terrain of 5-10% (ie gently rolling) however, if the terrain is flatter or steeper, this will have the effect of slowing down or speeding up overland flow and the value of C shall be reduced or increased according to Table 6.

Table 6: Slope Correction

Ground Slope	Adjustment factor for C
0 - 5%	- 0.05
5 - 19%	0
10 - 20%	+0.05
20% or steeper	+0.10

5.5.6.2 The runoff co-efficients given in Table 5 are for ground considered as already wet from previous rain, and shall be used in the calculation of surface water runoff.

5.5.7 Future Development

The chosen runoff co-efficient shall be based realistically on the conditions likely to exist after the full catchment development allowable by the operative plan under the Resource Management Act 1991.

5.5.8 Rainfall Intensity

The rainfall intensity shall be that for a storm having a duration equal to the time of concentration and a probability of occurrence as appropriate.

Note: Rainfall figures shall be determined from High Intensity Rainfall Design System (HIRDS). The HIRDS information system is available from National Institute of Water and Atmospheric Research Ltd (NIWA).

Appendix 1H provides for printouts using HIRDS for various sites in the area.

5.5.9 Time of Concentration

5.5.9.1 The time of concentration, and hence the critical storm duration of a catchment, is the time taken for surface water runoff to reach the design point from the furthest point (in time) of the catchment, so that the whole catchment is contributing to the maximum discharge at the design point for any given probability of occurrence.

The time of concentration t_c (minutes) is calculated from the formula:

$t_c = t_e + t_f$

where

t_e = Time for runoff to travel overland from roofs, downpipes, carriageways, road channels, etc, to the point of entry at either a pipe or channel inlet (minutes)

t_f = Time for network flow comprising time of flow in pipes and/or open channels to design point (minutes).

Note: In some catchments due to shape, surface water network and varying permeabilities within the catchment, part of the catchment under consideration may produce a higher peak flow than the whole of the catchment. Although the area for the part catchment is smaller, this may be more than offset by the higher intensity storm associated with a shorter time of concentration and storm duration. This situation will generally arise where the lower reaches of a catchment are densely developed and should be checked by calculation where appropriate.

5.5.9.2 The velocity of the surface water flow throughout the duration of a storm will vary as the depth of flow varies. Discharge characteristics normally give velocity somewhere between the mean velocity and the peak flow velocity. Unless better information is available, the velocity can be assumed to be 0.85 of the peak velocity.

5.5.9.3 Due allowance shall be made for the surface water disposal characteristics when analysing both the time of concentration and the runoff characteristics from the catchment area.

Note: 1. In some areas, the runoff from roofs and streets may be directly piped, whereas the runoff over paved and unpaved surfaces may have a component of overland flow before entering the system.

5.5.9.4 Where the catchment area has a well defined and regularly repeated pattern for directing the surface water to the drain, the time of entry may be taken as:

t_e = 5 minutes for commercial or industrial areas where the majority of the surface of the catchment area feeding the drain consists of asphalt, concrete, paved or metalled surfaces.

t_e = 7 - 10 minutes for residential areas.

t_e = 10 minutes for low density residential areas.

5.5.9.5 In other areas, and in cases where the catchment is longer than 1.0 km, separate estimates of time of overland flow, and time of road channel flow shall be calculated using the following approach:

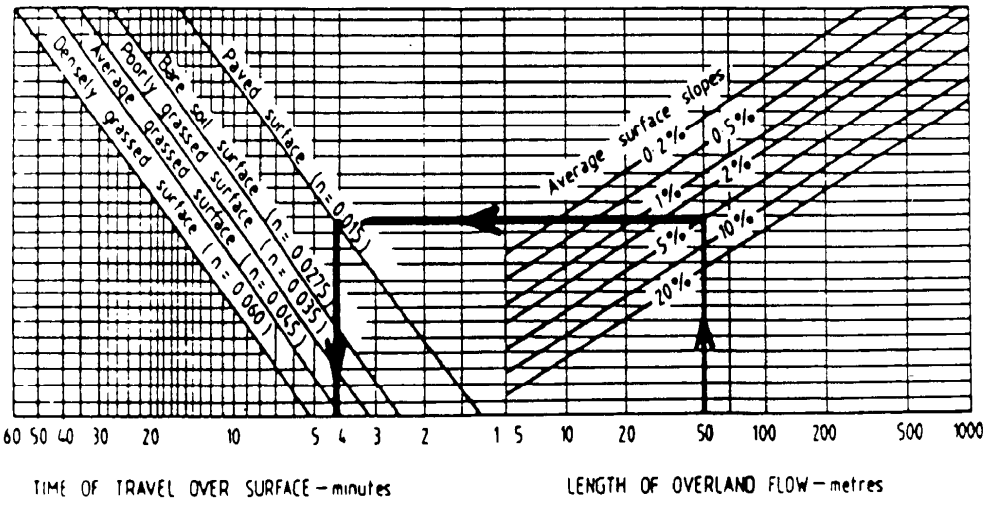
(a) The time of overland flow is to be calculated by the formula:

$$t = \frac{100\, nL^{0.33}}{S^{0.2}}$$

where
t = time in minutes
L = length of overland flow in metres
S = slope in percent
n = the value for surface roughness.

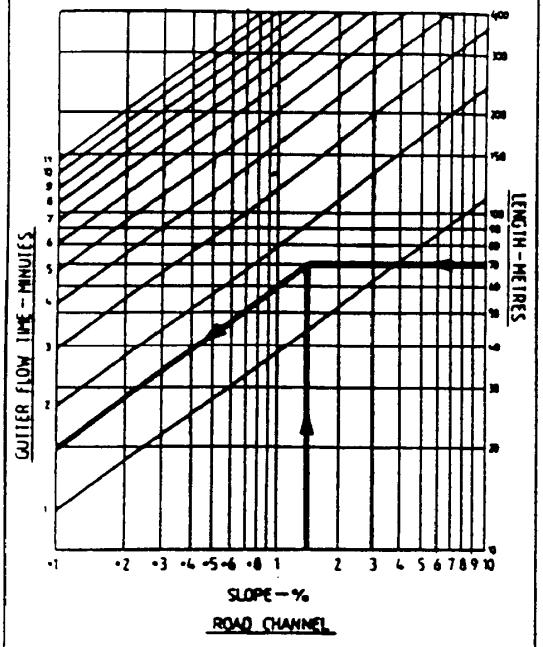
The results from this formula, for normal surface types, are shown in Figure 1.

Figure 1: Times for overland flow



Example: For surface water flowing 50 m over a paved surface at a slope of 5 %, the time of travel is 4.1 minutes

Figure 2: **Road channel flow time**



Example: **For a slope of 1.4 % and a road channel length of 70 metres the time of road channel flow is 1.7 minutes**

(b) The time of road channel flow is the time taken for water to flow from the point of entering the road channel, to the point of discharge to a sump, catchpit, drain or other outlet. Figure 2 may be used to obtain the time of flow.

5.5.9.6 *Time of Pipe Flow*

The time of pipe flow can be calculated from Figure 3 which is based on Manning's formula with n = 0.013. To follow this procedure, longitudinal sections are required of the piped systems, giving internal pipe diameters, lengths and gradients.

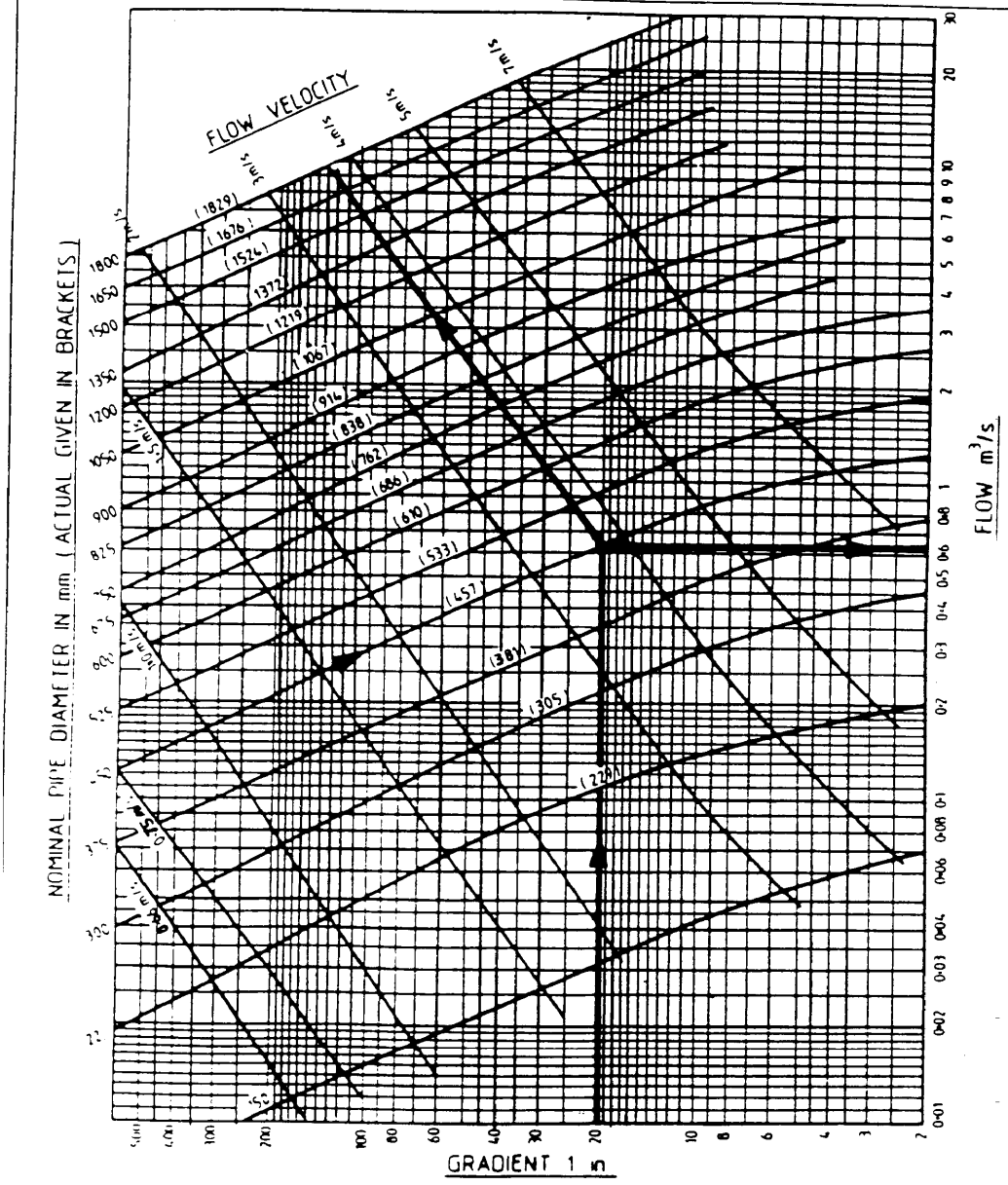
5.5.9.7 For preliminary calculations, if there is little detail of the final pipe systems, average pipe flow velocities if 3m/s for moderate to steep gradients and 1.5m/s for low gradients may be used.

5.5.9.8 *Time of Open Channel Flow*

The time of flow in open channels (either water-courses of lined channels) is calculated by means of Manning's formula.

5.5.9.9 If there is insufficient data to calculate the time of open channel flow, the approximately natural stream velocities as given in Table 7 are recommended for channels that are not severely restricted by meanders, or fallen and tangled trees and other vegetation.

Figure 3: **Pipe flow relationships for different combinations of internal diameter, velocity and gradient**
(based on Mannings formula using n = 0.013 with an allowance for air entrainment)



Example: A 450 internal diameter pipe of a gradient of 1 in 20 will have a flow velocity of 3.75 m/s and a flow of 0.63 m^3/s

Table 7 : Approximate Natural Stream Velocities		
Catchment Description	Average Slope %	Velocity m/s
Relatively flat	1 - 4	0.3 - 1.0
Undulating	2 - 8	0.6 - 2.0
Hilly	6 - 15	1.5 - 3.0

5.5.9.10 *Alternative Procedure*

An alternative procedure uses the Ramser-Kirpich formula which is particularly suitable for rural areas and enables the calculation of time of concentration from:

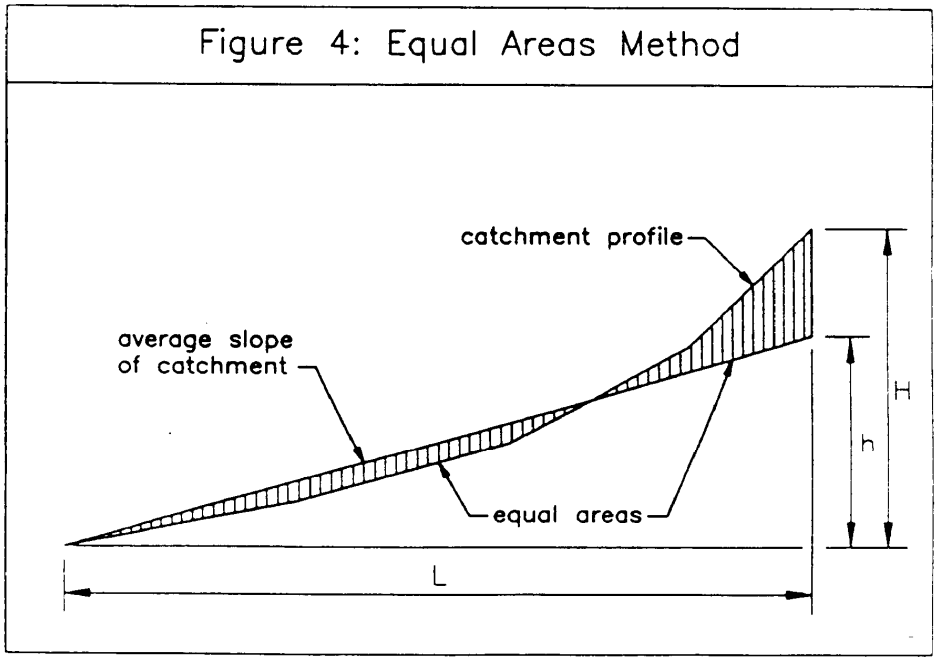
$$t_c = 0.0195 \left(\frac{L^3}{H} \right) 0.385$$

where

t_c = time of concentration in minutes
L = length of catchment in metres measured along the flow path
H = rise from bottom to top of catchment in metres.

5.5.9.11 If Resource Management Act 1991equal catchment slope varies significantly from the value H/L (eg with a sudden steepening in the upper reaches) the average slope and height 'h' shall be determined from the equal areas method shown in Figure 4. Height 'h' shall be substituted for 'H' in the formula.

Figure 4: Equal Areas Method



5.5.10 Sizing of Surface Water System

This section deals with the sizing of surface water drains and relates only to drains which are "barrel controlled" for flow capacity. For drains which are controlled by either "inlet" or "outlet" flow conditions, flow capacity shall be calculated in a manner which incorporates the effects of the restriction. This limitation would normally only relate to large diameter pipes designed to control a significant quantity of water originating "off site".

5.5.11 Minimum Size of Drains

To avoid blockages, public surface water drains shall have an internal diameter of no less than:

200mm ∅ for main pipes

225mm ∅ for cesspit leads less than 15m long

300mm ∅ for cesspit leads greater than 15m long

375mm ∅ for cesspit leads for double sumps

100mm ∅ for property connections

The internal diameter of a drain shall not decrease in size in the direction of flow.

5.5.12 Hydraulic Design

Pipes shall be sized with the use of the following:

(a) *Manning's Formula*

$$V = R^{2/3} S^{1/2} n^{-1}$$

where

V = velocity

R = hydraulic radius in metres $= \frac{A}{P}$

where

A = cross-sectional area of flow

P = perimeter of the cross-section of the flow

S = slope $= \frac{\text{vertical rise}}{\text{horizontal distance}}$

n = roughness co-efficient. For circular pipes flowing full, n is to be taken as

0.011 for HDPE and uPVC
0.013 for ceramic and concrete pipes
0.015 for cast insitu concrete culverts and drains, and drains with velocity less than 1m/s
0.03 - 0.035 for open ditches

(b) *Colebrook-White Formula*

$$v = -2\sqrt{(2gDi)}\log\left(\frac{ks}{3.7D} + \frac{2.51v}{D\sqrt{2gDi}}\right)$$

where

v	=	velocity
g	=	gravitational acceleration
i	=	hydraulic gradient
v	=	kinematic viscosity of fluid or 1.14mm^2/s for water at 15°C
D	=	diameter
ks	=	pipe roughness co-efficient

ks	=	1.5 mm sanitary sewers
ks	=	1.5 mm Stormwater sewers < 500mm diameter
ks		0.6 mm Stormwater sewers > 500mm diameter

Design tables based on the above have been included in Appendix 1F. The tables cover both sanitary sewers and stormwater sewers of different roughness co-efficients.

The diameter used in calculating the velocity and discharge is the actual internal diameter as listed. Higher classes of concrete pipe of the same nominal diameter will have smaller internal diameters and discharges must be reduced accordingly.

(c) *Steep Gradients Allowance*

Where a pipe gradient exceeds 1 in 10, an allowance for the bulking of the flow due to air entrainment should be made. This allowance is made by increasing the area of the pipe for the additional volume of air in the flow. The air to water ratio may be calculated from the formula:

$$\frac{\text{air}}{\text{water}} = \frac{kv^2}{gR}$$

where

k	=	co-efficient of entrainment (dimensionless)
	=	0.004 for smooth concrete pipes, or 0.008 for cast insitu concrete culverts
v	=	velocity m/s
R	=	hydraulic radius m
g	=	acceleration due to gravity m/s^2

Where air entrainment is likely, facilities to dissipate the excess energy and to allow the free escape of the excess air to the atmosphere are to be provided.

5.5.13 Energy Loss Through Structures

Hydraulic design shall make the appropriate allowance for energy losses at structures. These losses are generally associated with a change in direction of the flow, or an increase of decrease

in pipe size. As an access chamber is normally required at such changes, an additional fall can be provided through the access chamber to allow for the losses. This fall H_L is in addition to the fall produced by the gradient of the pipeline, and can be calculated by:

$$H_L = \frac{Kv^2}{2g}$$

where

K = loss co-efficient for change in direction and can be determined from figure 5.

Where there is an increase in pipe size at the access chamber, the hydraulic design shall ensure gravity flow with no surcharging for a storm having a 10% probability of occurring annually.

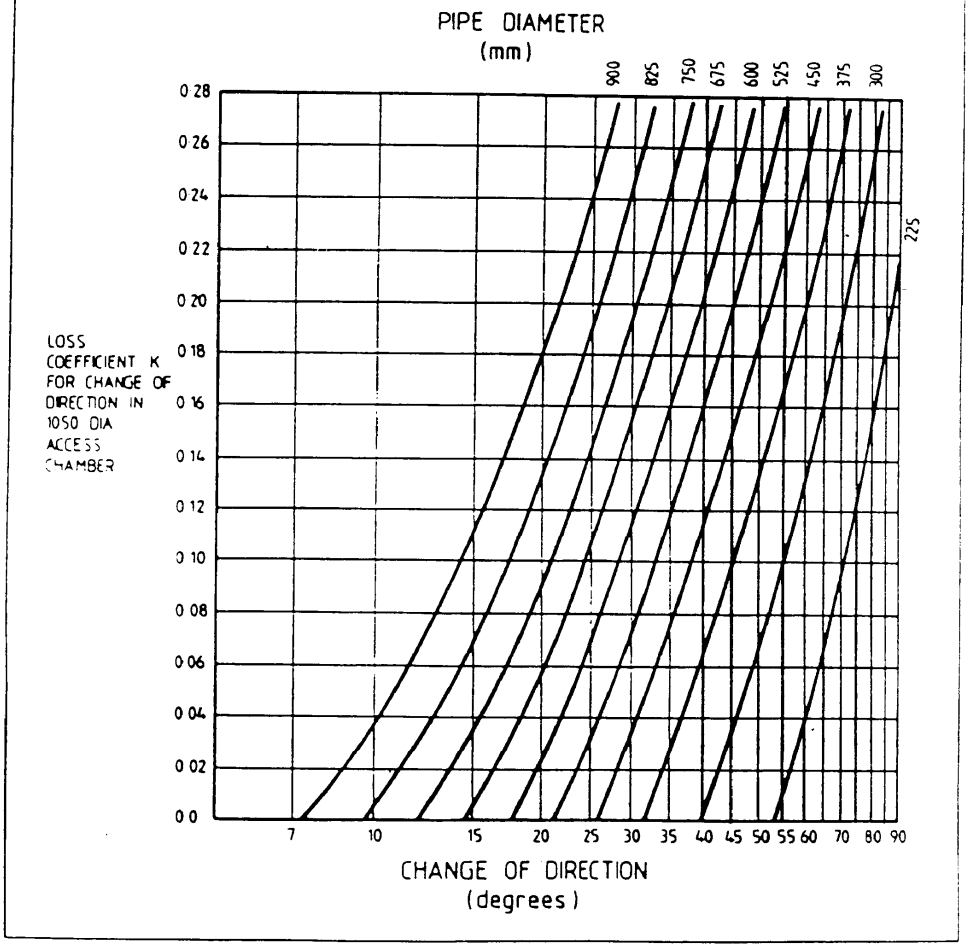
Note: This is normally achieved by maintaining the same soffit level for both drains at the access chamber.

In cases where a reduction in drain size is justified by a large increase in gradient, an additional head loss of $0.5v_e^{\ 2}/2g$ is to be allowed for (v_e = exit velocity).

5.5.14 Energy Dissipation Structures

Where the hydraulic analysis demonstrates that a significant turbulence or energy dissipation will occur, control structures shall be provided for energy dissipation to prevent damage to the drainage system, its outfall and the surrounding environment.

Figure 5: **Energy loss coefficient**



5.5.15 Minimum and Maximum Velocity

A drain flowing full shall have a minimum velocity of 0.7m/second.

No limitation on maximum velocity is practical, however pipes must be laid within the limitations set by their manufacturers.

5.5.16 Disposal to Soak Pit

Where the collected surface water is to be discharged to a soak pit, the suitability of the natural ground to receive the water shall be determined. This evaluation may involve field testing of ground soakage and discussion or direction from suitably qualified soils or geotechnical engineers.

Field testing of soakage may be carried out as follows:

(a) Bore test holes of 100mm to 150mm diameter to the depth of the proposed soakhole. Record the ground profile as excavation proceeds.

(b) Fill the hole with water and maintain full for at least four hours (unless the soakage is so great that the hole completely drains in a short time).

(c) Fill the hole with water to within 750mm of ground level, and record the drop in water level against time until the hole is almost empty, or over four hours, whichever is the shortest.

(d) Plot the drop in water level against time on a graph, and the soakage rate in mm/hr is determined from the minimum slope of the curve. If there is a marked decrease in soakage rate as the hole becomes nearly empty, the lower rates may be discarded and the value closer to the average can be adopted.

5.5.17 Drain Leakage Tests

While testing of surface water drains will not normally be required, the materials and workmanship used in surface water drains may be required and shall be capable of passing one of the following tests:

(a) Water test

(b) Low pressure air test

(c) High pressure air test

Testing may be required where pipelines are laid in filled areas or where Council requires assurance of the integrity of the pipeline.

All tests require the pipeline to be sealed with suitably restrained plugs at both ends at branch connections. Because porous pipes such as those of ceramic or concrete materials absorb water and can transmit air through their walls, they should have the voids filled by soaking prior to testing.

5.5.18.1 *Water Test*

(a) Fill pipe with water, ensuring all air is expelled.

(b) If pipe materials absorb water, leave for 24 hours.

(c) Top up water to test head level. The minimum head shall be 1.5m above the top of the pipe or ground water level, whichever is the higher. The maximum head at the lower end of the pipeline should not exceed 6.0m.

(d) Leave for 30 minutes then measure water loss.

(e) The pipeline is acceptable if water loss does not exceed 2ml per hour, per millimetre of internal diameter, per metre of pipeline length.

Note: Care should be taken when conducting water testing of pipes on steep gradients, to ensure that excessive hydraulic pressures are not applied.

5.5.18.2 *Low Pressure Air Test*

(a) Introduce air to the pipeline till a pressure of 300mm of water is reached. (This may be measured by a manometer such as a 'U' tube, connected to the system.)

(b) Wait until the air temperature is uniform. (Indicated by the pressure remaining steady.)

(c) Disconnect the air supply.

(d) Measure pressure drop after 5 minutes.

(e) The pipeline is acceptable if the pressure drop does not exceed 50mm.

Note: 1. The low pressure air test is highly susceptible to temperature fluctuations during the test period. A 1°C change during the 5 minute test period will cause a pressure change of 30mm water gauge or 60% of the permitted change.

2. Failure to soak ceramic and concrete pipes can cause highly variable results.

5.5.18.3 *High Pressure Air Test*

(a) Pressurise pipeline to 25 kPa.

(b) Wait at least 2 minutes to ensure temperature stabilisation.

(c) Disconnect air supply.

(d) Measure the time taken (minutes) for the pressure to drop to 17 kPa.

(e) The pipeline is acceptable if the time does not exceed that given for the appropriate pipe size in Table 8.

Table 8 : Time for Pressure Drop versus Internal Pipe Diameter

Internal Pipe diameter (mm)	Time for Permissible Pressure Drop (minutes)
90	3
100	3
150	4
225	6

5.6 OPEN WATER-COURSES

5.6.1 All open water-courses are to be piped. However, the Engineer may approve concrete lined channels or unlined drains where flows exceed the capacity of a 1200mm diameter pipe.

5.6.2 Where the use of an open water-course is permitted, the extent of improvement work shall be agreed with the Engineer in order to achieve a satisfactory compromise between the retention of the natural topography and vegetation and maintenance, hydraulic and safety considerations, including the downstream effects of the work.

Open water-courses where permitted shall generally be located in a drainage reserve or easement vested in Council to enable maintenance to be carried out. The cross-section and erosion protection for the open water-course shall be specifically designed and to the approval of the Engineer.

5.7 LOCATION OF PIPELINES

5.7.1 Stormwater drainage pipelines shall generally be aligned parallel with the street network, however their alignment may deviate from the standard parallel alignment provided there is no interference with other services and the pipes are located in the road reserve. Alternatively, stormwater drainage pipelines may be located in areas which will not reduce the building area available on the lot.

5.7.2 Manhole structures shall be located at least 1.0 metre clear of all boundary lines.

5.7.3 Where a stormwater drain or structure is laid within private property, it shall be protected by an easement in favour of Council and of sufficient width to allow practical access for maintenance, and shall not be less than 3.0m wide.

5.8 PIPES

5.8.1 The following pipes may be used for stormwater drainage work, provided they comply with the relevant Standards, and subject to the following conditions:

Table 9 : Acceptable Pipe Materials	
Concrete	NZS 3107 : 1978
uPVC	NZS 7649 : 1988
HDPE	NZS 7604 : 1981
ABS	NZS 7609 : 1990

5.8.2 Other pipes may be permitted subject to the specific approval of the Engineer.

5.9 JOINTS

All joints in drains shall be watertight and prevent the infiltration of groundwater and the intrusion of tree roots.

Table 10 : Acceptable Jointing Methods		
Pipe Material	Jointing Method	Standard
Concrete	Rubber ring	BS 2494 : 1976
uPVC	Rubber ring	BS 2494, NZS 7643 : 1979
HDPE	Heated welded or flanged	AS 2033 : 1980
ABS	Solvent welded or flanged	NZS 7609 : 1990

Acceptable jointing methods and the relevant standards are given in Table 10. Jointing of drains shall be subject to the tests called for. In case of HDPE pipes with rubber ring joints, the procedure for jointing, along with the relevant standard for rubber ring jointing, must be submitted for the Engineer's approval, prior to construction.

Where a drain consists of concrete, uPVC or HDPE, two flexible joints shall be installed within 750mm of the outside wall of any access chamber, but outside the line of the base and on each pipeline.

Note: This allows for differential settlement between the access chamber and the pipeline while minimising damage to the pipeline.

5.10 STRUCTURAL STRENGTH OF PIPES AND BEDDING

5.10.1 The pipe bedding shall be selected to meet the requirements of the class of pipe to be used and the design loading conditions.

5.10.2 The type of bedding and class of pipes adopted shall be in accordance with the pipe laying tables and bedding diagrams in NZS/AS 3725 : 1989.

5.10.3 Under normal ground conditions, pipes except uPVC may be laid in accordance with the Type C bedding procedure as set out in NZS 4452 : 1986.

5.10.4 The requirements for uPVC shall be as set out in the SAA CA 68 and NZS 7643 : 1979.

5.10.5 Where a pipeline is to be constructed through soft ground in unsuitable foundations, such material shall be removed and replaced with other approved material or alternatively other methods of construction shall be carried out to the approval of the Engineer to provide an adequate foundation for the pipeline.

5.10.6 The minimum cover for pipelines shall be 0.5m in private properties or 0.75m in road reserve. Where this cover cannot be provided, additional protection shall be provided. Alternatively, the Engineer may allow the cover to be provided according to the manufacturer's specifications.

5.11.7 Trench Slope

Where the slope of the trench is 1 in 3 or greater, anti-scour blocks shall be provided. These anti-scour blocks shall be:

(a) Constructed from 150mm thick concrete (17.5 mPa) up to pipe diameters of 300mm and 2300mm thick concrete (17.5 mPa) for diameters greater than 300mm.

(b) Keyed into the sides and floor of the trench by 150mm.

(c) Extended to 300mm above the drain or to ground level where the drain cover is less than 300mm, and

(d) Spaced at:

  (i) 7.5m centres for trench slopes between 1 in 8 and 1 in 5, or

  (ii) 5.0m centres for trench slopes greater than 1 in 5.

Note: The anti-scour blocks partition off the trench and prevent ground or surface water running along the trench and causing scouring.

5.12 PIPELINE CONSTRUCTION

5.12.1 The construction of pipelines shall be carried out in accordance with the requirements of NZS 4452 : 1986 and NZS 7643 : 1979, as appropriate.

5.13 BACKFILL

5.13.1 Backfill above the specified pipe bedding and surround in grassed surfaces shall consist of excavated material machine compacted in layers not exceeding 300mm compacted depth. The surface shall be reinstated with a minimum depth of 100mm of topsoil, and grassed.

5.13.2 Backfill material and compaction procedures for pipes laid in existing carriageways shall be in accordance with Standard Drawing G 03. Note that the sand bedding and surround shown on the drawing shall be replaced with the specified pipe bedding and surround.

5.13.3 Where pipes are to be laid under a proposed roadway, the backfilling must be in accordance with the following:

(a) 200mm above pipe to be selected, compacted granular material to act as a cushion.

(b) Remainder of trench to within 400mm of surface to be backfilled with compacted hardfill placed in 200mm layers.

(c) The backfilling of the final 400mm should be carried out in conjunction with formation work of the proposed road.

5.14 MANHOLES

5.14.1 General

Generally manholes shall normally be provided at each change of direction or gradient, and at each branching line and at a spacing of not more than 100m. Manholes may either cast insitu or of precast concrete.

5.14.2 Standard Manholes

5.14.2.1 These are to be circular manholes with a minimum internal diameter of 1050mm and may be used in situations where the largest inlet pipe does not exceed 600mm in diameter. However in a situation where there are multiple entries into a manhole with an inlet pipe of 600mm diameter or less, a larger diameter manhole may be required.

Outlet pipes from manholes should always be of not less a diameter than the largest size pipe leading into the manhole. The Engineer may however give dispensation from this requirement in certain cases.

In environments where the Engineer considers that loose detritus is likely to find its way into stormwater systems, silt traps and/or special purpose screens may be required to be installed at intervals within the systems.

5.14.2.2 Cast insitu manholes shall be constructed using ordinary grade concrete (17.5 mPa) vibrated to give maximum density and watertight construction.

5.14.2.3 Precast manholes shall consist of centrifugally spun 1050mm diameter concrete pipes to Class X standard. They shall have holes cast in the side for step irons.

The method of joining the precast sections shall be strictly in accordance with the recommendations of the precaster, and when using a proprietary jointing compound or adhesive, in conformity with the manufacturer's instructions to provide a watertight structure to the satisfaction of the Engineer.

5.14.3 Deep Manholes

5.14.3.1 Where manholes are more than 5.0m deep, they shall be specifically designed and shall incorporate intermediate landing platforms or grills in order to prevent a free fall of more than 3.0m.

5.14.4 Shallow Manholes

5.14.4.1 Where the depth to invert of a manhole is less than 1.0m, a shallow manhole may be constructed with a minimum diameter of 600mm, or a minimum width in the case of a rectangular shallow manhole of 450mm. In all cases, shallow manholes shall be of sufficient diameter to allow full benching.

5.14.5 Stormwater Manholes on Larger Pipelines

5.14.5.1 Manholes on stormwater pipelines more than 600mm diameter and on smaller pipelines where the use of standard manholes is not suitable, should be specifically designed, and will require the Engineer's approval.

5.14.6 Manhole Requirements

5.14.6.1 All cesspit leads shall be connected to stormwater mains via manholes, except that the Engineer may approve of saddling on to pipes of 600 mm diameter or larger, or if the sump lead is less than 1.0m long and the saddle is less than 10m from the manhole. Saddles shall only be allowed where manufactured junctions cannot be obtained.

5.14.6.2 The internal walls of the manhole shall be made smooth and free from joint gaps, to the satisfaction of the Engineer.

All joints that will allow grout to take hold, shall be filled and made smooth. In particular, between risers, manhole top collar (lid rings) and frame, and manhole top and risers.

In addition, all internal, rough or protruding material, left over from the casting process shall be removed by suitable means and made smooth to the satisfaction of the Engineer.

5.14.7 Step Irons, Steps and Ladders

5.14.7.1 All manholes, other than shallow manholes, shall be provided with approved galvanised steel step irons, steps or ladders in order to give reasonable access. Step irons shall be of the "dropper" or

"safety" type such that a foot will not slide off them. All fittings used shall be hot-dip galvanised after fabrication. Where the smallest pipe entering a manhole is 600mm or greater, recessed steps shall be provided in the haunching within the manhole such that a person standing in the invert of the manhole may easily reach the lowest rung of the manhole steps or ladder.

5.14.8 Drop Connections

5.14.8.1 Drop connections on stormwater manholes may be avoided by allowing pipes up to and including 300mm diameter to have an open "cascade" inside the manhole, provided the steps are clear of any cascade.

5.14.9 Manholes in Soft Ground

5.14.9.1 Where the manhole is to be constructed in soft ground, the area under the manhole shall be undercut, backfilled and compacted with suitable hardfill to provide an adequate foundation for the manhole base.

5.15 CONNECTIONS

5.15.1 The connection provided for each residential lot shall be of a type capable of taking the spigot end of an approved drainpipe of 100 mm internal diameter unless the Engineer requires a larger size connection to be provided.

5.15.2 Where the stormwater pipeline is outside the lot to be served, a 100mm diameter connection shall be extended to the boundary of the lot.

5.15.3 If the above conditions cannot be met, then the connection shall be a 150mm diameter line branching from a manhole in the main line. An extended 150mm diameter connection may be terminated without a manhole provided it is not more than 40m long and also that it does not serve more than two houses, otherwise a manhole shall be provided.

5.15.4 Where the design data is available, connections for commercial and industrial lots shall be designed to take the full design flow from the area served by the connection.

5.15.5 Each connection shall be marked by a 50mm x 50mm timber stake (treated pine or better) extending to 300mm above ground level with the top painted blue. This marker post shall be placed alongside a timber marker installed at the time of pipelaying and extending from the connection to 150mm below finished ground level. The lower end of the marker post shall be adjacent to, and not touching the connection. Connections shall be accurately indicated on "As built" plans.

5.15.6 All connections, whether to reticulation lines or to manholes, shall be sealed either by a factory sealed stopper or a plug fixed with a rubber ring and held with stainless steel wire.

5.16 RAMPED RISERS

5.16.1 Where an extended connection is to be taken from a pipeline to the boundary of another lot, a ramped riser need not be used, and the extended connection may be sloped up at a continuous

gradient from the pipeline, to terminate just inside the lot to be served at sufficient depth to drain the building site.

5.17 CONNECTIONS TO DEEP LINES

5.17.1 Where an existing or proposed stormwater pipeline is more than 3m deep to the top of the pipe, connections shall not be made directly to it, but a new, shallower branch pipeline shall be laid from a manhole on the deep stormwater line and connections provided to the lots to be served.

5.18 INLET AND OUTLET STRUCTURES

5.18.1 Approved structures shall be constructed at the inlets and outlets of pipelines. An acceptable type of concrete structure is shown on Stormwater and Land Drainage Drawing SW 05. Provision must be made for energy dissipation unless it is demonstrated that outlet velocities and soil conditions are such as to make this unnecessary. The design shall ensure non-scouring velocities at the point of discharge.

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Section 6.0

Utilities - Sewerage Reticulation and Disposal Facilities

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SECTION 6.0 – UTILITIES SEWERAGE RETICULATION AND DISPOSAL FACILITIES

6.1 GENERAL

All sanitary drainage systems shall be capable of serving the entire natural catchment upstream of the actual system. The flow from the upper section of catchment shall generally be calculated assuming complete urbanisation of the area or other such specific users as the Engineer may require.

Provision may be required to allow for the flow from a pumping station outside the natural catchment, the details being supplied by a Registered Engineer. A contribution towards the additional cost of the gravity system will be considered by Council where allowance for a pumping station flow is required.

6.2 FLOW REQUIREMENTS

Flow requirements shall be calculated from the District Plan zoning for the subdivision for the greatest flow possible from the catchment in question, and shall be to the Engineer's approval. Specific calculations are to be carried out using the following data.

6.2.1 Domestic Flow

Average sewage flow	=	200 litres per head per day
Peak & dilution flow factor	=	5 times daily average sewage flow
Minimum velocity	=	0.7 metres per second

Note: Velocities shall be calculated with due allowance for the proportional depth of flow in the sewer.

6.2.2 Industrial Flow

Specific design will be required within each industrial subdivision and to assess the future upstream flow.

The following maybe used as a preliminary design basis :

Industry Type (water usage)	Minimum design flow (litres/second/ hectare)
Light	0.4
Medium	0.7
Heavy	1.3

The above design flows include both normal sanitary sewage and trade wastes.

6.3 PIPE SIZES

In no case shall a sanitary sewer main be less than 150mm internal diameter.

6.4 GRADIENTS

Pipe gradients shall be determined using Tables in Appendix 1F. Specific approval of the Engineer is required and shall be obtained prior to the submission of detailed design if the maximum or minimum gradients shown in Table 11 are exceeded.

6.4.1 The pipe roughness coefficients *ks* used in the design shall be those nominated by or agreed upon with the Engineer on the basis of commonly adopted modern engineering design practice. For preliminary design purposes, it is recommended that *ks* be assumed 1.5 mm as an overall coefficient allowing for joints and so on.

6.4.2 The desirable flow velocity in 150mm diameter pipes when full shall normally be not less than 0.65 metre/second (minimum gradient 0.55%), but 0.75 metre/second (minimum gradient 0.72%) shall be the desirable minimum velocity for the upper portions of sanitary sewer systems.

6.4.3 Gradients flatter than 0.55% for 150mm diameter pipes may be permitted in special cases where otherwise pumping would be required.

6.4.4 A 150mm diameter pipeline at a gradient of 0.75% has 14 litre/second capacity (equivalent to 300 houses or 1 200 people).

6.4.5 A 150mm diameter pipeline at a gradient of 0.55% has 12 litre/second capacity (equivalent to 257 houses or 1 030 people).

6.4.6 In practical terms, unless the catchment exceeds 250 houses, dwelling units, or their equivalent, and where no flow from a pumping station is involved, 150mm diameter pipes laid within the above limits will be adequate without specific hydraulic design.

6.4.7 In flat or rolling country every effort should be made in the design to have the sewers as steep as reasonably possible.

Table 11 : Minimum Pipe Gradient for Different Pipe Diameters

Pipe Diameter (mm)	Minimum Gradient (%)
100	1.67
150	0.55
200	0.37
225	0.34
300	0.30

These gradients shall be subject to clause 6.2 above and are for full pipes.

Where the velocity and gradient limits cannot possibly be complied with, the Engineer may require certain additional works to ensure satisfactory operation of the system.

6.5 PIPES AND FITTINGS - MATERIALS

All pipe and pipe fittings shall comply with the relevant New Zealand, British or Australian Standard.

All fittings shall be of the type specifically designed for use with the pipe in which they are inserted. No fabricated fittings, adaptors, end seals, etc shall be used without permission from the Engineer.

Unless specified by the Engineer, solvent cement jointed pipes shall not be used for the construction.

The following pipes may be used on sanitary drainage works

uPVC Gravity Pipes	shall comply with NZS 7649 : 1988
uPVC Pressure Pipes	shall comply with NZS 7648 : 1987
Concrete Lined Spiral Welded Steel Pipes	shall comply with NZS 4442 : 1988. Flanges shall be to BS 4504 1989, BS10 Table D
Bends and Junctions and Specials	shall be of a proprietary manufacture complying in all respects with the requirements of the relevant New Zealand Standard unless specified or approved in writing by the Engineer,
Manhole Frames and Covers	These shall be of the Opotiki District Council's "Standard Heavy" pattern. Refer Standard Detail Drawings.
Cast Iron Fittings	Cast iron fittings shall have a minimum Class C rating unless otherwise specified and purchased from an approved supplier.
Ductile Iron Pipes and Fittings	Ductile iron pressure pipes and fittings shall comply with AS 2280 : 1986 and unless otherwise stated, have a minimum Class K9 rating. Ductile iron non-pressure pipes and fittings shall be coated with bituminous paint. Rubber rings for joints shall comply with AS 1646 : 1984.
Rubber Rings for Pipe Joints	(excluding ductile iron pipes) shall comply in every respect with BS 2494 : 1976 and amendments. Rings of any one size delivered to the site shall have been moulded at the same factory. Only an approved water soluble lubricant shall be used for jointing pipes. Mineral based grease shall not be used.
HDPE Pipes	All materials supplied shall be in accordance with NZS 7604 : 1981 and be purchased from an approved supplier.

6.6 VALVES AND FITTINGS

Valves and fittings shall be installed and fixed in accordance with accepted practice and the manufacturer's recommendations. the position of all valves, fittings and bends shall be marked by

the subdivider by an approved method adjacent to the fitting at the time of backfilling. No fittings are to be backfilled until approved by the subdivider's representative. All connections to uPVC pipes shall be by purpose made tees and under no circumstances will the use of tapping bands or the like be permitted.

Unbalanced thrust in the vertical plane resulting from sharp changes of grade, sufficient to warrant special bends, shall also be provided against. Upward thrust shall be countered by special anchors to the Engineer's approval. Downward thrust shall be countered by thrust blocks at least 200mm thick on the firm bottom of the trench with a minimum ground bearing area of 400 x 400mm.

6.7 FLANGE JOINTS

The faces of flanges shall be perfectly clean before jointing and the joints shall be made with approved rings of insertion rubber not less than 1.5mm thick. The nuts shall be carefully tightened in opposite pairs until the joint ring is only just sufficiently compressed between the flanges to ensure water tightness at test pressure.

6.8 CONCRETE

All concrete shall be in accordance with NZS 3101:1995, NZS 3109:1997 and the New Zealand Building Code. All concrete shall have a minimum crushing strength of 20 mPa at 28 days except where specified differently.

6.9 PIPE LAYING AND JOINTING

6.9.1 General

No pipe laying shall be commenced until the foundation in the trench has been inspected and passed by the subdivider's representative.

Only competent workmen shall be employed on pipe laying and workmen who are unsuitable in the opinion of the Engineer shall be taken off pipe laying.

Laying of uPVC pipe shall comply with NZS 7643 : 1979 and NZS 4451 : 1986. The deflection of rubber ring jointed uPVC pipe shall not exceed 300mm per 6 metre length (ie 3° per joint). Approval must be received from the Engineer prior to any gravity line being laid in a curved fashion.

6.9.2 Construction

The construction of all underground sewers must conform to the requirements of NZS 4452 : 1986 "Code of Practice for the Construction of Underground Pipe Sewers and Drains" and the requirements of these Standards, the latter to take precedence over NZS 4452 : 1986.

All pipes shall be tested and conform to the Low Pressure Air Test.

6.9.3 Bedding

The pipe bedding shall be selected to meet the requirements of the class of pipes adopted shall be in accordance with the pipe laying tables and bedding diagrams in NZS 4452 except that a specific design maybe required for flush jointed pipe bedding.

The requirements for uPVC shall be as set out in SAA CA 68 and NZS 7643.

Where unstable or unsuitable material is encountered in the bottom of the trench prior to pipelaying, the material shall be undercut and replaced with other approved material or alternatively, other methods of construction shall be carried out to the approval of the Engineer to provide adequate foundation for the pipeline.

Where the gradient is steeper than ten percent (10%) or where in the opinion of the Engineer ground conditions merit the need, sufficient cement shall be added to the granular bedding material to provide a weak concrete with a strength of not less than 7 MPa.

Where the pipeline gradients are equal or greater than 20 % the Engineer may require anti scour blocks constructed in accordance with Standard Drawing SW 06.

uPVC pipe shall not be encased or bedded with concrete unless specifically directed by the Engineer.

6.9.4 Flexibility of Encased Pipes

Where pipes are bedded, capped or surrounded in ordinary grade concrete, provision shall be made for breaking the concrete at each pipe joint to preserve the flexibility. This can be done by inserting a piece of "soft board" into the wet concrete at the time of pouring.

6.9.5 Cover

Cover to pipes shall preferably be not less than 750mm in roads or driveways; or 600mm in berms, gardens or footpaths. Exceptions may be allowed where absolutely necessary. The width of the excavation shall be the minimum required to permit reasonable access for laying, jointing and installing fittings and shall comply with NZS 7643 for uPVC pipes or otherwise in accordance with the pipe manufacturer's recommendation. The bottom of trenches are to be trimmed where necessary and the depth may have to be varied through local undulations to prove reasonably uniform grades, but in no case shall the cover be less than that stipulated above except with the express permission or instruction of the Engineer. Additional depth of excavation may be necessary through "over-vertical" or summit curves to ensure that the minimum specified cover is maintained throughout.

6.9.6 Pipes Through Walls

Where pipes pass through walls, the joints shall be watertight. Extreme care shall be taken that the pipe is free of all dirt and grease. All pipes through walls shall conform to the appropriate Standard.

All uPVC sewer pipe shall be connected to concrete structures via a proprietary uPVC manhole connector supplied by the pipe manufacturer.

6.9.7 Pipelaying Below Water

Should water appear in excavations, it shall be kept down below the level of the joints and bedding by the appropriate means of either a side channel and pumping, or well pointing.

All wells or sumps shall be sunk and pumps fixed so as not to interfere with the work of bedding, laying and jointing of the pipe.

Should the subdivider fail to take adequate steps to keep the subsoil water down, or should the Engineer consider the methods adopted by the subdivider are endangering or damaging the bedding or pipe, the Engineer shall advise the subdivider and may require pipes and bedding to be relaid when methods acceptable to the Engineer are in place.

All care shall be taken to ensure that no completed lines are subject to floating. Any pipelines which float are to be relaid. The cost of relaying shall be borne by the subdivider.

Where the bedding material is soft, wet, or spongy and in the opinion of the Engineer, is not satisfactory for the laying of pipes, the subdivider shall supply approved free draining material (eg basecourse) to stabilise the bedding.

In the event of infiltration being detected after laying pipes through subsoil water areas, the subdivider shall locate and repair the defects causing the infiltration.

6.9.8 Backfilling

6.9.8.1 *General*

Where the Engineer requires, unsuitable excavated material shall be replaced by approved material. No backfilling shall be done until the laying, jointing and haunching of the pipeline has been approved for backfilling by the Engineer. All material for backfilling shall be approved by the Engineer. Backfilling shall be carried out as soon as possible after the pipeline has been approved for backfilling. Material shall be carefully placed and not dropped and shall be well compacted in layers by approved mechanical means.

6.9.8.2 *Haunching*

The maximum particle size shall generally not exceed 10mm. The presence of an occasional particle between 20mm and 40mm is acceptable provided that the total quantity of such particles is less than five percent (5%) of the whole. If particles over 40mm are present, the material shall be rejected. The excavated material, if free from rock and well broken up by the trencher, may provide a suitable bedding material.

Haunching of the surround to half barrel height shall be carried out after the pipe has been laid on the bedding and inspected and approved by the Engineer. The bedding material, except when otherwise directed, shall be used for the haunching which shall be well compacted by hand tamping in layers not exceeding 150mm. Material at the sides of the pipes shall be compacted to 80% of the optimum density before placing excavated or imported materials over the pipe.

6.9.8.3 *Initial Backfilling*

The initial backfilling will be carried out over the haunching to a maximum height of 150mm above the top of the pipe with selected fill approved by the Engineer and this shall be compacted in layers not exceeding 150mm. The initial backfilling and haunching shall be by the same method regardless of the location of the sewer, ie whether under road reserves or in lawns, gardens, etc.

6.9.8.4 *Final Backfilling*

Final backfilling shall be carried out above the initial backfilling with excavated or other approved material. Layers shall not exceed 150mm in road reserve or private driveways nor exceed 500mm in lawns, gardens, etc, and shall be compacted mechanically. No mechanical compaction shall be used until the pipe is covered by the pipe manufacturer's recommended depth of material.

6.9.8.5 *Compaction Requirements*

In all cases, compaction will be carried out in accordance with Standard Drawing G 03.

6.10 CONNECTIONS

6.10.1 General

All connections, whether into reticulation lines or into manholes shall be sealed by a factory manufactured stopper fixed with a rubber ring. Connections shall conform to the details in the Standard Drawings.

The connection provided for each lot shall be of a type capable of taking an approved drain pipe of 100mm internal diameter, unless the Engineer requires a larger size connection to be provided.

Where the sanitary sewer line is outside the lot to be served by it, a 100mm diameter connection shall be extended to within the boundary of the lot, (refer 6.10.3).

Where the connection will cross more than one lot boundary, then specific approval of the Engineer will be required.

If the above conditions cannot be met, then a 150mm diameter branch sewer line shall be constructed complete with a terminal manhole.

6.10.2 Branch Connections

Where lengths of 100mm diameter branch connections are included in the works, these shall be constructed of uPVC pipes. All specification clauses relating to trenching, excavation, pipe laying, backfilling, etc, shall apply to the construction of these lines.

6.10.3 Position of Laterals to Properties

All households shall be provided with an individual connection. The connection shall extend 0.5m into the body of each lot.

6.10.4 Connections to Pipelines

Connections and junctions to the main shall be accomplished as detailed in the Standard Drawings. The level of the connection will be constructed to terminate at the level appropriate to service the building site but shall be not less than 1.2 m deep.

6.10.5 Saddling

Saddling of pipes for connections will not be permitted unless with specific approval of the Engineer.

6.10.6 Marker Posts

The termination of a house connection shall be marked by a 50mm x 50mm treated timber (treated pine or better) marker post painted red. This post shall extend from the pipe end to at least 300mm above the finished ground level. Posts shall be supplied by the subdivider at his/her expense. The posts shall be inserted at the time of installation of connection and not driven into the ground after backfilling has been completed. Connections shall be accurately indicated on "As built" plans.

6.11 MANHOLES

6.11.1 General

Manholes shall be provided at every change of direction, at every main junction, at every change of gradient, at distances apart not exceeding 100 metres and at the end of every line except where approved by the Engineer. A manhole will be required at the termination of all sewer lines greater than 35 metres in length.

6.11.2 Shallow Manholes

Where the depth to invert of the manhole is less than one metre and it is serving less than four houses, a shallow type manhole may be constructed with a minimum diameter of 600mm. In all cases, shallow manholes shall be of sufficient dimension to allow full benching.

6.11.3 Standard Manholes

Where the depth to invert exceeds one metre the Standard Manhole is to be constructed. (Refer to Standard Drawing SS 05)

Precast manholes shall consist of 1050mm diameter Class X flush jointed pipes with holes precast into the walls for step rungs. Prior to jointing, the recess at the joint shall be filled with an approved jointing compound such as RB200 in order to prevent leakage at the joint. In country where the water table is high or where directed by the Engineer, joints between sections and between manholes and lid shall be effected using approved jointing "clips".

6.11.4 Step Rungs

Where manhole depths exceed one metre, step rungs shall be provided to conform with the Standard Drawings. The step rungs shall be constructed from 20mm diameter mild steel, hot dipped galvanised with a coating of not less than 400 grams per square metre.

6.11.5 Manhole Lids and Covers

Standard manholes shall conform with the following:

Table 12 : Standard Manhole Specification			
Location	Type of Cover	Thickness of Lid Slab	Diameter of R/Steel in Concrete Cover
In all situations	Cast iron heavy duty manhole cover 600mm diameter clear opening	150mm	12mm diameter at 150mm centres

Casting shall be in accordance with the weights shown on the Standard Drawings.

The use of lid rings on the top slab shall be limited to a maximum height of 200mm.

6.11.6 Drop Junctions

Where the fall in a manhole exceeds 500mm, a drop connection is required in accordance with Standard Drawings. Where the fall is less than 500mm but greater than 200mm, falls shall be constructed as ramps for the incoming pipe to the channel invert.

External drops shall be used on 150mm or greater diameter lines unless otherwise directed by the Engineer.

6.11.7 Manholes on Unsuitable Foundation Material

Where a manhole is to be constructed on unsuitable foundation conditions, the area under the manhole shall be undercut down to solid ground or until suitable conditions are reached and backfilled up to the underside of the manhole base with compacted hardfill.

6.11.8 Fall Through Manholes

Where there is a change of direction in a manhole, the loss of velocity at change of direction must be compensated for by a drop of 10mm plus 3mm for every 15° of change of direction. this applies for velocities up to 1.2 metres per second.

For higher velocities:

$$\text{Drop} = 10\text{mm} + \left(\frac{\text{Angle of Deviation} \times V^2 \text{mm}}{7.5} \right)$$

The minimum fall allowable is 15mm.
Where an increase in pipe size occurs, the soffit(s) of the inlet(s) shall not be lower than the soffit of the outlet. This will also apply to multiple inlets subject always to the requirement for minimum fall through the manhole in respect of each pipe.

6.11.9 Backfilling Around Manholes

Backfilling around manholes in road reserves and private driveways shall be carried out with selected fill or other approved material which shall be compacted in layers not exceeding 150mm, and in lawns, gardens, etc, not exceeding 500mm.

6.11.10 Precast Lids

Standard precast reinforced flat lids of a minimum 150mm thickness shall be used. The opening shall be located as shown on the Standard Drawings.

6.11.11 Precast Riser Sections

Precast concrete riser sections shall be manufactured to the requirements of NZS 3107 : 1978 Precast Concrete Drainage and Pressure Pipes. The standard precast risers shall consist of circular sections with nominal internal diameter of 1050mm and wall thickness shall be in accordance with NZS 3107 : 1978 Class X pipes unless otherwise specified.

6.11.12 Manhole Benching

Benching in manholes shall be concrete rendered and trowelled smooth with a steel tool and neat cement. Inverts to manholes shall be made smooth and true to grade with flow channels neatly curved at changes in direction of the pipelines or at junctions. The practice of utilising a half round pipe to form the channel is permitted on manholes without any change of direction only. All channels shall be true to grade, properly shaped and constructed in accordance to the Standard Drawings. All connections to manholes shall enter by way of properly formed channels through the benching. All branch connections shall be curved in the direction of the flow and set to discharge above the invert of the main channel.

6.11.13 Cast Insitu Bases

Cast insitu bases for manholes shall be a minimum 150mm thickness and shall extend at least 150mm radially outside of the outer dimension of the manhole section. The base concrete shall be brought up to the top or over the connecting sewer pipes before the first riser section is placed. If required, the riser section may be recessed to fit over the connecting sewer pipe. The riser section may be placed before the base concrete has taken initial set and then carefully adjusted to alignment. A minimum 25mm gap between the sewer pipe and manhole riser shall be maintained to ensure no direct load is on the sewer pipe. The base concrete is to extend 150mm up the outside of the riser section.

6.11.14 Precast Bases

Shall comply with the Standard Drawings in all respects and shall be carefully placed on the prepared bedding so as to be fully and uniformly supported in true alignment. The openings for incoming or outgoing sewers shall be neatly broken out. Pipes shall be cast into the wall using Epar epoxy or similar compound to provide a firm water tight joint.

6.11.15 Finishes to Manholes

The internal walls of the manholes shall be made smooth and free from joint gaps, to the satisfaction of the Engineer.

All joints that will allow grout to take hold, shall be filled and made smooth. In particular, between risers, manhole top collar (lid rings) and frame, and manhole top and risers.

In addition, all internal, rough or protruding material, left over from the casting process shall be removed by suitable means and made smooth to the satisfaction of the Engineer.

6.12 CLEANING EYES

Cleaning eyes may be constructed, after obtaining prior approval in writing from the Engineer. They shall be constructed in accordance with the Standard Drawings. All connections must be provided downstream of the cleaning eye. No connection will be permitted on to the stoppered end of the line. A cleaning eye may be placed on all terminating 150 diameter lines less than 35m long.

6.13 TESTING GRAVITY SEWERS AND MANHOLES

6.13.1 Testing - General

The subdivider shall supply all equipment required to carry out the tests. All pipes should be pre-tested by the subdivider before testing in the presence of the Engineer. All sewers shall be visually inspected for joints and bedding at the "as laid" condition. No joints may be covered until the pipe line has been approved by the Engineer. Open trench testing may be used for the interim acceptance of a pipe line, but shall not be used as a basis for final acceptance.

The tests will be carried out in the presence of the Engineer upon receipt of 24 hours notice from the subdivider. The first test will incur no charge from Council. In the event of this test failing, any further tests on the same line will be charged at cost.

6.13.2 Infiltration Test

If the groundwater level is above the buried pipe line, a test of infiltration will be carried out in accordance with clause 402.15.2 of NZS 4404 : 1981, ie, total infiltration in any portion of a sanitary sewer shall not exceed a rate of 600ml per 25mm of pipe diameter per 1000m of pipe in five minutes.

The source of any observed infiltration shall be investigated and any defect discovered made good.

6.13.3 Lamping/Inspection

All sewers shall be lamped to check trueness of alignment and grade and that they are free from obstructions and joint defects. Final acceptance will be based on the above tests carried out after all backfilling has been completed.

6.13.4 Air Test

All sewers shall be air tested. If the pipe invert is above ground water level, then the low pressure air test shall be carried out as described in clause 11.4 of NZS 4452 : 1986, otherwise the following shall apply.

This will supersede clause 11.5 of NZS 4452 : 1986. Code of Practice for the Construction of Underground Pipe Sewers and Drains.

6.13.4.1 *Method*

The completed pipeline shall be effectively plugged and air introduced until the required internal pressure is reached. After the air inside the pipe has attained a uniform temperature, as indicated by the pressure becoming steady, the supply of air shall be disconnected and the pressure checked and again measured after the test period of five minutes. Pressure will be measured by means of a suitable gauge marked in graduations of 1kPa.

6.13.4.2 *Test Pressures*

The aim is to submit the pipe to an internal pressure equivalent to 2.5m head of water greater than the external pressure. Thus the test pressure will vary according to the surrounding ground water level.

As 1 metre head of water is equivalent to 10kPa, the initial test pressure shall be 25 kPa when pipes are laid above ground water level. The allowable drop in pressure after five minutes will be 7 kPa. For every 0.5 metres below ground water level, these pressures will increase by 5kPa (see table below).

Table 13 : Test Pressures for Gravity Sewers

Location of Pipe Invert Relative to Ground Water Level (m)	Initial Test Pressure (kPa)	Minimum allowable Pressure after 5 minutes (kPa)
Above ground water level	25	18
0 - 0.40 m below	30	23
0.5 - 0.99 m below	35	28
1.0 - 1.49 m below	40	33
1.5 - 1.99 m below	45	38

6.13.5 Water Test

The test shall be carried out in accordance with NZS 4452 : 1986 clause 11.3.

6.13.6 Testing of Manholes

Manholes will be tested for water tightness by filling for 30 minutes. The allowable loss shall not exceed 1 litre per metre depth. Care must be taken that undue pressure is not put on any of the downstream sewer while this test is taking place.

6.14 PRESSURE LINE TESTING FOR PUMPING MAINS

All rising/pumping mains shall be tested in accordance with the procedure below.

The subdivider shall be responsible for testing all lines and fittings and for providing all the necessary equipment, water and materials for such testing.

All pipes and fittings shall be subjected to a pressure test after laying, jointing and covering with backfill. The section to be tested shall be capped or flanged off at either end. The blanked off

ends and all bends, tees, etc, shall be securely strutted or otherwise prevented from movement before applying any pressure. The subdivider shall provide means of bleeding air from both ends of the pipeline where directed by the Engineer. Pipes shall be slowly filled with water allowing all air to escape and left for 24 hours to allow any take-up. The pressure shall then be slowly raised by means of a pump to the test pressures indicated below. The test pressure shall be measured at the lowest point of the line under test and for steel pipe lines, shall be maintained for a period of 30 minutes during which time the leakage shall not exceed 750ml per 100mm of pipe diameter per kilometre of pipe. Testing of uPVC pipe shall be in accordance with the requirements of Section 9 Procedure B of NZS 7643 : 1979, except for pipes of diameter less than 100mm NB which shall be tested in accordance with Procedure A. Test pressures shall be as tabulated below:

Table 14 : Test Pressures for Pressure Lines

Class of Pipe	Test Pressure	
	Meter Head	kPa
Class B uPVC	90	900
Class C uPVC	135	1350
Class D uPVC	180	1800

Any faulty pipes, joints or fittings shall be replaced by the subdivider and the line retested. All pipes are to be tested so that the specified test pressures are achieved but not exceeded in such lengths of pipe as may be approved by the Engineer. All pipes shall be pre-tested by the subdivider before testing in the presence of the Engineer. Should any section of pipe fail this latter tests, the cost of attendance by the Engineer at the subsequent test or tests shall be charged at cost. Test sections shall not be longer than 1000 metres.

6.15 SEWAGE PUMPING STATIONS

6.15.1 General

Sewage pumping stations shall be vested in the Opotiki District Council.

Sewage pumping station design shall be subject to the Engineer's specific approval, and shall meet the following general requirements:

(a) The electrical control cabinet shall be above ground level, and shall be to the Opotiki District Council design and specification.

(b) The pump well shall be underground and have lockable aluminium lids.

(c) Pumps shall be "Flygt" 3 phase submersible type designed for each to take the full flow and be capable of passing a 75mm diameter solid.

(d) There shall be a minimum of two pumps in all pump stations.

(e) Valve chambers shall be below ground level, attached but separate from the pump well. Provision shall be made to bypass the pumps in case of breakdown. Non-return valves shall be ball valves full-bore opening. Valve chambers shall have lockable aluminium lids.

(f) The capacity of the wet well between start and stop levels shall be such as to limit pump starts to no more than ten per hour.

(g) Residential pump stations shall be designed for a peak flow rate of $1m^3$ per person per day of the fully development catchment. Other pump stations capacity will be subject to specific design and must be approved by the Engineer.

(h) All pump chambers shall have a single inlet pipe.

6.15.2 Duty

Pumps shall be controlled so that while one pump is acting as duty pump, the other is on automatic standby. The switchboard configuration shall allow the duty sequence to be interchangeable remotely via the District Council Telemetry System.

6.15.3 Emergency Provisions

Pump stations shall have emergency storage in case of mechanical or electrical failure or blockage of the pumps or rising main. The storage must be located at such a level as to prevent overflow from any manholes, gully traps, pump station lids or any other outlet from the system. Emergency storage capacity equal of eight hours at the design average daily 250 litres per person per day flow is to be provided.

All stations shall be constructed with a standard plug for the connection of a Mobile Generator. All pump stations shall have an approved and controlled overflow system which discharges in such a manner to ensure maximum storage is used prior to discharge.

6.15.4 Site

The actual site of the pumping station shall be on a separate lot with an accessway (if required) to a formed road. Resource consent may be required for the installation, and where necessary must be obtained by the developer prior to the commencement of engineering works. The site shall be developed to prevent entry of surface runoff into the station.

6.15.5 Telemetry Monitoring System

The Telemetry Monitoring System shall be a "Intellution" System linked to the Opotiki District Council by an approved radio link.

6.15.6 Power Supply

The power supply to the station shall be underground.

6.15.7 Water Supply

A 25 mm water supply shall be provided to the immediate vicinity of the station. The supply shall be fitted with a backflow preventor in accordance with the requirements of the Building Act and the Engineer. The supply shall also be fitted with an approved water meter.

6.15.8 Access

Permanently surfaced vehicle access and manoeuvring areas shall be provided to the station.

6.15.9 Fencing

The area around the pumping station shall be fenced to the Engineer's satisfaction, and such that Council shall not become a party to fencing costs.

6.16 TREATMENT PLANTS

6.16.1 General

In special cases where a treatment plant is required, the subdivider must construct a plant to a design that is satisfactory to the Engineer, the Regional Council and the Medical Officer of Health. The design must have the prior approval of these authorities. Resource consents may be required and where necessary, must be obtained by the subdivider prior to the commencement of any engineering works within the subdivision. Any consents necessary shall be obtained by the subdivider.

6.16.2 Power Supply

The power supply to the plant must be underground.

6.16.3 Water Supply

The Treatment Plant is to be provided with a water supply in the immediate vicinity. The supply shall be fitted with an approved backflow preventer and meter.

6.16.4 Access

Sealed vehicle access and manoeuvring areas must be provided to the plant.

6.16.5 Fencing

The area around the plant must be fenced and provided with a suitable locked gate, all to the Engineer's satisfaction.

6.16.6 Site

The actual site of the plant shall be on a separate lot with access to a formed road. After the plant has finished operating, it must be removed and the area may revert to any suitable site the subdivider may stipulate. In certain cases, Council may require that the site and plant be vested in Council. In such case, specific conditions will be set by Council resolution at the time of the subdivision consent approval.

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Section 7.0

Utilities -Water Supply and Reticulation

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SECTION 7.0 - UTILITIES - WATER SUPPLY AND RETICULATION

7.1 FLOW REQUIREMENTS

The system shall provide sufficient water at fire hydrants to comply with the current Fire Services Code of Practice, for the class of development proposed, plus the daily average domestic demand or any other demands where those in total exceed one-third of the appropriate fire demand. For purely residential subdivisions, this shall be 25 litres per second from each hydrant at a minimum running pressure of 10 metres head. For the purposes of preliminary design, it may be generally assumed that water is supplied into the reticulation at a minimum running pressure of 30 metres head under conditions of maximum draw-off excluding any fire demand. This should be verified with the Engineer in peripheral and/or elevated areas.

For other than residential subdivisions and developments, the developer shall meet the appropriate level of protection as specified by the Fire Service.

7.2 ADDITIONAL RETICULATION REQUIREMENTS

The Engineer may require an increase in the size or length of pipes used to meet further reticulation requirements or if the minimum running pressure of 30 metres head is not available or where otherwise required to achieve a satisfactory supply pressure within the proposed reticulation.

7.3 GENERAL REQUIREMENTS

A water main fitted with fire hydrants and service connections to the street frontage of each lot is required on one side of all streets and a rider main with service connection to the street frontage of each lot is required on the opposite site of the street. Mains and rider mains are to be laid in the grass berm on the standard alignments specified in the Standard Drawing R O2.

Reticulation shall be designed to minimise pipework passing under road surfaces. Rider mains shall be looped so as to serve the maximum number of lots with the minimum number of road crossings. In the case of cul-de-sacs, the rider main will continue on standard alignment from the end of the larger main around the head of the cul-de-sac and up the other side of the street.

Should an unreasonable length of rider main with no service connection be involved, the Engineer may agree to extra road crossings being provided. In the case of some routes, eg dual carriageways, industrial developments, the Engineer may require fire mains to be laid in both sides of the street.

7.4 WATER MAINS

No main on which a fire hydrant is installed shall be of lesser diameter than 100mm. Mains shall be laid using uPVC (NZS 7648 : 1987) or HDPE (NZS 7602 : 1977).

All pipes shall conform to Class D requirements unless the Engineer expressly approves a lesser standard for low pressure areas or a higher class of pipe is required for an area of higher working pressure.

Pipe joints shall be of an approved type and generally of the pipe manufacturer's proprietary type rubber ring flexible joint. Detachable gibault type joints are not to be used without Council's Engineers written approval.

Special pipes may be approved in the case of unusual circumstances.

For normal construction works, rider mains shall be of Medium Density Polyethylene Pipe (MDPE) Class D to NZS 7610 : 1991, or unplasticised Polyvinylchloride (uPVC) pipe to NZS 7648 : 1987 Class D rubber ring jointed. Solvent welded joints may be permitted in the fabrication of tees, bends or specials, and shall be to the Engineer's requirements.

Subject to special written approval, pipes of other manufacture, material or class may be used.

7.5 RIDER MAINS

Rider mains shall be connected to the supply main by means of a tee or tapped elongated gibault in accordance with the Standard Drawings. Where possible rider mains shall be fed from both ends, by connection to a larger main and the size of rider mains shall be governed by the following table:

Table 15 : Criteria for Rider Mains

Maximum Number of Services	Size of Rider Main Internal Dia (mm)	
	Single Feed	Both Ends Fed
Less than 3	25	25
3 - 6	50	32
7- 40	Not applicable	50

When a rider main must be laid on a curve which is to sharp for convenient laying of rigid pipes, eg small diameter cul-de-sacs, the Engineer may approve the use of flexible pipe over those lengths where curvature is excessive, or alternatively may require the line to be laid as a series of straights connected with formed bends and couplings. If, for any reason, a rider main is reduced in diameter, the whole of the length of the rider main shall be assessed as if it was fed from one end only.

In this requirement, it is assumed that all service connections will be for normal 20mm internal diameter connections to all lots. Where special provision is made for larger supplies, then larger rider mains may be required or special connections made to the principal main in the street. Such cases shall be subject to special approval.

7.6 SERVICE PIPES AND CONNECTIONS

All sizes refer to internal diameter.

Service connections will normally be made by the subdivider in subdivisions where connections are not directly connected to Council's existing mains otherwise the connection shall be made upon application and payment of the relevant connection fees at the time of building permit application.

Where service connections are required, the following Standard applies:

- Except for special large connections, all lots shall be provided with a 20mm service connection connected to the main by means of an approved tapping band of approved proprietary type as shown on the Standard Drawing WS 06

- All rear lots shall be individually serviced by connection to the street frontage with the connection points located offset from the right of way so as to be clear of the vehicle crossing.

- All service connections shall terminate with a 20 dia "Plasson" PVC valve. Valves shall be enclosed in a meter box in accordance with the Standard Drawings WS 06

All rural, industrial and other developments as required by the Engineer, shall be provided with an approved backflow preventor.

7.7 POSITION OF MAINS AND RIDER MAINS

All water mains shall be laid in accordance with the Standard Drawings and alignments unless otherwise approved by Council's Engineer.

7.8 VALVES

Valves in mains shall be epoxy coated cast iron water works pattern resilient sealing sluice valves conforming to BS 5163 : 1986 NP 16. All valves shall be anti-clockwise closing unless stipulated otherwise. The use of light pattern valves will not be permitted. Valves shall be flanged.

All valves shall be enclosed in a surface box set flush with the finished ground surface in such a way that the spindle is not more than 600mm below finished ground level and readily accessible to a standard valve key.

Valves in rider mains shall be either sluice valves as above or gate valves. Gate valves shall be hand wheel operated and enclosed in a surface box set flush with the finished ground surface. Valves shall have the hand wheel not more than 600mm below the finished ground level. Gate valves shall conform to BS 5154 : 1989 Class 150 or higher, with non-rising stems.

Valves shall generally be placed on all branches of each tee or cross and shall be sited adjacent to the flanged tee or cross or at such other location as may be directed. Valves shall be located clear of the carriageway. The spacing of line valves on principal mains in any street shall not exceed 500m. Where possible, not more than 40 consumers on a main or rider main shall be isolated should the supply be shut down for maintenance purposes. Individual branch mains are to be valved at the tee or cross and all sections of inter-connecting mains and riders are to be provided with isolation valves at each end. In no case shall more than three valves be required to isolate any section of the reticulation.

7.9 HYDRANTS

All mains (other than rider mains) 100mm or more in diameter, shall be provided with fire hydrants. These shall be clockwise closing of the screw-down type and shall be of the "medium" pattern epoxy coated cast iron and complying with BS 750 : 1984 or as otherwise approved by the Engineer.

Hydrants shall generally be located at street intersections and near private accessways. Hydrants shall be evenly spaced between these points so that the maximum spacing does not exceed 135m. In the case of special conditions, the Engineer may require this spacing to be reduced.

In cul-de-sacs or other terminal streets or rights of way, the last hydrant at the end of the supply main shall be not more than half the maximum approved spacing from the head of the street, and in no case more than 125 metres from the furthest building site on any allotment when measured along the route of travel.

Hydrants shall be mounted on approved hydrant tees with risers, if necessary, so that the top of the spindle on the valve is between 115mm and 300mm below the finished surface level. A loose lid surface box shall be installed to enclose the hydrant in such a way that a standpipe and key can be fitted and the hydrant operated without obstruction.

7.10 HYDRANT FLOW TEST

Following completion of the pipe test and connection to the main supply, the subdivider shall provide certification from an independent authority (eg Fire Service) that each hydrant meets the required minimum flow for 95% of the time.

7.11 AIR RELEASE, DRAINING OF MAINS

All high points on mains and rider mains shall be provided with a 15mm service connection and valve mounted vertically and enclosed in a surface box for the purpose of air release. Approved scour points shall be provided where directed by the Engineer. Notwithstanding the gradients of mains to be laid, all rider mains shall have one such provision for the purposes of flushing.

7.12 DEPTH OF MAINS

The minimum depth of mains from the finished surface level to the top of the pipe shall be as shown in Table 16 below:

Table 16 : Depths of Mains

Location	Minimum Depth of Mains from the Finished Surface Level to Top of the Pipe (mm)
Under grass berms and footpaths	600
Under carriageways	900
Service pipes in all cases	200

Note: No service pipe shall be deeper than 500mm nor shallower than 160mm at the property boundary.

7.13 INDICATION

The position of all sluice valves and hydrants in rural areas shall be indicated by means of an approved marker post set vertically in the ground within 200mm of the street boundary.

The position of hydrants shall be marked with a painted triangle on the carriageway surface in accordance with NZS 4501 : 1972. Where the carriageway is not permanently surfaced, hydrant marker posts shall be used. Refer to Section 7.15 for painting requirements.

7.14 PIPE FITTINGS

Pipe fittings such as tees, hydrant tees, tapers, crosses, hydrant risers, caps, plugs and bends shall be of approved manufacture to the general requirements of the relevant Standard. All pipe fittings shall comply with the dimensions of the line in which they are to be used. Flanges shall be drilled to BS 4504 : 1989 Table D.

All fittings for use with uPVC pipe shall be moulded fittings as produced by the pipe manufacturer to a pressure rating of no less than 12 Bar or equal to at least that of the pipe used.

In the case of specials, the Engineer may approve fabricated units of welded steel pipe complying with the specification for pipes of like material. All specials shall be dimensionally equivalent to the pipe line in which they are to be used and capable of insertion using the same joining method as the main.

Gibaults, tapping bands, etc, shall be of approved type and material.

The arrangement of inter-connected flanged and flexible jointed fittings is to be to the approval of the Engineer.

7.15 SURFACE BOXES

Hydrant boxes shall comply with BS 750 : 1984 and shall be Grade A. Hydrant boxes shall be loose lid type, cast iron and mounted on concrete sections supported on a firm foundation in accordance with the Standard Drawings so that no load can transfer to the pipe. Surface boxes shall be set flush with the finished surface level or a maximum of 10mm above.

Valve boxes and toby boxes shall be surrounded in concrete and mounted over the valve in accordance with the Standard Drawings.

Hydrant boxes and toby boxes shall be surrounded in concrete and mounted over the valve in accordance with the Standard Drawings.

Hydrant indicator posts, valve indicator posts and toby boxes shall be painted with road marking paint complying with Transit New Zealand specifications.

7.16 THRUST BLOCKS

Cast insitu thrust blocks shall be provided at all bends, sluice valves, tees, and crosses. All thrust blocks shall be poured against trimmed natural ground and placed in such a way that access to and removal of any bolts on adjacent fittings is unimpaired.

All sluice valves shall be provided with anchorage in accordance with Standard Drawings. Special requirements apply to the anchoring of uPVC lines and subdividers should refer to the manufacturer's specification.

7.17 PIPE LAYING

Pipes shall be laid on straight grades or lines or on smooth curves without exceeding the manufacturer's recommended deflection of the joints or, in the case of flexible pipe, the recommended curvature of the barrel.

Where greater deflections are needed, formed bends shall be separated by one full pipe length unless flanged joints are used. Flanged joint combinations must be interspersed by flexible couplings to allow ready removal and replacement of individual fittings. A series of flexible joints in close proximity to each without adequate lateral support will not be acceptable.

The method of pipe laying and jointing shall be as recommended by the manufacturers for the type and class of pipe in use. All pipe barrels shall be evenly supported over their entire length by the trench floor or other suitable bedding material placed before the pipe is laid. Collars shall be unsupported. The open ends of pipes shall be kept covered to prevent the ingress of foreign matter and all pipes shall be inspected and cleared as laying proceeds.

uPVC pipes shall be laid in conformity with the requirements of NZS 7643 : 1979.

7.18 TESTING

The subdivider shall be responsible for testing all lines and fittings and for providing all the necessary equipment, water and materials for such testing.

All pipes and fittings shall be subjected to a pressure test after laying, jointing and covering with backfill. The section to be tested shall be capped or flanged off at either end. The blanked off ends and all bends, tees, etc, shall be securely strutted or otherwise prevented from movement before applying any pressure. The subdivider shall provide means of bleeding air from both ends of the pipeline where directed by the Engineer. Pipes shall be slowly filled with water allowing all air to escape and left for 24 hours to allow any take-up. The pressure shall then be slowly raised by means of a pump to the test pressures indicated below. The test pressure shall be measured at the lowest point of the line under test and for steel pipe lines, shall be maintained for a period of 30 minutes during which time the leakage shall not exceed 750ml per 100mm of pipe diameter per kilometre of pipe. Testing of uPVC pipe shall be in accordance with the requirements of Section 9 Procedure B of NZS 7643 : 1979, except for pipes of diameter less than 100mm NB which shall be tested in accordance with Procedure A. Test pressures shall be as tabulated below:

Table 14 : Test Pressures for Pressure Lines			
	Test Pressure		
Class of Pipe	Meter Head	kPa	PSI
Class B uPVC	90	900	130
Class C uPVC	135	1350	200
Class D uPVC	180	1800	265

Any faulty pipes, joints or fittings shall be replaced by the subdivider and the line retested. All pipes are to be tested so that the specified test pressures are achieved but not exceeded in such lengths of pipe as may be approved by the Engineer. All pipes shall be pre-tested by the subdivider before testing in the presence of the Engineer. Should any section of pipe fail this latter tests, the cost of attendance by the Engineer at the subsequent test or tests shall be charged at cost. Test sections shall not be longer than 1000 metres.

As a minimum, a 100mm diameter test pressure gauge manufactured to NZS 1780 : 1985, Specification for Bourdon Tube Pressure and Vacuum Gauges, section 1 - Industrial - accuracy (less than 1% error) in good working order is required, holding current test certification (within last 12 months).

7.19 CONNECTION TO EXISTING RETICULATION

After the system has passed the pressure test, a connection to the existing distribution system will be made. It will be necessary for the contractor to give at least 48 hours notice to Council staff that a connection is required.

7.20 FLUSHING AND STERILISING

When the connection to existing reticulation has been made, the new reticulation shall be thoroughly flushed through a standpipe or other suitable tapping to remove all debris and chlorinated water. Refer to "*Water Supply System Disinfection Worksheet* " (following).

Flows through hydrants shall be measured to ensure that no obstruction remains in the pipe lines. Where such obstruction is considered present, the lines shall be dismantled and cleared through fully open ends.

All mains shall be fully sterilised prior to flushing in a manner approved by the Engineer.

All mains shall be kept at working pressure on completion of testing and flushing to ensure any subsequent damage caused by installation of other services is detected.

7.21 BACKFILLING

Cover material placed over each pipe for anchorage during testing shall be evenly spread along the trench length and compacted before backfilling commences.

This initial layer shall be laid evenly along and around the pipe to a minimum of 50mm depth over the pipe and compacted by hand. Backfilling shall proceed in layers not exceeding 150mm depth with each layer being fully compacted as it is placed. Any unsuitable material removed from the trench shall be removed from the site and not used for backfilling. Any settlement of backfill shall be made good until the completed subdivision has been accepted by Council. Backfill in roadways shall conform with the appropriate requirements for roading. Install detector tapes.

Refer to NZS 7643 : 1979 for the requirements for backfilling of uPVC lines.

Water Supply System Disinfection Worksheet.

PROJECT REFERENCE: .....

LOCATION: .....

DISINFECTION TYPE:

- New Mains ☐
- Mains Repair ☐
- New Reservoir ☐
- Reservoir Cleaning ☐

(Tick ✔One)

DESIGN DATE __/__/__ CHLORINATION DATE __/__/__ DECHLORINATION DATE __/__/__

DISINFECTION SUPERVISOR. . . . . CERT NUMBER .....

Calculate Total Chlorine Quantity Required

Note - All Dimensions in Metres (m)

Pipe: Diameter(d) . . . . . Length(L) . . . . . $V = \Pi r^2 x L$.....(m^3)

Circular Reservoir: Diameter(d) . . . . . Height(H) . . . . . $V = \Pi r^2 x H$.....(m^3)

Rectangular Reservoir: Length(L) . . . . . Width(W) . . . . . Depth(D): . . . . . V = LWD.....(m^3)

Select Required Chlorine Concentration from Table Below:

VESSEL TO BE DISINFECTED	REASON	TIME	RECOMMENDED DOSE
Reservoir	New Reservoir for WSPR Compliance	48 Hrs	10 g/m^3 +
Reservoir	" " "	Calculate to suit requirements	10 - 100g/m^3
Reservoir	Cleaning for Routine Maintenance	24 Hrs	5 - 10 g/m^3
Reservoir	Cleaning Following Contamination	24 Hrs	25 g/m^3 +
Reservoir	Boost Chlorination for Zero or Low Residual	Minimum (4 hours)	2 - 5 g/m^3
Mains	New Mains for WSPR Compliance	24 hrs	20 g/m^3
Mains Repair	If Contaminant Entry is Possible / Likely	Calculated to suit your requirements	10 - 100g/m^3

* ***Dose should be in the range 10 - 100 g/m^3, time is then calculated from 7200g/m^3 / dose.***

Select Residual of Chlorine Required.....g/m^3. Increase to .....g/m^3 due to state of water/main.

Req Dose:..... Time:.....Quantity Pure Cl_2 = Volume..... x Dose.....+1000.= .....kg

Select Chlorine Source: HTH @ 65%☐, Sodium hypo @ 15%☐, Gas @ 100%☐, Other @ .....%☐

Quantity of Chemical = Quantity Pure Cl_2 in kg.....x 100 ÷ %strength.....= .....kg / L

Quantity Ordered.....kg /L Quantity Received.....kg / L

Calculate Weight (kg/L) of Chlorine to Make Up Solution:
(in cleaning tank, dosing tank or reservoir as slug Dosing)
Calculate Volume of Solution Tank

Circular Tank: Diameter(d) . . . . . Height(H) . . . . . $V = \Pi r^2 x H$ . . . . . (L)
Rectangular Tank: Length(L) . . . . . Width(W) . . . . . Depth(D): . . . . . $V = LWD$ . . . . . (L)
Select Solution Strength Required . . . . . %
Select Chlorine Source: HTH @ 65%☐, Sodium hypo @ 15% ☐, Gas @ 100%☐, Other @ . . . . . %☐
Chlorine to add = Tank Volume . . . . . x % sol strength . . . . . ÷100 x 100÷%strength . . . . . = ... kg / L

Calculate Dose Rate of Chlorine Feed from Dosing System into Pipe Being Filled:

Select rate of filling main . . . . . L/min (if uncertain, use 100L/min)
Select dose rate of chlorine required . . . . . g/m^3 Increase to . . . . . g/m^3 due to state of water / main
Dose pump flow = chlorine dose . . . . . g/m^3 x filling rate . . . . . L/min ÷ soln strength . . . . . % ÷10,000= . . . . . L/min
Pump setting = ... L/min x 60 x 100 ÷ . . . . . @max pump capacity (L/hr) = ... % stroke setting.

Dosing Pump Calibration:

Set pump to 100% stroke and/or 100% speed with water in solution tank. Run and measure drop in level over time period.
Calculate Volume of Drop in Solution Tank
Circular Tank: Diameter(d) . . . . . Height(H) . . . . . $V = \Pi r^2 x H$ . . . . . (m^3)
Rectangular Tank: Length(L) . . . . . Width(W) . . . . . Depth(D): . . . . . $V = LWD$ . . . . . (m^3)
Measure time for drop . . . . . minutes to empty the tank.
Pump flow at 100% stroke and speed = volume . . . . . m^3 x 1000÷ time . . . . . minutes = ... L/min
L/hr @max pump setting . . . . . L/min x 60 . . . . . L/hr

Sodium Thiosulphate Calculations:
Quantity required: Chlorine available after specific contact time = ... kg x 3 = ... kg

Weight required to make up solution or to Dose into Reservoir (Slug Dosing):

Calculate Volume of Solution Tank
Circular Tank: Diameter(d) . . . . . Height(H) . . . . . $V = \Pi r^2 x H$ . . . . . (m^3)
Rectangular Tank: Length(L) . . . . . Width(W) . . . . . Depth(D): . . . . . $V = LWD$ . . . . . (m^3)
Select Solution Strength Required . . . . . % (if uncertain, use 1%)
Thio to add = Tank Volume . . . . . m^3 x 1000 x Sodium thio soln strength . . . . . % ÷100 = ... kg

Proportional Dosing – Calculate the Dose rate:
Select rate of draining main . . . . . L/min (if uncertain use 100L/min)
Measure concentration of chlorine . . . . . g/m^3
Dose pump flow = chlorine dose . . . . . g/m^3 x 3 x draining rate . . . . . L/min+ soln strength . . . . . % + 10,000 = ... L/min
Pump setting = ... L/min x 60 x 100+ . . . . . max pump capacity (L/hr)= . . . . . %

Section 8.0

Utilities -Power, Telecom and Gas Services

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SECTION 8.0 - UTILITIES - POWER, TELECOM AND GAS

8.1 POWER RETICULATION

8.1.1 For small subdivisions, of up to 3 lots, in existing reticulated areas, a letter from the appropriate authority shall be provided by the subdivider to the Council, that adequate power facilities are available to the lots.

8.1.2 For larger subdivisions, greater than 3 lots, the subdivider shall provide a letter from the appropriate authority that the subdivision has been reticulated and will provide adequate power facilities for proposed future developments.

8.2 TELECOMMUNICATIONS

8.2.1 For small subdivisions, of up to 3 lots, in existing reticulated areas, a letter from the appropriate authority shall be provided by the subdivider to the Council, that adequate telecommunication facilities are available to the lots.

8.2.2 For larger subdivisions, greater than 3 lots, the subdivider shall provide a letter from the appropriate authority that the subdivision has been reticulated and will provide adequate telecommunication facilities for proposed future developments.

8.2 GAS RETICULATION (OPTIONAL)

8.2.1 For small subdivisions, of up to 3 lots, in existing reticulated areas, a letter from the appropriate authority shall be provided by the subdivider to the Council, that adequate gas facilities are available to the lots.

8.2.2 For larger subdivisions, greater than 3 lots, the subdivider shall provide a letter from the appropriate authority that the subdivision has been reticulated and will provide adequate gas facilities for proposed future developments.

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Section 9.0

Specific Application Infill or Crosslease Subdivisions

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SECTION 9.0 - GENERAL

Infill subdivisions shall comply with the requirements of the Code of Practice in respect to access and servicing.

9.1 SANITARY SEWER

Standard Drawings SS 08 to SS 10 set out the standard types of sewer connection and requirement for infill subdivision.

Where a subdivision is occurring of an existing cross-lease site, then the options for sewer are as follows:

(i) separate services as per Standard Drawings SS 08, SS 09 or SS 10

(ii) as per Standard Drawing SS 10 with a memorandum of agreement on the title. (Note: Option 1 is preferred by Council).

9.2 WATER CONNECTION

Independent separately metered water connection supply for each dwelling is required as shown on Standard Drawing WS 14.

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Appendices

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Appendix 1A, 1B and 1C

Statements of Professional Opinion

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APPENDIX 1A

To: The Engineer
Opotiki District Council
P O Box 44
OPOTIKI 3092

STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR SUBDIVISION

Subdivision:	
Owner/Developer:	
Location:	

I, _____ of _____
(Full name) *(Name of Firm)*

_____
(Address of Firm)

hereby confirm that:

1. I am a Registered Engineer experienced in the field of soils engineering and more particularly, land slope and foundation stability as applicable and was retained by the owner/developer as the Soils Engineer on the above subdivision.

2. Site investigations have been carried out under my direction and are described in my report dated _____ .

3. I am aware of the details of the proposed scheme of subdivision and of the general nature of proposed engineering works as shown on the following drawings:

   _____
   (Insert reference to all drawings including dates of latest amendments)

4. In my professional opinion, not to be construed as a guarantee, I certify that the proposed works give due regard to land slope and foundation stability considerations and that the land is suitable for the proposed subdivision, provided that:

   (a) _____

   (b) _____

   (c) _____

5. This professional opinion is furnished to the Council and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for further inspection during the course of the works.

Signed: _____ Date: _____

APPENDIX 1B

To: The Engineer
Opotiki District Council
P O Box 44
OPOTIKI 3092

STATEMENT OF PROFESSIONAL OPINION AS TO SUITABILITY OF LAND FOR BUILDING DEVELOPMENT

Subdivision:	
Owner/Developer:	
Location:	

I, _____ of _____
(Full name) *(Name of Firm)*

_____
(Address of Firm)

hereby confirm that:

1. I am a Registered Engineer experienced in the field of soils engineering and was retained by the owner/developer as the Soils Engineer on the above subdivision.

2. The extent of my inspections during construction, and the results of all tests carried out are described in my report dated _____ .

3. In my professional opinion, not to be construed as a guarantee, I certify that:

   *(a) That earthfills shown on the attached Plan No. _____ have been placed in compliance with the Code of Practice – Subdivision and Development of the Opotiki District Council.

   *(b) The completed works give due regard to land slope and foundation stability considerations.

   *(c) The filled ground is suitable for the erection thereon of residential buildings not requiring specific design in terms of NZ Building Act 1991 and NZ Building Regulations 1992, and related documents providing that:

   (i) _____

   (ii) _____

   (iii) _____

   *(d) The original ground not affected by filling is suitable for the erection thereon of residential buildings not requiring specific design in terms of NZ Building Act 1991 and NZ Building Regulations 1992, and related documents, providing that::

   (i) _____

   (ii) _____

   (iii) _____

4. This professional opinion is furnished to the Council and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any dwelling.

Signed: _____ Date: _____

** Delete items not applicable*

APPENDIX 1C

To: The Engineer
Opotiki District Council
P O Box 44
OPOTIKI 3092

CERTIFICATE FOR AS BUILT DRAWINGS

Subdivision:	
Owner/Developer:	
Location:	

I, _____, Registered Engineer/Surveyor, hereby certify that the manhole positions, invert and lid levels, connection locations and distances between manholes and pipe sizes are correct as shown on Drawings numbered:

_____

_____

_____
Registered Engineer/Surveyor

Date: _____

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Appendix 1D

Certification of Subdivision Construction

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APPENDIX 1D.1

ROAD AND TRAFFIC

CERTIFICATION OF SUBDIVISION CONSTRUCTION

Name of Subdivision:	
Council File No:	
Main Contractor:	
Roading Sub Contractor:	
Engineer Responsible for Supervision:	of
Qualifications:	

		Y	N/A	N	Date of Test/Inspection /Comments
A	KERBING AND CHANNELLING				
	Kerb & channel complete and free of defects				
	Kerb type as per engineer drawings approved by Council				
	Carriageway positions as shown on approved engineering drawings				
	Kerb levels checked and found to be as per approved engineering drawings				
B	SUBGRADE				
	Subgrade inspected and approved by supervising engineer prior to metalling				
	Subgrade compaction, strength and uniformity found to be as per documents approved by Council and as necessary for pavement design				
	Subgrade level and smoothness tolerances found to be as per documents approved by Council				
C	BASECOURSE				
	Basecourse supplied complies with documents approved by Council				
	Basecourse compacted to the standard given in the documents approved by Council				
	Basecourse depth checked @ 20m crs max and found to be not less than that shown on engineering drawings				
D	SEALING SURFACE				
	Sealing surface inspected and approved by supervising engineer prior to sealing				
	Sealing surface true to line and free of bumps				
	Water will not pond on the sealing surface				
	Sealing surface swept clean of loose aggregate, dust and dirt prior to sealing				
	Sealing surface smooth and tightly bonded and presenting a clean stone mosaic free of a skin of fines				
	Sealing surface reasonably dry @ time of sealing				

		Y	N/A	N	Date of Test/Inspection /Comments
D	SEALING/ASPHALTIC CONCRETING				
	Sealing chips supplied comply with documents approved by Council				
	Sealing chips sufficiently dry and good adherence to binder achieved				
	Bitumen cutback approved by supervising Engineer				
	Application rate approved by supervising Engineer				
	Chip rolled with pneumatic tyred rollers as per documents approved by Council				
	Second coat chip seal applied				
	Surplus chip removed				
	Asphaltic concrete applied in accordance with the documents approved by Council				
E	MISCELLANEOUS				
	All shared accesses constructed in accordance with Council's Code of Practice				
	Street lighting completed as per documents approved by Council				
	Materials tested as required by approved specification				
	Street lights activated				
	Footpaths completed				
	All pedestrian accessways constructed in accordance with Councils Code of Practice				
	Berms topsoiled, grass established and mown once				
	Pedestrian accessways fenced				
	Road marking completed as per documents approved by Council				
	Benchmarks placed in kerb @ 250 metres crs max from nearest benchmark				
	Traffic signs erected as per documents approved by Council				
	Street name signs erected as per documents approved by Council				

COMMENTS: _____

_____

_____

I am experienced in roading construction and, as per clause 2.1.2 and 2.2.7 of Council's Code of Practice – Subdivision and Development, I have been engaged by the owner to supervise the roading construction for the above subdivision. As per clause 2.1.2(c), I hereby certify that except as noted above the roading, footpaths, street lighting and signage are now complete and the works have been carried out in accordance with the documents approved by Council and sound engineering practice.

Signed: _____*(Engineer Responsible for Supervision)*

Name: _____ Date: _____

APPENDIX 1D.2

STORMWATER RETICULATION
CERTIFICATION OF SUBDIVISION CONSTRUCTION

Name of Subdivision:	
Council File No:	
Main Contractor:	
Stormwater Sub Contractor:	
Engineer Responsible for Supervision:	of
Qualifications:	

		Y	N/A	N	Date of Test/Inspection /Comments
A	LINES AND LATERALS				
	All pipe diameter and classes as per approved engineering drawings				
	Lines laid in the position shown on approved engineering drawings				
	Lines laid to levels given on approved engineering drawings				
	All lines laid in accordance with Manufacturer's instructions and relevant NZ Standards				
	All pipe bedding as per drawings/specifications approved by Council				
	All lines and laterals true to grade				
	All lines and laterals true to line				
	All lines free of faults, debris and obstructions				
	Each lot provided with a stormwater connection				
	The levels of all connections are such that pumping of stormwater by home owners will not be necessary				
	Ends of all connections pegged as per of Council's Code				
B	MANHOLES				
	All joints sealed as per manufacturer's instructions				
	All manholes benched and haunched				
	All safety steps installed as per standard drawings				
C	SUMPS AND STRUCTURES				
	All sumps cleaned out at completion of roading				
	All inlet and outlet structures as per approved engineering drawings				

COMMENTS: _____

_____

I am experienced in stormwater reticulation and, as per clause 2.1.2 and 2.2.7 of Council's Code of Practice – Subdivision and Development, I have been engaged by the owner to supervise the roading construction for the above subdivision. As per clause 2.1.2 (c), I hereby certify that except as noted above the stormwater reticulation system is now complete and the works have been carried out in accordance with the documents approved by Council roading, and sound engineering practice.

Signed: _____*(Engineer Responsible for Supervision)*

Name: _____ Date: _____

APPENDIX 1D.3

WASTE WATER RETICULATION
CERTIFICATION OF SUBDIVISION CONSTRUCTION

Name of Subdivision:	
Council File No:	
Main Contractor:	
Wastewater Sub Contractor:	
Engineer Responsible for Supervision:	of
Qualifications:	

		Y	N/A	N	Date of Test/Inspection	Comments
A	LINES AND LATERALS					
	All pipe diameter and classes as per approved engineering drawings					
	Lines laid in the position shown on approved engineering drawings					
	Lines laid to levels given on approved engineering drawings					
	All lines laid in accordance with Manufacturer's instructions and relevant NZ Standards					
	All pipe bedding as per drawings/specifications approved by Council					
	All trench backfill compacted to specified standard					
	All lines lamped by Engineer after backfilling and found to be satisfactory					
	All lines and laterals true to grade					
	All lines and laterals true to line					
	All lines free of faults, debris and obstructions					
	All lines and laterals satisfactorily tested as per Code of Practice in the presence of the Engineer					
	No infiltration of water into lines visible					
	A sewer connection has been provided for each lot					
	The levels of all connections are such that pumping of sewage by home owners will not be necessary					
	Ends of all connections pegged as per Council's Code					
B	MANHOLES					
	All joints sealed as per manufacturer's instructions					
	No infiltration of water visible					
	All haunching level with pipe soffits					
	Benching above soffit at a grade of 3:1 to make MH self cleansing					
	All safety steps installed as per standard drawing					
	All manholes tested as per clause 6.13.6					
C	RODDING EYES					
	Rodding eyes identified at surface with approved box with letters RE on lid					

COMMENTS:

_____

_____

_

_____

_

I am experienced in wastewater reticulation and, as per clause 2.1.2 and 2.2.7 of Council's Code of Practice – Subdivision and Development, I have been engaged by the owner to supervise the roading construction for the above subdivision. As per clause 2.1.2 (c), I hereby certify that except as noted above the wastewater reticulation system is now complete and the works have been carried out in accordance with the documents approved by Council roading, and sound engineering practice.

Signed: _____*(Engineer Responsible for Supervision)*

Name: _____ Date: _____

APPENDIX 1D.4

WATER RETICULATION
CERTIFICATION OF SUBDIVISION CONSTRUCTION

Name of Subdivision:	
Council File No:	
Main Contractor:	
Water Sub Contractor:	
Engineer Responsible for Supervision:	of
Qualifications:	

	Y	N/A	N	Date of Test/Inspection /Comments
Mains laid in the position shown on engineering drawings approved by Council				
All pipework, valves and fittings inspected by Engineer prior to backfill and found to be satisfactory				
All pipe diameter and classes as per approved Engineering drawings				
All pipe jointing and connecting systems as per Council's Code and documents approved by Council				
All pipes and fittings laid on a uniform fine bedding				
All anchor blocks required are installed				
Separation distance between water mains and other services has been achieved as per standard drawings				
Minimum cover to mains 900mm in carriageway, 750mm in berms and footpaths and 180 mm @ tobies				
All trench backfill compacted to required standard				
Fire hydrants and valve boxes installed				
Top of hydrant spindle between 115 and 300mm below finished ground level				
All hydrant and valve markers installed				
All hydrant and valve boxes painted				
All hydrants flow tested and certification provided by independent authority				
After backfilling all mains and connections have been satisfactorily pressured tested in the presence of the Engineer				
Each lot provided with a water connection				
Connections terminate with a gate valve 300mm (min) inside road reserve in meter box				
Connections marked as per Council's Code				
Position of lines, connections, hydrants and valves recorded for as builts.				
The new subdivision reticulation system connected to Council's mains				

COMMENTS:

_____

_____

_

_____

_

I am experienced in the construction of water reticulation and, as per clause 2.1.2 and 2.2.7 of Council's Code of Practice – Subdivision and Development, I have been engaged by the owner to supervise the roading construction for the above subdivision. As per clause 2.1.2 (c), I hereby certify that except as noted above the water reticulation system is now complete and the works have been carried out in accordance with the documents approved by Council roading, and sound engineering practice.

Signed: _____*(Engineer Responsible for Supervision)*

Name: _____ Date: _____

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Appendix 1E

Specification for the Excavation and Reinstatement of Trenches and Repair of Services in Existing Streets

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INDEX

SPECIFICATION FOR THE EXCAVATION AND REINSTATEMENT OF TRENCHES AND REPAIR OF SERVICES IN EXISTING STREETS

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OPOTIKI DISTRICT COUNCIL

SPECIFICATION FOR

THE EXCAVATION AND REINSTATEMENT OF TRENCHES

AND REPAIR OF SERVICES IN EXISTING STREETS

MARCH 1999

1.0 INTRODUCTION

Roads and streets in the Opotiki District, are vested in the Opotiki District Council.

Before any trench or excavation is opened up on any road or street including the berm, in the Opotiki District, advice must be given to the Opotiki District Council as to the arrangements which have been made to maintain the trench or excavation in a safe condition, to backfill the trench or excavation and reinstate the surface.

Specific criteria are to apply to proposed work in the Central Business District and urban shopping centres.

Government departments, ad hoc utility corporations, Council departments and statutory corporations, or other organisations with statutory authority to place or maintain services in roads or streets will be required to submit a street opening notice to the Opotiki District Council's Asset Manager/Engineering and Services Manager and complete the work and reinstatement within the time constraints of clause 14 of this document.

> *The acceptance of a street opening notice by the Opotiki District Council does not confer any approval to work on Council utility assets - see Section 5(iv).*

2.0 INTERPRETATION

'Carriageway' means any portion of a road used by motor vehicles.

'Engineer' means the Opotiki District Council's Asset Manager/Engineering and Services Manager or his/her representative.

'Road' or *'Street'* means any area under the control of the Opotiki District Council and includes State Highways, whether formed or unformed. It includes carriageways, berms and other grassed areas, footpaths and pedestrian accessways, and is the total area from boundary to boundary, customarily referred to as 'road reserve'.

'Street Opening Notice' means a notice in the form of Appendix A.

'Trench' means any excavation within a road for the purpose of maintaining, locating or installing services, except shallow excavations for the purpose of constructing vehicle crossings, and excavations on grassed berms for the purpose of providing or maintaining services to residential sections.

'Trenching Authority' means any Board, Corporation, government department, or any other legally constituted group of persons or person responsible for providing underground services.

'Trencher' means any person or persons responsible for actually carrying out the trenching or underground thrusting work for or on behalf of any Trenching Authority, or privately.

'Urban Shopping Centres' means any grouping of two or more shops within the Opotiki Urban or Community Board areas.

3.0 STREET OPENING NOTICE REQUIRED

A Street Opening Notice in the form of Appendix A is required to be lodged at the office of the Opotiki District Council for each separate job or section of a continuing job which involves excavation or the lifting of the road pavement or footpath surfacing on a road or street in the Opotiki District.

A minimum of seven (7) days notice is to be given for planned excavations. Where emergency maintenance work is necessary, the notice is to be lodged by fax as soon as practicable but no later than the next working day.

If the street involved is a State Highway, the notice will require that Transit New Zealand has been notified and conditions imposed by that body received.

4.0 PUBLIC LIABILITY INSURANCE AND LEGAL LIABILITY

The Trenching Authority and any Trencher employed to undertake the work on its behalf shall have current Public Liability Insurance cover. The policy must include a local authority Extension Clause indemnifying the Opotiki District Council against liability for any damage, loss or injury for an amount not less than $1,000,000 for any claim or series of claims arising out of the existence of a trench or excavation or other obstacle associated with the work.

Compliance with any instruction of the Engineer in performing what he considers to be necessary actions in terms of this 'Specification' shall not absolve the Trencher from any legal liability that he would otherwise have had in regard to claims for damage or failure of work for his/her client.

5.0 PROTECTION OF EXISTING SERVICES

(Refer to Standard Berm Details Drawing R 02 for required location of services for new subdivisions.)

The positions of existing watermains, sewers and other services or structures above or below ground, insofar as they are known, are available for the information of the Trenching Authority and/or its agents at the offices of the District Council and respective authorities, but their positions are not guaranteed. In particular, the Trenching Authority is strongly advised to make itself fully aware of

the position of all underground services in the locality, before commencing work, as required by Clause 12(d) of the Construction Act 1959.

The following shall also apply:

(a) Each utility authority shall maintain a complete and accurate record of all of its works within the road reserve, and will make appropriate parts of these records available to any body authorised by Council to trench within the road reserve.

(b) Where the public utility decides that any one particular work is unduly vulnerable because of the proposed trenching, it shall take whatever additional measures it considers warranted, such as locating and marking the position of its work on the surface, providing site supervision, etc.

(c) A Trencher may not use mechanical digging closer than 0.5 m horizontally or 0.3 m vertically from the recorded position until the service has been located by hand-digging.

(d) No authorised Trencher will be held responsible for any damage caused to works not shown or incorrectly shown on the record supplied to him by the public utility.

(e) Access to all hydrants and valves on watermains, sumps, manholes and inspection chambers on underground structures of any kind shall be kept free from obstruction as far as possible at all times. Where access to hydrants has been restricted, the New Zealand Fire Service shall be kept fully informed.

(f) Street trees and ornamental planting or gardens owned or approved by Council shall not be interfered with without the consent of the Manager - Parks and Recreation.

The following special restraints shall apply for:

(i) Underground Electricity Power Cables

(a) 400-230 volt cables to be located by hand-digging. Supervision by power authority for deep excavation.

(b) 11 000 volt cables to be located by hand-digging. Supervision required by power authority when working closer than 0.3 m vertical above or 0.6 m horizontal and if deep excavation. Notification 48 hours, except in genuine cases of emergency.

(c) 33 000 kV cables to be located by power authority. Supervision required when working closer than 1 m vertical above to 2 m horizontal. Notification 48 hours, except in genuine cases of emergency.

(d) No cables are to be moved by anyone except Bay of Plenty Electricity.

(e) Except with the prior written approval of the owner, and subject to the conditions as specified, no person shall, in the case of any pole supporting any conductor, or a stay wire supporting any pole, excavate or otherwise interfere with any land:

(1) within 2 m of the pole or stay; or

(2) at a depth greater than 750 mm between 2 m and 5 m of any pole; or

(3) in such a way as to create an unstable batter.

(f) Excavated or other material shall not be deposited under or near an electric line so as to reduce the conductor to ground clearance to less than those as specified in the New Zealand Electrical Code of Practice (No 34) for Electrical Safety Distances.

(g) The owner or operator of any excavation or mobile plant shall not bring any such device or part thereof closer than 4 metres to any overhead line conductors unless written approval has been received from the owner of the line stipulating the line voltage and the minimum approach specified.

(h) Bare copper conductors may be located buried some distance from transformer or line structures. These conductors form an integral part of the earthing system of these devices and as such, most not be disturbed. If these conductors are located or damaged Bay of Plenty Electricity must be informed and their instructions followed.

(ii) Telecom High Priority Cables

(a) Machinery is not to be used within 1.5 (one point five) metres of the position of fibre-optic, high capacity copper trunk or coaxial cables as determined by a pipe locator and recorded with pegs at intervals of 4 (four) metres.

(b) Machinery can be used up to 0.5 (point five) metres from the cable when the cable has been located by hand at intervals of less than two metres. The machinery is to be operated away from the cable.

(c) 48 hours' notification is required in all cases except genuine emergencies.

(iii) Gas Mains

When planning to work closer than 1 metre or cross an intermediate pressure (IP) or a strategic medium pressure (MP), gas main a works agreement is to be uplifted from the offices of the Natural Gas Corporation prior to work commencing.

When working closer than 500 mm or crossing a gas main, then the gas main is to be located by hand digging under the supervision of Natural Gas Corporation personnel.

Forty eight hours notification is required in all cases except genuine emergency. In emergency cases, then notification is to be given as soon as is reasonably practical.

(iv) Opotiki District Council Water and Sewer Utilities

(a) The approval of the Asset Manager/Engineering and Services Manager must be obtained prior to carrying out any works on Opotiki District Council Utilities Assets.

(b) *Water*

Any person proposing to carry out excavation work shall view the as-built information to establish whether or not Opotiki District Council services are located in the vicinity of its services. Where appropriate, the Opotiki District Council will mark out to within ±0.5 m on the ground the location of its services, and may nominate in writing any restrictions on the work it considers necessary to protect its services. The Opotiki District Council may charge for this service.

(c) *Sewer*

No person shall excavate, or carry out piling or similar work closer than:

(i) 5 m from the centre line of any rising main or trunk sewer, or

(ii) 2 m from the centre line of any public sewer,

without approval. Such approval may impose conditions on the carrying out of any work near the sewer.

6.0 RESPONSIBILITY FOR REPAIRS AND REINSTATEMENT

The cost of repair or reinstatement of any disturbances or damage done to any roadway, berm, fence, footpath, water-pipe, sewer and stormwater drain, channelling, foundation, retaining walls, poles or other services or structure or neighbouring property shall be borne by the Trenching Authority. Council officers should inspect lines after laying to ensure that the Council's existing services are undamaged. Where existing services are damaged as a result of the trenching work, the Trencher shall immediately advise the owner of the damaged service.

Additionally, the Trenching Authority shall be responsible for the maintenance of the reinstatement for 12 months.

7.0 DRAINAGE

The Contractor shall ensure that the drainage of the ground is not altered so as to create further or future ground instability. If de-watering of trenches is carried out, no material, fines, etc, from beyond the line of the trench shall be removed that is unable to be replaced. No water-borne sediment removed by de-watering shall go to any catchpit or manhole. Sediment control shall be in accordance with the Bay of Plenty Regional Council Erosion and Sediment Control Guidelines.

8.0 PUBLIC RELATIONS

Prior to planned excavation commencing, the Trenching Authority shall deliver to the properties affected, a brief statement explaining what the work is, how the property owner will be affected and who to contact for further information or to convey complaints.

A copy of this statement is to be lodged with the Street Opening Notice. Where the authority has an established public relations programme of its own, this condition will be waived.

A programme of work is required in high pedestrian/traffic areas. Approval will be subject to a maximum length of trench being open (normally fifty metres), and a suitable programme of restoration.

9.0 METHODS TO BE USED IN EXCAVATION

Wherever possible, underground thrusting of road carriageways and driveways shall be utilised.

When an excavation is required to be made through any cement concrete, asphaltic concrete or chip seal surface, the proposed edges of the excavation or trench shall be cut with a power-saw prior to the excavation of the trench. The cut is to extend through the full thickness of the surface layer in a clean straight vertical line.

As excavation proceeds, all excavated material unsuitable for backfilling shall be removed from the site immediately. Specific approval must be obtained from the Engineer prior to reutilising any material as backfill.

Areas adjacent to the excavation shall not be undercut. If slumping of material from the sides of the excavation causes depressed areas adjacent to the excavation or if the edges of the pavement are lifted during excavation, additional saw-cutting outside of the original line of the excavation and outside the area of damage will be required before reinstatement is permitted.

All saw-cuts will be in clean, straight, parallel lines and be a minimum of 0.5 m in width.

10.0 SITE SAFETY

All Trenching Authorities shall ensure that all works are carried out in accordance with the Health and Safety in Employment Act 1992.

Temporary traffic control shall be in accordance with Transit New Zealand Specification G1 1996. A Traffic Management Plan will be required where traffic flows are affected in any way.

11.0 TRAFFIC AND PEDESTRIANS

The Trenching Authority is required to organise its work in such a manner that:

(i) it avoids carrying out work on the carriageway during times of peak traffic flow;

(ii) whenever possible, the carriageway will be fully open to traffic during hours of darkness and no more than half the carriageway will be closed at any one time, except with the express permission in writing of the Engineer;

(iii) the length of trench open at any one time is kept at a minimum. The maximum length of trench open at any time shall be fifty metres, unless the Trenching Authority obtains the prior approval of the Engineer. This requirement shall not be applicable for multicore electricity cables of 400 Volt and 11 kV, and for all cables 33 kV and above which have particularly difficult jointing and laying problems. When the length of trench open on a footpath is likely to restrict pedestrian access to shops or services, a temporary bridge of

suitable materials is to be provided at twenty metre intervals for access across the trench.

(iv) In all cases, the Trenching Authority shall give priority to thrusting or boring.

(v) If Council has good and sufficient reason, it may require work to be undertaken outside normal working hours.

(vi) The maximum period that any length of trench may be left open (ie, not backfilled to surface level) shall be seven days, unless the Trenching Authority obtains the written approval of the Engineer.

12.0 BACKFILLING

The material used for bedding underneath and around the service or service duct shall be as required by the Trenching Authority. In no case shall it exceed 100 mm above the top of the service, unless specific coverage is required by a reticulation pipe-laying specification.

The backfilling of trenches shall be in accordance with 'Trench Reinstatement Standards' Drawing G 03, and be to the approval of the Engineer.

13.0 SURFACE REINSTATEMENT

No permanent surface reinstatement shall be carried out until the Engineer is satisfied that the backfilling procedures have been satisfactorily completed. Reinstatement works are to be carried out in accordance with the following requirements.

(a) Grassed Areas

All grassed areas disturbed by trenching work shall be reinstated in accordance with section 4.2.6 and 4.2.7 of the Opotiki District Council Code of Practice - Subdivision and Development.

(b) (i) *Cement Concrete Surfaces*.

All concrete must be poured on a firm compacted subgrade.

All parts of the surface damaged during or after excavation shall be fully reinstated to an 'as found' condition. The minimum dimension of any reinstated portion of the footpath shall not be less than 0.5 m. The width of existing undamaged footpath is not to be less than 0.6 m. If these criteria cannot be met then the reinstatement is to be across the full width of the footpath.

The minimum thickness of concrete shall be 75 mm and the concrete shall attain a minimum compressive strength of 17.5 mPa after 28 days. Vehicle crossings which are affected by the work shall be reinstated with 115 mm thick concrete for residential crossings and 150 mm thick with steel reinforcement for heavy duty crossings. Where appropriate, or for structural or aesthetic requirements, the Engineer may direct that the full crossing be replaced. Construction joints shall be formed at 2.5 m centres, and the line and level of the finished surface shall match the crossfall and level of the adjacent undamaged surface.

(ii) *Asphaltic Concrete or Slurry Sealed Surfaces*

(1) All asphaltic concrete shall be placed on a waterproofing primer coat of emulsified bitumen.

(2) If DGEM is proposed, it must be blinded with sand and sealed with a G5 emulsion coat.

(3) Thin asphaltic surfacings 25 mm of mix 10 A/C.

(4) Structured asphaltic surfaces 50 mm of mix 20 A/C.

(c) Sealed Surfaces

(i) *Transverse Trenches*

25 mm of mix 10 hot mix as in 13(ii). *Note* - in roads identified for resealing method (ii) will apply.

(ii) *Longitudinal and Isolated Repairs outside Traffic Lanes*

Two coat G3/5 bitumen seal coat.

(d) Interlocking Pavement Block Surfaces

The blocks removed during excavation or new blocks of identical shape, thickness and colour shall be replaced on a subgrade similar to that in adjoining undisturbed areas and compacted and filled to give a true surface in accordance with NZS 3116:1981. Contractor shall nominate a competent paving sub contractor.

14.0 RESPONSE TIMES

Resurfacing must be completed within the following time periods:

(a) *Arterial Roads* - 2 days

(b) *Collector Roads* - 4 days

(c) *Local Roads* - 7 days

Where work is continuous, a sacrificial emulsion coat sealing will be used to meet the response times with permanent sealing at the completion of the works.

Note: The contractor will be responsible for the maintenance of the road surface for the extent of the project.

15.0 CLEAN UP AND MAKE GOOD

As work proceeds the Trenching Authority shall progressively carry out all restoration and tidying up work. If regular tidying up and restoration is no being done, the Engineer will require and instruct the Authority concerned to carry out this work immediately. On completion of the work, the Trenching Authority shall remove all plant, materials and other things that may have been brought upon the site in aid of the works, and generally clear away all rubbish and leave the site in a similar condition to that which existed before the work was commenced.

Any trees or branches cut down or tree stumps uprooted during the work shall be removed. Branches that require removal should be cut by saw and not broken by machinery. The Trenching Authority shall clean out all kerbs, channels, sumps and repair or reinstate all road surfaces, fencing, walls, floors, lawns, gardens, paths, inclusive of transplanting trees, shrubs, etc, and make good all damage which may have been caused through his/her operations in connection with the work.

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Appendix A

Opotiki District Council
Street Opening Notice ~ Application

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Opotiki District Council

Street Opening Notice ~ Application

No. _____ _____
Eg. Yr/Number – 00/001

TO : ***The Engineering Department***
Opotiki District Council
PO Box 44, 108 St John Street
Opotiki
Ph ; (07) 315-6167 Fax : (07) 315-7050

I / We wish to carry out the works described in the plans and specifications deposited herewith and/or as described over.

Date of Application : _____/_____/_____

Utility / Contractor		
Postal Address		
Street Address		
Phone Number	Work ( )	A/Hrs ( )
Contact Person		

NOTICE TO CONTRACTOR

- A copy of the Notice shall be held on site while work is undertaken for inspection by Council's Inspector. Failure to produce a Notice shall result in a Stop Work Notice being issued.
- A six [6] month defects liability period from the time of inspection shall exist on this work.
- It is the Contractor's responsibility to notify Council of the completion of reinstatement works so an inspection can be carried out.
- If during the construction, the work varies substantially from the work described in this application a Stop Work Notice may be issued.
- If after one [1] week of services being installed the reinstatement has not been completed, the Council may carry out the work to it's satisfaction, and at the Utility Contractor's (above) expense.
- Except in emergencies an application shall be lodged with Opotiki District Council ten (10) working days before work is to commence on site.
- A Street Opening Notice shall be filled out after the emergency situation has finished.

Opotiki District Council
PO Box 44, 108 St John Street
Opotiki

DETAILS OF WORK TO BE CARRIED OUT

Street / Road Name :	
Type of Service :	
Depth of Service	
Area of Legal Road/Street Affected	
Date for Commencement of Work	
Date for Completion of Work (Estimated)	

All work will be carried out to Opotiki District Council Standards and to the satisfaction of Opotiki District Council (A copy of Opotiki District Council's Street Opening Reinstatement Standards will be supplied on application - if requested)

REINSTATEMENT OF :	CARRIED OUT BY (CONTRACTOR) :
❒ Asphaltic Concrete	
❒ Chip Sealed Carriageway	
❒ Cobblestones/Paving Stones	
❒ Concrete	
❒ Excavation/Trench	
❒ Grass	
❒ Unsealed Carriageway	
❒ Other	

- If reinstatement work is to be carried out by a Contractor that is unknown to Opotiki District Council then proof of work experience and track record may be requested before work can start.

I / We understand the requirements of this application and shall conform with all other Acts and Regulations pertaining to this work and have read and understood the "Notice to Contractor" Section on the front page of this Notice.

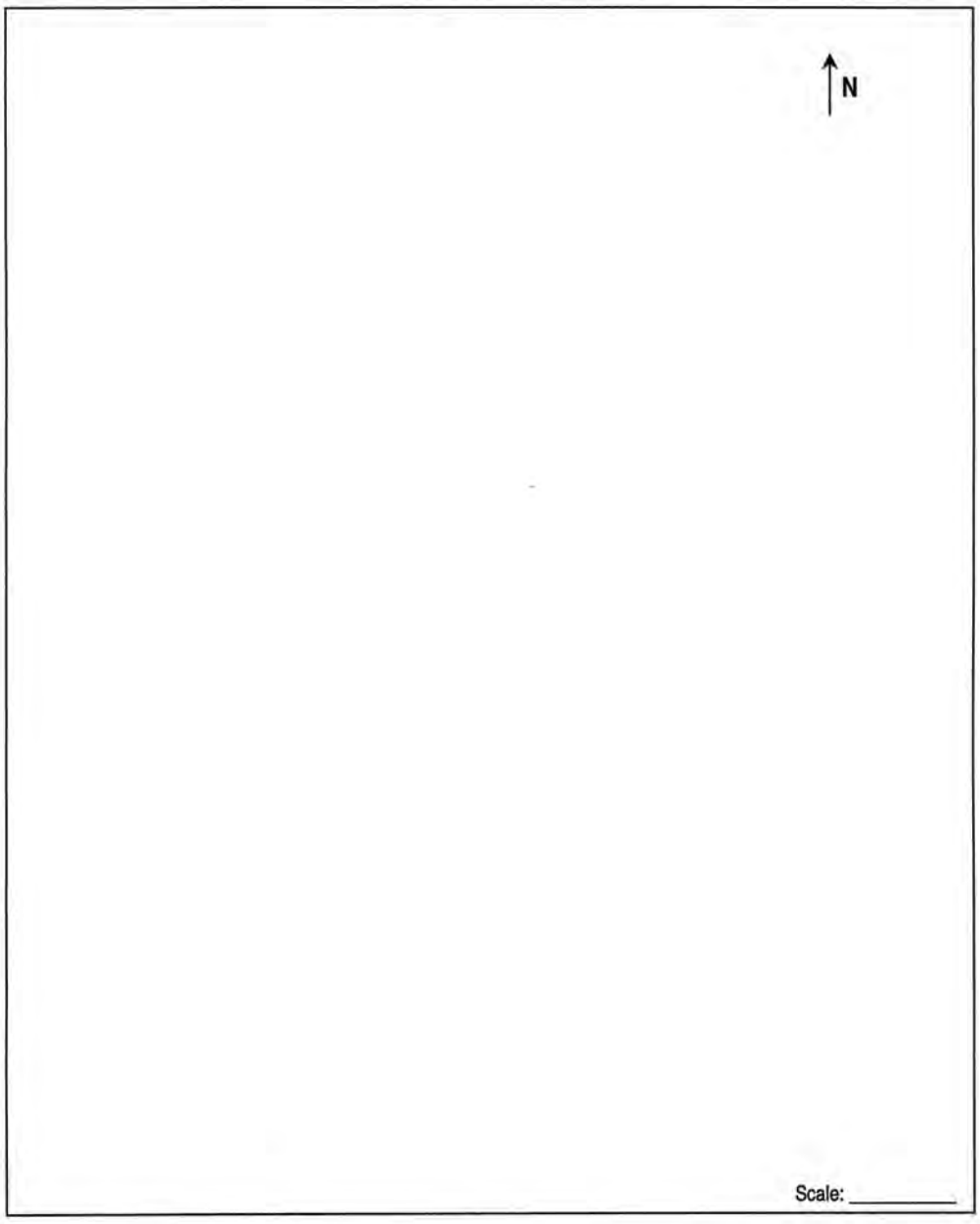
Further, all other utility services will be/have been located before work commences.

Applicants Signature _____

Name (Please Print) _____

AS-BUILT OF PROGRAMMED WORK

- With dimensions
- Showing temporary traffic signs and positions (where applicable)
- Any other relevant details
- If space below is insufficient please supply as-built on separate sheet



FOR OPOTIKI DISTRICT COUNCIL USE ONLY

Applicants work authorized subject to :

Date : _____/_____/_____ Signed : _____

Position : _____

Works have been completed and all surface reinstatement undertaken to standards and Council's satisfaction.

Date Inspected : _____/_____/_____ Signed : _____

Position : _____

[\\ORION\errinn\ERRIN\ROADING\St Opening Notice Mar00.doc]

Appendix 1F

Stormwater and Sanitary Sewer Design Tables

Colebrook-White Equation

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Opotiki District Council
Appendix 1F
Stormwater & Sanitary Sewer Design Tables
Colebrook- White Equation

Water (or sewerage) @ 15 C full bore conditions
Velocities in m/s (italic type) discharges in l/s **ks =** 1.5

Nominal Dia	160	200	250	315	400	225	300	375	450
Material	uPVC	uPVC	uPVC	uPVC	uPVC	Conc	Conc	Conc	Conc
Actual ID	151	190	238	300	380	229	305	381	457
Gradient %									
0.10	*0.27*	*0.32*	*0.37*	*0.43*	*0.51*	*0.36*	*0.44*	*0.51*	*0.57*
	4.90	9.07	16.55	30.67	57.47	14.93	32.04	57.87	93.74
0.11	*0.29*	*0.34*	*0.39*	*0.46*	*0.53*	*0.38*	*0.46*	*0.53*	*0.60*
	5.14	9.52	17.37	32.18	60.31	15.67	33.63	60.73	98.36
0.12	*0.30*	*0.35*	*0.41*	*0.48*	*0.56*	*0.40*	*0.48*	*0.56*	*0.63*
	5.38	9.95	18.16	33.63	63.02	16.38	35.14	63.46	102.78
0.13	*0.31*	*0.37*	*0.43*	*0.50*	*0.58*	*0.41*	*0.50*	*0.58*	*0.65*
	5.60	10.36	18.91	35.02	65.62	17.06	36.60	66.08	107.01
0.14	*0.32*	*0.38*	*0.44*	*0.51*	*0.60*	*0.43*	*0.52*	*0.60*	*0.68*
	5.82	10.76	19.63	36.36	68.12	17.71	38.00	68.60	111.09
0.15	*0.34*	*0.39*	*0.46*	*0.53*	*0.62*	*0.45*	*0.54*	*0.62*	*0.70*
	6.03	11.14	20.33	37.65	70.54	18.34	39.34	71.03	115.03
0.16	*0.35*	*0.41*	*0.47*	*0.55*	*0.64*	*0.46*	*0.56*	*0.64*	*0.72*
	6.23	11.52	21.01	38.90	72.87	18.95	40.65	73.38	118.83
0.17	*0.36*	*0.42*	*0.49*	*0.57*	*0.66*	*0.47*	*0.57*	*0.66*	*0.75*
	6.42	11.87	21.66	40.11	75.14	19.55	41.91	75.66	122.52
0.18	*0.37*	*0.43*	*0.50*	*0.58*	*0.68*	*0.49*	*0.59*	*0.68*	*0.77*
	6.61	12.22	22.30	*41.29*	*77.34*	*20.12*	*43.14*	*77.88*	*126.10*
0.19	*0.38*	*0.44*	*0.52*	*0.60*	*0.70*	*0.50*	*0.61*	*0.70*	*0.79*
	6.79	12.56	22.91	*42.43*	*79.48*	*20.68*	*44.34*	*80.03*	*129.58*
0.20	*0.39*	*0.45*	*0.53*	*0.62*	*0.72*	*0.52*	*0.62*	*0.72*	*0.81*
	6.97	12.89	23.52	*43.54*	*81.56*	*21.22*	*45.50*	*82.13*	*132.98*
0.21	*0.40*	*0.47*	*0.54*	*0.63*	*0.74*	*0.53*	*0.64*	*0.74*	*0.83*
	7.15	13.22	24.10	*44.63*	*83.59*	*21.75*	*46.63*	*84.17*	*136.28*
0.22	*0.41*	*0.48*	*0.55*	*0.65*	*0.75*	*0.54*	*0.65*	*0.76*	*0.85*
	7.32	13.53	24.68	*45.69*	*85.57*	*22.27*	*47.74*	*86.17*	*139.51*
0.23	*0.42*	*0.49*	*0.57*	*0.66*	*0.77*	*0.55*	*0.67*	*0.77*	*0.87*
	7.49	13.84	25.24	*46.73*	*87.51*	*22.77*	*48.82*	*88.12*	*142.67*
0.24	*0.43*	*0.50*	*0.58*	*0.68*	*0.79*	*0.56*	*0.68*	*0.79*	*0.89*
	7.65	14.14	25.79	*47.74*	*89.41*	*23.27*	*49.88*	*90.03*	*145.76*
0.25	*0.44*	*0.51*	*0.59*	*0.69*	*0.80*	*0.58*	*0.70*	*0.81*	*0.91*
	7.81	14.44	26.32	*48.73*	*91.27*	*23.75*	*50.92*	*91.90*	*148.79*
0.26	*0.44*	*0.52*	*0.60*	*0.70*	*0.82*	*0.59*	*0.71*	*0.82*	*0.93*
	7.97	*14.73*	*26.85*	*49.71*	*93.09*	*24.23*	*51.94*	*93.74*	*151.76*
0.27	*0.45*	*0.53*	*0.62*	*0.72*	*0.84*	*0.60*	*0.72*	*0.84*	*0.94*
	8.12	*15.01*	*27.37*	*50.66*	*94.87*	*24.70*	*52.94*	*95.54*	*154.67*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s				**ks =**	1.5				
Nominal Dia	160	200	250	315	400	225	300	375	450
Material	uPVC	uPVC	uPVC	uPVC	uPVC	Conc	Conc	Conc	Conc
Actual ID	151	190	238	300	380	229	305	381	457
0.28	*0.46*	*0.54*	*0.63*	*0.73*	*0.85*	*0.61*	*0.74*	*0.85*	*0.96*
	8.27	*15.29*	*27.87*	*51.60*	*96.63*	*25.15*	*53.92*	*97.30*	*157.52*
0.29	*0.47*	*0.55*	*0.64*	*0.74*	*0.87*	*0.62*	*0.75*	*0.87*	*0.98*
	8.42	*15.56*	*28.37*	*52.52*	*98.35*	*25.60*	*54.88*	*99.04*	*160.33*
0.30	*0.48*	*0.56*	*0.65*	*0.76*	*0.88*	*0.63*	*0.76*	*0.88*	*0.99*
	8.57	*15.83*	*28.86*	*53.43*	*100.04*	*26.05*	*55.83*	*100.74*	*163.09*
0.31	*0.49*	*0.57*	*0.66*	*0.77*	*0.90*	*0.64*	*0.78*	*0.90*	*1.01*
	8.71	*16.09*	*29.34*	*54.32*	*101.71*	*26.48*	*56.76*	*102.42*	*165.80*
0.32	*0.49*	*0.58*	*0.67*	*0.78*	*0.91*	*0.65*	*0.79*	*0.91*	*1.03*
	8.85	*16.36*	*29.82*	*55.19*	*103.35*	*26.91*	*57.67*	*104.07*	*168.47*
0.33	*0.50*	*0.59*	*0.68*	*0.79*	*0.93*	*0.66*	*0.80*	*0.93*	*1.04*
	8.99	*16.61*	*30.28*	*56.06*	*104.96*	*27.33*	*58.57*	*105.70*	*171.10*
0.34	*0.51*	*0.59*	*0.69*	*0.81*	*0.94*	*0.67*	*0.81*	*0.94*	*1.06*
	9.13	*16.86*	*30.74*	*56.91*	*106.55*	*27.74*	*59.46*	*107.30*	*173.69*
0.35	*0.52*	*0.60*	*0.70*	*0.82*	*0.95*	*0.68*	*0.83*	*0.95*	*1.07*
	9.26	*17.11*	*31.20*	*57.74*	*108.12*	*28.15*	*60.33*	*108.87*	*176.24*
0.36	*0.52*	*0.61*	*0.71*	*0.83*	*0.97*	*0.69*	*0.84*	*0.97*	*1.09*
	9.39	*17.36*	*31.64*	*58.57*	*109.66*	*28.56*	*61.20*	*110.43*	*178.75*
0.37	*0.53*	*0.62*	*0.72*	*0.84*	*0.98*	*0.70*	*0.85*	*0.98*	*1.10*
	9.52	*17.60*	*32.08*	*59.38*	*111.18*	*28.95*	*62.05*	*111.96*	*181.23*
0.38	*0.54*	*0.63*	*0.73*	*0.85*	*0.99*	*0.71*	*0.86*	*1.00*	*1.12*
	9.65	*17.84*	*32.52*	*60.19*	*112.68*	*29.35*	*62.89*	*113.47*	*183.68*
0.39	*0.55*	*0.64*	*0.74*	*0.86*	*1.01*	*0.72*	*0.87*	*1.01*	*1.13*
	9.78	*18.07*	*32.95*	*60.98*	*114.17*	*29.73*	*63.71*	*114.96*	*186.09*
0.40	*0.55*	*0.65*	*0.75*	*0.87*	*1.02*	*0.73*	*0.88*	*1.02*	*1.15*
	9.91	*18.31*	*33.37*	*61.76*	*115.63*	*30.11*	*64.53*	*116.44*	*188.48*
0.41	*0.56*	*0.65*	*0.76*	*0.88*	*1.03*	*0.74*	*0.89*	*1.03*	*1.16*
	10.03	*18.54*	*33.79*	*62.53*	*117.08*	*30.49*	*65.34*	*117.89*	*190.83*
0.42	*0.57*	*0.66*	*0.77*	*0.90*	*1.04*	*0.75*	*0.91*	*1.05*	*1.18*
	10.15	*18.76*	*34.20*	*63.30*	*118.50*	*30.86*	*66.14*	*119.33*	*193.16*
0.43	*0.57*	*0.67*	*0.78*	*0.91*	*1.06*	*0.76*	*0.92*	*1.06*	*1.19*
	10.28	*18.99*	*34.61*	*64.05*	*119.91*	*31.23*	*66.92*	*120.75*	*195.45*
0.44	*0.58*	*0.68*	*0.79*	*0.92*	*1.07*	*0.77*	*0.93*	*1.07*	*1.21*
	10.40	*19.21*	*35.01*	*64.80*	*121.31*	*31.60*	*67.70*	*122.16*	*197.73*
0.45	*0.59*	*0.69*	*0.80*	*0.93*	*1.08*	*0.78*	*0.94*	*1.08*	*1.22*
	10.51	*19.43*	*35.41*	*65.53*	*122.69*	*31.96*	*68.47*	*123.54*	*199.97*
0.46	*0.59*	*0.69*	*0.80*	*0.94*	*1.09*	*0.78*	*0.95*	*1.10*	*1.23*
	10.63	*19.64*	*35.80*	*66.26*	*124.05*	*32.31*	*69.24*	*124.92*	*202.19*
0.47	*0.60*	*0.70*	*0.81*	*0.95*	*1.11*	*0.79*	*0.96*	*1.11*	*1.25*
	10.75	*19.86*	*36.19*	*66.98*	*125.40*	*32.66*	*69.99*	*126.28*	*204.39*
0.48	*0.61*	*0.71*	*0.82*	*0.96*	*1.12*	*0.80*	*0.97*	*1.12*	*1.26*
	10.86	*20.07*	*36.58*	*67.70*	*126.73*	*33.01*	*70.73*	*127.62*	*206.56*
0.49	*0.61*	*0.72*	*0.83*	*0.97*	*1.13*	*0.81*	*0.98*	*1.13*	*1.27*
	10.98	*20.28*	*36.96*	*68.40*	*128.05*	*33.36*	*71.47*	*128.95*	*208.71*

Water (or sewerage) @ 15 C full bore conditions
Velocities in m/s (italic type) discharges in l/s **ks =** 1.5

Nominal Dia	160	200	250	315	400	225	300	375	450
Material	uPVC	uPVC	uPVC	uPVC	uPVC	Conc	Conc	Conc	Conc
Actual ID	151	190	238	300	380	229	305	381	457
0.50	*0.62*	*0.72*	*0.84*	*0.98*	*1.14*	*0.82*	*0.99*	*1.14*	*1.29*
	11.09	*20.49*	*37.34*	*69.10*	*129.36*	*33.70*	*72.20*	*130.27*	*210.84*
0.52	*0.63*	*0.74*	*0.86*	*1.00*	*1.16*	*0.83*	*1.01*	*1.17*	*1.31*
	11.31	*20.90*	*38.09*	*70.48*	*131.94*	*34.37*	*73.64*	*132.86*	*215.04*
0.54	*0.64*	*0.75*	*0.87*	*1.02*	*1.19*	*0.85*	*1.03*	*1.19*	*1.34*
	11.53	*21.30*	*38.82*	*71.83*	*134.46*	*35.03*	*75.05*	*135.40*	*219.16*
0.56	*0.66*	*0.77*	*0.89*	*1.03*	*1.21*	*0.87*	*1.05*	*1.21*	*1.36*
	11.74	*21.69*	*39.53*	*73.16*	*136.95*	*35.68*	*76.44*	*137.90*	*223.20*
0.58	*0.67*	*0.78*	*0.90*	*1.05*	*1.23*	*0.88*	*1.06*	*1.23*	*1.38*
	11.95	*22.08*	*40.24*	*74.46*	*139.38*	*36.31*	*77.80*	*140.36*	*227.17*
0.60	*0.68*	*0.79*	*0.92*	*1.07*	*1.25*	*0.90*	*1.08*	*1.25*	*1.41*
	12.16	*22.46*	*40.93*	*75.74*	*141.78*	*36.94*	*79.14*	*142.77*	*231.07*
0.62	*0.69*	*0.81*	*0.94*	*1.09*	*1.27*	*0.91*	*1.10*	*1.27*	*1.43*
	12.36	*22.83*	*41.61*	*77.00*	*144.13*	*37.55*	*80.45*	*145.14*	*234.90*
0.64	*0.70*	*0.82*	*0.95*	*1.11*	*1.29*	*0.93*	*1.12*	*1.29*	*1.46*
	12.56	*23.20*	*42.28*	*78.24*	*146.45*	*38.16*	*81.75*	*147.47*	*238.68*
0.66	*0.71*	*0.83*	*0.97*	*1.12*	*1.31*	*0.94*	*1.14*	*1.31*	*1.48*
	12.76	*23.56*	*42.94*	*79.46*	*148.73*	*38.75*	*83.02*	*149.77*	*242.39*
0.68	*0.72*	*0.84*	*0.98*	*1.14*	*1.33*	*0.96*	*1.15*	*1.33*	*1.50*
	12.95	*23.92*	*43.59*	*80.66*	*150.98*	*39.34*	*84.28*	*152.03*	*246.06*
0.70	*0.73*	*0.86*	*0.99*	*1.16*	*1.35*	*0.97*	*1.17*	*1.35*	*1.52*
	13.14	*24.27*	*44.23*	*81.84*	*153.19*	*39.92*	*85.51*	*154.26*	*249.66*
0.72	*0.74*	*0.87*	*1.01*	*1.17*	*1.37*	*0.98*	*1.19*	*1.37*	*1.54*
	13.33	*24.62*	*44.86*	*83.01*	*155.38*	*40.49*	*86.73*	*156.46*	*253.22*
0.74	*0.75*	*0.88*	*1.02*	*1.19*	*1.39*	*1.00*	*1.20*	*1.39*	*1.57*
	13.51	*24.96*	*45.49*	*84.16*	*157.53*	*41.05*	*87.94*	*158.63*	*256.73*
0.76	*0.76*	*0.89*	*1.04*	*1.21*	*1.41*	*1.01*	*1.22*	*1.41*	*1.59*
	13.70	*25.30*	*46.10*	*85.30*	*159.65*	*41.61*	*89.12*	*160.77*	*260.19*
0.78	*0.77*	*0.90*	*1.05*	*1.22*	*1.43*	*1.02*	*1.24*	*1.43*	*1.61*
	13.88	*25.63*	*46.71*	*86.42*	*161.75*	*42.15*	*90.29*	*162.88*	*263.60*
0.80	*0.78*	*0.92*	*1.06*	*1.24*	*1.44*	*1.04*	*1.25*	*1.45*	*1.63*
	14.06	*25.96*	*47.31*	*87.52*	*163.82*	*42.69*	*91.45*	*164.96*	*266.97*
0.82	*0.79*	*0.93*	*1.08*	*1.25*	*1.46*	*1.05*	*1.27*	*1.46*	*1.65*
	14.23	*26.29*	*47.90*	*88.62*	*165.86*	*43.23*	*92.59*	*167.02*	*270.30*
0.84	*0.80*	*0.94*	*1.09*	*1.27*	*1.48*	*1.06*	*1.28*	*1.48*	*1.67*
	14.41	*26.61*	*48.48*	*89.70*	*167.88*	*43.75*	*93.72*	*169.06*	*273.59*
0.86	*0.81*	*0.95*	*1.10*	*1.28*	*1.50*	*1.07*	*1.30*	*1.50*	*1.69*
	14.58	*26.92*	*49.06*	*90.76*	*169.88*	*44.28*	*94.83*	*171.07*	*276.84*
0.88	*0.82*	*0.96*	*1.12*	*1.30*	*1.52*	*1.09*	*1.31*	*1.52*	*1.71*
	14.75	*27.24*	*49.63*	*91.82*	*171.85*	*44.79*	*95.94*	*173.05*	*280.05*
0.90	*0.83*	*0.97*	*1.13*	*1.31*	*1.53*	*1.10*	*1.33*	*1.54*	*1.73*
	14.92	*27.55*	*50.19*	*92.86*	*173.80*	*45.30*	*97.03*	*175.01*	*283.23*
0.92	*0.84*	*0.98*	*1.14*	*1.33*	*1.55*	*1.11*	*1.34*	*1.55*	*1.75*
	15.08	*27.85*	*50.75*	*93.89*	*175.73*	*45.80*	*98.10*	*176.96*	*286.37*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s				**ks =** 1.5					
Nominal Dia	160	200	250	315	400	225	300	375	450
Material	uPVC	uPVC	uPVC	uPVC	uPVC	Conc	Conc	Conc	Conc
Actual ID	151	190	238	300	380	229	305	381	457
0.94	*0.85*	*0.99*	*1.15*	*1.34*	*1.57*	*1.12*	*1.36*	*1.57*	*1.76*
	15.25	*28.16*	*51.30*	*94.91*	*177.64*	*46.30*	*99.17*	*178.88*	*289.48*
0.96	*0.86*	*1.00*	*1.17*	*1.36*	*1.58*	*1.14*	*1.37*	*1.59*	*1.78*
	15.41	*28.46*	*51.85*	*95.92*	*179.52*	*46.79*	*100.22*	*180.78*	*292.55*
0.98	*0.87*	*1.01*	*1.18*	*1.37*	*1.60*	*1.15*	*1.39*	*1.60*	*1.80*
	15.57	*28.75*	*52.39*	*96.92*	*181.39*	*47.28*	*101.27*	*182.66*	*295.60*
1.00	*0.88*	*1.02*	*1.19*	*1.39*	*1.62*	*1.16*	*1.40*	*1.62*	*1.82*
	15.73	*29.05*	*52.92*	*97.91*	*183.24*	*47.76*	*102.30*	*184.52*	*298.61*
1.05	*0.90*	*1.05*	*1.22*	*1.42*	*1.66*	*1.19*	*1.43*	*1.66*	*1.87*
	16.12	*29.77*	*54.24*	*100.34*	*187.78*	*48.95*	*104.84*	*189.10*	*306.01*
1.10	*0.92*	*1.07*	*1.25*	*1.45*	*1.69*	*1.22*	*1.47*	*1.70*	*1.91*
	16.50	*30.47*	*55.52*	*102.71*	*192.22*	*50.11*	*107.31*	*193.56*	*313.23*
1.15	*0.94*	*1.10*	*1.28*	*1.49*	*1.73*	*1.24*	*1.50*	*1.74*	*1.95*
	16.87	*31.16*	*56.77*	*105.03*	*196.56*	*51.24*	*109.74*	*197.93*	*320.30*
1.20	*0.96*	*1.12*	*1.30*	*1.52*	*1.77*	*1.27*	*1.53*	*1.77*	*1.99*
	17.24	*31.84*	*58.00*	*107.29*	*200.80*	*52.35*	*112.11*	*202.20*	*327.21*
1.25	*0.98*	*1.15*	*1.33*	*1.55*	*1.81*	*1.30*	*1.57*	*1.81*	*2.04*
	17.60	*32.50*	*59.20*	*109.52*	*204.95*	*53.43*	*114.43*	*206.39*	*333.98*
1.30	*1.00*	*1.17*	*1.36*	*1.58*	*1.84*	*1.32*	*1.60*	*1.85*	*2.08*
	17.95	*33.14*	*60.38*	*111.69*	*209.03*	*54.49*	*116.70*	*210.49*	*340.61*
1.35	*1.02*	*1.19*	*1.38*	*1.61*	*1.88*	*1.35*	*1.63*	*1.88*	*2.12*
	18.29	*33.78*	*61.54*	*113.83*	*213.02*	*55.54*	*118.93*	*214.51*	*347.12*
1.40	*1.04*	*1.21*	*1.41*	*1.64*	*1.91*	*1.37*	*1.66*	*1.92*	*2.16*
	18.63	*34.40*	*62.67*	*115.93*	*216.94*	*56.56*	*121.13*	*218.46*	*353.51*
1.45	*1.06*	*1.23*	*1.43*	*1.67*	*1.95*	*1.40*	*1.69*	*1.95*	*2.19*
	18.96	*35.01*	*63.78*	*117.99*	*220.80*	*57.57*	*123.28*	*222.34*	*359.78*
1.50	*1.08*	*1.26*	*1.46*	*1.70*	*1.98*	*1.42*	*1.72*	*1.98*	*2.23*
	19.29	*35.61*	*64.88*	*120.01*	*224.58*	*58.56*	*125.39*	*226.15*	*365.95*
1.55	*1.09*	*1.28*	*1.48*	*1.73*	*2.01*	*1.45*	*1.74*	*2.02*	*2.27*
	19.61	*36.21*	*65.96*	*122.00*	*228.31*	*59.53*	*127.47*	*229.90*	*372.02*
1.60	*1.11*	*1.30*	*1.51*	*1.75*	*2.05*	*1.47*	*1.77*	*2.05*	*2.30*
	19.92	*36.79*	*67.02*	*123.96*	*231.97*	*60.48*	*129.52*	*233.59*	*377.99*
1.65	*1.13*	*1.32*	*1.53*	*1.78*	*2.08*	*1.49*	*1.80*	*2.08*	*2.34*
	20.23	*37.36*	*68.06*	*125.89*	*235.58*	*61.43*	*131.54*	*237.23*	*383.86*
1.70	*1.15*	*1.34*	*1.55*	*1.81*	*2.11*	*1.51*	*1.83*	*2.11*	*2.38*
	20.54	*37.93*	*69.09*	*127.79*	*239.14*	*62.35*	*133.52*	*240.81*	*389.65*
1.75	*1.16*	*1.36*	*1.58*	*1.83*	*2.14*	*1.54*	*1.85*	*2.14*	*2.41*
	20.84	*38.48*	*70.10*	*129.66*	*242.64*	*63.27*	*135.48*	*244.33*	*395.36*
1.80	*1.18*	*1.38*	*1.60*	*1.86*	*2.17*	*1.56*	*1.88*	*2.17*	*2.44*
	21.14	*39.03*	*71.10*	*131.51*	*246.09*	*64.17*	*137.41*	*247.81*	*400.98*
1.85	*1.20*	*1.40*	*1.62*	*1.89*	*2.20*	*1.58*	*1.91*	*2.20*	*2.48*
	21.43	*39.57*	*72.08*	*133.33*	*249.49*	*65.06*	*139.31*	*251.24*	*406.52*
1.90	*1.21*	*1.41*	*1.64*	*1.91*	*2.23*	*1.60*	*1.93*	*2.23*	*2.51*
	21.72	*40.11*	*73.05*	*135.13*	*252.85*	*65.94*	*141.18*	*254.62*	*412.00*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s					**ks =** 1.5				
Nominal Dia	160	200	250	315	400	225	300	375	450
Material	uPVC	uPVC	uPVC	uPVC	uPVC	Conc	Conc	Conc	Conc
Actual ID	151	190	238	300	380	229	305	381	457
1.95	*1.23*	*1.43*	*1.66*	*1.94*	*2.26*	*1.62*	*1.96*	*2.26*	*2.54*
	22.01	*40.63*	*74.01*	*136.90*	*256.17*	*66.80*	*143.04*	*257.96*	*417.40*
2.00	*1.24*	*1.45*	*1.68*	*1.96*	*2.29*	*1.64*	*1.98*	*2.29*	*2.58*
	22.29	*41.15*	*74.96*	*138.65*	*259.44*	*67.65*	*144.86*	*261.25*	*422.73*
2.10	*1.28*	*1.49*	*1.73*	*2.01*	*2.34*	*1.68*	*2.03*	*2.35*	*2.64*
	22.84	*42.17*	*76.82*	*142.08*	*265.86*	*69.33*	*148.45*	*267.72*	*433.19*
2.20	*1.31*	*1.52*	*1.77*	*2.06*	*2.40*	*1.72*	*2.08*	*2.40*	*2.70*
	23.38	*43.17*	*78.63*	*145.44*	*272.14*	*70.97*	*151.96*	*274.04*	*443.41*
2.30	*1.34*	*1.56*	*1.81*	*2.10*	*2.45*	*1.76*	*2.13*	*2.46*	*2.76*
	23.91	*44.14*	*80.41*	*148.72*	*278.27*	*72.57*	*155.38*	*280.21*	*453.40*
2.40	*1.36*	*1.59*	*1.85*	*2.15*	*2.51*	*1.80*	*2.17*	*2.51*	*2.82*
	24.43	*45.10*	*82.14*	*151.92*	*284.27*	*74.14*	*158.73*	*286.26*	*463.17*
2.50	*1.39*	*1.62*	*1.88*	*2.19*	*2.56*	*1.84*	*2.22*	*2.56*	*2.88*
	24.93	*46.03*	*83.84*	*155.07*	*290.15*	*75.67*	*162.02*	*292.17*	*472.75*
2.60	*1.42*	*1.66*	*1.92*	*2.24*	*2.61*	*1.87*	*2.26*	*2.61*	*2.94*
	25.43	*46.95*	*85.51*	*158.15*	*295.91*	*77.18*	*165.23*	*297.97*	*482.13*
2.70	*1.45*	*1.69*	*1.96*	*2.28*	*2.66*	*1.91*	*2.30*	*2.66*	*3.00*
	25.92	*47.84*	*87.14*	*161.17*	*301.56*	*78.65*	*168.39*	*303.66*	*491.33*
2.80	*1.47*	*1.72*	*1.99*	*2.32*	*2.71*	*1.94*	*2.35*	*2.71*	*3.05*
	26.39	*48.72*	*88.75*	*164.13*	*307.11*	*80.10*	*171.49*	*309.25*	*500.37*
2.90	*1.50*	*1.75*	*2.03*	*2.36*	*2.76*	*1.98*	*2.39*	*2.76*	*3.10*
	26.86	*49.59*	*90.32*	*167.05*	*312.55*	*81.52*	*174.53*	*314.74*	*509.24*
3.00	*1.53*	*1.78*	*2.07*	*2.40*	*2.80*	*2.01*	*2.43*	*2.81*	*3.16*
	27.32	*50.44*	*91.87*	*169.91*	*317.91*	*82.92*	*177.53*	*320.13*	*517.97*
3.10	*1.55*	*1.81*	*2.10*	*2.44*	*2.85*	*2.05*	*2.47*	*2.85*	*3.21*
	27.78	*51.28*	*93.39*	*172.73*	*323.18*	*84.29*	*180.47*	*325.43*	*526.55*
3.20	*1.58*	*1.84*	*2.13*	*2.48*	*2.90*	*2.08*	*2.51*	*2.90*	*3.26*
	28.22	*52.10*	*94.89*	*175.50*	*328.36*	*85.65*	*183.36*	*330.65*	*534.99*
3.30	*1.60*	*1.87*	*2.17*	*2.52*	*2.94*	*2.11*	*2.55*	*2.95*	*3.31*
	28.66	*52.91*	*96.37*	*178.22*	*333.46*	*86.98*	*186.21*	*335.79*	*543.30*
3.40	*1.62*	*1.89*	*2.20*	*2.56*	*2.98*	*2.14*	*2.59*	*2.99*	*3.36*
	29.10	*53.71*	*97.82*	*180.91*	*338.49*	*88.29*	*189.02*	*340.85*	*551.49*
3.50	*1.65*	*1.92*	*2.23*	*2.60*	*3.03*	*2.18*	*2.62*	*3.03*	*3.41*
	29.52	*54.50*	*99.25*	*183.56*	*343.44*	*89.58*	*191.79*	*345.84*	*559.55*
3.60	*1.67*	*1.95*	*2.26*	*2.63*	*3.07*	*2.21*	*2.66*	*3.08*	*3.46*
	29.94	*55.27*	*100.67*	*186.17*	*348.32*	*90.86*	*194.51*	*350.75*	*567.50*
3.70	*1.70*	*1.98*	*2.29*	*2.67*	*3.11*	*2.24*	*2.70*	*3.12*	*3.51*
	30.36	*56.04*	*102.06*	*188.74*	*353.14*	*92.11*	*197.20*	*355.60*	*575.35*
3.80	*1.72*	*2.00*	*2.32*	*2.71*	*3.16*	*2.27*	*2.74*	*3.16*	*3.55*
	30.77	*56.79*	*103.43*	*191.28*	*357.89*	*93.35*	*199.86*	*360.39*	*583.08*
3.90	*1.74*	*2.03*	*2.36*	*2.74*	*3.20*	*2.30*	*2.77*	*3.20*	*3.60*
	31.17	*57.54*	*104.79*	*193.79*	*362.57*	*94.58*	*202.48*	*365.11*	*590.72*
4.00	*1.76*	*2.06*	*2.39*	*2.78*	*3.24*	*2.33*	*2.81*	*3.24*	*3.65*
	31.57	*58.27*	*106.13*	*196.26*	*367.20*	*95.79*	*205.06*	*369.77*	*598.26*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s					**ks =**	1.5			
Nominal Dia	160	200	250	315	400	225	300	375	450
Material	uPVC	uPVC	uPVC	uPVC	uPVC	Conc	Conc	Conc	Conc
Actual ID	151	190	238	300	380	229	305	381	457
4.10	*1.78*	*2.08*	*2.42*	*2.81*	*3.28*	*2.35*	*2.84*	*3.28*	*3.69*
	31.96	*59.00*	*107.45*	*198.71*	*371.77*	*96.98*	*207.61*	*374.37*	*605.70*
4.20	*1.81*	*2.11*	*2.44*	*2.85*	*3.32*	*2.38*	*2.88*	*3.32*	*3.74*
	32.35	*59.72*	*108.75*	*201.12*	*376.29*	*98.16*	*210.14*	*378.92*	*613.06*
4.30	*1.83*	*2.13*	*2.47*	*2.88*	*3.36*	*2.41*	*2.91*	*3.36*	*3.78*
	32.74	*60.42*	*110.04*	*203.51*	*380.75*	*99.32*	*212.63*	*383.41*	*620.33*
4.40	*1.85*	*2.16*	*2.50*	*2.91*	*3.40*	*2.44*	*2.94*	*3.40*	*3.83*
	33.12	*61.12*	*111.32*	*205.87*	*385.16*	*100.48*	*215.09*	*387.85*	*627.51*
4.50	*1.87*	*2.18*	*2.53*	*2.95*	*3.43*	*2.47*	*2.98*	*3.44*	*3.87*
	33.49	*61.82*	*112.58*	*208.20*	*389.52*	*101.61*	*217.53*	*392.24*	*634.61*
4.60	*1.89*	*2.20*	*2.56*	*2.98*	*3.47*	*2.49*	*3.01*	*3.48*	*3.91*
	33.86	*62.50*	*113.83*	*210.50*	*393.83*	*102.74*	*219.94*	*396.58*	*641.64*
4.70	*1.91*	*2.23*	*2.59*	*3.01*	*3.51*	*2.52*	*3.04*	*3.52*	*3.95*
	34.23	*63.18*	*115.06*	*212.78*	*398.10*	*103.85*	*222.32*	*400.88*	*648.59*
4.80	*1.93*	*2.25*	*2.61*	*3.04*	*3.55*	*2.55*	*3.08*	*3.55*	*4.00*
	34.59	*63.85*	*116.28*	*215.04*	*402.32*	*104.95*	*224.68*	*405.13*	*655.46*
4.90	*1.95*	*2.28*	*2.64*	*3.07*	*3.58*	*2.57*	*3.11*	*3.59*	*4.04*
	34.95	*64.51*	*117.49*	*217.27*	*406.50*	*106.04*	*227.01*	*409.33*	*662.26*
5.00	*1.97*	*2.30*	*2.67*	*3.11*	*3.62*	*2.60*	*3.14*	*3.63*	*4.08*
	35.31	*65.17*	*118.69*	*219.48*	*410.63*	*107.12*	*229.32*	*413.50*	*669.00*
5.20	*2.01*	*2.34*	*2.72*	*3.17*	*3.69*	*2.65*	*3.20*	*3.70*	*4.16*
	36.01	*66.47*	*121.04*	*223.84*	*418.78*	*109.25*	*233.87*	*421.70*	*682.27*
5.40	*2.05*	*2.39*	*2.77*	*3.23*	*3.76*	*2.70*	*3.26*	*3.77*	*4.24*
	36.70	*67.73*	*123.35*	*228.11*	*426.77*	*111.34*	*238.33*	*429.75*	*695.28*
5.60	*2.09*	*2.43*	*2.82*	*3.29*	*3.83*	*2.75*	*3.32*	*3.84*	*4.32*
	37.37	*68.98*	*125.62*	*232.31*	*434.61*	*113.38*	*242.72*	*437.65*	*708.06*
5.80	*2.12*	*2.48*	*2.87*	*3.34*	*3.90*	*2.80*	*3.38*	*3.91*	*4.39*
	38.04	*70.21*	*127.85*	*236.43*	*442.32*	*115.40*	*247.02*	*445.41*	*720.61*
6.00	*2.16*	*2.52*	*2.92*	*3.40*	*3.97*	*2.85*	*3.44*	*3.97*	*4.47*
	38.69	*71.41*	*130.04*	*240.47*	*449.89*	*117.37*	*251.25*	*453.03*	*732.95*
6.20	*2.20*	*2.56*	*2.97*	*3.46*	*4.03*	*2.90*	*3.50*	*4.04*	*4.54*
	39.33	*72.59*	*132.20*	*244.46*	*457.34*	*119.32*	*255.41*	*460.54*	*745.08*
6.40	*2.23*	*2.60*	*3.02*	*3.51*	*4.10*	*2.94*	*3.55*	*4.10*	*4.62*
	39.96	*73.76*	*134.32*	*248.38*	*464.67*	*121.23*	*259.51*	*467.92*	*757.02*
6.60	*2.27*	*2.64*	*3.07*	*3.57*	*4.16*	*2.99*	*3.61*	*4.17*	*4.69*
	40.58	*74.90*	*136.40*	*252.23*	*471.89*	*123.12*	*263.54*	*475.18*	*768.78*
6.80	*2.30*	*2.68*	*3.11*	*3.62*	*4.22*	*3.03*	*3.66*	*4.23*	*4.76*
	41.20	*76.03*	*138.46*	*256.03*	*479.00*	*124.97*	*267.51*	*482.34*	*780.35*
7.00	*2.33*	*2.72*	*3.16*	*3.68*	*4.29*	*3.08*	*3.71*	*4.29*	*4.83*
	41.80	*77.14*	*140.48*	*259.78*	*486.00*	*126.80*	*271.42*	*489.39*	*791.76*
7.20	*2.37*	*2.76*	*3.20*	*3.73*	*4.35*	*3.12*	*3.77*	*4.35*	*4.90*
	42.39	*78.24*	*142.48*	*263.47*	*492.90*	*128.60*	*275.28*	*496.34*	*803.01*
7.40	*2.40*	*2.80*	*3.25*	*3.78*	*4.41*	*3.17*	*3.82*	*4.41*	*4.96*
	42.98	*79.32*	*144.45*	*267.11*	*499.71*	*130.38*	*279.08*	*503.20*	*814.10*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s					**ks =** 1.5				
Nominal Dia	160	200	250	315	400	225	300	375	450
Material	uPVC	uPVC	uPVC	uPVC	uPVC	Conc	Conc	Conc	Conc
Actual ID	151	190	238	300	380	229	305	381	457
7.60	*2.43*	*2.84*	*3.29*	*3.83*	*4.47*	*3.21*	*3.87*	*4.47*	*5.03*
	43.56	*80.39*	*146.39*	*270.70*	*506.43*	*132.13*	*282.83*	*509.97*	*825.04*
7.80	*2.46*	*2.87*	*3.33*	*3.88*	*4.52*	*3.25*	*3.92*	*4.53*	*5.10*
	44.13	*81.44*	*148.31*	*274.25*	*513.06*	*133.86*	*286.54*	*516.64*	*835.84*
8.00	*2.50*	*2.91*	*3.38*	*3.93*	*4.58*	*3.29*	*3.97*	*4.59*	*5.16*
	44.69	*82.48*	*150.20*	*277.75*	*519.60*	*135.57*	*290.19*	*523.23*	*846.50*
8.20	*2.53*	*2.95*	*3.42*	*3.98*	*4.64*	*3.33*	*4.02*	*4.65*	*5.22*
	45.25	*83.51*	*152.07*	*281.20*	*526.07*	*137.26*	*293.80*	*529.74*	*857.03*
8.40	*2.56*	*2.98*	*3.46*	*4.03*	*4.69*	*3.37*	*4.07*	*4.70*	*5.29*
	45.80	*84.52*	*153.92*	*284.62*	*532.45*	*138.93*	*297.37*	*536.17*	*867.43*
8.60	*2.59*	*3.02*	*3.50*	*4.07*	*4.75*	*3.41*	*4.12*	*4.76*	*5.35*
	46.34	*85.53*	*155.74*	*287.99*	*538.76*	*140.57*	*300.90*	*542.53*	*877.71*
8.80	*2.62*	*3.05*	*3.54*	*4.12*	*4.81*	*3.45*	*4.17*	*4.81*	*5.41*
	46.88	*86.52*	*157.55*	*291.33*	*545.00*	*142.20*	*304.38*	*548.81*	*887.87*
9.00	*2.65*	*3.09*	*3.58*	*4.17*	*4.86*	*3.49*	*4.21*	*4.87*	*5.47*
	47.41	*87.50*	*159.33*	*294.62*	*551.17*	*143.81*	*307.83*	*555.02*	*897.92*
9.20	*2.68*	*3.12*	*3.62*	*4.21*	*4.91*	*3.53*	*4.26*	*4.92*	*5.53*
	47.94	*88.47*	*161.10*	*297.88*	*557.27*	*145.40*	*311.23*	*561.16*	*907.85*
9.40	*2.71*	*3.15*	*3.66*	*4.26*	*4.97*	*3.57*	*4.31*	*4.98*	*5.59*
	48.45	*89.43*	*162.84*	*301.11*	*563.30*	*146.98*	*314.60*	*567.23*	*917.68*
9.80	*2.76*	*3.22*	*3.74*	*4.35*	*5.07*	*3.64*	*4.40*	*5.08*	*5.71*
	49.48	*91.31*	*166.28*	*307.46*	*575.18*	*150.08*	*321.24*	*579.19*	*937.02*
10.00	*2.79*	*3.25*	*3.78*	*4.39*	*5.12*	*3.68*	*4.44*	*5.13*	*5.77*
	49.98	*92.24*	*167.97*	*310.58*	*581.02*	*151.61*	*324.50*	*585.08*	*946.54*
10.50	*2.86*	*3.33*	*3.87*	*4.50*	*5.25*	*3.77*	*4.55*	*5.26*	*5.91*
	51.22	*94.52*	*172.12*	*318.26*	*595.39*	*155.36*	*332.53*	*599.54*	*969.94*
11.00	*2.93*	*3.41*	*3.96*	*4.61*	*5.37*	*3.86*	*4.66*	*5.38*	*6.05*
	52.43	*96.75*	*176.18*	*325.77*	*609.42*	*159.02*	*340.36*	*613.67*	*992.79*
11.50	*2.99*	*3.49*	*4.05*	*4.71*	*5.49*	*3.95*	*4.76*	*5.50*	*6.19*
	53.61	*98.93*	*180.14*	*333.10*	*623.13*	*162.60*	*348.02*	*627.48*	*1015.13*
12.00	*3.06*	*3.56*	*4.14*	*4.81*	*5.61*	*4.03*	*4.87*	*5.62*	*6.32*
	54.76	*101.06*	*184.03*	*340.27*	*636.55*	*166.10*	*355.52*	*640.99*	*1036.99*
12.50	*3.12*	*3.64*	*4.22*	*4.91*	*5.73*	*4.12*	*4.97*	*5.74*	*6.45*
	55.89	*103.15*	*187.83*	*347.30*	*649.69*	*169.53*	*362.86*	*654.22*	*1058.39*
13.00	*3.18*	*3.71*	*4.31*	*5.01*	*5.84*	*4.20*	*5.06*	*5.85*	*6.58*
	57.00	*105.20*	*191.55*	*354.18*	*662.57*	*172.89*	*370.05*	*667.19*	*1079.37*
13.50	*3.24*	*3.78*	*4.39*	*5.11*	*5.95*	*4.28*	*5.16*	*5.96*	*6.71*
	58.09	*107.20*	*195.21*	*360.94*	*675.20*	*176.19*	*377.11*	*679.92*	*1099.95*
14.00	*3.30*	*3.85*	*4.47*	*5.20*	*6.06*	*4.36*	*5.26*	*6.07*	*6.83*
	59.16	*109.17*	*198.79*	*367.57*	*687.61*	*179.43*	*384.04*	*692.41*	*1120.16*
14.50	*3.36*	*3.92*	*4.55*	*5.29*	*6.17*	*4.43*	*5.35*	*6.18*	*6.95*
	60.21	*111.11*	*202.32*	*374.09*	*699.79*	*182.61*	*390.85*	*704.68*	*1140.00*
15.00	*3.42*	*3.99*	*4.63*	*5.38*	*6.28*	*4.51*	*5.44*	*6.29*	*7.07*
	61.24	*113.01*	*205.78*	*380.49*	*711.77*	*185.74*	*397.54*	*716.74*	*1159.51*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s				**ks =** 1.5					
Nominal Dia	160	200	250	315	400	225	300	375	450
Material	uPVC	uPVC	uPVC	uPVC	uPVC	Conc	Conc	Conc	Conc
Actual ID	151	190	238	300	380	229	305	381	457
15.50	*3.48*	*4.05*	*4.70*	*5.47*	*6.38*	*4.58*	*5.53*	*6.39*	*7.19*
	62.25	*114.88*	*209.19*	*386.78*	*723.55*	*188.81*	*404.12*	*728.60*	*1178.70*
16.00	*3.53*	*4.12*	*4.78*	*5.56*	*6.48*	*4.66*	*5.62*	*6.49*	*7.30*
	63.25	*116.72*	*212.54*	*392.98*	*735.13*	*191.84*	*410.59*	*740.27*	*1197.57*
16.50	*3.59*	*4.18*	*4.85*	*5.65*	*6.58*	*4.73*	*5.71*	*6.59*	*7.41*
	64.23	*118.54*	*215.84*	*399.08*	*746.54*	*194.82*	*416.96*	*751.76*	*1216.16*
17.00	*3.64*	*4.24*	*4.92*	*5.73*	*6.68*	*4.80*	*5.79*	*6.69*	*7.53*
	65.20	*120.32*	*219.09*	*405.09*	*757.78*	*197.75*	*423.24*	*763.07*	*1234.46*
17.50	*3.69*	*4.31*	*5.00*	*5.81*	*6.78*	*4.87*	*5.88*	*6.79*	*7.64*
	66.16	*122.08*	*222.29*	*411.01*	*768.86*	*200.64*	*429.43*	*774.22*	*1252.50*
18.00	*3.75*	*4.37*	*5.07*	*5.90*	*6.88*	*4.94*	*5.96*	*6.89*	*7.74*
	67.10	*123.82*	*225.45*	*416.85*	*779.77*	*203.49*	*435.53*	*785.22*	*1270.28*
18.50	*3.80*	*4.43*	*5.14*	*5.98*	*6.97*	*5.01*	*6.04*	*6.98*	*7.85*
	68.02	*125.53*	*228.56*	*422.60*	*790.54*	*206.30*	*441.54*	*796.06*	*1287.82*
19.00	*3.85*	*4.49*	*5.21*	*6.06*	*7.06*	*5.08*	*6.12*	*7.08*	*7.96*
	68.94	*127.21*	*231.63*	*428.28*	*801.16*	*209.07*	*447.47*	*806.75*	*1305.12*
19.50	*3.90*	*4.55*	*5.27*	*6.14*	*7.16*	*5.14*	*6.20*	*7.17*	*8.06*
	69.84	*128.88*	*234.67*	*433.89*	*811.64*	*211.81*	*453.33*	*817.31*	*1322.19*
20.00	*3.95*	*4.60*	*5.34*	*6.22*	*7.25*	*5.21*	*6.28*	*7.26*	*8.16*
	70.73	*130.52*	*237.66*	*439.42*	*821.99*	*214.51*	*459.11*	*827.73*	*1339.05*

Opotiki District Council
Appendix 1F
Stormwater & Sanitary Sewer Design Tables
Colebrook- White Equation

Water (or sewerage) @ 15 C full bore conditions
Velocities in m/s (italic type) discharges in l/s **ks =** 0.6

Nominal Dia	525	600	675	750	825	900	1050	1200	1350
Material	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc
Actual ID	533	610	686	762	838	914	1067	1219	1372
Gradient %									
0.10	*0.70*	*0.77*	*0.83*	*0.88*	*0.94*	*0.99*	*1.09*	*1.18*	*1.27*
	157.08	224.13	305.27	402.41	516.59	648.84	973.81	1380.57	1881.59
0.11	*0.74*	*0.81*	*0.87*	*0.93*	*0.98*	*1.04*	*1.14*	*1.24*	*1.34*
	164.89	235.26	320.43	422.37	542.19	680.97	1021.97	1448.78	1974.48
0.12	*0.77*	*0.84*	*0.91*	*0.97*	*1.03*	*1.08*	*1.19*	*1.30*	*1.40*
	172.36	245.91	334.91	441.43	566.65	711.67	1067.99	1513.96	2063.25
0.13	*0.80*	*0.88*	*0.94*	*1.01*	*1.07*	*1.13*	*1.24*	*1.35*	*1.45*
	179.53	256.12	348.80	459.73	590.11	741.11	1112.13	1576.48	2148.38
0.14	*0.84*	*0.91*	*0.98*	*1.05*	*1.11*	*1.17*	*1.29*	*1.40*	*1.51*
	186.42	265.94	362.16	477.33	612.69	769.45	1154.60	1636.63	2230.31
0.15	*0.87*	*0.94*	*1.01*	*1.08*	*1.15*	*1.21*	*1.34*	*1.45*	*1.56*
	193.08	275.42	375.06	494.31	634.47	796.79	1195.59	1694.68	2309.36
0.16	*0.89*	*0.97*	*1.05*	*1.12*	*1.19*	*1.25*	*1.38*	*1.50*	*1.61*
	199.51	284.59	387.53	510.74	655.54	823.23	1235.23	1750.83	2385.81
0.17	*0.92*	*1.00*	*1.08*	*1.15*	*1.23*	*1.29*	*1.42*	*1.55*	*1.66*
	205.75	293.48	399.62	526.66	675.96	848.87	1273.65	1805.24	2459.92
0.18	*0.95*	*1.03*	*1.11*	*1.19*	*1.26*	*1.33*	*1.47*	*1.59*	*1.71*
	211.81	302.11	411.37	*542.12*	*695.80*	*873.76*	*1310.96*	*1858.08*	*2531.88*
0.19	*0.98*	*1.06*	*1.14*	*1.22*	*1.30*	*1.37*	*1.51*	*1.64*	*1.76*
	217.70	310.50	422.78	*557.16*	*715.08*	*897.96*	*1347.25*	*1909.47*	*2601.86*
0.20	*1.00*	*1.09*	*1.17*	*1.25*	*1.33*	*1.40*	*1.55*	*1.68*	*1.81*
	223.44	318.68	433.91	*571.81*	*733.87*	*921.54*	*1382.59*	*1959.53*	*2670.03*
0.21	*1.03*	*1.12*	*1.20*	*1.29*	*1.36*	*1.44*	*1.58*	*1.72*	*1.85*
	229.03	326.65	444.76	*586.09*	*752.19*	*944.54*	*1417.06*	*2008.35*	*2736.52*
0.22	*1.05*	*1.14*	*1.23*	*1.32*	*1.40*	*1.47*	*1.62*	*1.76*	*1.89*
	234.50	334.44	455.35	*600.04*	*770.09*	*967.00*	*1450.72*	*2056.03*	*2801.44*
0.23	*1.07*	*1.17*	*1.26*	*1.35*	*1.43*	*1.51*	*1.66*	*1.80*	*1.94*
	239.84	342.05	465.70	*613.68*	*787.58*	*988.95*	*1483.63*	*2102.63*	*2864.90*
0.24	*1.10*	*1.20*	*1.29*	*1.37*	*1.46*	*1.54*	*1.70*	*1.84*	*1.98*
	245.07	349.50	475.84	*627.02*	*804.69*	*1010.43*	*1515.83*	*2148.23*	*2927.00*
0.25	*1.12*	*1.22*	*1.31*	*1.40*	*1.49*	*1.57*	*1.73*	*1.88*	*2.02*
	250.19	356.79	485.76	*640.09*	*821.46*	*1031.47*	*1547.36*	*2192.89*	*2987.82*
0.26	*1.14*	*1.25*	*1.34*	*1.43*	*1.52*	*1.60*	*1.77*	*1.92*	*2.06*
	255.21	*363.94*	*495.49*	*652.90*	*837.89*	*1052.09*	*1578.27*	*2236.67*	*3047.43*
0.27	*1.17*	*1.27*	*1.37*	*1.46*	*1.55*	*1.63*	*1.80*	*1.95*	*2.10*
	260.13	*370.96*	*505.03*	*665.47*	*854.00*	*1072.31*	*1608.59*	*2279.61*	*3105.91*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s					**ks =**	0.6			
Nominal Dia	525	600	675	750	825	900	1050	1200	1350
Material	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc
Actual ID	533	610	686	762	838	914	1067	1219	1372
0.28	*1.19*	*1.29*	*1.39*	*1.49*	*1.58*	*1.66*	*1.83*	*1.99*	*2.14*
	264.97	*377.84*	*514.40*	*677.80*	*869.83*	*1092.17*	*1638.36*	*2321.77*	*3163.32*
0.29	*1.21*	*1.32*	*1.42*	*1.51*	*1.61*	*1.69*	*1.86*	*2.02*	*2.18*
	269.72	*384.61*	*523.60*	*689.92*	*885.37*	*1111.68*	*1667.60*	*2363.18*	*3219.71*
0.30	*1.23*	*1.34*	*1.44*	*1.54*	*1.63*	*1.72*	*1.90*	*2.06*	*2.22*
	274.38	*391.26*	*532.65*	*701.83*	*900.64*	*1130.85*	*1696.33*	*2403.88*	*3275.13*
0.31	*1.25*	*1.36*	*1.47*	*1.56*	*1.66*	*1.75*	*1.93*	*2.09*	*2.25*
	278.97	*397.80*	*541.54*	*713.54*	*915.67*	*1149.71*	*1724.60*	*2443.91*	*3329.64*
0.32	*1.27*	*1.38*	*1.49*	*1.59*	*1.69*	*1.78*	*1.96*	*2.13*	*2.29*
	283.49	*404.23*	*550.30*	*725.07*	*930.45*	*1168.26*	*1752.41*	*2483.30*	*3383.28*
0.33	*1.29*	*1.40*	*1.51*	*1.61*	*1.71*	*1.81*	*1.99*	*2.16*	*2.32*
	287.94	*410.57*	*558.91*	*736.42*	*945.01*	*1186.53*	*1779.79*	*2522.07*	*3436.09*
0.34	*1.31*	*1.43*	*1.54*	*1.64*	*1.74*	*1.84*	*2.02*	*2.19*	*2.36*
	292.31	*416.81*	*567.40*	*747.60*	*959.34*	*1204.52*	*1806.76*	*2560.27*	*3488.10*
0.35	*1.33*	*1.45*	*1.56*	*1.66*	*1.77*	*1.86*	*2.05*	*2.23*	*2.39*
	296.63	*422.95*	*575.77*	*758.61*	*973.47*	*1222.25*	*1833.33*	*2597.91*	*3539.36*
0.36	*1.35*	*1.47*	*1.58*	*1.69*	*1.79*	*1.89*	*2.08*	*2.26*	*2.43*
	300.88	*429.02*	*584.01*	*769.47*	*987.40*	*1239.73*	*1859.53*	*2635.01*	*3589.88*
0.37	*1.37*	*1.49*	*1.60*	*1.71*	*1.82*	*1.92*	*2.11*	*2.29*	*2.46*
	305.08	*434.99*	*592.14*	*780.18*	*1001.13*	*1256.97*	*1885.37*	*2671.60*	*3639.71*
0.38	*1.39*	*1.51*	*1.62*	*1.73*	*1.84*	*1.94*	*2.14*	*2.32*	*2.50*
	309.22	*440.89*	*600.17*	*790.74*	*1014.68*	*1273.97*	*1910.86*	*2707.70*	*3688.87*
0.39	*1.40*	*1.53*	*1.65*	*1.76*	*1.86*	*1.97*	*2.17*	*2.35*	*2.53*
	313.31	*446.71*	*608.08*	*801.17*	*1028.06*	*1290.76*	*1936.02*	*2743.33*	*3737.39*
0.40	*1.42*	*1.55*	*1.67*	*1.78*	*1.89*	*1.99*	*2.19*	*2.38*	*2.56*
	317.34	*452.46*	*615.90*	*811.46*	*1041.26*	*1307.33*	*1960.86*	*2778.51*	*3785.29*
0.41	*1.44*	*1.57*	*1.69*	*1.80*	*1.91*	*2.02*	*2.22*	*2.41*	*2.59*
	321.32	*458.13*	*623.62*	*821.63*	*1054.30*	*1323.69*	*1985.39*	*2813.25*	*3832.60*
0.42	*1.46*	*1.59*	*1.71*	*1.82*	*1.93*	*2.04*	*2.25*	*2.44*	*2.62*
	325.26	*463.74*	*631.25*	*831.67*	*1067.18*	*1339.86*	*2009.62*	*2847.57*	*3879.33*
0.43	*1.48*	*1.61*	*1.73*	*1.85*	*1.96*	*2.07*	*2.27*	*2.47*	*2.66*
	329.15	*469.28*	*638.79*	*841.60*	*1079.91*	*1355.83*	*2033.56*	*2881.48*	*3925.51*
0.44	*1.49*	*1.62*	*1.75*	*1.87*	*1.98*	*2.09*	*2.30*	*2.50*	*2.69*
	332.99	*474.76*	*646.24*	*851.40*	*1092.49*	*1371.62*	*2057.23*	*2915.00*	*3971.16*
0.45	*1.51*	*1.64*	*1.77*	*1.89*	*2.00*	*2.11*	*2.33*	*2.53*	*2.72*
	336.79	*480.17*	*653.60*	*861.10*	*1104.93*	*1387.23*	*2080.63*	*2948.14*	*4016.29*
0.46	*1.53*	*1.66*	*1.79*	*1.91*	*2.03*	*2.14*	*2.35*	*2.55*	*2.75*
	340.55	*485.52*	*660.88*	*870.70*	*1117.23*	*1402.67*	*2103.77*	*2980.91*	*4060.92*
0.47	*1.54*	*1.68*	*1.81*	*1.93*	*2.05*	*2.16*	*2.38*	*2.58*	*2.78*
	344.27	*490.82*	*668.09*	*880.18*	*1129.40*	*1417.95*	*2126.67*	*3013.34*	*4105.07*
0.48	*1.56*	*1.70*	*1.83*	*1.95*	*2.07*	*2.18*	*2.40*	*2.61*	*2.81*
	347.95	*496.06*	*675.22*	*889.57*	*1141.44*	*1433.06*	*2149.32*	*3045.41*	*4148.75*
0.49	*1.58*	*1.72*	*1.85*	*1.97*	*2.09*	*2.21*	*2.43*	*2.64*	*2.84*
	351.59	*501.25*	*682.27*	*898.86*	*1153.36*	*1448.01*	*2171.73*	*3077.16*	*4191.98*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s					**ks =** 0.6				
Nominal Dia	525	600	675	750	825	900	1050	1200	1350
Material	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc
Actual ID	533	610	686	762	838	914	1067	1219	1372
0.50	*1.59*	*1.73*	*1.86*	*1.99*	*2.11*	*2.23*	*2.45*	*2.66*	*2.86*
	355.19	*506.38*	*689.26*	*908.06*	*1165.15*	*1462.81*	*2193.92*	*3108.58*	*4234.78*
0.52	*1.62*	*1.77*	*1.90*	*2.03*	*2.15*	*2.27*	*2.50*	*2.72*	*2.92*
	362.29	*516.50*	*703.02*	*926.18*	*1188.39*	*1491.98*	*2237.64*	*3170.50*	*4319.09*
0.54	*1.65*	*1.80*	*1.94*	*2.07*	*2.20*	*2.32*	*2.55*	*2.77*	*2.98*
	369.26	*526.42*	*716.52*	*943.95*	*1211.19*	*1520.59*	*2280.53*	*3231.24*	*4401.80*
0.56	*1.69*	*1.83*	*1.97*	*2.11*	*2.24*	*2.36*	*2.60*	*2.82*	*3.03*
	376.09	*536.16*	*729.77*	*961.40*	*1233.57*	*1548.68*	*2322.63*	*3290.86*	*4483.00*
0.58	*1.72*	*1.87*	*2.01*	*2.15*	*2.28*	*2.40*	*2.64*	*2.87*	*3.09*
	382.81	*545.73*	*742.79*	*978.54*	*1255.55*	*1576.27*	*2363.98*	*3349.43*	*4562.75*
0.60	*1.75*	*1.90*	*2.04*	*2.18*	*2.32*	*2.44*	*2.69*	*2.92*	*3.14*
	389.41	*555.13*	*755.58*	*995.39*	*1277.16*	*1603.39*	*2404.63*	*3407.00*	*4641.15*
0.62	*1.77*	*1.93*	*2.08*	*2.22*	*2.35*	*2.48*	*2.73*	*2.97*	*3.19*
	395.90	*564.38*	*768.16*	*1011.96*	*1298.41*	*1630.06*	*2444.61*	*3463.62*	*4718.25*
0.64	*1.80*	*1.96*	*2.11*	*2.25*	*2.39*	*2.52*	*2.78*	*3.02*	*3.24*
	402.29	*573.49*	*780.54*	*1028.26*	*1319.33*	*1656.31*	*2483.94*	*3519.33*	*4794.11*
0.66	*1.83*	*1.99*	*2.14*	*2.29*	*2.43*	*2.56*	*2.82*	*3.06*	*3.29*
	408.58	*582.45*	*792.73*	*1044.31*	*1339.91*	*1682.14*	*2522.67*	*3574.17*	*4868.80*
0.68	*1.86*	*2.02*	*2.18*	*2.32*	*2.47*	*2.60*	*2.86*	*3.11*	*3.34*
	414.78	*591.27*	*804.74*	*1060.12*	*1360.19*	*1707.59*	*2560.82*	*3628.20*	*4942.36*
0.70	*1.89*	*2.05*	*2.21*	*2.36*	*2.50*	*2.64*	*2.91*	*3.15*	*3.39*
	420.88	*599.97*	*816.57*	*1075.70*	*1380.17*	*1732.67*	*2598.40*	*3681.43*	*5014.85*
0.72	*1.91*	*2.08*	*2.24*	*2.39*	*2.54*	*2.68*	*2.95*	*3.20*	*3.44*
	426.90	*608.54*	*828.23*	*1091.06*	*1399.87*	*1757.39*	*2635.46*	*3733.91*	*5086.32*
0.74	*1.94*	*2.11*	*2.27*	*2.43*	*2.57*	*2.72*	*2.99*	*3.24*	*3.49*
	432.84	*617.00*	*839.74*	*1106.21*	*1419.30*	*1781.77*	*2672.00*	*3785.66*	*5156.79*
0.76	*1.97*	*2.14*	*2.30*	*2.46*	*2.61*	*2.75*	*3.03*	*3.29*	*3.54*
	438.69	*625.34*	*851.09*	*1121.15*	*1438.46*	*1805.83*	*2708.06*	*3836.72*	*5226.32*
0.78	*1.99*	*2.17*	*2.33*	*2.49*	*2.64*	*2.79*	*3.07*	*3.33*	*3.58*
	444.47	*633.57*	*862.28*	*1135.90*	*1457.38*	*1829.56*	*2743.64*	*3887.12*	*5294.95*
0.80	*2.02*	*2.20*	*2.36*	*2.52*	*2.68*	*2.82*	*3.11*	*3.37*	*3.63*
	450.18	*641.70*	*873.34*	*1150.46*	*1476.05*	*1853.00*	*2778.77*	*3936.87*	*5362.69*
0.82	*2.04*	*2.22*	*2.39*	*2.55*	*2.71*	*2.86*	*3.15*	*3.42*	*3.67*
	455.81	*649.73*	*884.26*	*1164.84*	*1494.50*	*1876.15*	*2813.46*	*3986.00*	*5429.60*
0.84	*2.07*	*2.25*	*2.42*	*2.59*	*2.74*	*2.89*	*3.18*	*3.46*	*3.72*
	461.38	*657.66*	*895.05*	*1179.04*	*1512.71*	*1899.01*	*2847.73*	*4034.54*	*5495.70*
0.86	*2.09*	*2.28*	*2.45*	*2.62*	*2.78*	*2.93*	*3.22*	*3.50*	*3.76*
	466.88	*665.50*	*905.71*	*1193.08*	*1530.72*	*1921.61*	*2881.60*	*4082.50*	*5561.01*
0.88	*2.12*	*2.30*	*2.48*	*2.65*	*2.81*	*2.96*	*3.26*	*3.54*	*3.81*
	472.32	*673.24*	*916.25*	*1206.95*	*1548.51*	*1943.94*	*2915.07*	*4129.91*	*5625.57*
0.90	*2.14*	*2.33*	*2.51*	*2.68*	*2.84*	*3.00*	*3.30*	*3.58*	*3.85*
	477.69	*680.90*	*926.66*	*1220.67*	*1566.11*	*1966.02*	*2948.17*	*4176.78*	*5689.40*
0.92	*2.16*	*2.36*	*2.54*	*2.71*	*2.87*	*3.03*	*3.33*	*3.62*	*3.89*
	483.01	*688.47*	*936.97*	*1234.24*	*1583.51*	*1987.86*	*2980.90*	*4223.14*	*5752.52*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s					**ks =**	0.6			
Nominal Dia	525	600	675	750	825	900	1050	1200	1350
Material	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc
Actual ID	533	610	686	762	838	914	1067	1219	1372
0.94	*2.19*	*2.38*	*2.56*	*2.74*	*2.90*	*3.06*	*3.37*	*3.66*	*3.93*
	488.27	*695.97*	*947.16*	*1247.66*	*1600.72*	*2009.46*	*3013.28*	*4268.99*	*5814.96*
0.96	*2.21*	*2.41*	*2.59*	*2.76*	*2.93*	*3.10*	*3.41*	*3.70*	*3.98*
	493.47	*703.38*	*957.24*	*1260.94*	*1617.75*	*2030.83*	*3045.31*	*4314.36*	*5876.74*
0.98	*2.23*	*2.43*	*2.62*	*2.79*	*2.96*	*3.13*	*3.44*	*3.74*	*4.02*
	498.62	*710.71*	*967.22*	*1274.08*	*1634.60*	*2051.98*	*3077.02*	*4359.26*	*5937.88*
1.00	*2.26*	*2.46*	*2.64*	*2.82*	*2.99*	*3.16*	*3.48*	*3.77*	*4.06*
	504	*718*	*977*	*1287*	*1651*	*2073*	*3108*	*4404*	*5998*
1.05	*2.31*	*2.52*	*2.71*	*2.89*	*3.07*	*3.24*	*3.56*	*3.87*	*4.16*
	516	*736*	*1001*	*1319*	*1692*	*2124*	*3186*	*4513*	*6147*
1.10	*2.37*	*2.58*	*2.77*	*2.96*	*3.14*	*3.31*	*3.65*	*3.96*	*4.26*
	528	*753*	*1025*	*1350*	*1732*	*2175*	*3261*	*4620*	*6292*
1.15	*2.42*	*2.64*	*2.84*	*3.03*	*3.21*	*3.39*	*3.73*	*4.05*	*4.35*
	540	*770*	*1048*	*1381*	*1771*	*2224*	*3334*	*4724*	*6434*
1.20	*2.47*	*2.69*	*2.90*	*3.09*	*3.28*	*3.46*	*3.81*	*4.13*	*4.45*
	552	*787*	*1071*	*1411*	*1810*	*2272*	*3406*	*4826*	*6573*
1.25	*2.53*	*2.75*	*2.96*	*3.16*	*3.35*	*3.53*	*3.89*	*4.22*	*4.54*
	564	*803*	*1093*	*1440*	*1847*	*2319*	*3477*	*4926*	*6709*
1.30	*2.58*	*2.80*	*3.02*	*3.22*	*3.42*	*3.60*	*3.97*	*4.30*	*4.63*
	575	*819*	*1115*	*1468*	*1884*	*2365*	*3546*	*5024*	*6842*
1.35	*2.63*	*2.86*	*3.07*	*3.28*	*3.48*	*3.67*	*4.04*	*4.39*	*4.72*
	586	*835*	*1136*	*1497*	*1920*	*2410*	*3614*	*5120*	*6973*
1.40	*2.67*	*2.91*	*3.13*	*3.34*	*3.55*	*3.74*	*4.12*	*4.47*	*4.80*
	597	*850*	*1157*	*1524*	*1955*	*2455*	*3680*	*5214*	*7102*
1.45	*2.72*	*2.96*	*3.19*	*3.40*	*3.61*	*3.81*	*4.19*	*4.55*	*4.89*
	607	*865*	*1178*	*1551*	*1990*	*2498*	*3746*	*5306*	*7228*
1.50	*2.77*	*3.01*	*3.24*	*3.46*	*3.67*	*3.87*	*4.26*	*4.62*	*4.97*
	618	*880*	*1198*	*1578*	*2024*	*2541*	*3810*	*5398*	*7352*
1.55	*2.81*	*3.06*	*3.30*	*3.52*	*3.73*	*3.94*	*4.33*	*4.70*	*5.06*
	628	*895*	*1218*	*1604*	*2058*	*2583*	*3873*	*5487*	*7474*
1.60	*2.86*	*3.11*	*3.35*	*3.57*	*3.79*	*4.00*	*4.40*	*4.78*	*5.14*
	638	*909*	*1237*	*1630*	*2091*	*2625*	*3936*	*5575*	*7594*
1.65	*2.90*	*3.16*	*3.40*	*3.63*	*3.85*	*4.06*	*4.47*	*4.85*	*5.22*
	648	*924*	*1257*	*1655*	*2124*	*2666*	*3997*	*5662*	*7712*
1.70	*2.95*	*3.21*	*3.45*	*3.68*	*3.91*	*4.12*	*4.54*	*4.92*	*5.29*
	658	*938*	*1276*	*1680*	*2156*	*2706*	*4057*	*5747*	*7828*
1.75	*2.99*	*3.25*	*3.50*	*3.74*	*3.97*	*4.18*	*4.60*	*5.00*	*5.37*
	667	*951*	*1294*	*1705*	*2187*	*2746*	*4117*	*5831*	*7943*
1.80	*3.03*	*3.30*	*3.55*	*3.79*	*4.02*	*4.24*	*4.67*	*5.07*	*5.45*
	677	*965*	*1313*	*1729*	*2218*	*2785*	*4175*	*5914*	*8056*
1.85	*3.08*	*3.35*	*3.60*	*3.84*	*4.08*	*4.30*	*4.73*	*5.14*	*5.52*
	686	*978*	*1331*	*1753*	*2249*	*2823*	*4233*	*5996*	*8167*
1.90	*3.12*	*3.39*	*3.65*	*3.90*	*4.13*	*4.36*	*4.80*	*5.21*	*5.60*
	696	*991*	*1349*	*1777*	*2279*	*2861*	*4290*	*6077*	*8277*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s					**ks =** 0.6				
Nominal Dia	525	600	675	750	825	900	1050	1200	1350
Material	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc
Actual ID	533	610	686	762	838	914	1067	1219	1372
1.95	*3.16*	*3.44*	*3.70*	*3.95*	*4.19*	*4.42*	*4.86*	*5.28*	*5.67*
	705	*1004*	*1367*	*1800*	*2309*	*2899*	*4346*	*6157*	*8386*
2.00	*3.20*	*3.48*	*3.75*	*4.00*	*4.24*	*4.47*	*4.92*	*5.34*	*5.74*
	714	*1017*	*1384*	*1823*	*2339*	*2936*	*4402*	*6235*	*8493*
2.10	*3.28*	*3.57*	*3.84*	*4.10*	*4.35*	*4.59*	*5.04*	*5.48*	*5.89*
	732	*1042*	*1419*	*1868*	*2397*	*3009*	*4511*	*6390*	*8703*
2.20	*3.36*	*3.65*	*3.93*	*4.19*	*4.45*	*4.69*	*5.16*	*5.60*	*6.03*
	749	*1067*	*1452*	*1912*	*2453*	*3080*	*4617*	*6541*	*8908*
2.30	*3.43*	*3.73*	*4.02*	*4.29*	*4.55*	*4.80*	*5.28*	*5.73*	*6.16*
	766	*1091*	*1485*	*1956*	*2509*	*3149*	*4721*	*6688*	*9109*
2.40	*3.51*	*3.81*	*4.10*	*4.38*	*4.65*	*4.90*	*5.39*	*5.85*	*6.29*
	782	*1115*	*1517*	*1998*	*2563*	*3217*	*4823*	*6832*	*9305*
2.50	*3.58*	*3.89*	*4.19*	*4.47*	*4.74*	*5.00*	*5.51*	*5.98*	*6.42*
	798	*1138*	*1548*	*2039*	*2616*	*3284*	*4923*	*6974*	*9498*
2.60	*3.65*	*3.97*	*4.27*	*4.56*	*4.84*	*5.10*	*5.61*	*6.09*	*6.55*
	814	*1160*	*1579*	*2080*	*2668*	*3349*	*5021*	*7112*	*9686*
2.70	*3.72*	*4.05*	*4.35*	*4.65*	*4.93*	*5.20*	*5.72*	*6.21*	*6.68*
	830	*1183*	*1609*	*2119*	*2719*	*3413*	*5117*	*7248*	*9871*
2.80	*3.79*	*4.12*	*4.43*	*4.73*	*5.02*	*5.30*	*5.83*	*6.32*	*6.80*
	845	*1204*	*1639*	*2159*	*2769*	*3476*	*5211*	*7381*	*10053*
2.90	*3.86*	*4.19*	*4.51*	*4.82*	*5.11*	*5.39*	*5.93*	*6.44*	*6.92*
	860	*1226*	*1668*	*2197*	*2818*	*3537*	*5303*	*7512*	*10231*
3.00	*3.92*	*4.27*	*4.59*	*4.90*	*5.20*	*5.48*	*6.03*	*6.55*	*7.04*
	875	*1247*	*1697*	*2235*	*2866*	*3598*	*5394*	*7641*	*10407*
3.10	*3.99*	*4.34*	*4.67*	*4.98*	*5.28*	*5.57*	*6.13*	*6.66*	*7.16*
	890	*1268*	*1725*	*2272*	*2914*	*3658*	*5484*	*7768*	*10579*
3.20	*4.05*	*4.41*	*4.74*	*5.06*	*5.37*	*5.66*	*6.23*	*6.76*	*7.27*
	904	*1288*	*1752*	*2308*	*2961*	*3716*	*5572*	*7892*	*10749*
3.30	*4.11*	*4.48*	*4.82*	*5.14*	*5.45*	*5.75*	*6.33*	*6.87*	*7.38*
	918	*1308*	*1780*	*2344*	*3007*	*3774*	*5658*	*8015*	*10916*
3.40	*4.18*	*4.54*	*4.89*	*5.22*	*5.53*	*5.84*	*6.42*	*6.97*	*7.49*
	932	*1328*	*1807*	*2379*	*3052*	*3831*	*5743*	*8136*	*11080*
3.50	*4.24*	*4.61*	*4.96*	*5.29*	*5.61*	*5.92*	*6.52*	*7.07*	*7.60*
	945	*1347*	*1833*	*2414*	*3097*	*3887*	*5828*	*8255*	*11242*
3.60	*4.30*	*4.68*	*5.03*	*5.37*	*5.69*	*6.01*	*6.61*	*7.17*	*7.71*
	959	*1366*	*1859*	*2448*	*3141*	*3942*	*5910*	*8372*	*11402*
3.70	*4.36*	*4.74*	*5.10*	*5.44*	*5.77*	*6.09*	*6.70*	*7.27*	*7.82*
	972	*1385*	*1885*	*2482*	*3184*	*3997*	*5992*	*8488*	*11560*
3.80	*4.42*	*4.80*	*5.17*	*5.52*	*5.85*	*6.17*	*6.79*	*7.37*	*7.92*
	985	*1404*	*1910*	*2516*	*3227*	*4051*	*6073*	*8602*	*11715*
3.90	*4.47*	*4.87*	*5.24*	*5.59*	*5.93*	*6.25*	*6.88*	*7.47*	*8.03*
	998	*1422*	*1935*	*2549*	*3269*	*4104*	*6152*	*8715*	*11869*
4.00	*4.53*	*4.93*	*5.30*	*5.66*	*6.00*	*6.33*	*6.97*	*7.56*	*8.13*
	1011	*1441*	*1960*	*2581*	*3311*	*4156*	*6231*	*8826*	*12020*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s					**ks =**	0.6			
Nominal Dia	525	600	675	750	825	900	1050	1200	1350
Material	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc
Actual ID	533	610	686	762	838	914	1067	1219	1372
4.10	*4.59*	*4.99*	*5.37*	*5.73*	*6.08*	*6.41*	*7.06*	*7.66*	*8.23*
	1024	*1458*	*1984*	*2613*	*3352*	*4208*	*6308*	*8936*	*12170*
4.20	*4.64*	*5.05*	*5.43*	*5.80*	*6.15*	*6.49*	*7.14*	*7.75*	*8.33*
	1036	*1476*	*2009*	*2645*	*3393*	*4259*	*6385*	*9044*	*12318*
4.30	*4.70*	*5.11*	*5.50*	*5.87*	*6.23*	*6.57*	*7.23*	*7.84*	*8.43*
	1048	*1494*	*2032*	*2677*	*3433*	*4310*	*6461*	*9151*	*12464*
4.40	*4.75*	*5.17*	*5.56*	*5.94*	*6.30*	*6.64*	*7.31*	*7.93*	*8.53*
	1060	*1511*	*2056*	*2708*	*3473*	*4360*	*6536*	*9257*	*12608*
4.50	*4.81*	*5.23*	*5.63*	*6.00*	*6.37*	*6.72*	*7.39*	*8.02*	*8.62*
	1072	*1528*	*2079*	*2738*	*3513*	*4409*	*6610*	*9362*	*12751*
4.60	*4.86*	*5.29*	*5.69*	*6.07*	*6.44*	*6.79*	*7.47*	*8.11*	*8.72*
	1084	*1545*	*2102*	*2769*	*3552*	*4458*	*6683*	*9466*	*12892*
4.70	*4.91*	*5.34*	*5.75*	*6.14*	*6.51*	*6.87*	*7.55*	*8.20*	*8.81*
	1096	*1562*	*2125*	*2799*	*3590*	*4506*	*6755*	*9569*	*13032*
4.80	*4.96*	*5.40*	*5.81*	*6.20*	*6.58*	*6.94*	*7.63*	*8.29*	*8.91*
	1108	*1578*	*2148*	*2828*	*3628*	*4554*	*6827*	*9670*	*13170*
4.90	*5.02*	*5.46*	*5.87*	*6.27*	*6.65*	*7.01*	*7.71*	*8.37*	*9.00*
	1119	*1595*	*2170*	*2858*	*3666*	*4601*	*6898*	*9770*	*13306*
5.00	*5.07*	*5.51*	*5.93*	*6.33*	*6.71*	*7.08*	*7.79*	*8.46*	*9.09*
	1131	*1611*	*2192*	*2887*	*3703*	*4648*	*6968*	*9870*	*13442*
5.20	*5.17*	*5.62*	*6.05*	*6.46*	*6.85*	*7.22*	*7.95*	*8.62*	*9.27*
	1153	*1643*	*2236*	*2944*	*3777*	*4740*	*7106*	*10066*	*13708*
5.40	*5.27*	*5.73*	*6.16*	*6.58*	*6.98*	*7.36*	*8.10*	*8.79*	*9.45*
	1175	*1674*	*2278*	*3000*	*3849*	*4831*	*7242*	*10258*	*13970*
5.60	*5.36*	*5.84*	*6.28*	*6.70*	*7.11*	*7.50*	*8.25*	*8.95*	*9.62*
	1197	*1705*	*2320*	*3056*	*3919*	*4920*	*7375*	*10446*	*14227*
5.80	*5.46*	*5.94*	*6.39*	*6.82*	*7.23*	*7.63*	*8.39*	*9.11*	*9.79*
	1218	*1736*	*2361*	*3110*	*3989*	*5007*	*7506*	*10631*	*14479*
6.00	*5.55*	*6.04*	*6.50*	*6.94*	*7.36*	*7.76*	*8.54*	*9.27*	*9.96*
	1239	*1765*	*2402*	*3163*	*4057*	*5093*	*7634*	*10814*	*14727*
6.20	*5.64*	*6.14*	*6.61*	*7.05*	*7.48*	*7.89*	*8.68*	*9.42*	*10.13*
	1259	*1795*	*2442*	*3215*	*4125*	*5177*	*7761*	*10993*	*14971*
6.40	*5.74*	*6.24*	*6.71*	*7.16*	*7.60*	*8.02*	*8.82*	*9.57*	*10.29*
	1280	*1823*	*2481*	*3267*	*4191*	*5260*	*7885*	*11169*	*15211*
6.60	*5.82*	*6.34*	*6.82*	*7.28*	*7.72*	*8.14*	*8.96*	*9.72*	*10.45*
	1300	*1852*	*2519*	*3318*	*4256*	*5342*	*8008*	*11342*	*15447*
6.80	*5.91*	*6.43*	*6.92*	*7.38*	*7.83*	*8.26*	*9.09*	*9.86*	*10.61*
	1319	*1880*	*2557*	*3368*	*4320*	*5422*	*8128*	*11513*	*15680*
7.00	*6.00*	*6.53*	*7.02*	*7.49*	*7.95*	*8.38*	*9.22*	*10.01*	*10.76*
	1338	*1907*	*2595*	*3417*	*4383*	*5501*	*8247*	*11681*	*15909*
7.20	*6.08*	*6.62*	*7.12*	*7.60*	*8.06*	*8.50*	*9.35*	*10.15*	*10.91*
	1357	*1934*	*2632*	*3466*	*4445*	*5580*	*8364*	*11847*	*16135*
7.40	*6.17*	*6.71*	*7.22*	*7.70*	*8.17*	*8.62*	*9.48*	*10.29*	*11.06*
	1376	*1961*	*2668*	*3514*	*4507*	*5657*	*8480*	*12011*	*16358*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s				**ks =**	0.6				
Nominal Dia	525	600	675	750	825	900	1050	1200	1350
Material	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc
Actual ID	533	610	686	762	838	914	1067	1219	1372
7.60	*6.25*	*6.80*	*7.32*	*7.81*	*8.28*	*8.74*	*9.61*	*10.43*	*11.21*
	1395	*1987*	*2704*	*3561*	*4568*	*5733*	*8594*	*12173*	*16578*
7.80	*6.33*	*6.89*	*7.41*	*7.91*	*8.39*	*8.85*	*9.74*	*10.57*	*11.36*
	1413	*2013*	*2739*	*3607*	*4627*	*5808*	*8707*	*12332*	*16795*
8.00	*6.41*	*6.98*	*7.51*	*8.01*	*8.50*	*8.96*	*9.86*	*10.70*	*11.50*
	1431	*2039*	*2774*	*3654*	*4686*	*5882*	*8818*	*12489*	*17009*
8.20	*6.49*	*7.06*	*7.60*	*8.11*	*8.60*	*9.08*	*9.98*	*10.83*	*11.65*
	1449	*2064*	*2809*	*3699*	*4745*	*5955*	*8927*	*12645*	*17220*
8.40	*6.57*	*7.15*	*7.69*	*8.21*	*8.71*	*9.19*	*10.11*	*10.97*	*11.79*
	1467	*2090*	*2843*	*3744*	*4802*	*6028*	*9036*	*12798*	*17429*
8.60	*6.65*	*7.23*	*7.78*	*8.31*	*8.81*	*9.30*	*10.23*	*11.10*	*11.93*
	1484	*2114*	*2877*	*3788*	*4859*	*6099*	*9143*	*12950*	*17636*
8.80	*6.73*	*7.32*	*7.87*	*8.40*	*8.91*	*9.40*	*10.34*	*11.22*	*12.07*
	1501	*2139*	*2910*	*3832*	*4916*	*6170*	*9249*	*13100*	*17840*
9.00	*6.80*	*7.40*	*7.96*	*8.50*	*9.01*	*9.51*	*10.46*	*11.35*	*12.20*
	1518	*2163*	*2943*	*3876*	*4971*	*6239*	*9353*	*13248*	*18042*
9.20	*6.88*	*7.48*	*8.05*	*8.59*	*9.11*	*9.61*	*10.58*	*11.48*	*12.34*
	1535	*2187*	*2975*	*3918*	*5026*	*6309*	*9457*	*13395*	*18242*
9.40	*6.95*	*7.56*	*8.14*	*8.69*	*9.21*	*9.72*	*10.69*	*11.60*	*12.47*
	1552	*2211*	*3008*	*3961*	*5081*	*6377*	*9559*	*13540*	*18439*
9.80	*7.10*	*7.72*	*8.31*	*8.87*	*9.41*	*9.92*	*10.92*	*11.85*	*12.74*
	1584	*2257*	*3071*	*4044*	*5188*	*6511*	*9761*	*13825*	*18828*
10.00	*7.17*	*7.80*	*8.39*	*8.96*	*9.50*	*10.02*	*11.03*	*11.97*	*12.86*
	1600	*2280*	*3102*	*4086*	*5241*	*6578*	*9860*	*13966*	*19019*
10.50	*7.35*	*8.00*	*8.60*	*9.18*	*9.74*	*10.27*	*11.30*	*12.26*	*13.18*
	1640	*2337*	*3179*	*4187*	*5370*	*6740*	*10104*	*14311*	*19490*
11.00	*7.52*	*8.18*	*8.80*	*9.40*	*9.97*	*10.51*	*11.57*	*12.55*	*13.49*
	1679	*2392*	*3254*	*4285*	*5497*	*6899*	*10342*	*14648*	*19949*
11.50	*7.69*	*8.37*	*9.00*	*9.61*	*10.19*	*10.75*	*11.83*	*12.83*	*13.80*
	1717	*2446*	*3327*	*4382*	*5621*	*7054*	*10575*	*14978*	*20398*
12.00	*7.86*	*8.55*	*9.20*	*9.82*	*10.41*	*10.98*	*12.08*	*13.11*	*14.09*
	1754	*2498*	*3399*	*4476*	*5742*	*7206*	*10803*	*15300*	*20837*
12.50	*8.02*	*8.73*	*9.39*	*10.02*	*10.63*	*11.21*	*12.33*	*13.38*	*14.38*
	1790	*2550*	*3469*	*4569*	*5860*	*7355*	*11026*	*15616*	*21267*
13.00	*8.18*	*8.90*	*9.57*	*10.22*	*10.84*	*11.43*	*12.58*	*13.65*	*14.67*
	1825	*2601*	*3538*	*4659*	*5976*	*7501*	*11244*	*15926*	*21689*
13.50	*8.34*	*9.07*	*9.76*	*10.41*	*11.04*	*11.65*	*12.82*	*13.91*	*14.95*
	1860	*2650*	*3606*	*4748*	*6090*	*7644*	*11459*	*16230*	*22102*
14.00	*8.49*	*9.24*	*9.93*	*10.60*	*11.25*	*11.86*	*13.05*	*14.16*	*15.22*
	1894	*2699*	*3672*	*4836*	*6202*	*7785*	*11669*	*16528*	*22508*
14.50	*8.64*	*9.40*	*10.11*	*10.79*	*11.44*	*12.07*	*13.28*	*14.41*	*15.49*
	1928	*2747*	*3737*	*4921*	*6312*	*7923*	*11876*	*16821*	*22907*
15.00	*8.79*	*9.56*	*10.28*	*10.98*	*11.64*	*12.28*	*13.51*	*14.66*	*15.76*
	1961	*2794*	*3801*	*5005*	*6420*	*8058*	*12079*	*17109*	*23299*

Water (or sewerage) @ 15 C full bore conditions Velocities in m/s (italic type) discharges in l/s				**ks =** 0.6					
Nominal Dia	525	600	675	750	825	900	1050	1200	1350
Material	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc	Conc
Actual ID	533	610	686	762	838	914	1067	1219	1372
15.50	*8.93*	*9.72*	*10.45*	*11.16*	*11.83*	*12.48*	*13.73*	*14.90*	*16.02*
	1993	*2840*	*3864*	*5088*	*6527*	*8192*	*12279*	*17392*	*23685*
16.00	*9.08*	*9.87*	*10.62*	*11.34*	*12.02*	*12.68*	*13.95*	*15.14*	*16.28*
	2025	*2886*	*3926*	*5170*	*6631*	*8323*	*12476*	*17670*	*24064*
16.50	*9.22*	*10.03*	*10.79*	*11.51*	*12.21*	*12.88*	*14.17*	*15.38*	*16.53*
	2057	*2930*	*3987*	*5250*	*6734*	*8452*	*12670*	*17945*	*24437*
17.00	*9.36*	*10.18*	*10.95*	*11.69*	*12.39*	*13.08*	*14.38*	*15.61*	*16.78*
	2088	*2975*	*4047*	*5329*	*6836*	*8579*	*12860*	*18215*	*24805*
17.50	*9.49*	*10.33*	*11.11*	*11.86*	*12.57*	*13.27*	*14.59*	*15.84*	*17.02*
	2118	*3018*	*4106*	*5407*	*6936*	*8705*	*13048*	*18481*	*25168*
18.00	*9.63*	*10.47*	*11.27*	*12.03*	*12.75*	*13.46*	*14.80*	*16.06*	*17.27*
	2148	*3061*	*4164*	*5484*	*7034*	*8828*	*13234*	*18743*	*25525*
18.50	*9.76*	*10.62*	*11.42*	*12.19*	*12.93*	*13.64*	*15.00*	*16.28*	*17.50*
	2178	*3103*	*4222*	*5560*	*7131*	*8950*	*13416*	*19002*	*25878*
19.00	*9.89*	*10.76*	*11.58*	*12.36*	*13.10*	*13.82*	*15.21*	*16.50*	*17.74*
	2207	*3145*	*4279*	*5634*	*7227*	*9070*	*13597*	*19257*	*26225*
19.50	*10.02*	*10.90*	*11.73*	*12.52*	*13.27*	*14.01*	*15.41*	*16.72*	*17.97*
	2236	*3186*	*4335*	*5708*	*7322*	*9189*	*13775*	*19509*	*26568*
20.00	*10.15*	*11.04*	*11.88*	*12.68*	*13.44*	*14.18*	*15.60*	*16.93*	*18.20*
	2265	*3227*	*4390*	*5781*	*7415*	*9306*	*13950*	*19758*	*26907*

Appendix 1G

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Appendix 1H

Rainfall Intensity Printouts from HIRDS

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Appendix 1I

Standard Drawings

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Index Appendix 1I

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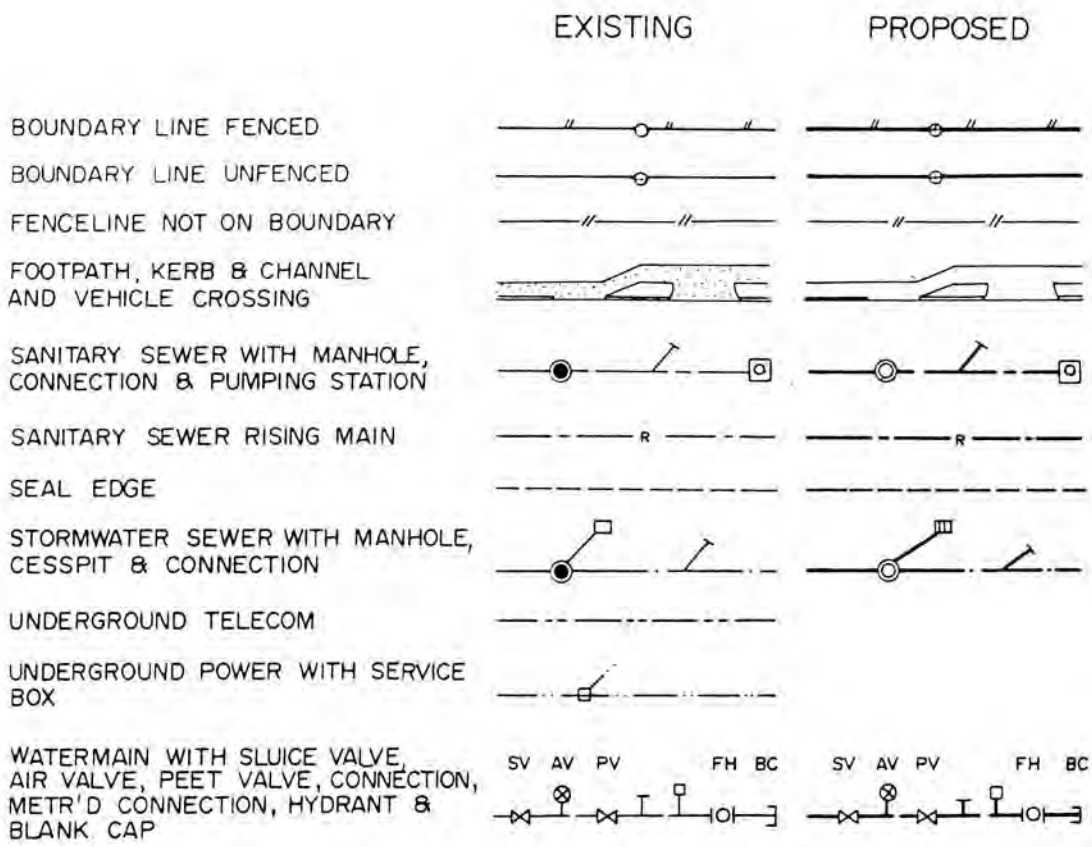
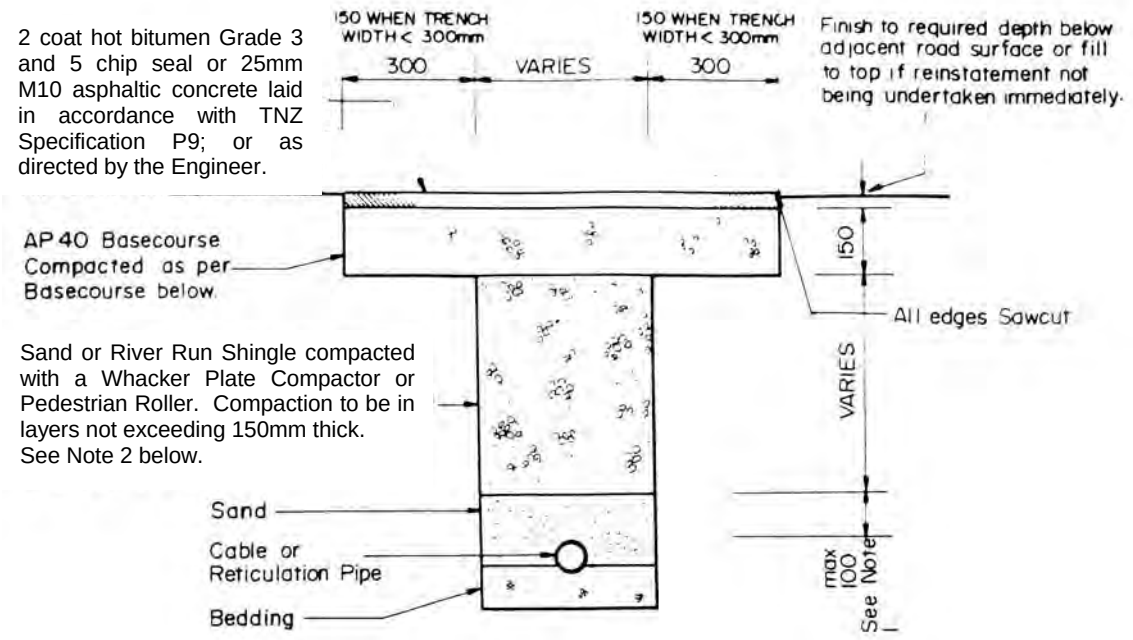
Appendix 1I

Standard Drawings

GO1 to R31



Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Drawing Symbols	G 01



Notes:

1. Maximum sand cover to the pipe shall be 100mm when necessary unless specific coverage is required by a reticulation pipe laying specification.

2. When sand is used for the balance of backfill material for the trench proper it shall be flooded to maximum moisture content during compaction.

3. Bedding and initial backfilling to be in accordance with the appropriate NZ Standard and pipe manufacturers recommendation.

4. In all case backfilling of the trench with either natural or imported material shall be compacted to achieve at least the density of the adjacent undisturbed material.

5. Where the trench is in a grassed berm, natural material is to be used to backfill and must be compacted to an equivalent density to the surrounding ground. The area is to have 75mm topsoil compacted and grass sown and established by the excavating Authority.

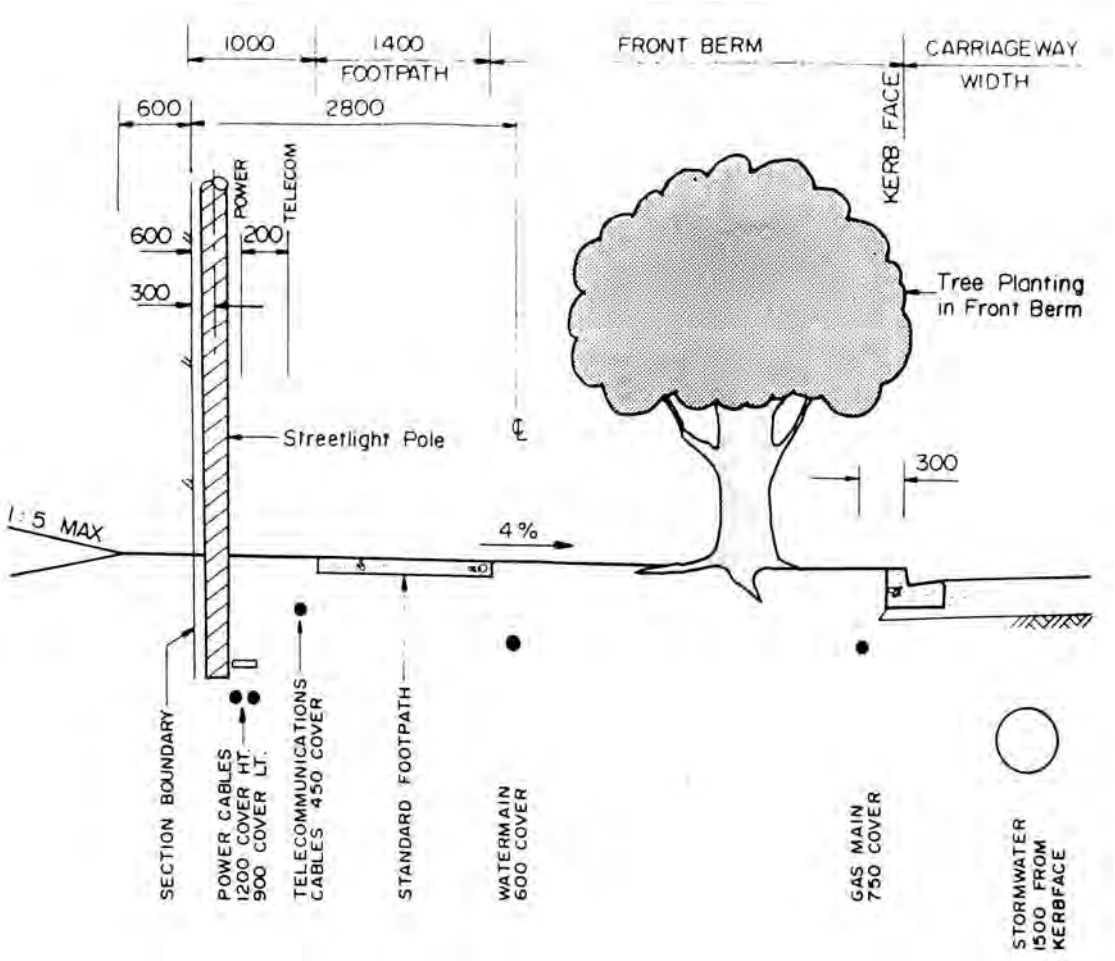
Opotiki District Council	Standard Drawings	*Not to Scale*
	Trench Reinstatement	G 03

Table 1.0 STREET CLASSIFICATION GUIDELINES

Class	Type	R.O.W Areas (m)	Carriageway (m)	Berms (m)	Footpath	Street Lights
Private Access	Urban 1 Lot	3.0	3.0	-	N/A	No
	Urban 2 Lots	4.0	3.0	0.5 & 0.5	N/A	No
	Urban 3-6 Lots	6.0	4.5	0.5 & 1.0	N/A	Yes
	Urban 7 or more	Legal Road				
	Rural 1 Lot	4.0	3.0	0.5 & 0.5	N/A	No
	Rural 2-3 Lots	9.0	4.0	2.5 & 2.5	N/A	No
	Rural 4-6 Lots	12.0	5.0	3.5 & 3.5	N/A	No
	Rural 7 or more	Legal Road				

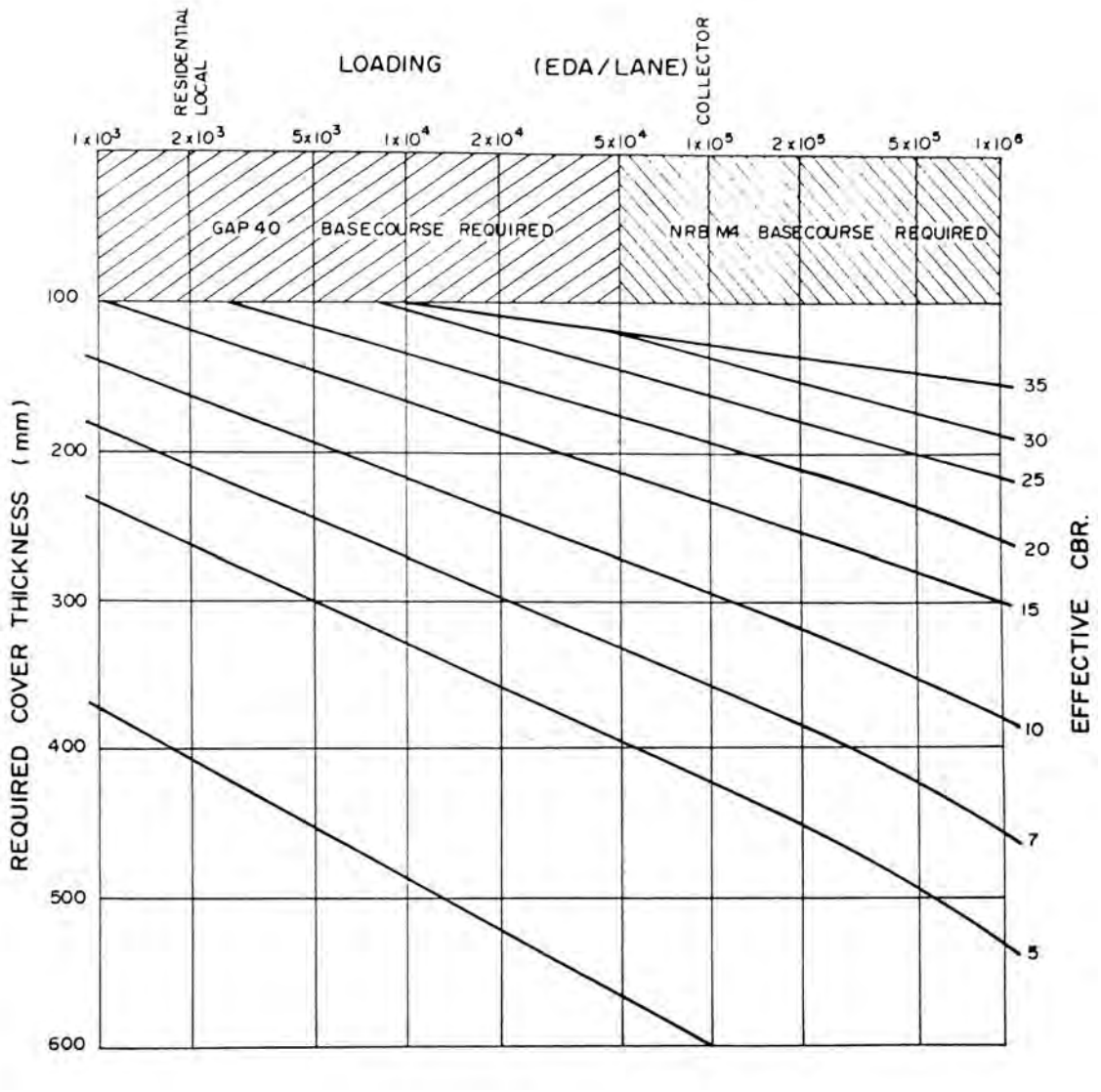
Public Road	Type	Road Reserve	Carriageway	Berms	Footpath	Street Lights
Local	Cul-de-sac <150m	15.0	6.0	4.5 & 4.5	One Side	Yes
	Cul-de-sac >150m	17.0	7.0	5.0 & 5.0	Both Sides	Yes
	Service Lane	7.0	6.0	1.0	N/A	Yes
	Residential Through Road and Loop Road	2.0	11.0*	4.5 & 4.5	Both Sides	Yes
	Commercial & Industrial	2.0	11.0	4.5 & 4.5	One Side	Yes
Collector	Residential	20.0	11.0*	5.5 & 5.5	Both Sides	Yes
	Commercial & Industrial	20.0	13.0	4.0 & 4.0	Both Sides	Yes
Arterial	Traffic Function	Specific Design				

*Guidelines to be modified for traffic calming features.



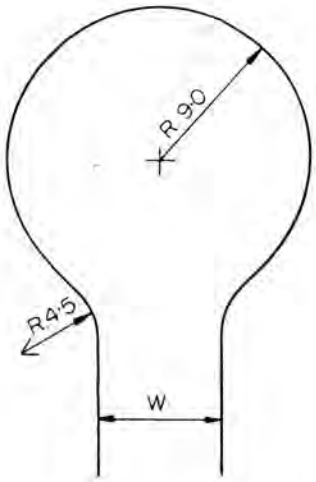
Carriageway Width	Front Berm Dimension	Berm Width One Side
6000	2100	4500
7000	2600	5000
11000 Residential Local	2100	4500
11000 Residential Collector	3100	5500
11000 Local, Commercial & Industrial	2100	4500
13000 Collector, Commercial Industrial	1600	4000

Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Berm	R 02



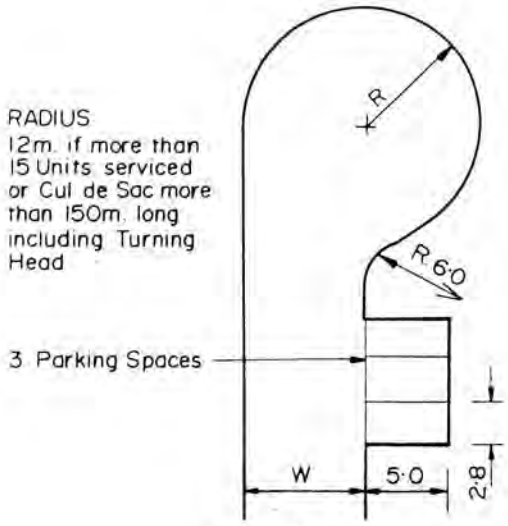
	Road Type	C/W Width m	Max. Allowable Deflection mm	Max. Desirable Gradient	Min. Basecourse Depth mm
A	Cul-de-sac <150	6.0	2.0	10%	125
B	Cul-de-sac >150	7.0	1.0	10%	125
C	Through Road	8.0	1.0	8.33%	150
D	Industrial Road	13.0	0.75	5%	200
Principal/Arterial		Design to Transit NZ Pavement Manual			

Opotiki District Council	Standard Drawings	*Not to Scale*
	Design Chart ~ Flexible Pavements	R 03



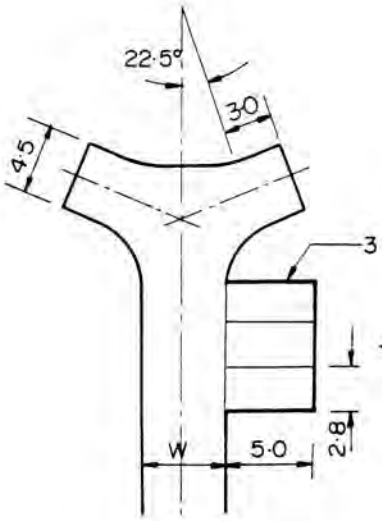
TYPE A

RADIUS = 9·0m FOR W = 6·0m
= 12·0m FOR W ≥ 7·0m



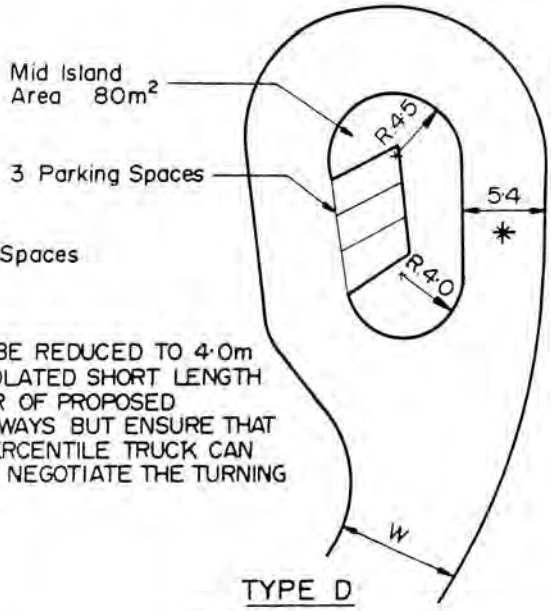
TYPE B

RADIUS = 9·0m. if less than 15 Units serviced and Cul de Sac less than 150m. long



TYPE C

W = 6·0m.
Maximum 15 Household Units serviced off Cul de Sac
Maximum 150m Length of Cul de Sac

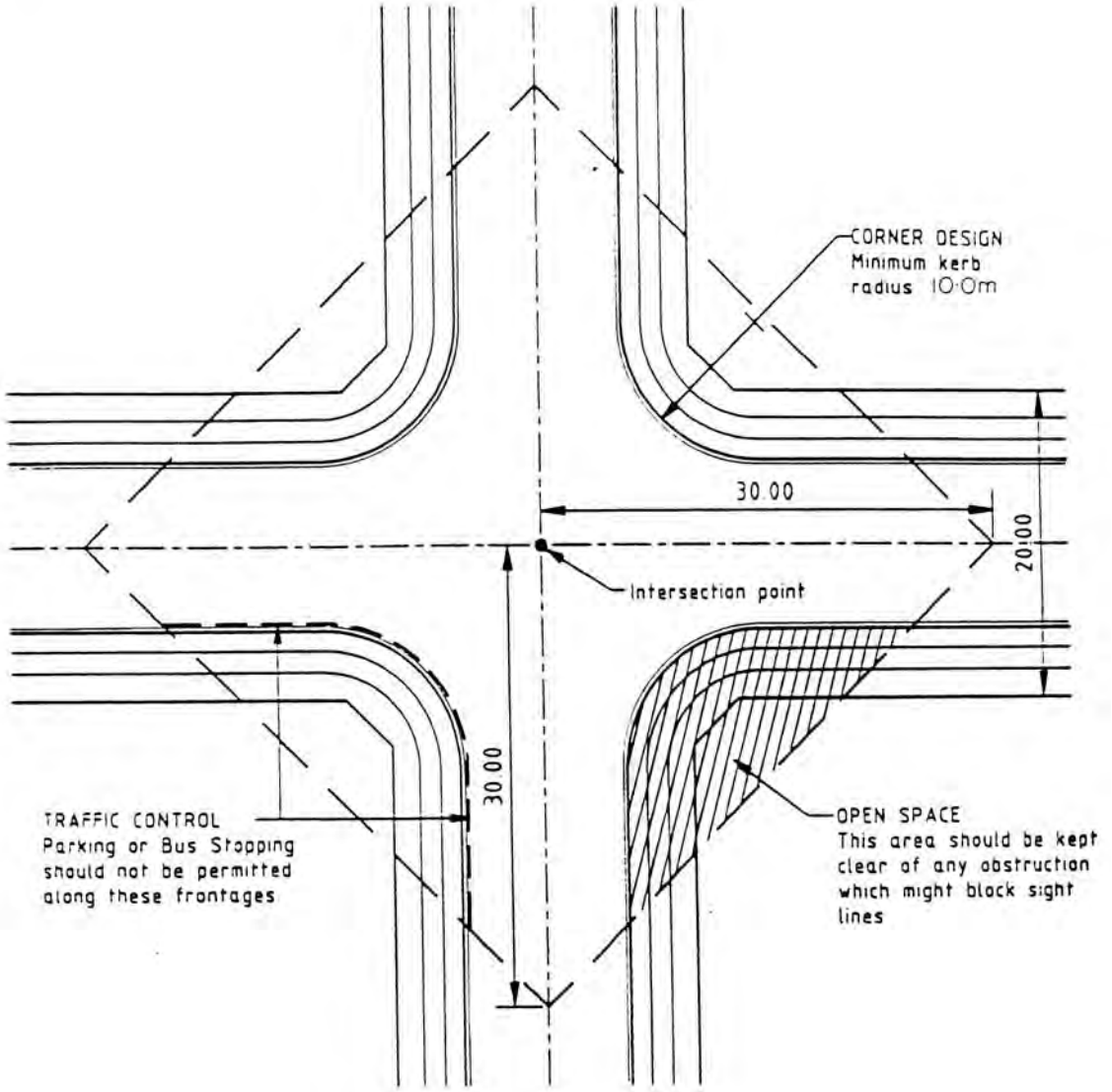


* MAY BE REDUCED TO 4·0m IN ISOLATED SHORT LENGTH CLEAR OF PROPOSED DRIVEWAYS BUT ENSURE THAT 90 PERCENTILE TRUCK CAN STILL NEGOTIATE THE TURNING HEAD

TYPE D

W = 7·0m
No Private Ways off Turning Head

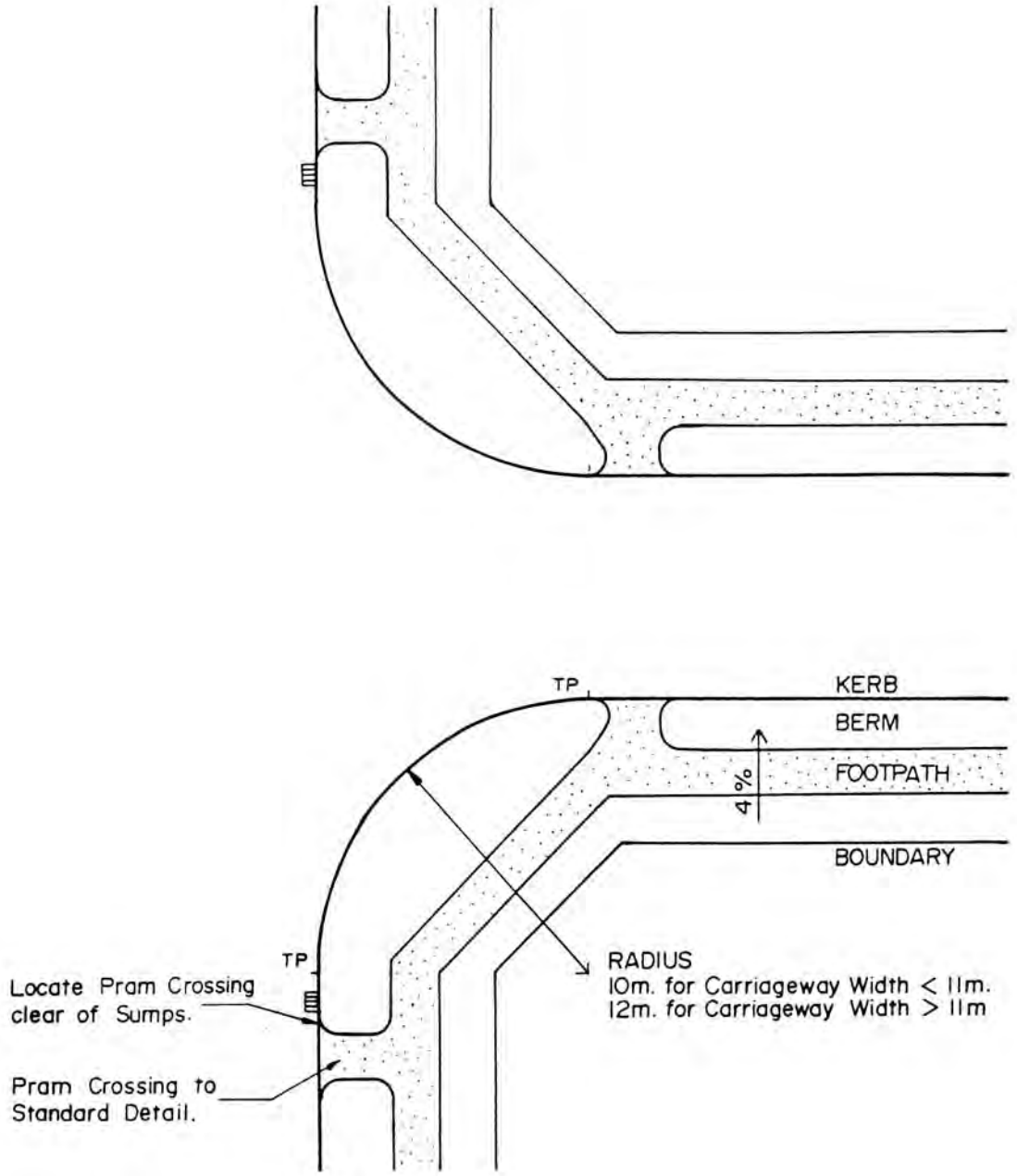
Opotiki District Council	Standard Drawings	*Not to Scale*
	Design Examples ~ Cul-de-sac Heads	R 04



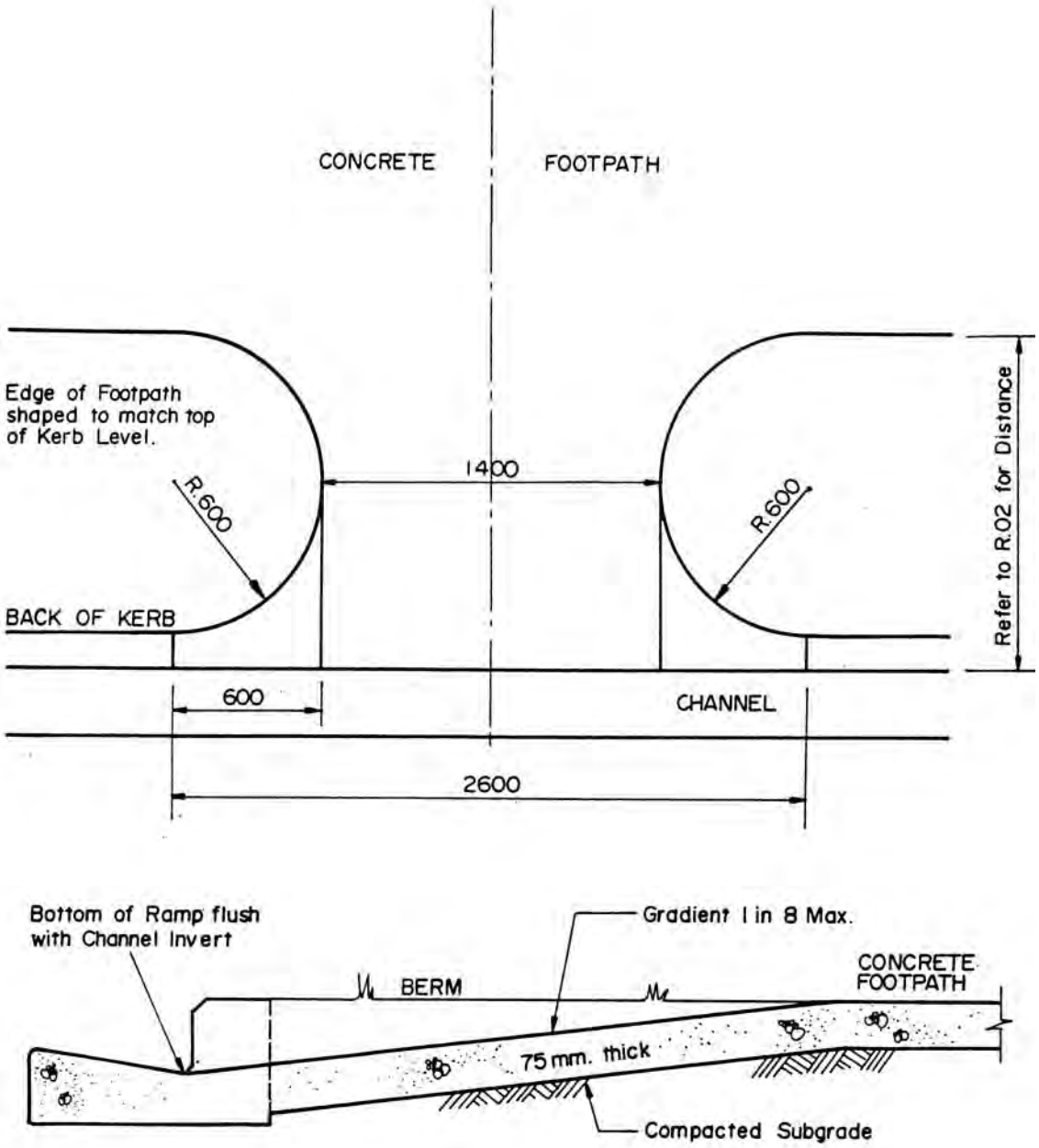
Note:

1. All Standards of Design illustrated hereon are jointly applicable to all corners of the intersection.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Urban Intersection Traffic Sight Lines	R 05

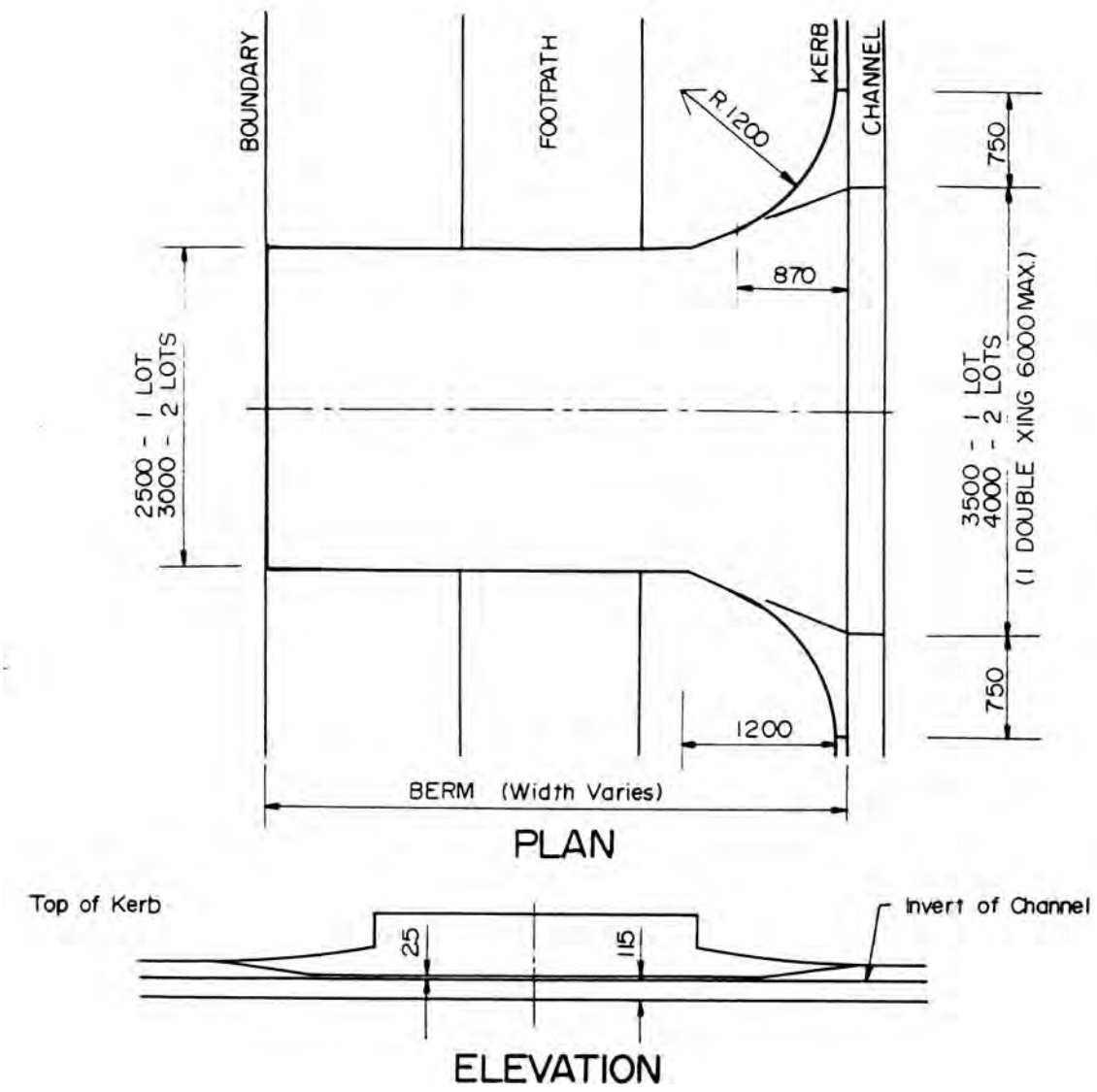


Opotiki District Council	Standard Drawings	*Not to Scale*
	Typical Intersection Layout	R 06



Section on Ramped Path ℄

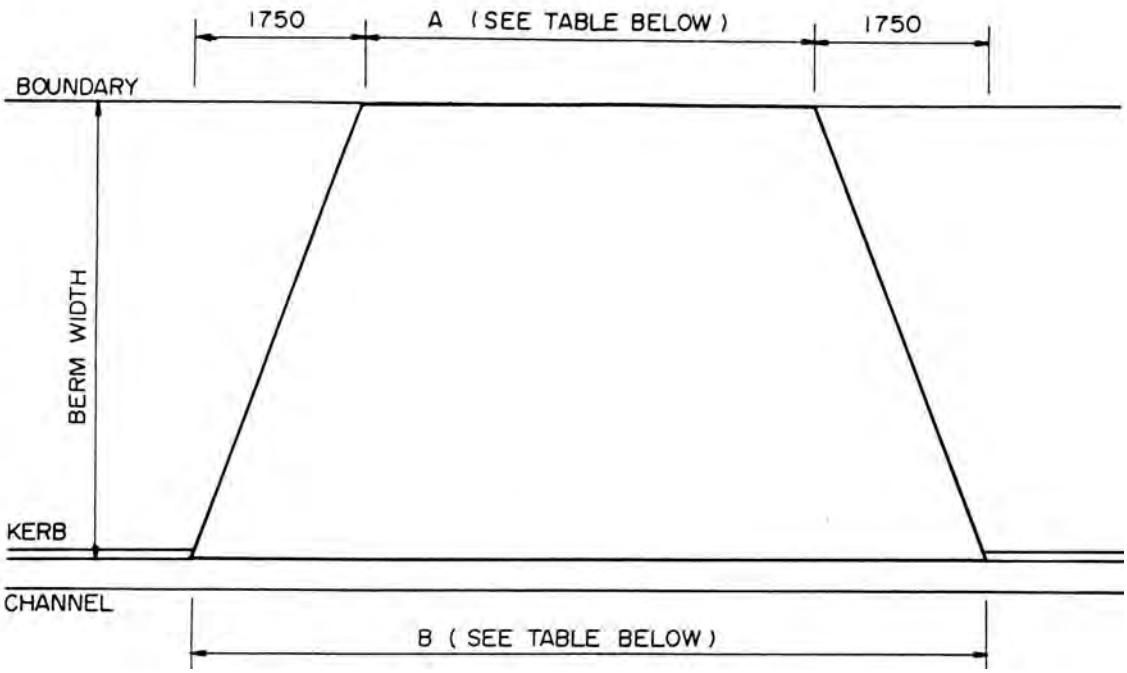
Opotiki District Council	Standard Drawings	*Not to Scale*
	Pram Crossing	R 07



Notes:

1. All concrete shall be 115 thick, have a strength of 20.0 MPa and be wood floated to a smooth surface.
2. All existing footpath to be replaced unless specifically exempted by the Engineer and the crossing shall run continuously between the kerb boundary and the property boundary.
3. If there is no existing footpath the Council will provide level pegs to ensure that the work ties in with the future footpath development.
4. The work shall be carried out in such a manner as to ensure the safety of road and footpath users.
5. Vehicle crossings shall be reinforced with hrc 665 mesh centrally placed. For more than 2 Lots refer to industrial/commercial Drawing R 09.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Vehicle Crossing Residential	R 08

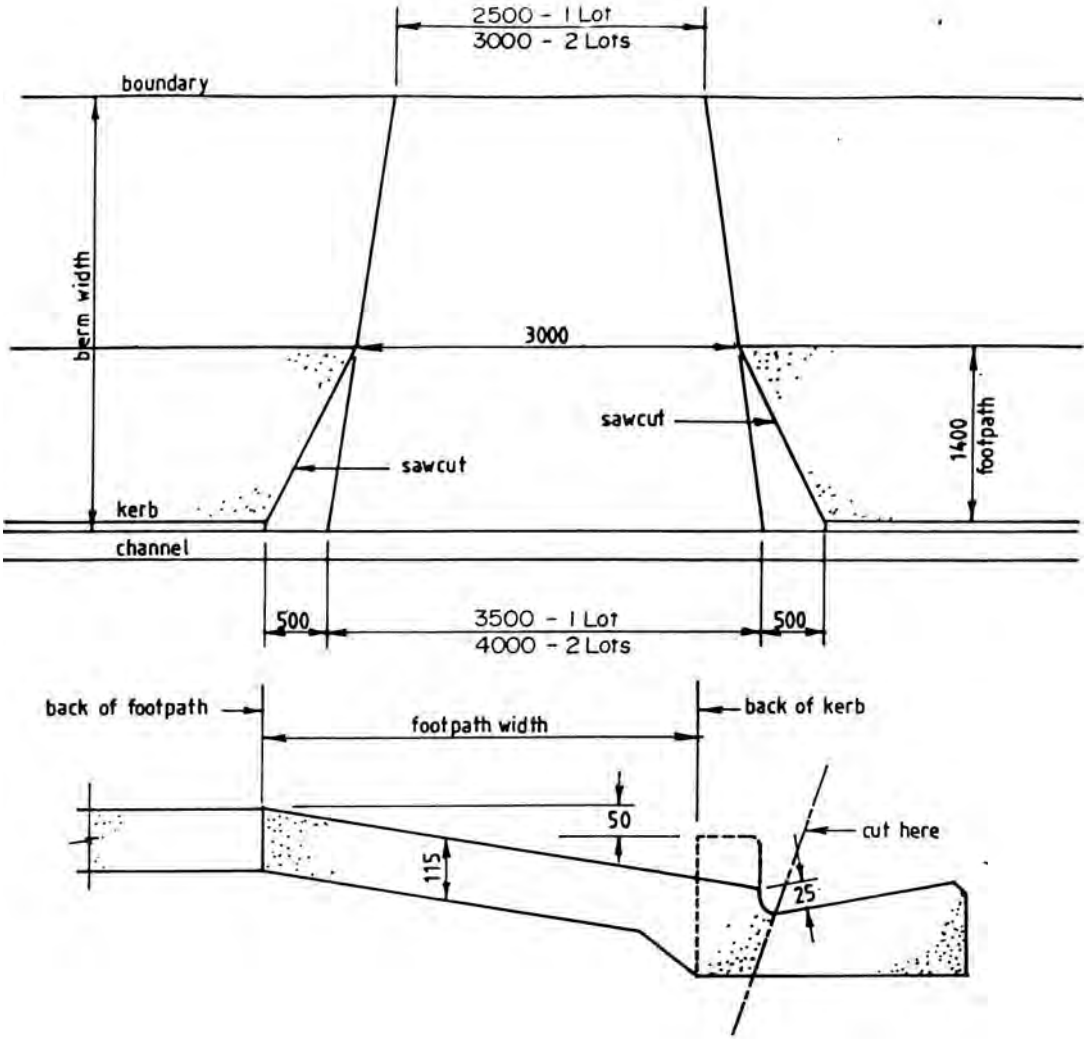


Notes:

1. The concrete including the new channel shall be 200mm thick and reinforced with one layer of hrc 665 mesh with 50mm cover from the bottom of the slab.
2. The concrete shall have a minimum crushing strength of 20MPa at 28 days and shall comply with NZS 3124:1987.
3. All existing footpath, kerb and channel are to be replaced and the crossing shall run continuously between the kerb and the property boundary.
4. If there is no existing footpath the contractor shall ensure that the work ties in with future footpath construction.
5. A 150mm thick concrete slab shall be constructed under the kerb and channel for all heavy industrial crossings.
6. The work shall be carried out in such a manner as ton ensure the safety of road and footpath.

Dimension	Heavy Industrial Double Lane	Heavy Industrial Single Lane	Light Industrial Commercial Single Lane	Light Industrial Commercial Double Lane
A	7000	4500	3500	6000
B	10500	8000	7000	9500

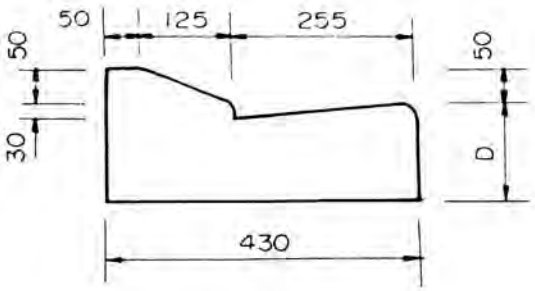
Opotiki District Council	Standard Drawings	*Not to Scale*
	Vehicle Crossing Industrial/Commercial	R 09



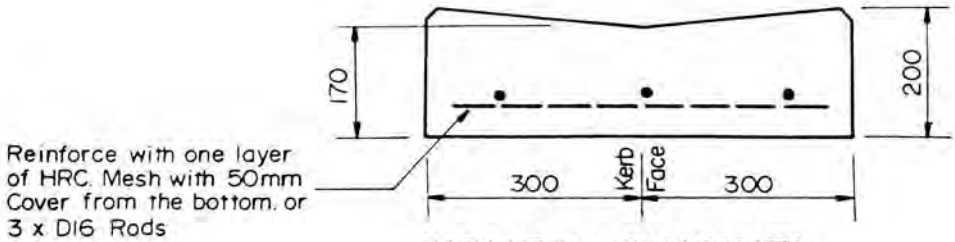
Notes:

1. All concrete shall be 115 thick, have a strength of 20.0 MPa and be wood floated to a smooth surface.
2. All existing footpath to be replaced unless specifically exempted by the Engineer and the crossing shall run continuously between the kerb boundary and the property boundary.
3. If there is no existing footpath the contractor shall ensure that the work ties in with the future footpath development.
4. The work shall be carried out in such a manner as to ensure the safety of road and footpath users.
5. Vehicle crossings shall be reinforced with hrc 665 mesh centrally placed. For more than 2 Lots refer to industrial/commercial Drawing R 09.

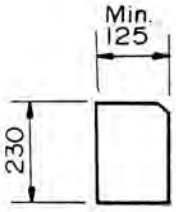
Opotiki District Council	Standard Drawings	*Not to Scale*
	Vehicle Crossing ~ Existing Residential Footpath Behind Kerb	R 10



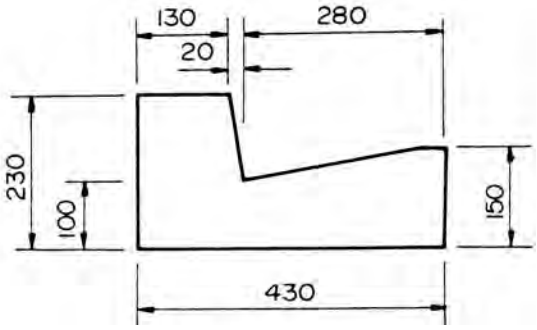
MOUNTABLE KERB & CHANNEL



DISHED CHANNEL



NIB KERB

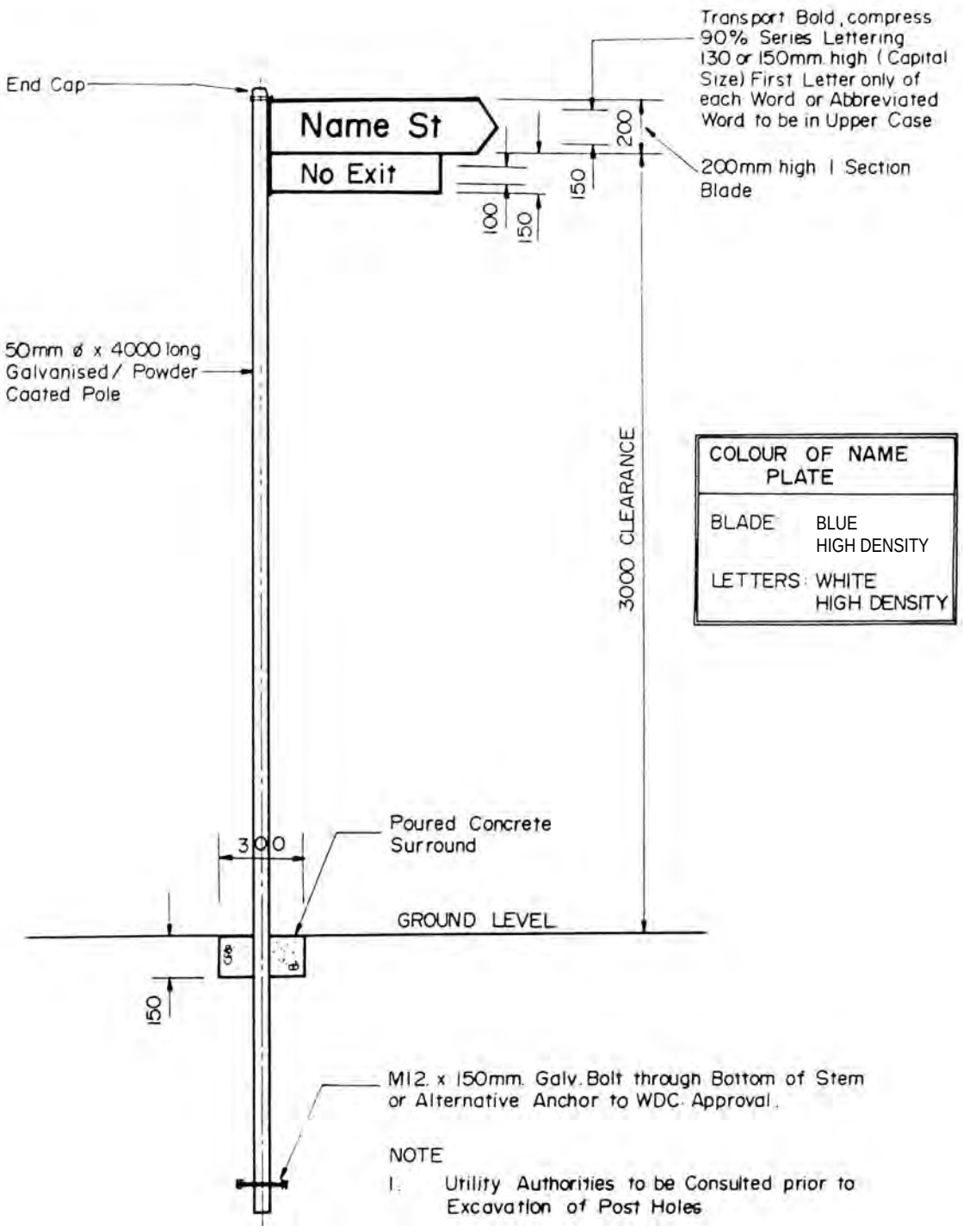


Vertical Kerb and Channel

Notes:

1. All Chamfers 25mm.
2. Concrete to be 20.0 MPa.
3. All dimensions are in millimetres.
4. Mountable kerb shall only be permitted where the Engineer is satisfied that berms will not be at risk as a result of indiscriminate access or continuous parking.
5. Depth D as shown on kerb and channel detail above is defined as follows:
   - Residential 150mm
   - Industrial/ Commercial 230mm
6. Subgrades beneath the kerbs and channels shall not be less than CBR 15.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Kerbing Profiles	R 11



Opotiki District Council	Standard Drawings	*Not to Scale*
	Street Sign Standard ~ Urban Areas	R 12

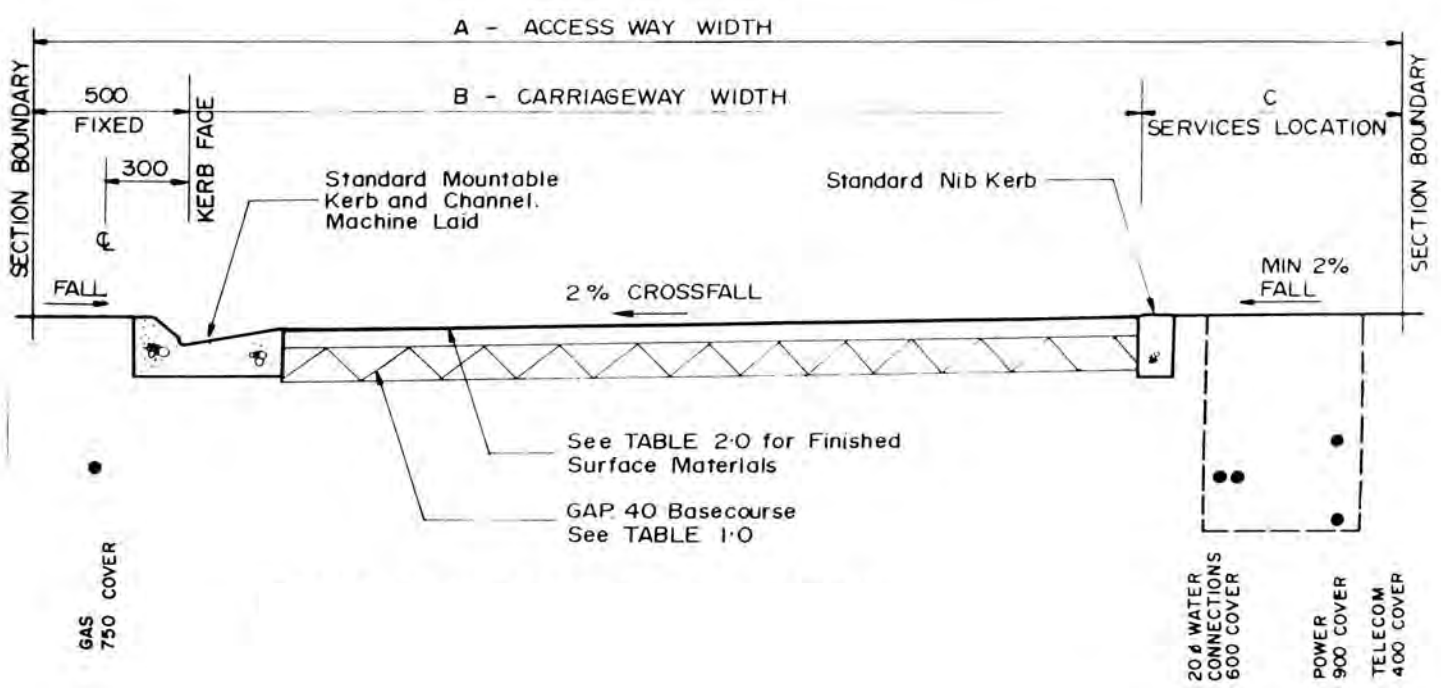
Opotiki District Council

Standard Drawings

Standard Urban Right-of-Way

R 13

Not to Scale

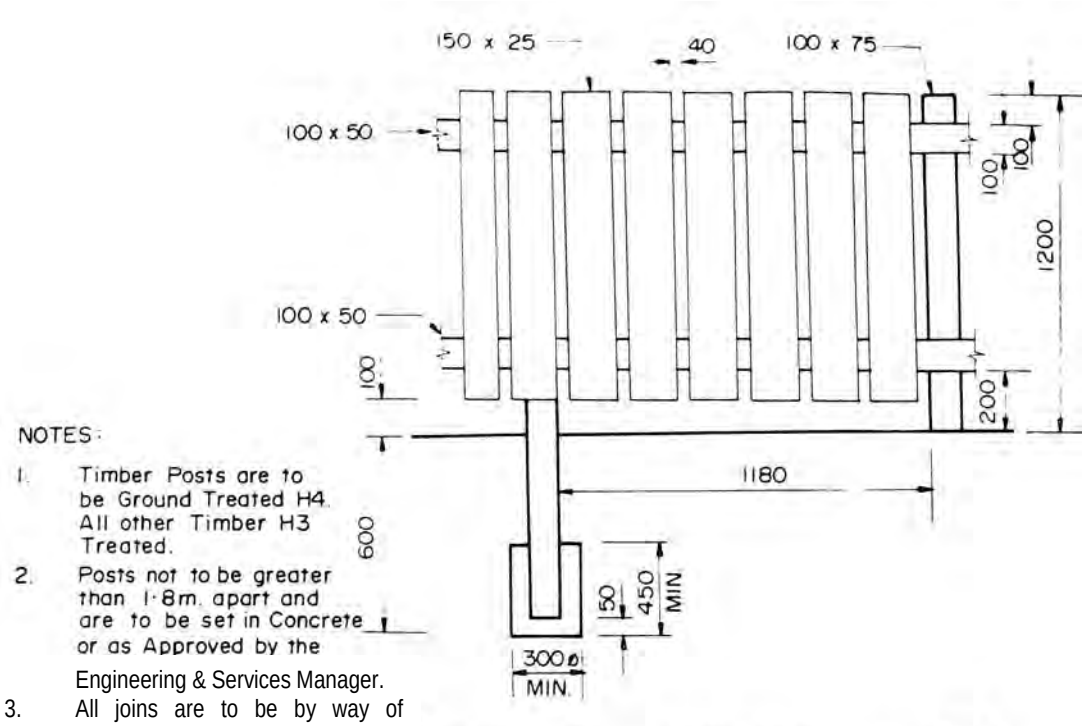


ACCESS WIDTHS			
No. of Lots	Dimension		
	A	B	C
1	3.0	3.0	-
2	4.0	3.0	0.5 & 0.5
3-6	6.0	4.5	0.5 & 1.0
7 or more	Legal Road		

SURFACING OPTIONS		
Option A	60mm	Cobblestones
	20mm	Scalpings
	100mm	Basecourse
Option B	50mm	Asphaltic Concrete
	125mm	(min) Basecourse
Option C	100mm	Concrete
	665	Mesh
Option D	Grade 3&5 Two Coat Bitumen Hot Seal	

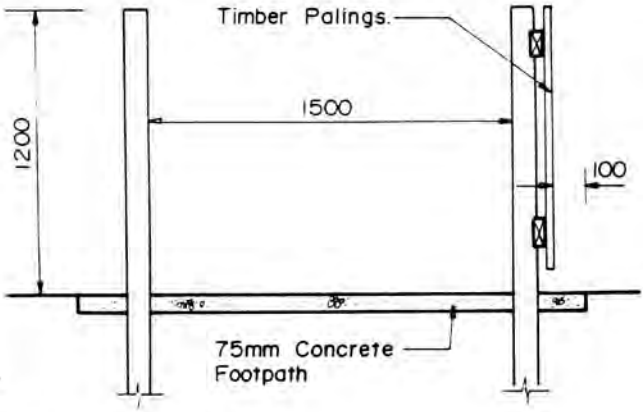
Notes:

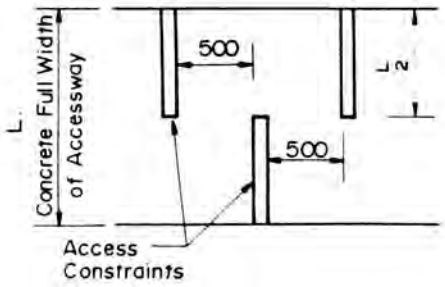
1. All concrete minimum 20.0 MPa
2. Maximum number of allotments served shall be 6



NOTES:

1. Timber Posts are to be Ground Treated H4. All other Timber H3 Treated.
2. Posts not to be greater than 1·8m. apart and are to be set in Concrete or as Approved by the Engineering & Services Manager.
3. All joins are to be by way of Galvanised Bolts or Nails and are to be firmly secured.
4. All construction to be in accordance with recognised Tradesman practice.
5. All timber unstained and unpainted.



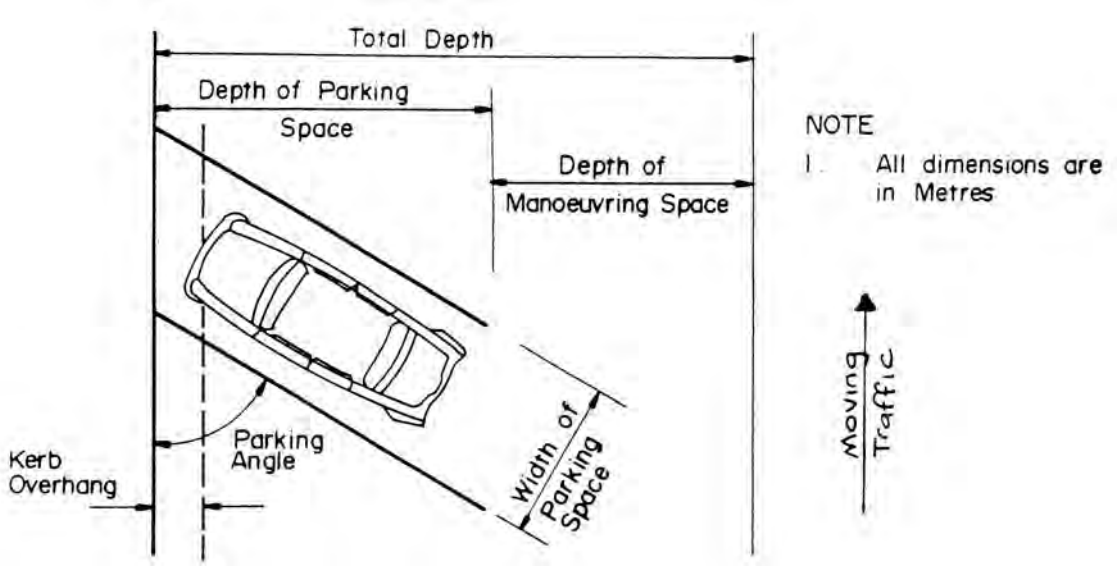


NOTES:

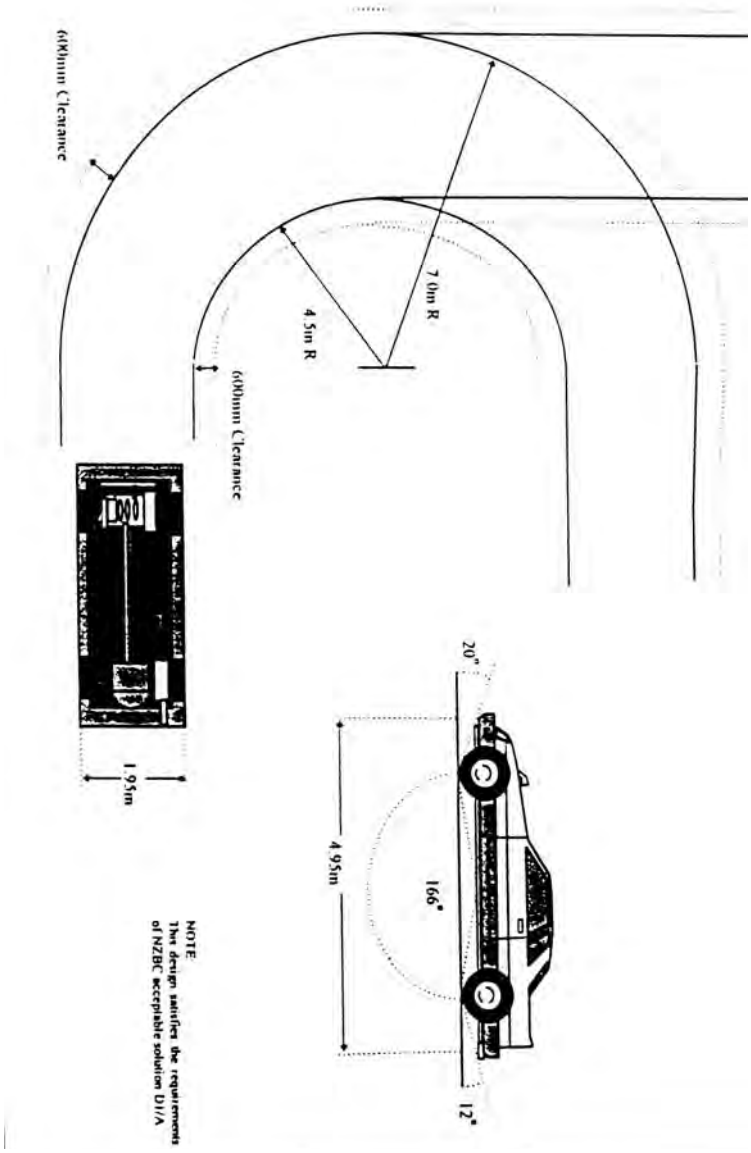
1. Fence shown represents minimum standard required. Alternatives may be agreed with the Engineering & Services Manager.
2. Access Constraints: U shaped 50mm dia Galv. Pipe. 900mm high above ground.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Fence Construction for Pedestrian Accessways	R 14

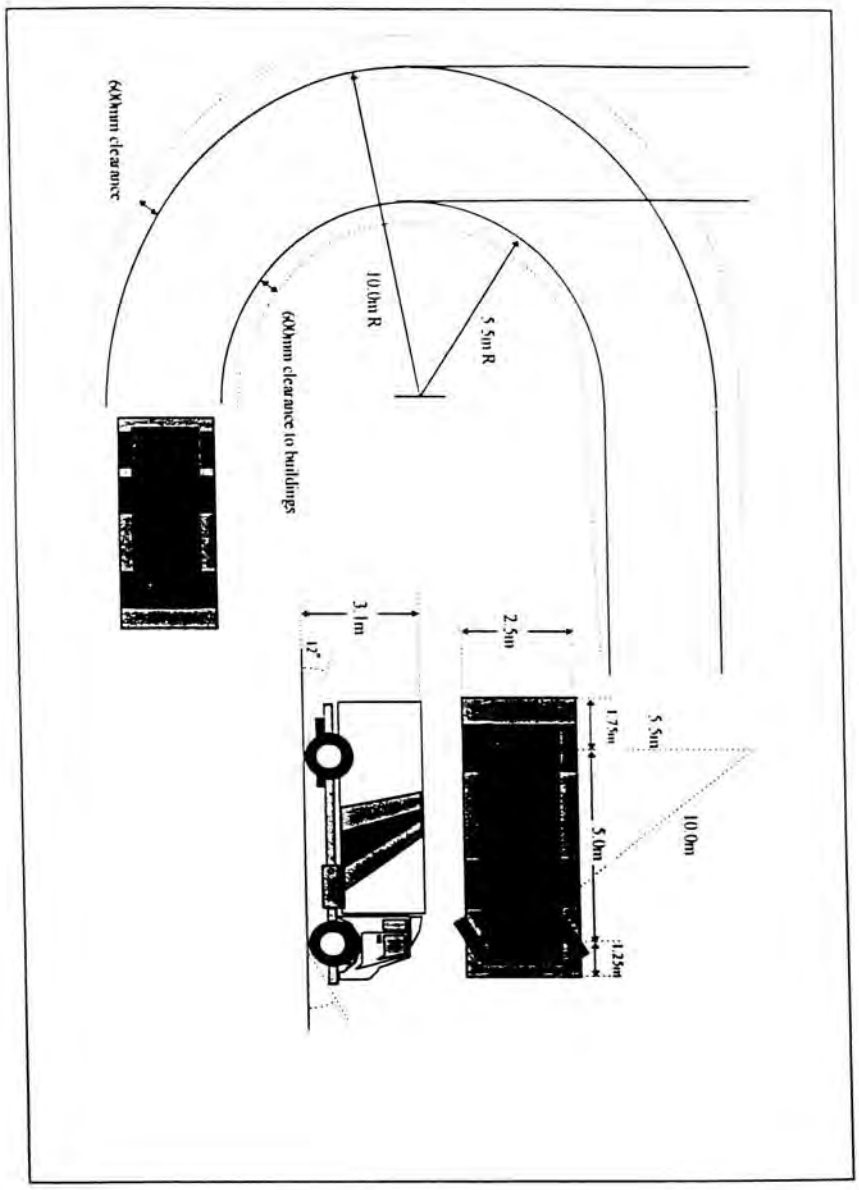
Angle to Park	Width of Parking Space	Kerb Overhang	Parking Space From A Wall	Parking Space From a Kerb	Depth Of Manoeuvre	Total Depth From a Wall
90 Degree	2.5 2.6 2.8	1.0	4.9	3.9	7.7 7.0 6.6	12.6 11.9 11.5
75 Degree	2.5 2.6 2.8	1.0	5.2	4.2	6.3 5.2 4.1	10.5 10.4 9.3
60 Degree	2.5 2.6 2.8	1.0	5.2	4.2	4.1 3.7 3.7	9.3 8.9 8.9
45 Degree	2.5 2.6 2.8	0.8	4.9	4.1	3.7 3.7 3.7	8.6 8.6 8.6
30 Degree	2.5 2.6 2.8	0.6	4.0	3.4	3.7 3.7 3.7	7.7 7.7 7.7
0 Degree Parallel	6.0	0.4	2.5	2.1	3.7	6.2



Opotiki District Council	Standard Drawings	*Not to Scale*
	Manoeuvring and Parking Dimensions	R 15



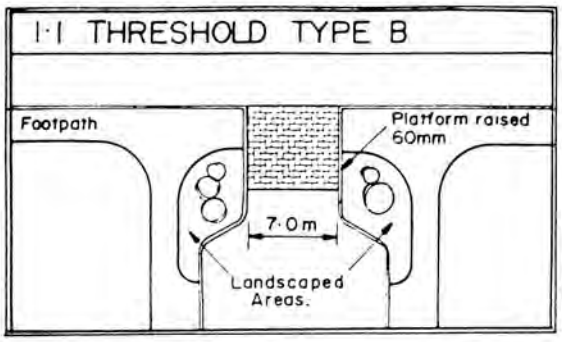
Opotiki District Council	Standard Drawings	*Not to Scale*
	99 Percentile Design for Car	R 16

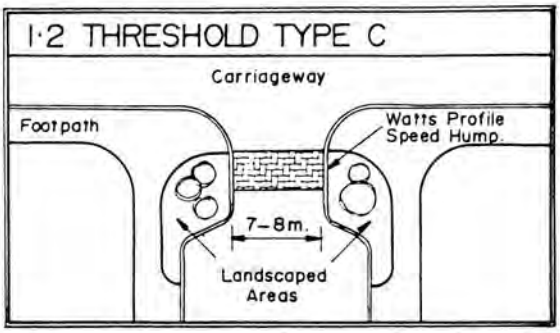


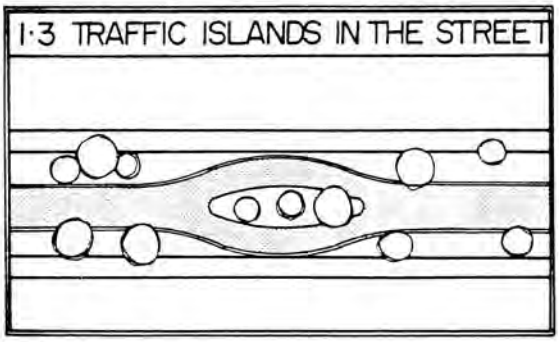
Notes:

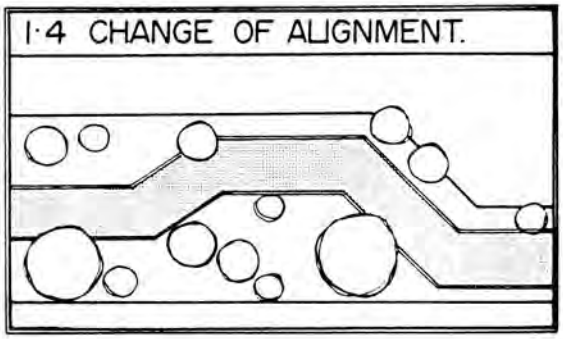
1. For other Turning Curves refer to New Zealand on Road Tracking Curves – Land Transport Safety Authority. October 1995.

Opotiki District Council	Standard Drawings	*Not to Scale*
	90 Percentile Design for Two Axle Truck	R 17

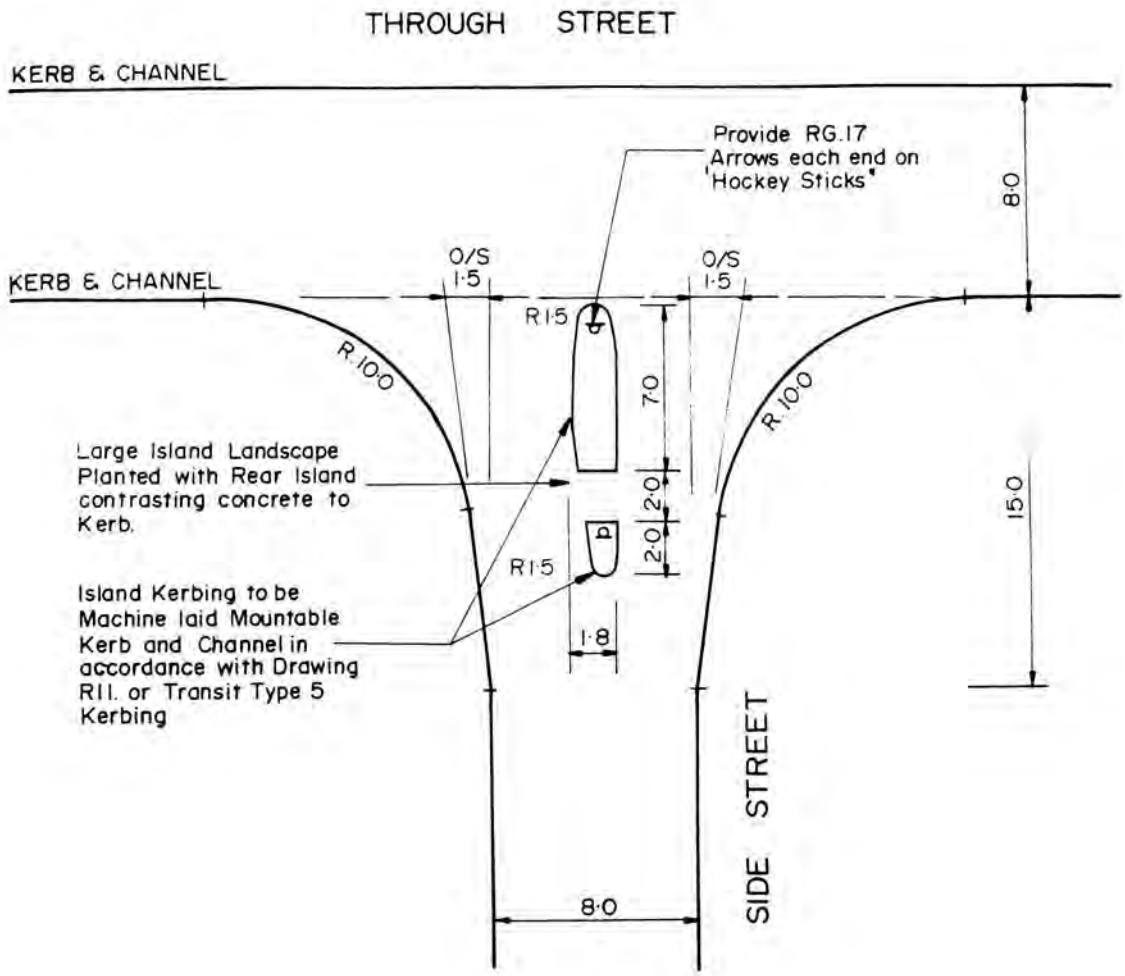








Opotiki District Council	Standard Drawings	*Not to Scale*
	Traffic Calming Devices Mild Restraints	R 19

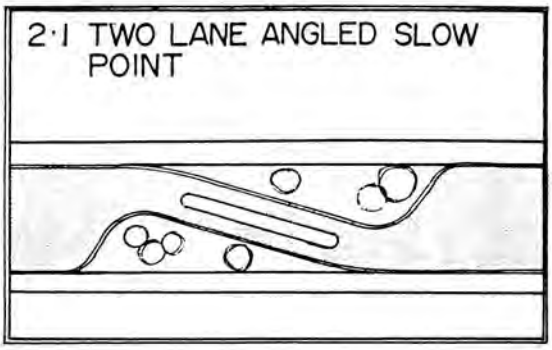


Notes:

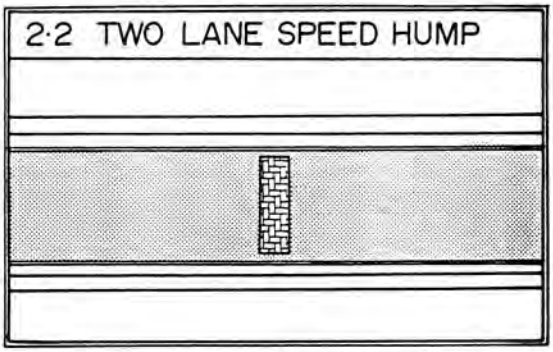
1. Where the 'Through Street' is wider than 8.0m both Tangents at the corner Radii shall be flared 1.5 metres.
2. Suitable for 90 Percentile Single Axle Truck.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Traffic Calming Devices Typical Tee Intersection	R 20

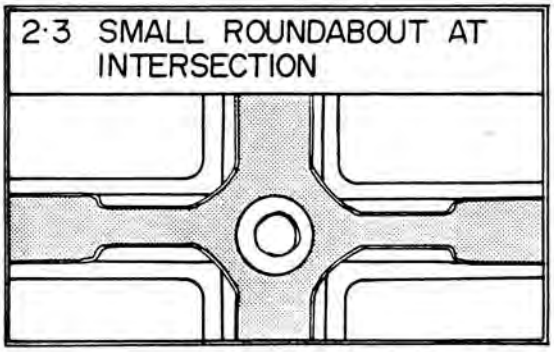
2·1 TWO LANE ANGLED SLOW POINT



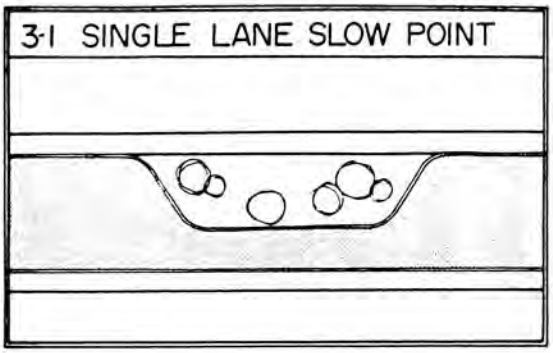
2·2 TWO LANE SPEED HUMP

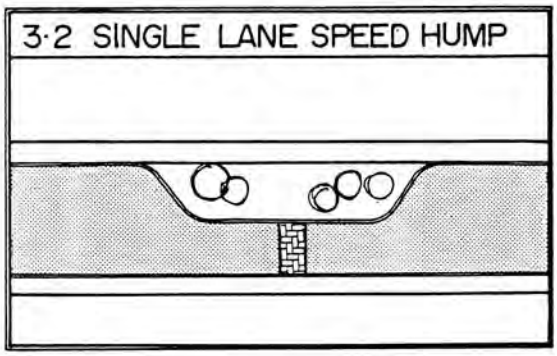


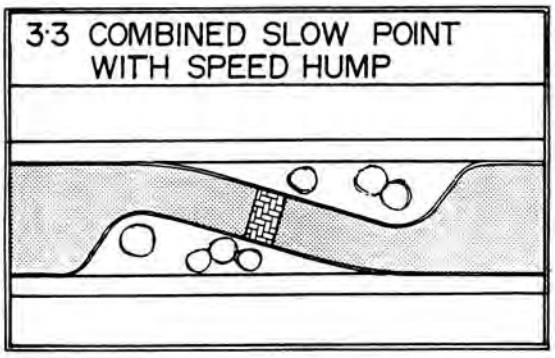
2·3 SMALL ROUNDABOUT AT INTERSECTION



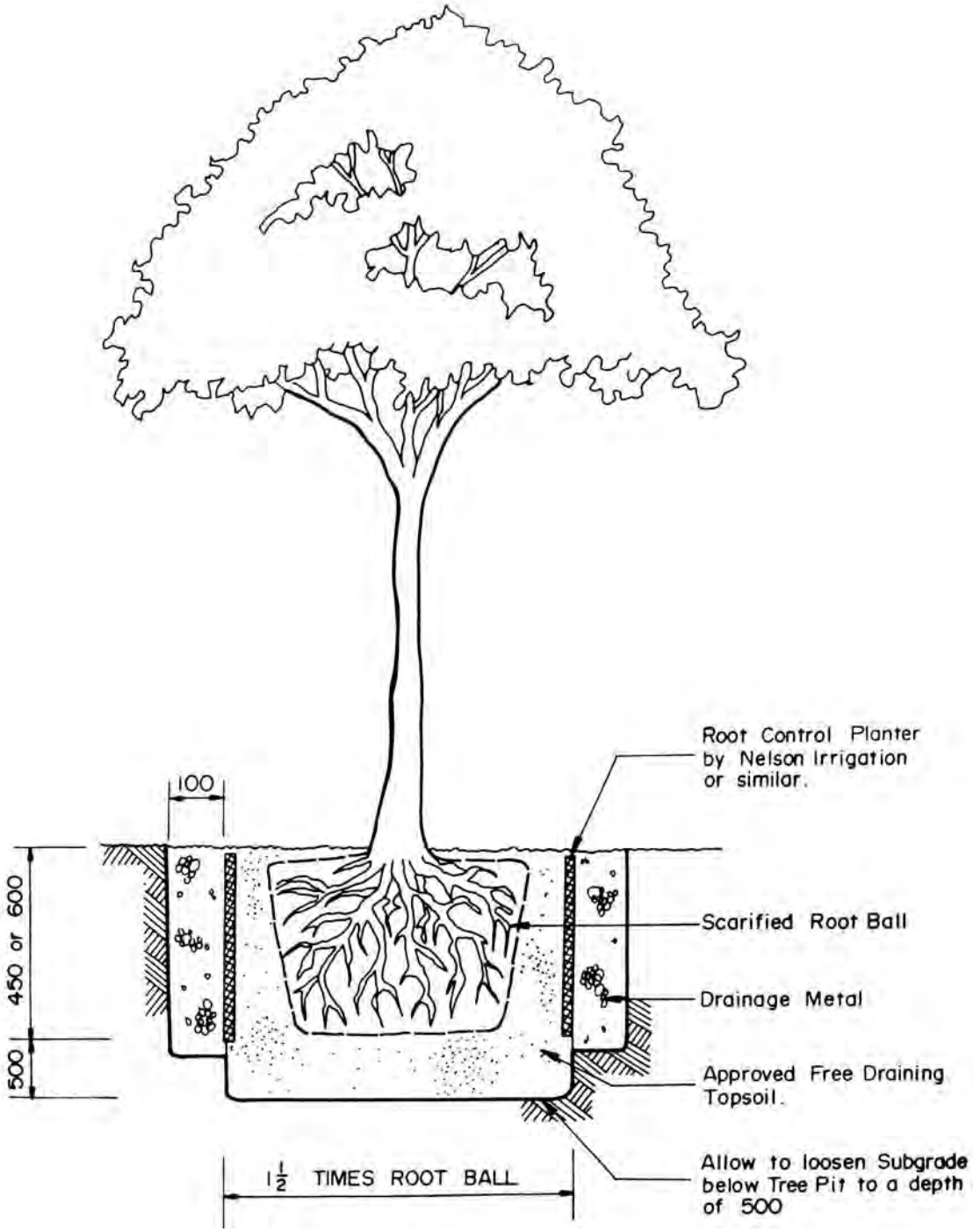
Opotiki District Council	Standard Drawings	*Not to Scale*
	Traffic Calming Devices Moderate Restraints	R 21



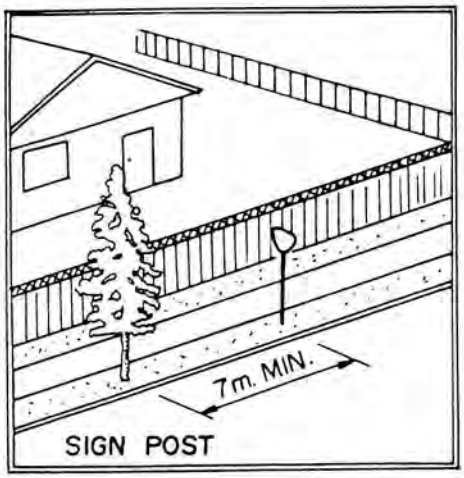


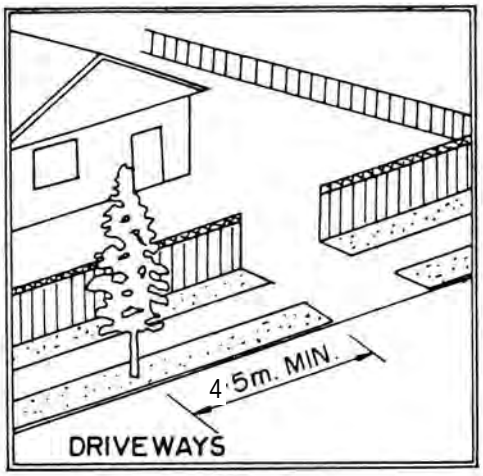


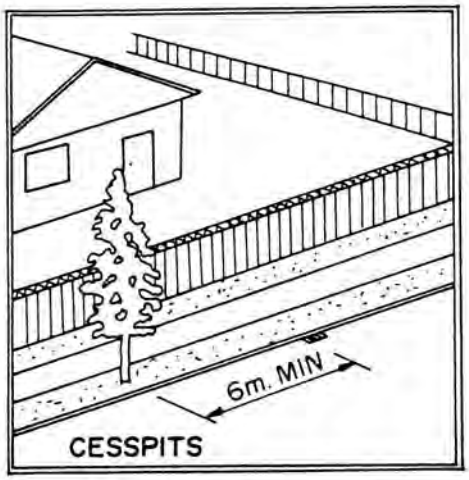
Opotiki District Council	Standard Drawings	*Not to Scale*
	Traffic Calming Devices Strong Restraints	R 22

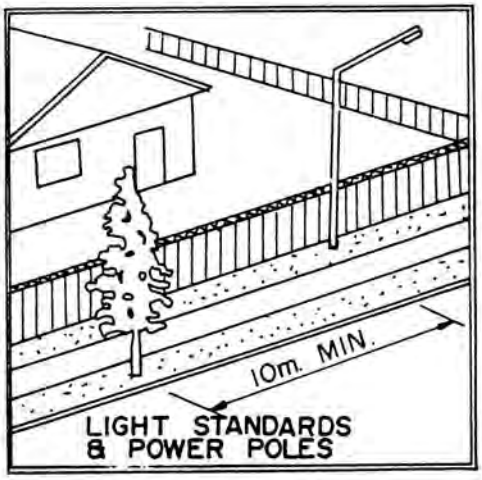


Opotiki District Council	Standard Drawings	*Not to Scale*
	Specimen Trees Root Control Planters	R 23





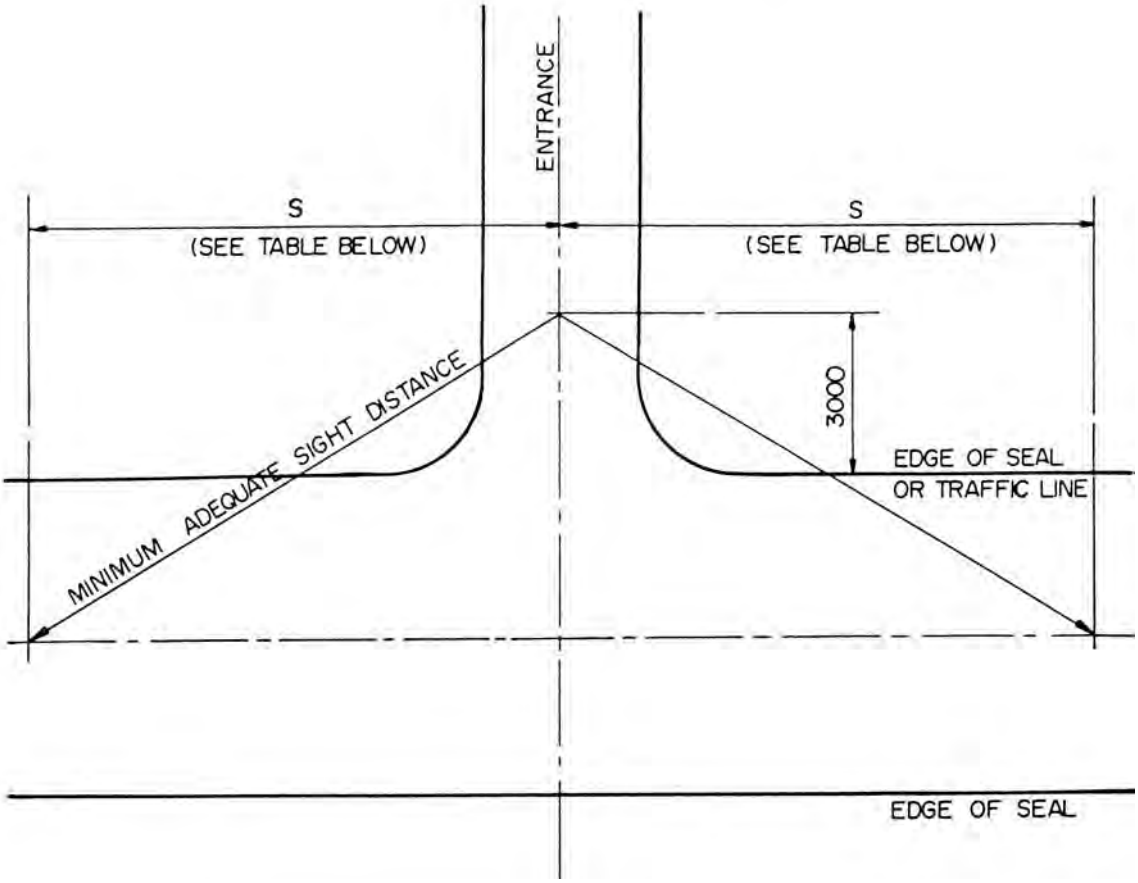




Notes:

1. At intersection it is desirable that trees are placed far enough back to maintain adequate sight distances. Refer to Drawing R25 for Sight Distances.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Street Tree Placement	**R 24**



Design Speed of Main Road Km/h	Safe Stopping Distance (M) S
30	35
40	45
50	60
60	75
70	95
80	110
90	125
100	145
110	185

Opotiki District Council	Standard Drawings	*Not to Scale*
	Sight Distances for Vehicle Entrances	R 25

STANDARD RURAL ACCESS WAY

MAXIMUM LENGTH 750m.

Refer to Drawing R 27 for Notes

Geometric Design will be in accordance with the "*Guide to Geometric Standards to Rural Roads*"

Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Rural Accessways	R 26

TABLE 1 – RURAL ACCESSWAY

No of Lots	Accessway Width *See Note 10	Carriageway Width	Metal Depth
1	4.0	3.0	100mm
2 - 3	9.0	4.0	
4 - 6	12.0	5.0 (sealed)	125mm

Notes:

1. Passing Bays: Shall be provided outside the minimum carriageway width at not more than 200 metre intervals. Passing Bays shall be large enough to enable a 90 percentile two axled truck to enter, park and exit in one manoeuvre. If the access serves all lots smaller than 1 hectare in size then the passing bay shall be constructed for the 90 percentile car.

2. Visibility: Minimum sight distances to be in accordance with Standard Drawing R 25.

3. Dimensions: Minimum dimensions are shown in Table 1. A grassed berm at least 2.5m shall be provided in one side of the carriageway for the provision of underground services.

4. Access and Gradient: The maximum carriageway gradient shall be 1 in 6 with the first 6 metres from edge of seal/metal at a gradient of 1 in 12. All lots relying on the access strip shall have a safe and practical access point to the formed carriageway to meet criteria herein.

5. Subgrade: Subgrade shall exclude organic or wet material and shall be trimmed and compacted. Minimum CBR 7.0 or 33mm blow with scala penetrometer.

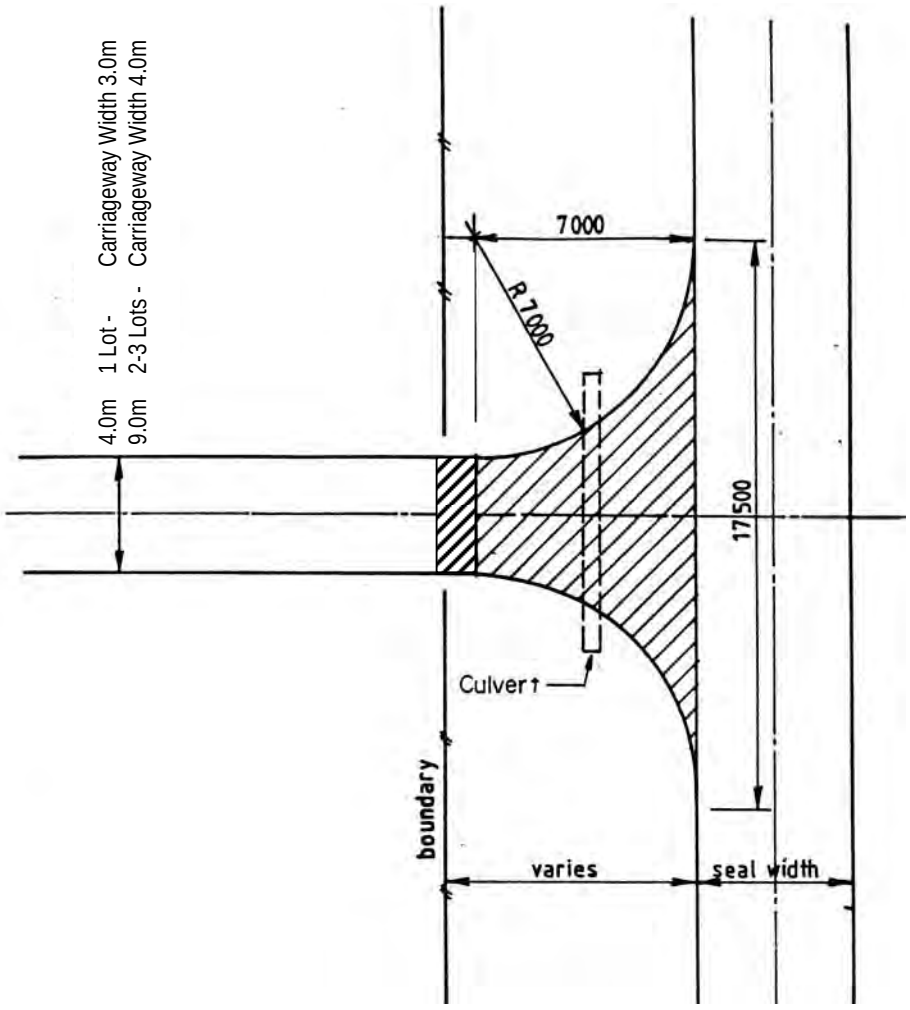
6. Basecourse: Shall be GAP 40 or MAP 40 compacted to a dense state. Clegg impact value of 33 or better. Minimum compacted thickness shall be 100mm for unsealed access or 125mm for sealed access.

7. Stormwater: Provision shall be made for the collection and disposal of stormwater. All upstream catchment shall be provided for. Consideration shall be given to scour and/or silting. All culverts shall be 300mm dia minimum installed to manufactures recommendations.

8. Sealcoat: Shall be 2 coat chipseal Grade 4 (First Coat) and Grade 5 (Second Coat). Asphaltic concrete and cobblestone paving will be permitted subject to specific approval of details.

9. Curves and Corners: Minimum inside radius of curves shall be 9 metres.

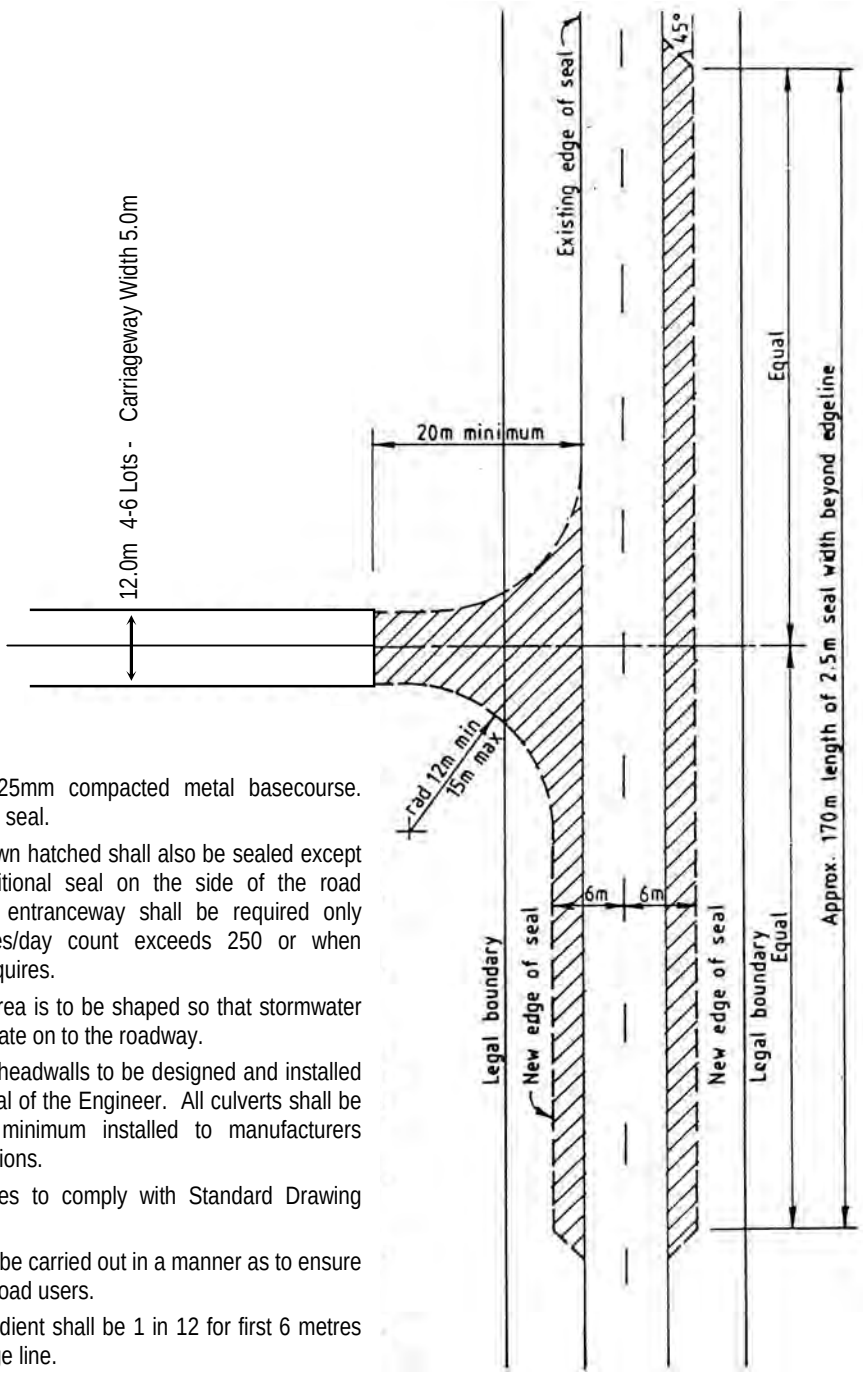
10. Accessway Width: The legal boundary of the accessway shall include all cut and fill batters and passing bays and if necessary minimum dimensions in Table 1 shall be increased.



Notes:

1. Formation: 100mm compacted metal basecourse.
2. Where the road is sealed the entrance area (shown hatched) shall also be sealed. The sealed area is to be shaped so that stormwater does not migrate on to the Highway.
3. Culverts and headwalls to be designed and installed to the approval of the Engineer. All culverts shall be 300mm dia minimum installed to manufacturers recommendations.
4. Sight distances to comply with Standard Drawing R 25.
5. All work shall be carried out in a manner as to ensure the safety of road users.
6. Maximum gradient shall be 1 in 12 for first 6 metres from road edge line.
7. Refer also to Standard Drawing R 27.

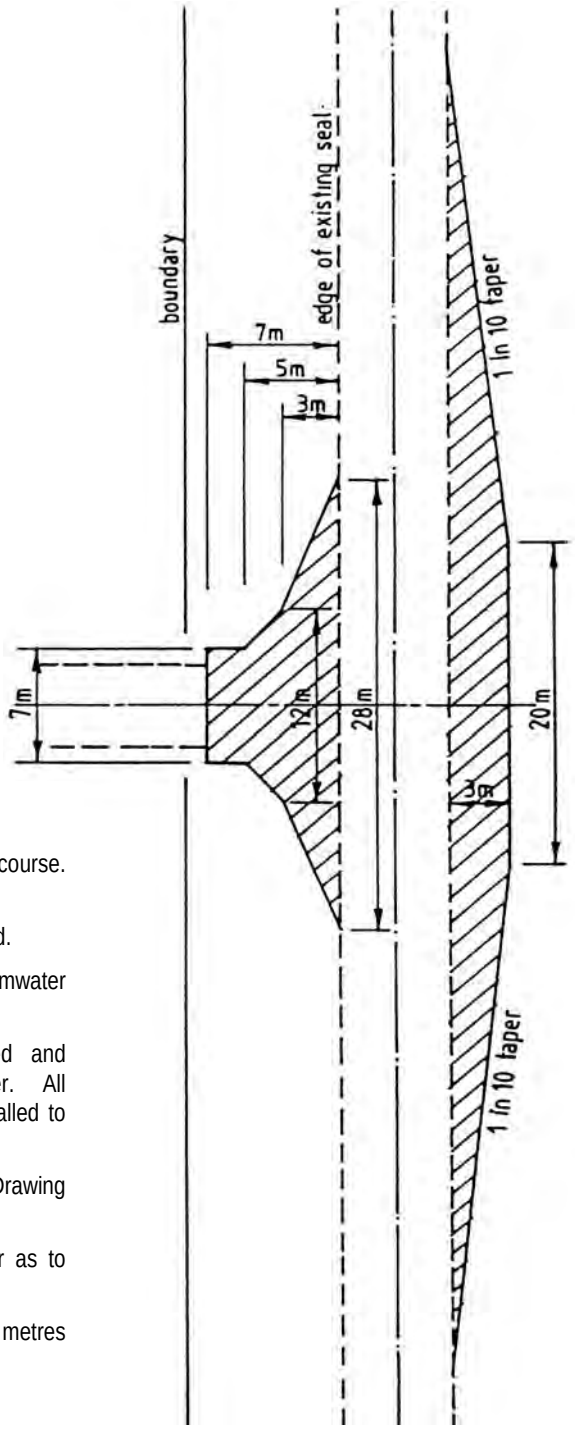
Opotiki District Council	Standard Drawings	*Not to Scale*
	Rural Vehicle Entrance (1 to 3 Lots)	R 28



Notes:

1. Formation: 125mm compacted metal basecourse. Two coat chip seal.
2. All areas shown hatched shall also be sealed except that the additional seal on the side of the road opposite the entranceway shall be required only when vehicles/day count exceeds 250 or when Transit NZ requires.
3. The sealed area is to be shaped so that stormwater does not migrate on to the roadway.
4. Culverts and headwalls to be designed and installed to the approval of the Engineer. All culverts shall be 300mm dia minimum installed to manufacturers recommendations.
5. Sight distances to comply with Standard Drawing R25.
6. All work shall be carried out in a manner as to ensure the safety of road users.
7. Maximum gradient shall be 1 in 12 for first 6 metres from road edge line.
8. Refer also to Standard Drawing R 27

Opotiki District Council	Standard Drawings	*Not to Scale*
	Rural Vehicle Entrance (4 or More Lots)	R 29



Notes:

1. Formation: 150mm compacted metal basecourse. Two coat chip seal.
2. All areas shown hatched shall also be sealed.
3. The sealed area is to be shaped so that stormwater does not migrate on to the roadway.
4. Culverts and headwalls to be designed and installed to the approval of the Engineer. All culverts shall be 300mm dia minimum installed to manufacturers recommendations.
5. Sight distances to comply with Standard Drawing R25.
6. All work shall be carried out in a manner as to ensure the safety of road users.
7. Maximum gradient shall be 1 in 12 for first 6 metres from road edge line.

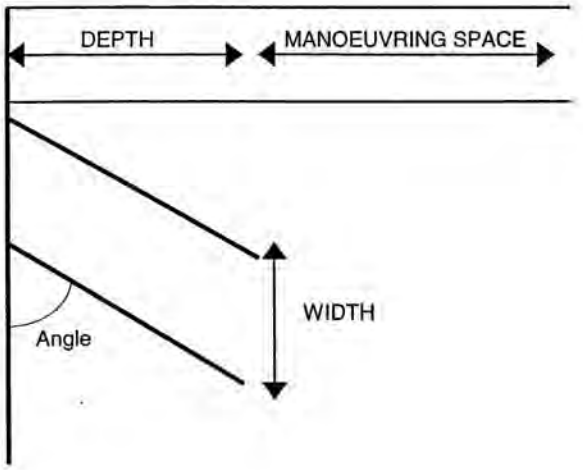
Opotiki District Council	Standard Drawings	*Not to Scale*
	Rural Vehicle Entrance Heavy Commercial Access	R 30

Car parking dimensions

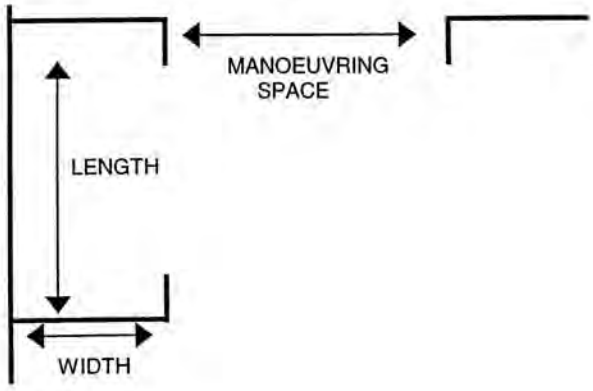
Minimum requirements for car parking spaces

Parking type	Width	Depth	Manoeuvring space	Total depth needed
Angle parking 90^0	2.5m	4.9m	7.7m	12.6m
Angle parking 75^0	2.5m	5.2m	6.3m	11.5m
Angle parking 60^0	2.5m	5.2m	4.1m	9.3m
Angle parking 45^0	2.5m	4.9m	3.7m	8.6m
Angle parking 30^0	2.5m	4.0m	3.7m	7.7m
		Length		
Parallel parking	2.5m	6.1m	3.7m	

ANGLE PARKING



PARALLEL PARKING

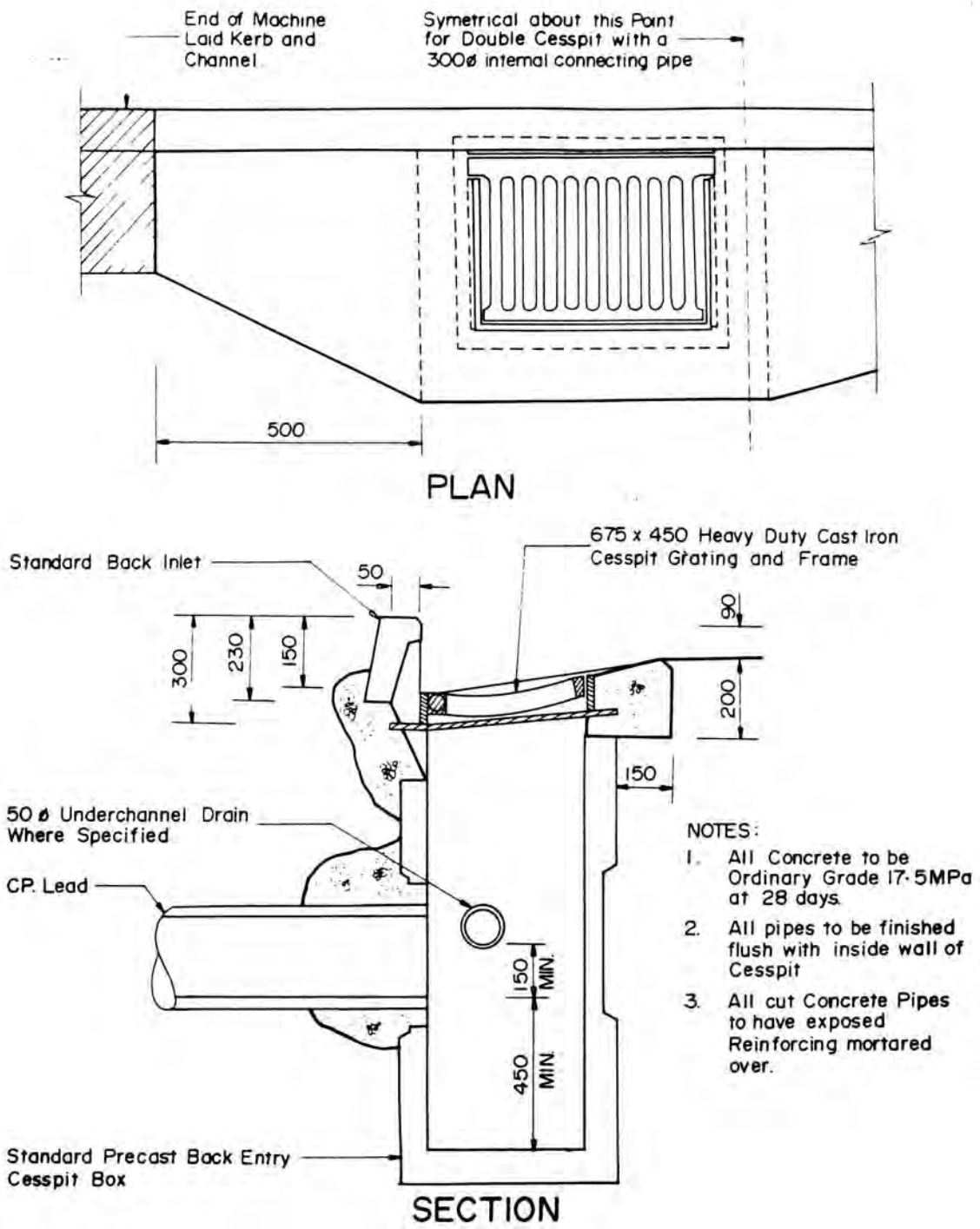


Opotiki District Council	Standard Drawings	*Not to Scale*
	Car Parking Dimensions	R 31

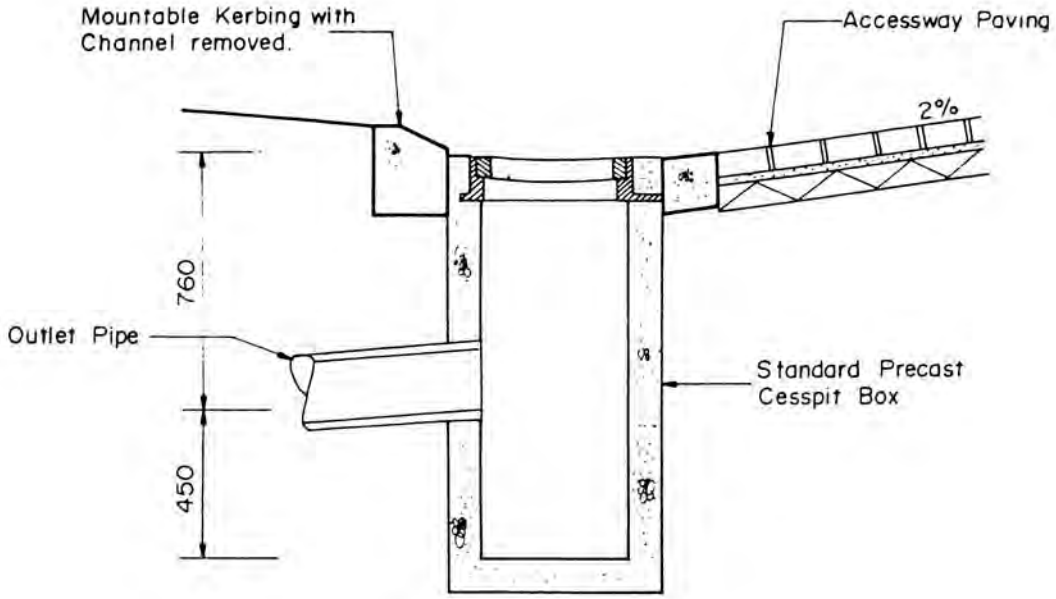
Appendix 1I

Standard Drawings

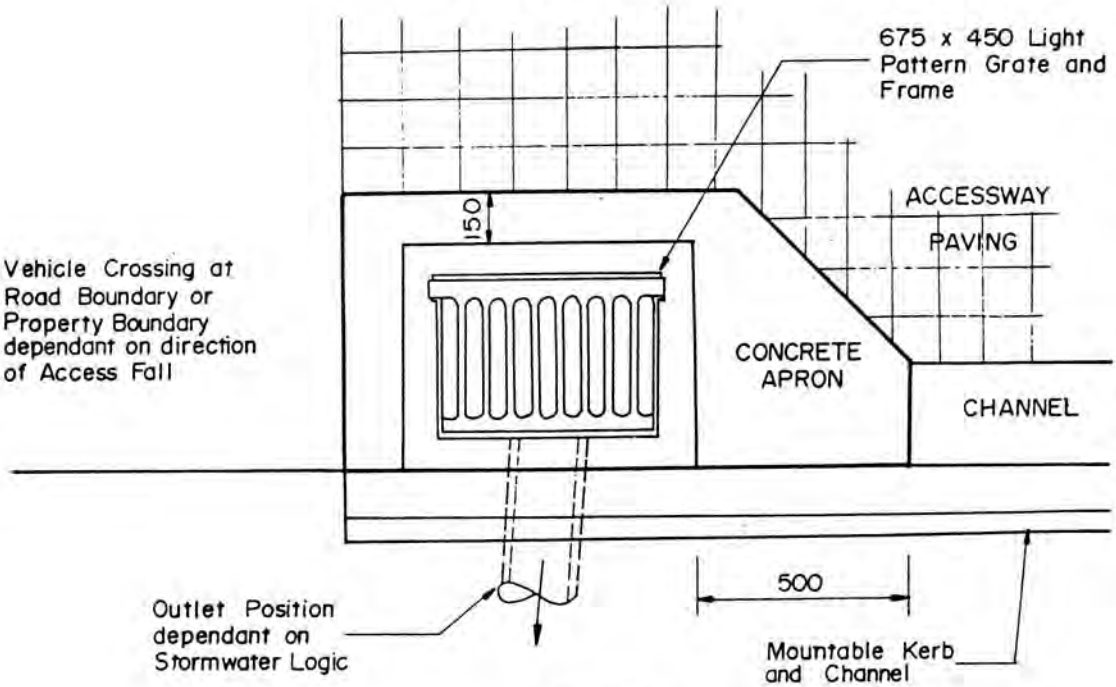
SW 01 to WS 14



Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Cesspit	SW 01

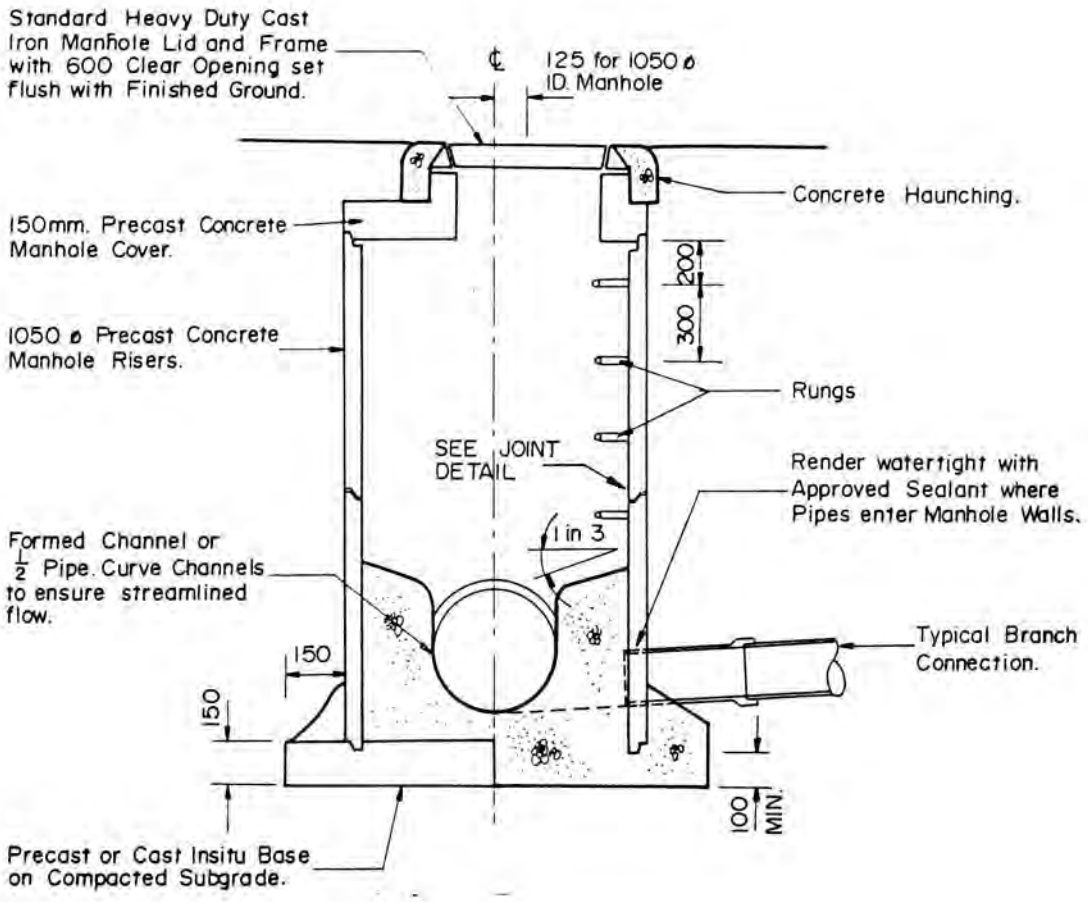


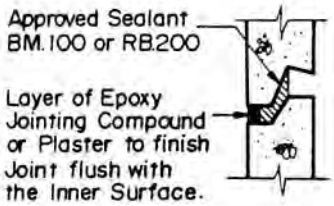
SECTION



PLAN

Opotiki District Council	Standard Drawings	*Not to Scale*
	Private Access Cesspit	SW 02



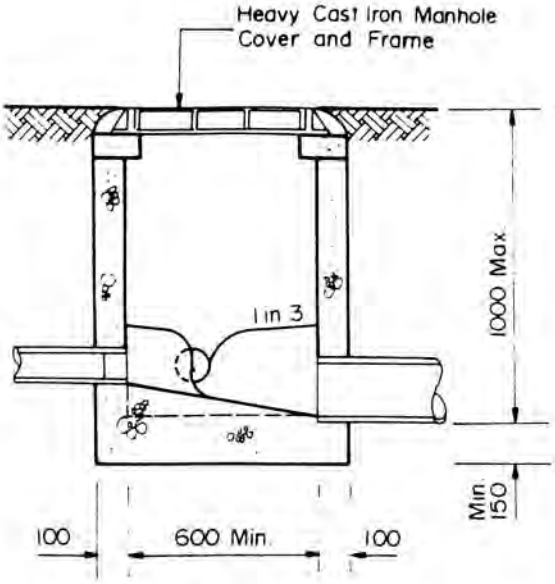


JOINT DETAIL

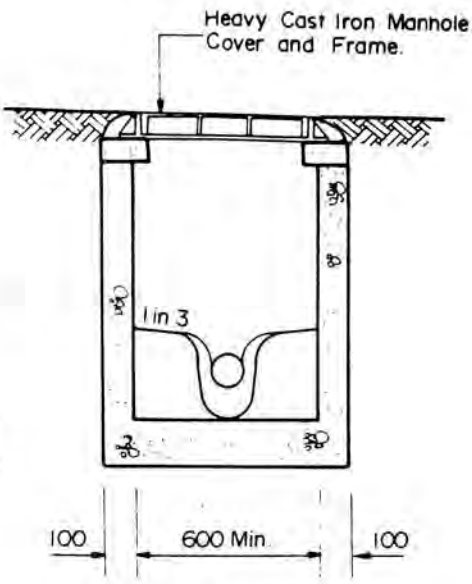
Notes

1. All cast insitu concrete other than site concrete shall have a minimum strength of 20 MPa at 28 days.
2. All precast manhole units are standard manufactured concrete units from a certified precast supplier.
3. Refer to drawing SS 06 & SS 07 for further details.
4. Manhole sizes subject to specific size design where pipes are larger than 750 mm dia or where angle or number of lines makes 1050 dia too small.
5. All cut concrete pipes to have exposed reinforcement mortared over.

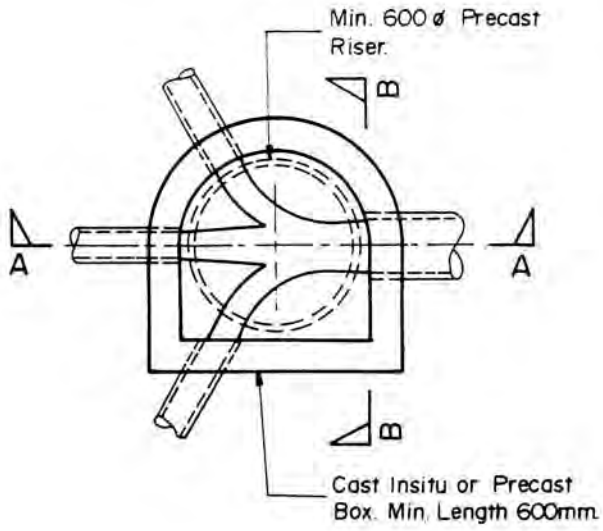
Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Manhole Details	SW 03



SECTION A-A



SECTION B-B

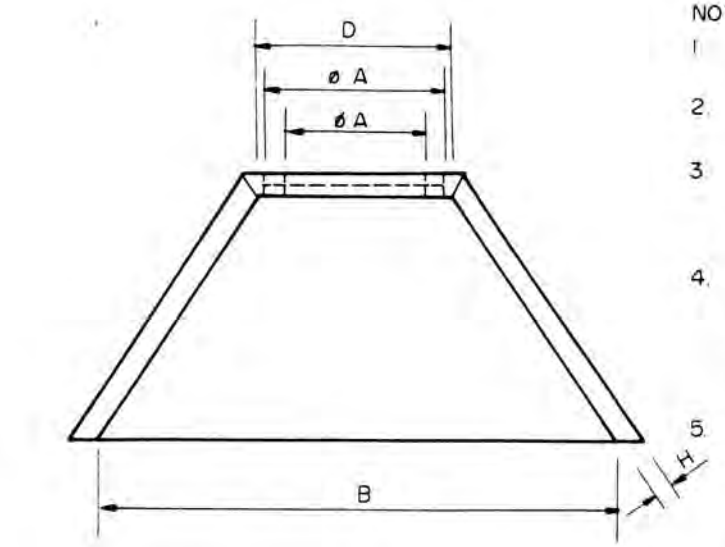


PLAN

NOTES :

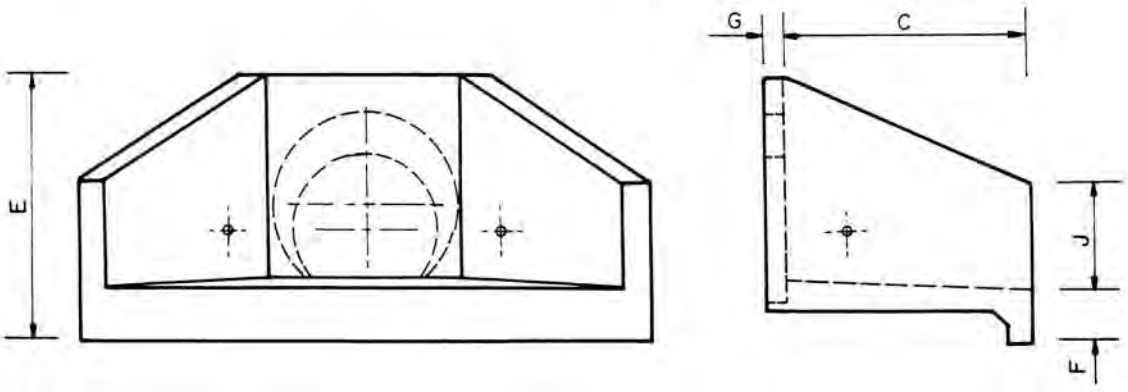
1. Refer to Drawing SS.05 for further Lid Details.
2. All pipes to be finished Flush with outside of Manhole Wall.
3. All cut Concrete Pipes to have exposed Reinforcement mortared over.
4. All Concrete to have a minimum Compressive Strength of 17·5 MPa. at 28 days.
5. Chambers must be large enough to allow full Benching.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Shallow Manhole Details	SW 04



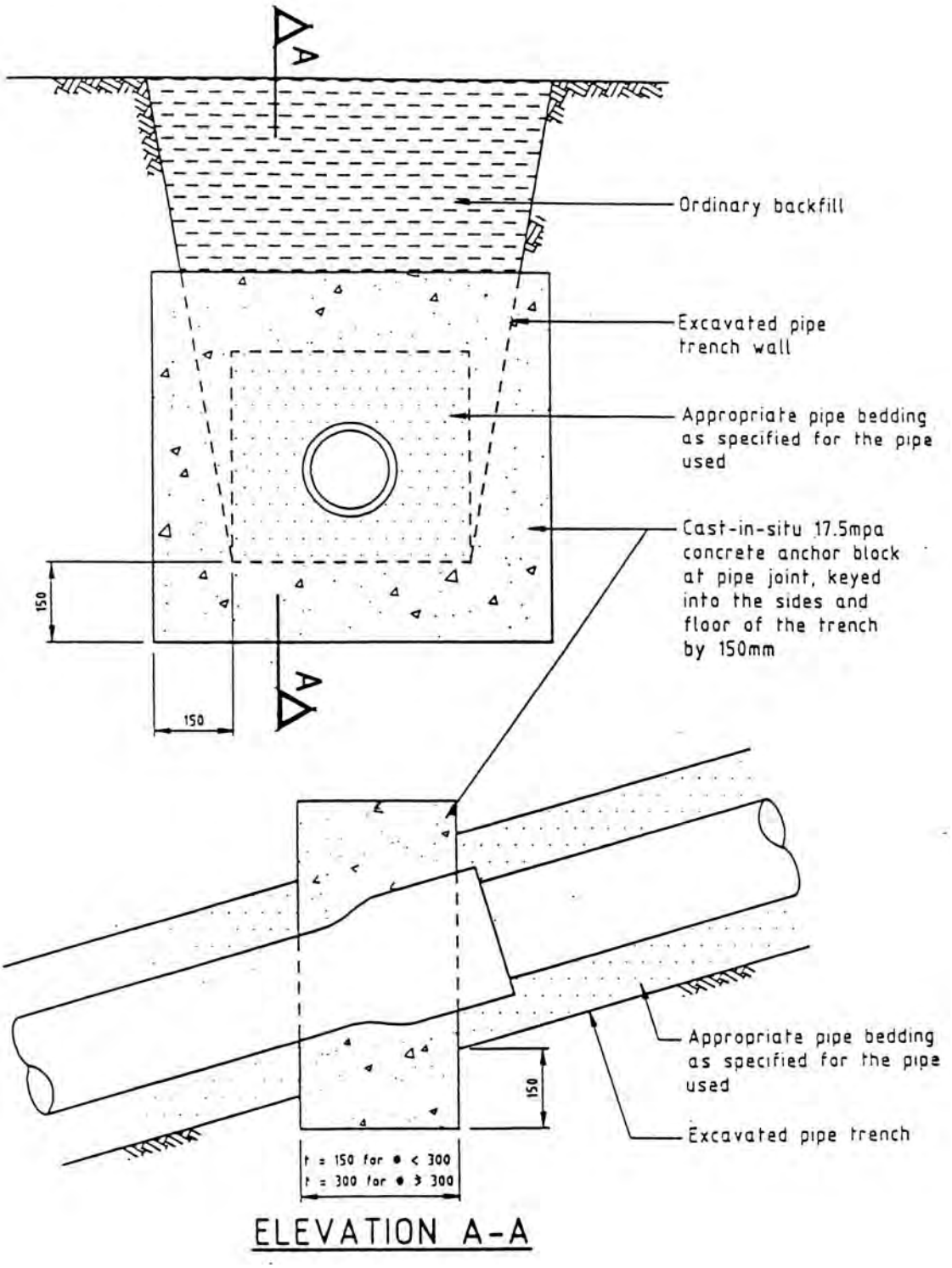
NOTES

1. Concrete strength & Reinforcement to be designed by Precaster.
2. Allow to bed Wingwall Unit on 300mm. Min. Drainage Metal.
3. Allow to provide Scour Protection where Outlet Velocities and Soft Soil Conditions dictate.
4. Allow to provide to the satisfaction of The Engineer a Galvanised Screen over the end of pipe in Residential Zones to prevent children entering pipe.
5. For Outfalls with Floodgates confirm Hole position with The Engineer prior to Fabrication.



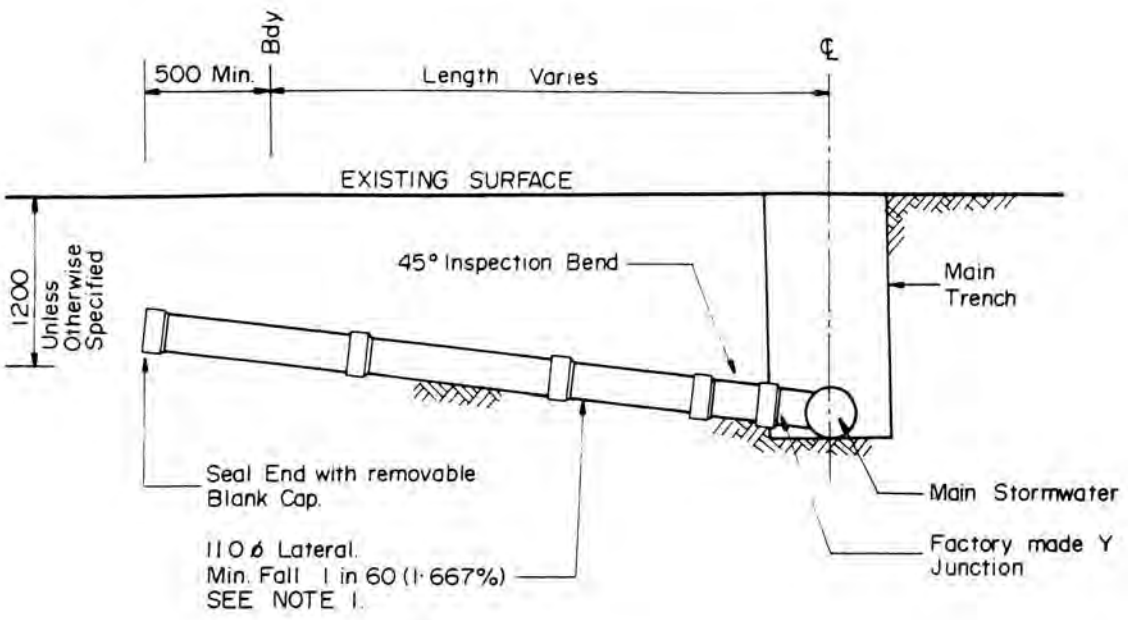
WING WALL DIMENSIONS											
Unit	Nominal Pipe Diameter	Approx. Mass KG	A		B	C	D	E	F	G H	J
			O/D Soft Spot	Hole to Suit							
Small	100– 300	185	375	225 or 300	1130	510	447	590	200	60	180
Medium	300– 675	650	800	600	2130	995	810	1075	200	100	430
Large	600-1050	1800	1250	-	3500	1670	1650	1775	250	100	580
Dimension A is either a soft spot or a hole only.										All dimensions are in millimetres.	

Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Outlet Details	SW 05



ELEVATION A-A

Opotiki District Council	Standard Drawings	*Not to Scale*
	Anti-Scour Block Details	SW 06



STANDARD CONNECTION FOR STORMWATER

Notes:

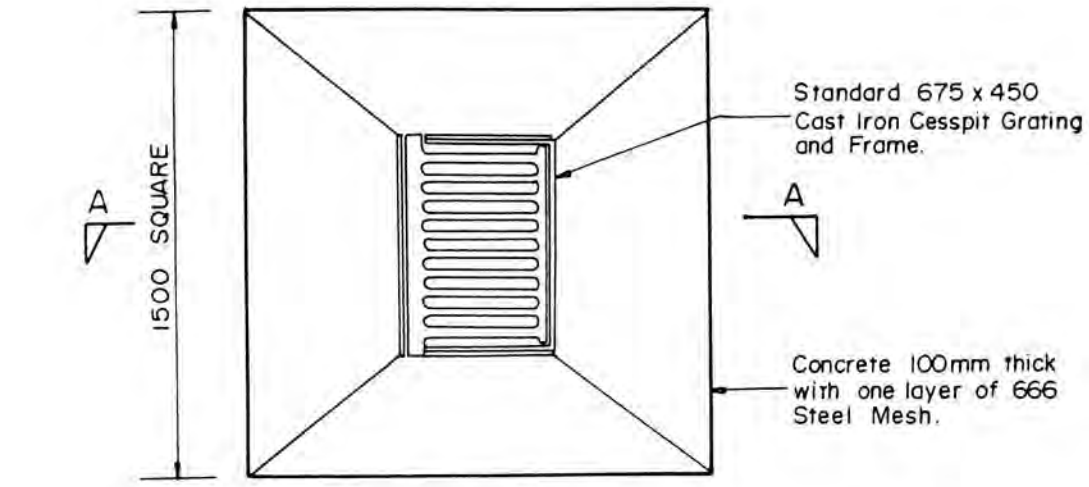
1. Pipe sizes shall match design flows from property served.

   Minimum Size: Industrial/Commercial - 160ø
   Residential - 110ø

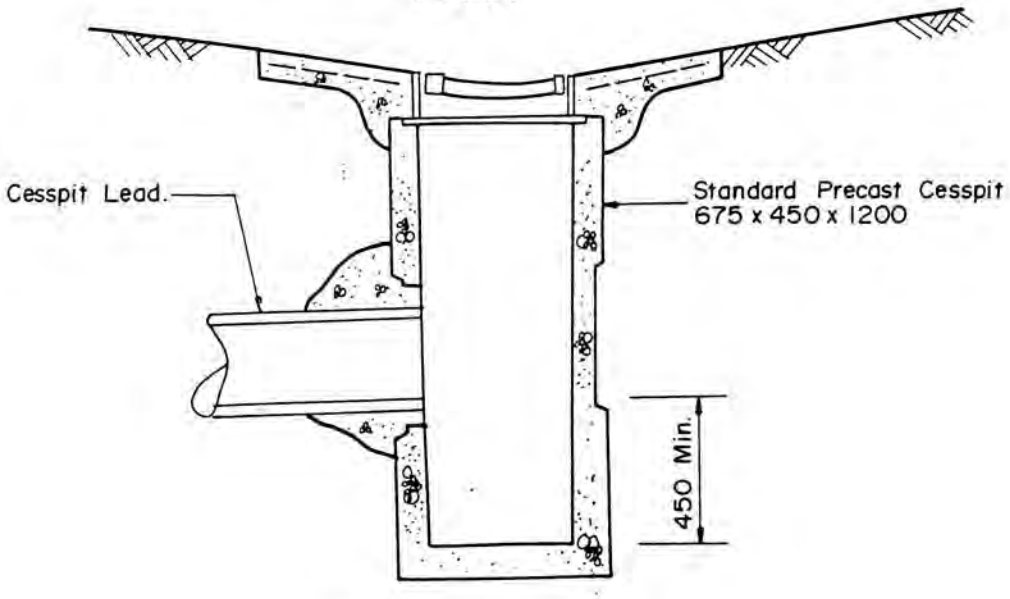
2. For large diameter pipes where factory junctions are not available, saddle connections subject to the approval of the Engineer may be allowed.

   When connecting to concrete pipes, hole openings shall be saw cut into the stormwater main.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Stormwater Connection	SW 07



PLAN

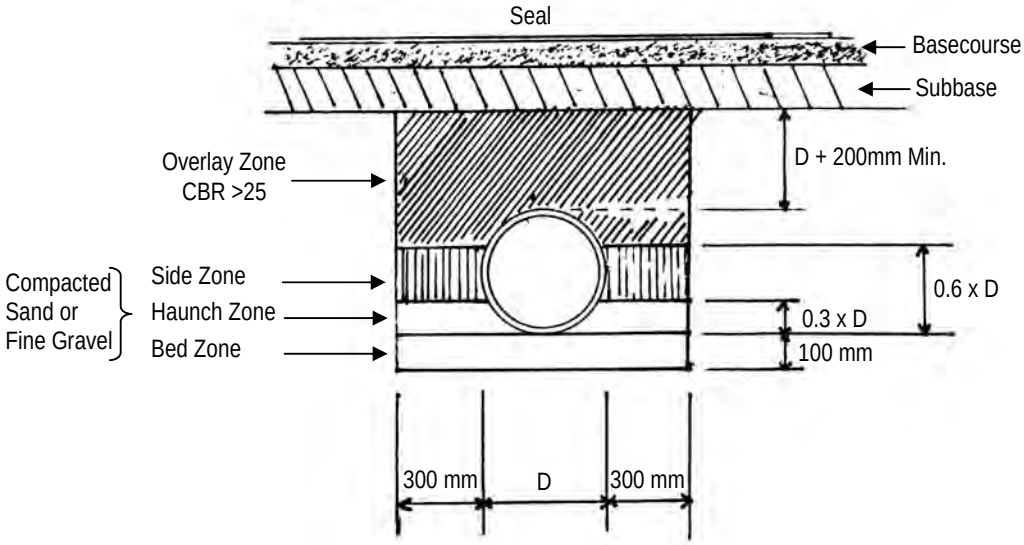


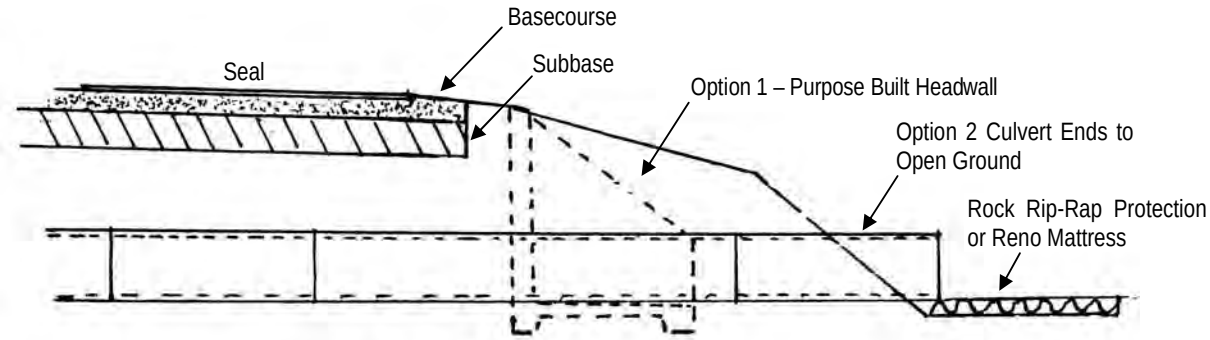
SECTION A-A

Notes:

1. All concrete to be ordinary grade 17.5 MPa at 28 days.
2. All pipes to be finished flush with inside wall of cesspit.
3. All cut concrete pipes to have exposed reinforcement mortared over.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Berm Cesspit	**SW 08**

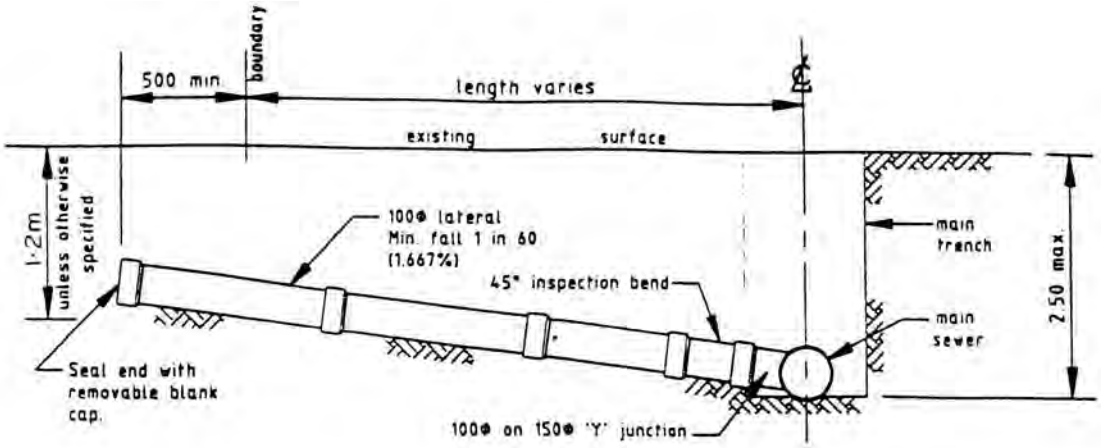




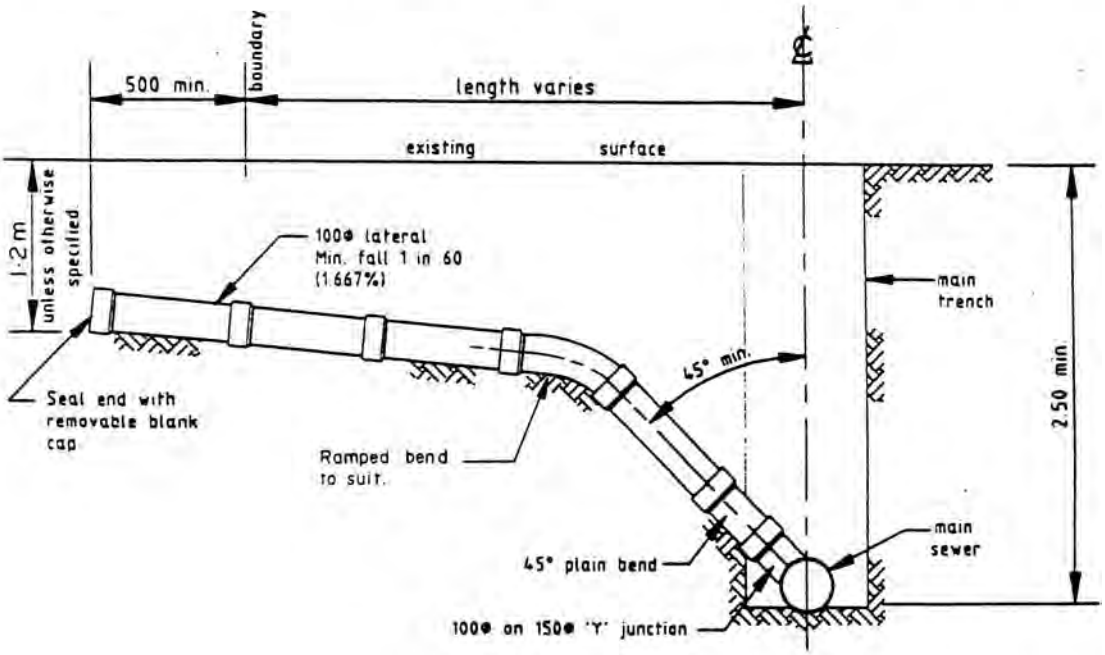
Note:

1. All culvert pipes shall be collared joined reinforce concrete, complete with rubber rings.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Culvert Installation	SW 09

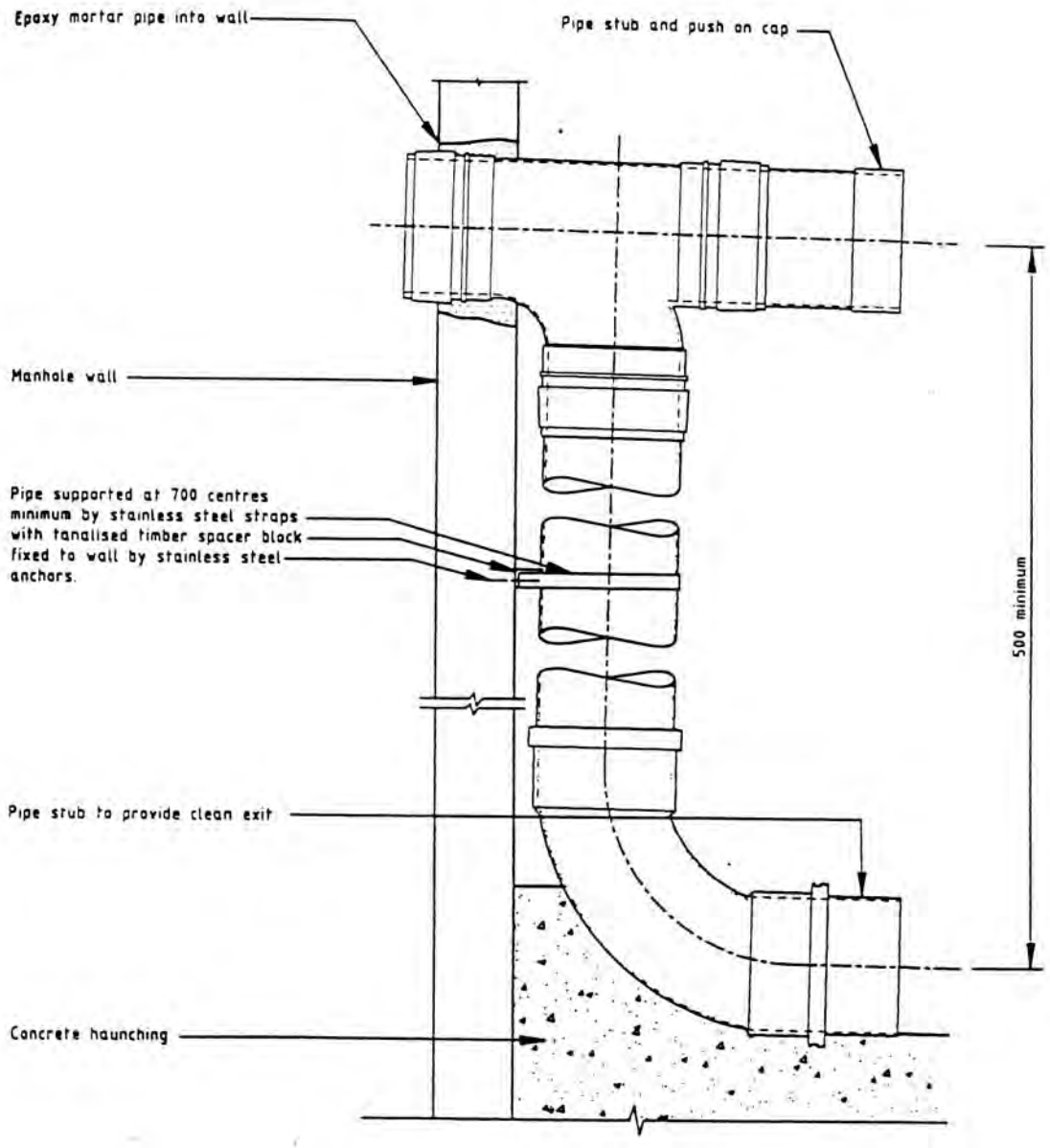


STANDARD CONNECTION FOR SEWERS WITH A DEPTH TO INVERT LESS THAN 2.50m

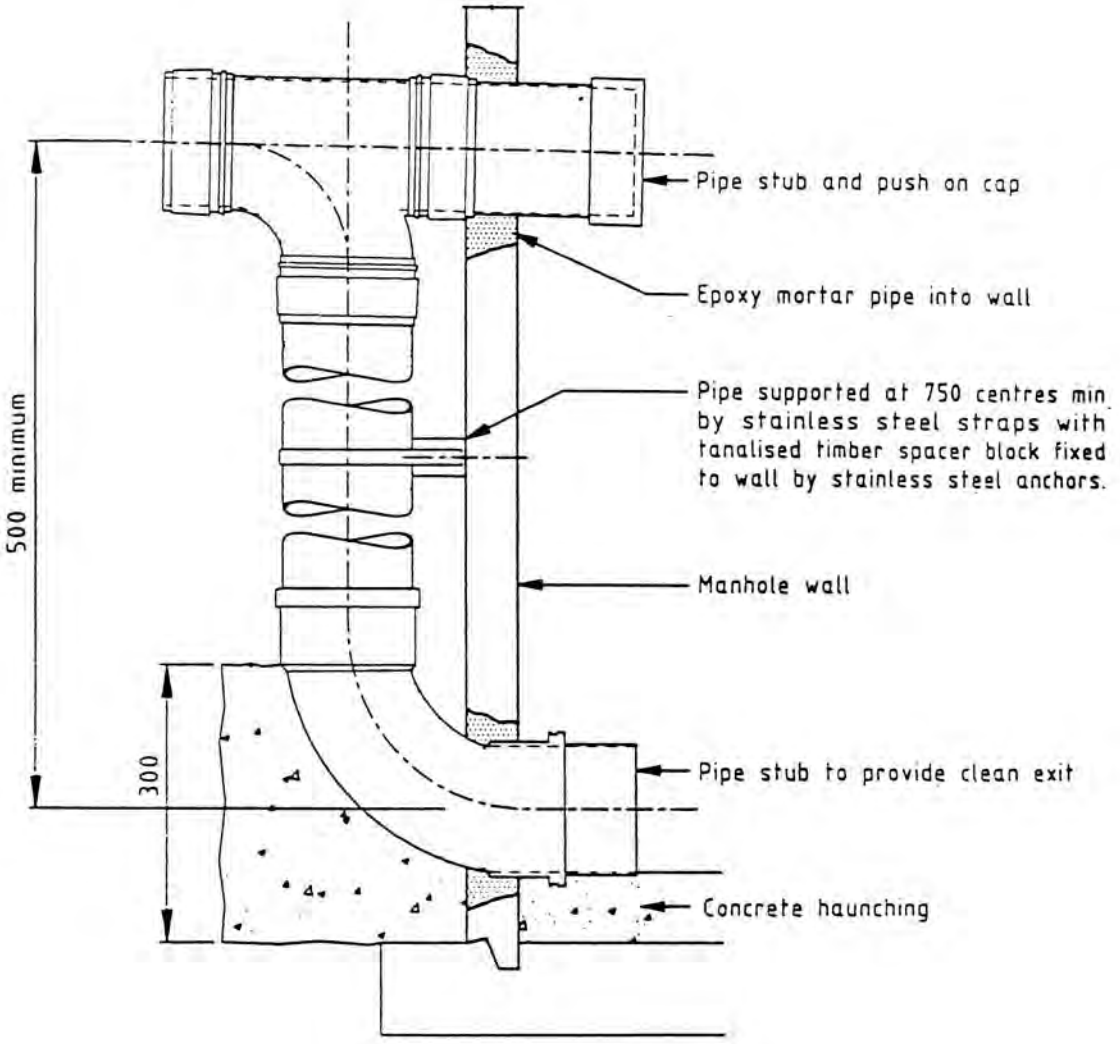


RAMP RISER CONNECTION FOR SEWERS WITH A DEPTH TO INVERT GREATER THAN 2.50m

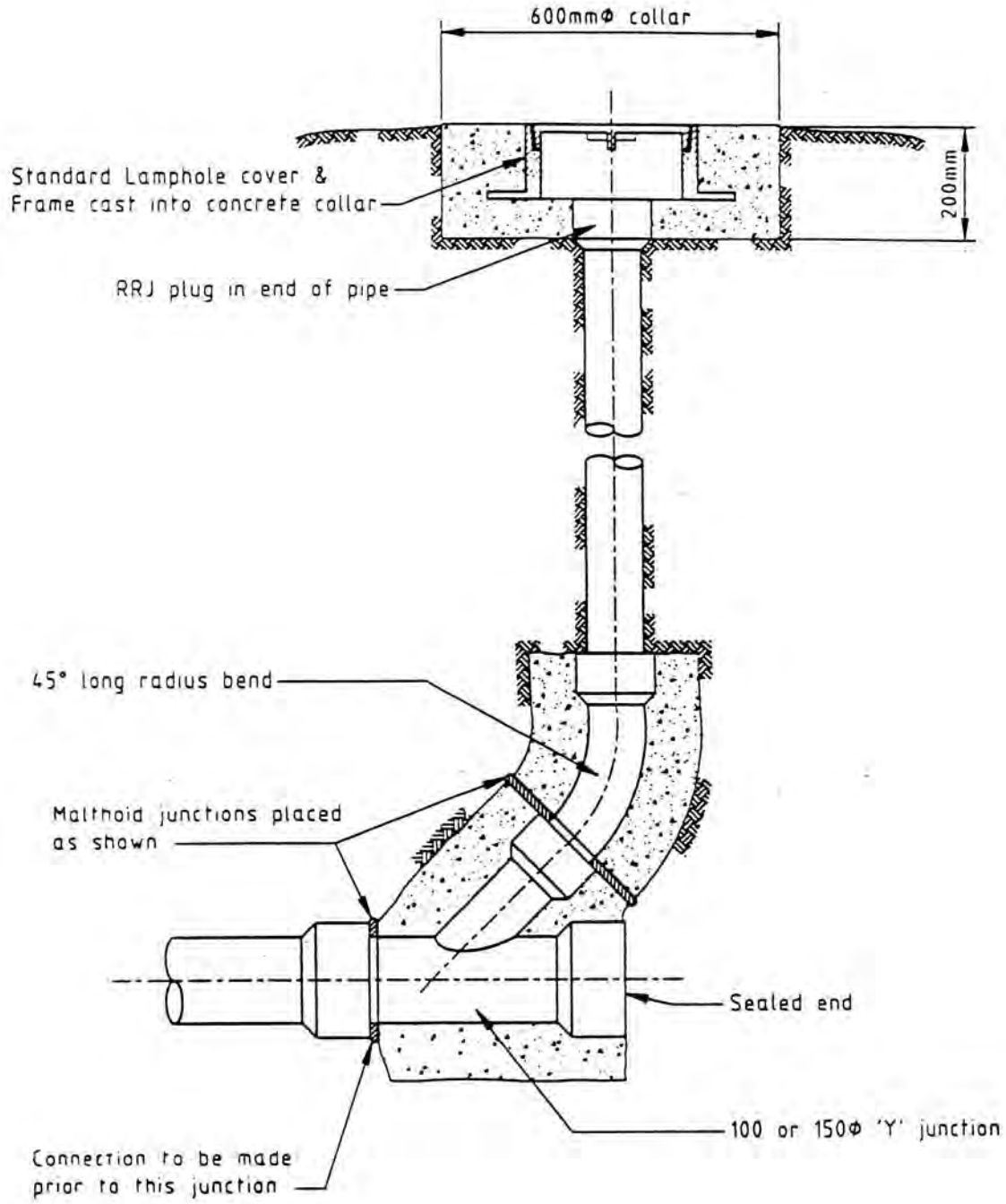
Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Sewer Connections	SS 01



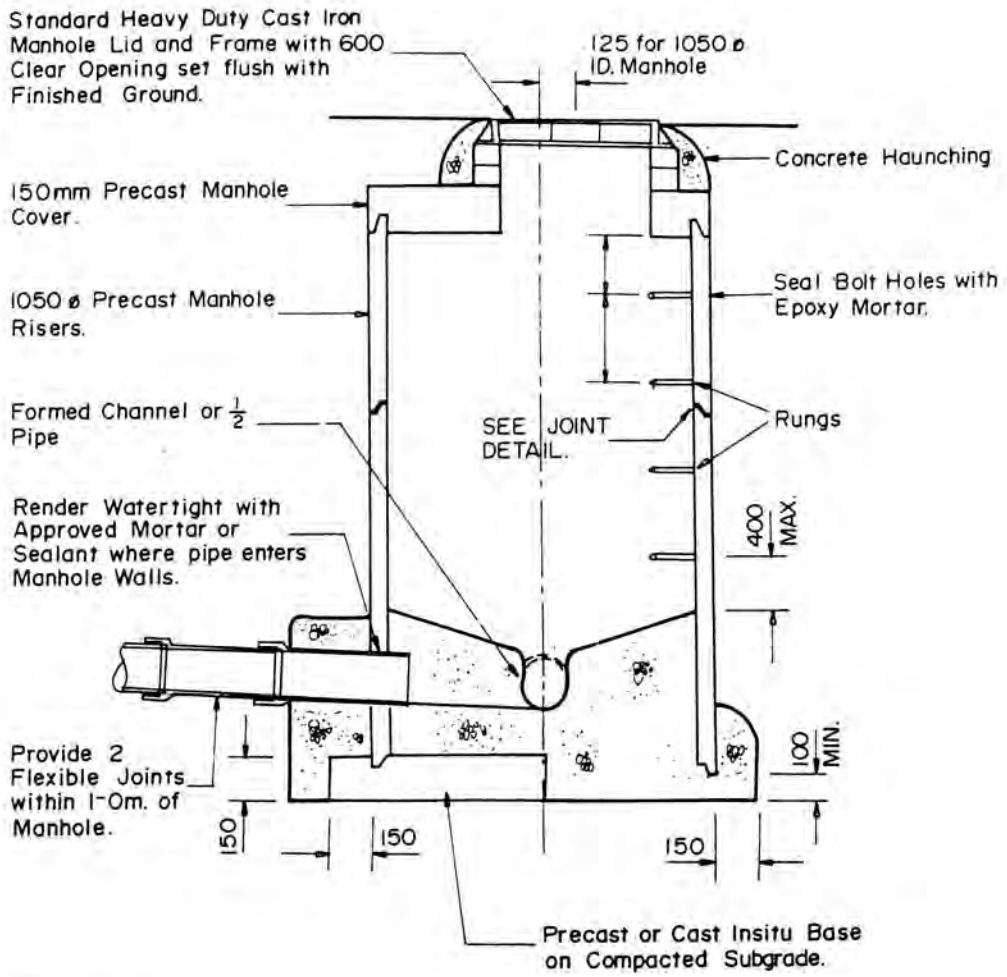
Opotiki District Council	Standard Drawings	*Not to Scale*
	Internal Drop Connection For 100mm Diameter Pipes	SS 02

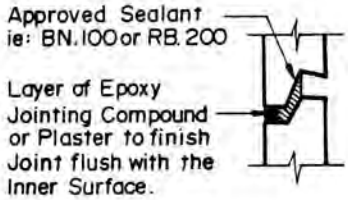


Opotiki District Council	Standard Drawings	*Not to Scale*
	External Drop Connection For 150mm Diameter Pipes	SS 03



Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Cleaning Eye	SS 04



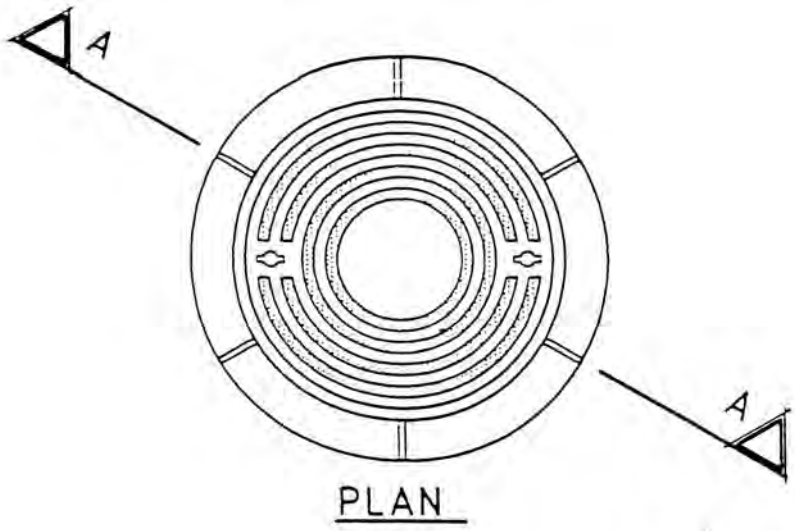


JOINT DETAIL

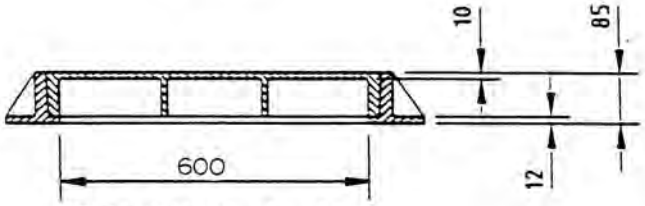
Notes

1. All cast insitu concrete other than site concrete shall have a minimum strength of 20 MPa at 28 days.
2. All precast manhole units are standard manufactured concrete units from a certified precast supplier.
3. Refer to drawing SS 06 & SS 07 for further details.
4. All Main Pipes constructed as per Lateral Pipes.

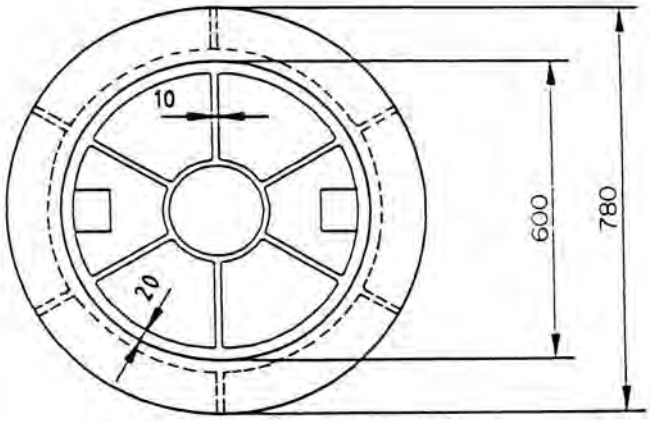
Opotiki District Council	Standard Drawings	*Not to Scale*
	Standard Sewer Manhole	**SS 05**



PLAN



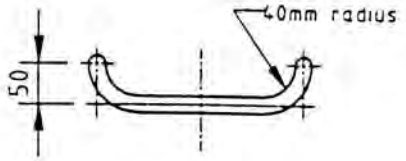
SECTION A-A



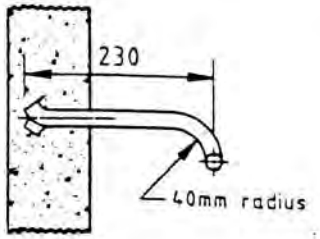
BOTTOM VIEW

APPROX WEIGHTS
COVER 48 kg
FRAME 40 kg

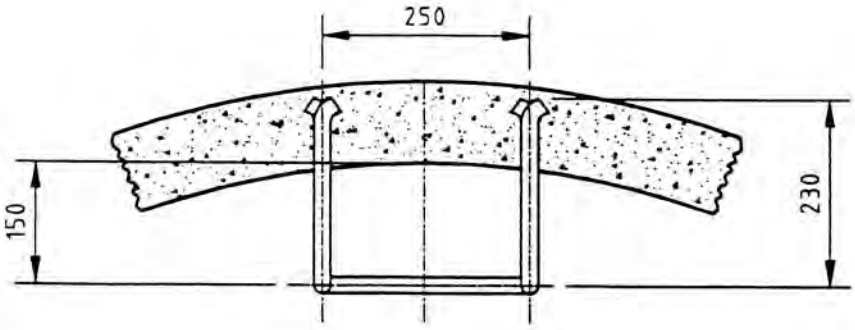
Opotiki District Council	Standard Drawings	*Not to Scale*
	Heavy Duty Manhole Cover and Frame	SS 06



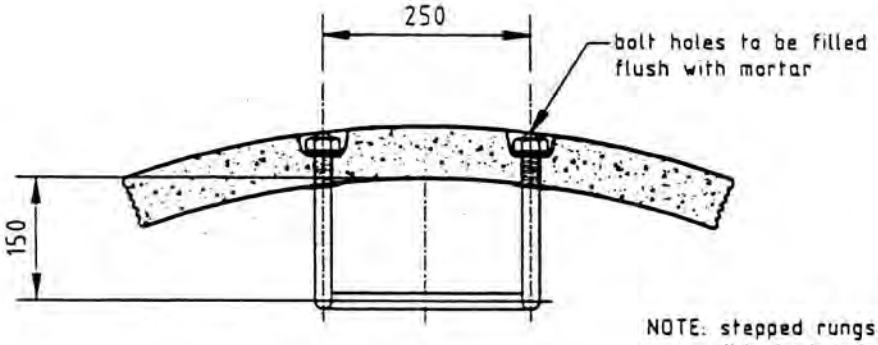
ELEVATION



SECTION



PLAN (cast in situ)

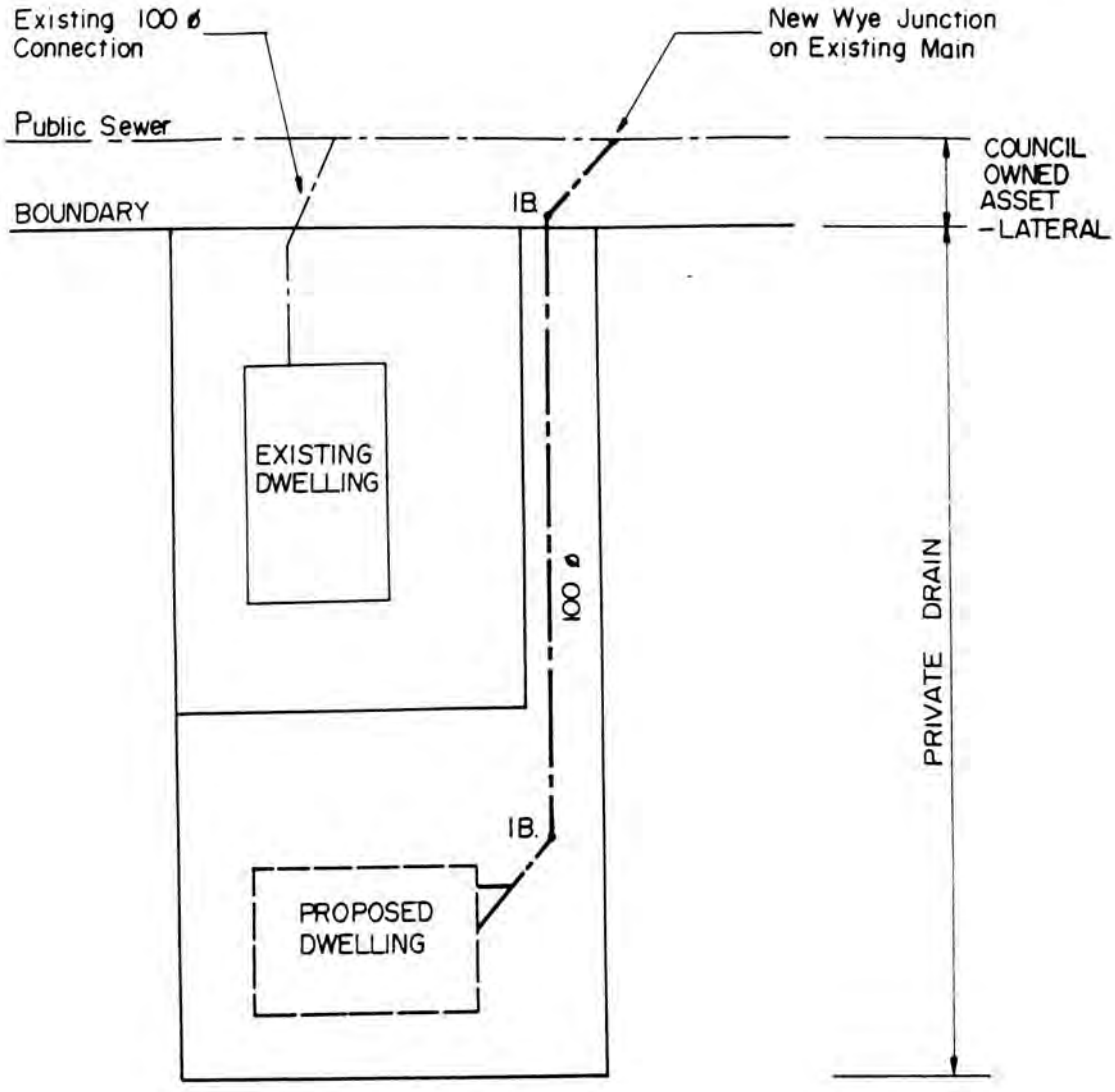


PLAN (precast)

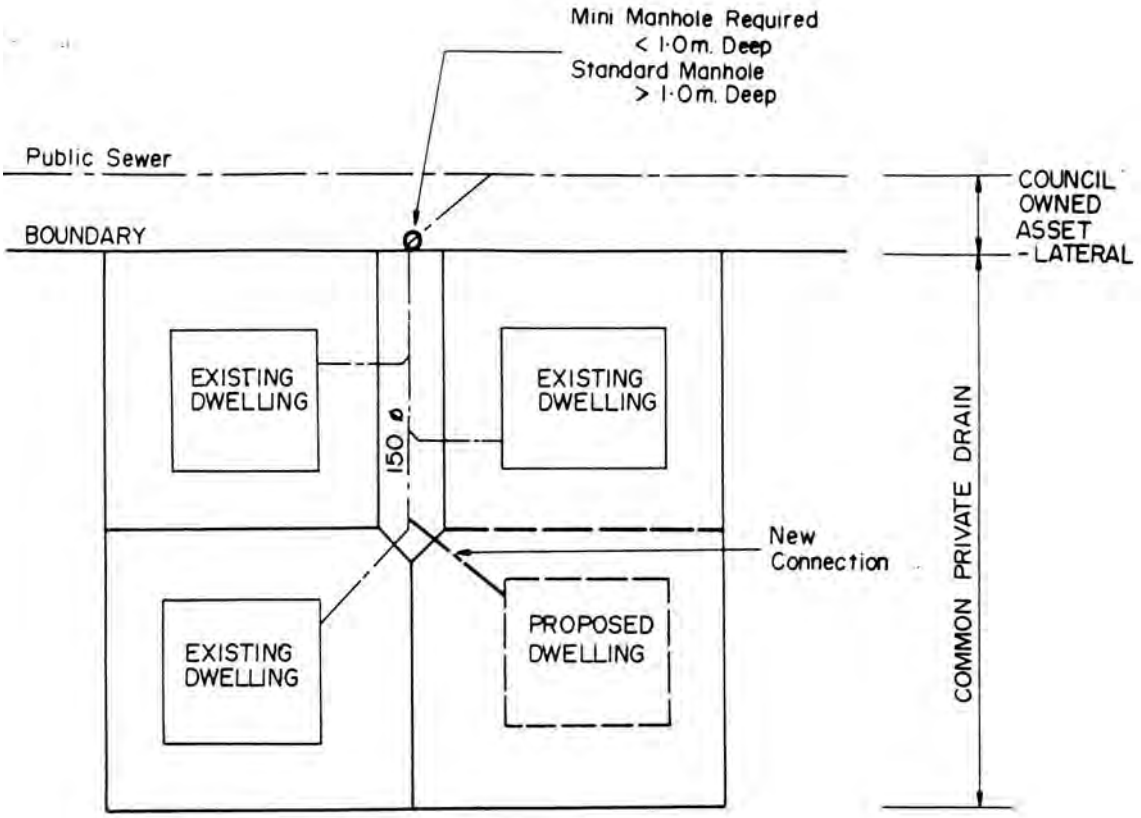
NOTE: stepped rungs shall be 20mmΦ mild steel rods, hot dipped galvanised after fabrication. The zinc coating to be not less than 400g/sq.m.

DETAILS OF STEPPED RUNGS

Opotiki District Council	Standard Drawings	*Not to Scale*
	Manhole Stepped Rungs	SS 07



Opotiki District Council	Standard Drawings	*Not to Scale*
	Private Drain to Public Sewer (Preferred Option)	SS 08



Conditions of Approval:

a. Approval from existing owners.

b. common private drain must be 150mm dia.

c. Must have mini manhole at lateral (<1m) or standard manhole (>1m).

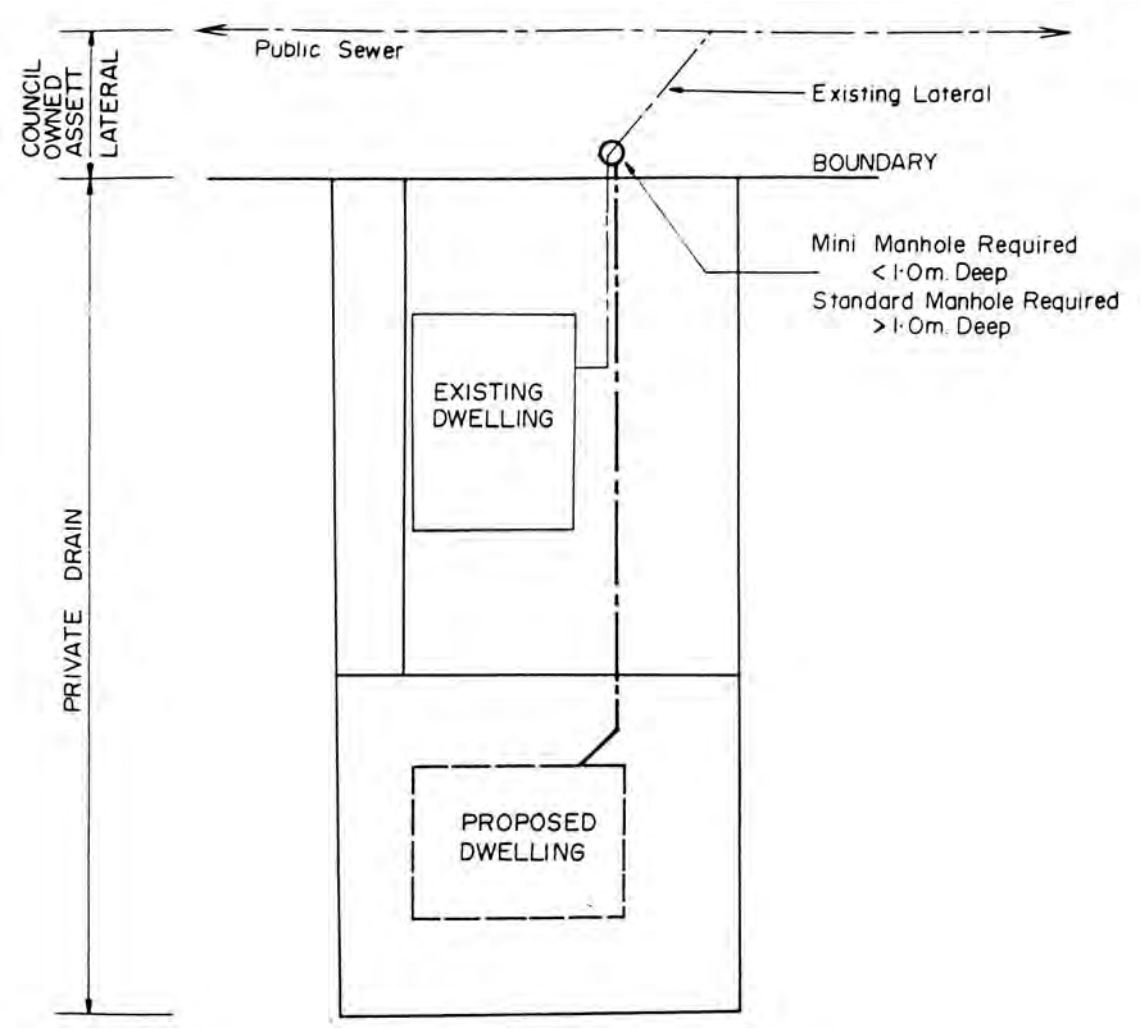
d. Council may require a sewer lateral inspection test.
- If requested this must be paid for by applicant.
- If test passed then connection approved.

If failed:

(i) Council will pay for lateral upgrade if only 1 additional household unit connecting.

(ii) Council will require contribution if >1 additional household unit connection.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Private Drain to Common Private Drain	SS 09



Conditions of Approval:

(a) Must have mini manhole at lateral (<1m) or
or standard manhole (>1m).

(b) Council may require a sewer lateral inspection test.

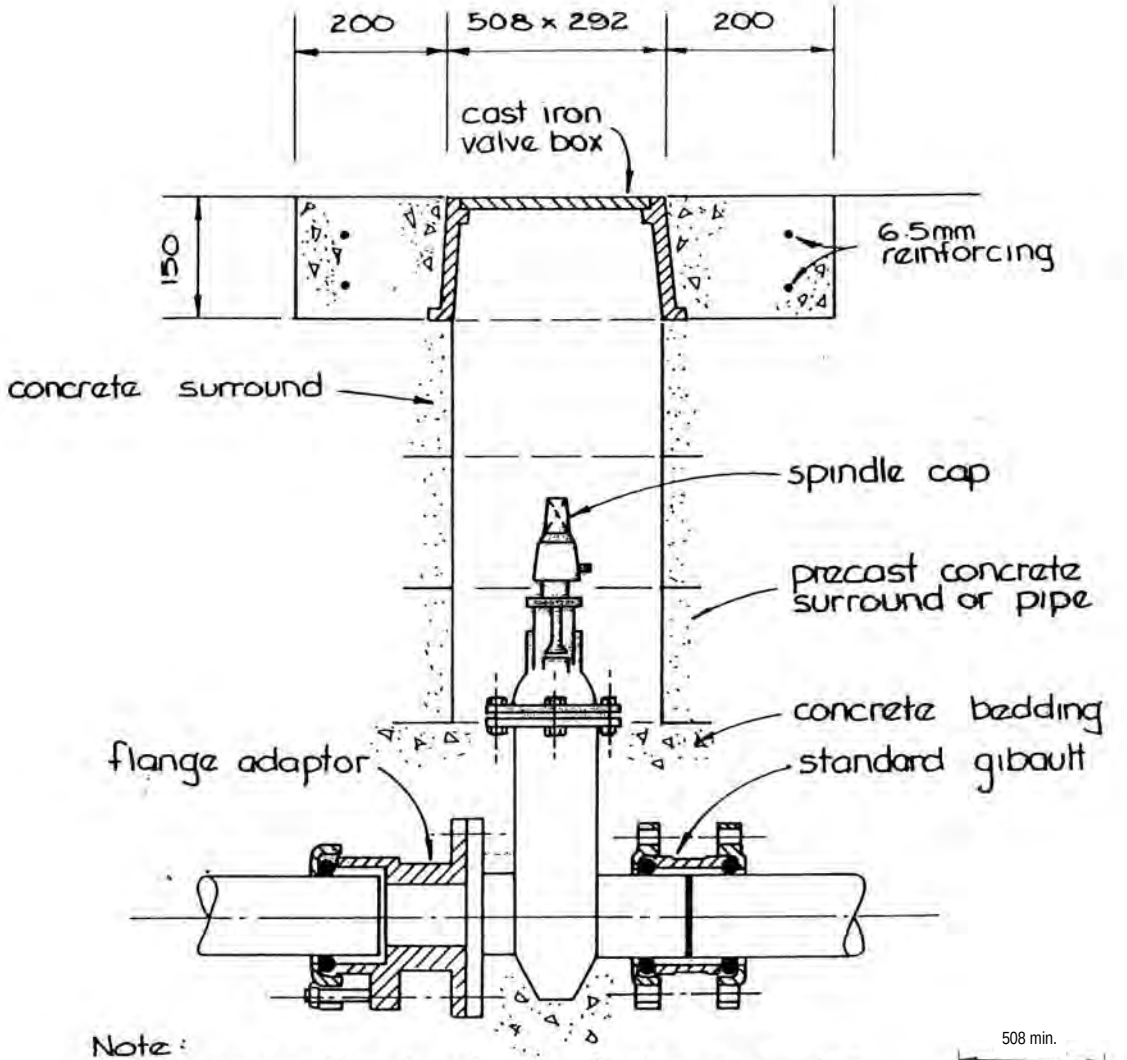
- If requested this must be paid for by applicant.
- If test passed then connection approved.

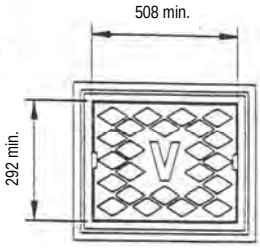
If failed:

(i) Council will pay for lateral upgrade if only 1 additional household unit connecting.

(ii) Council will require contribution if >1 additional household unit connection.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Private Drain To An Existing Lateral Connection	SS 10



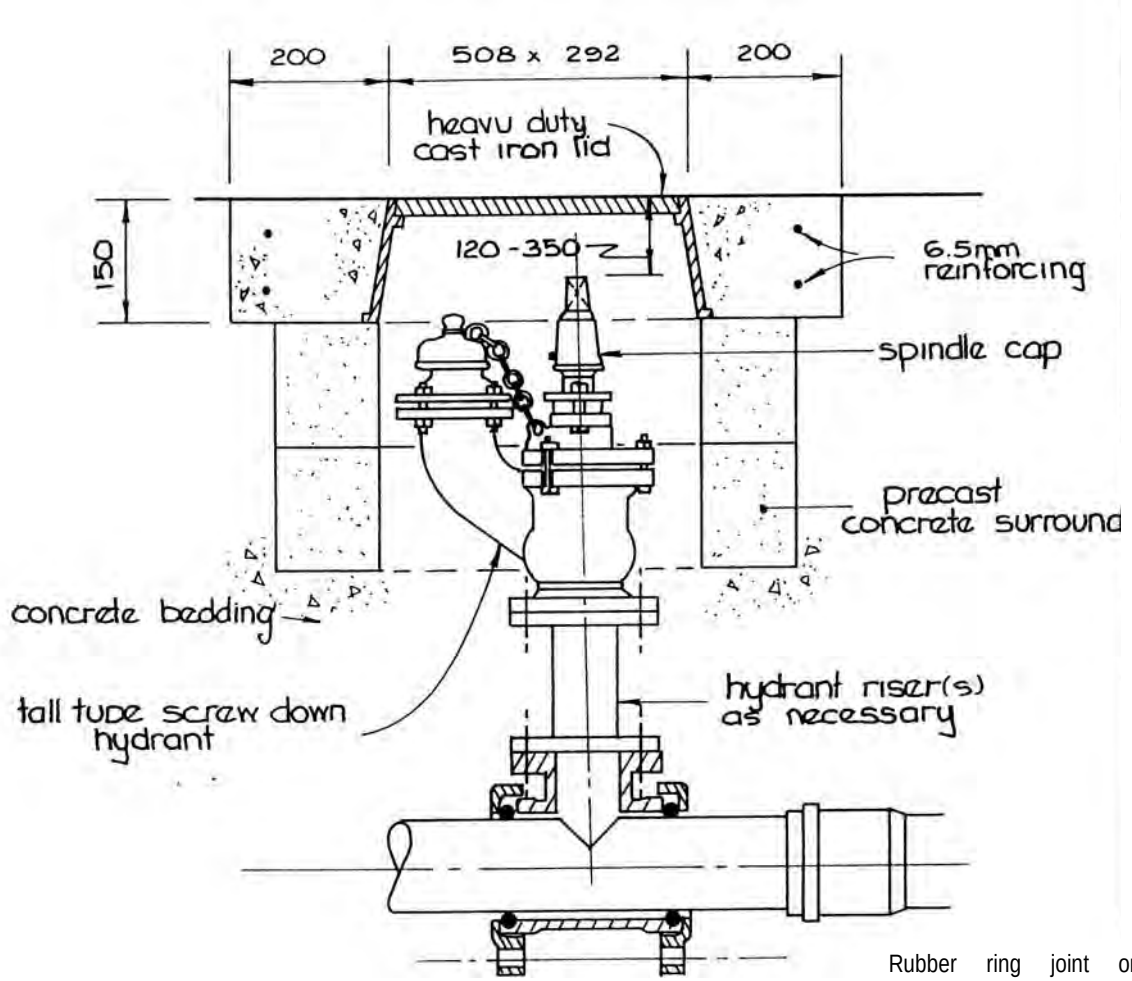


Top View

Note:

1. Allow to paint valve lid with 2 coats of road marking paint white to TNZ specifications.

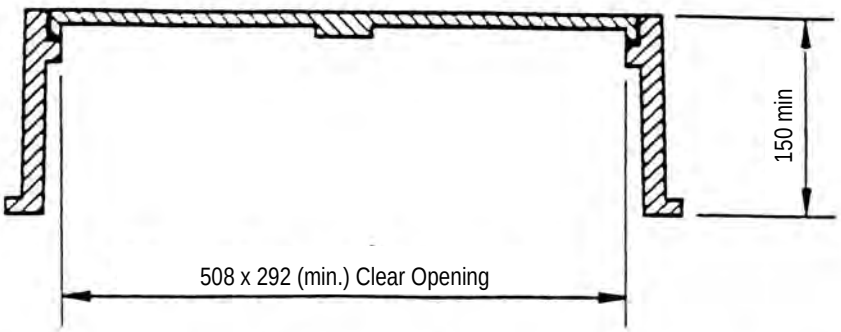
Opotiki District Council	Standard Drawings	*Not to Scale*
	Sluice Valve Installation	WS 01



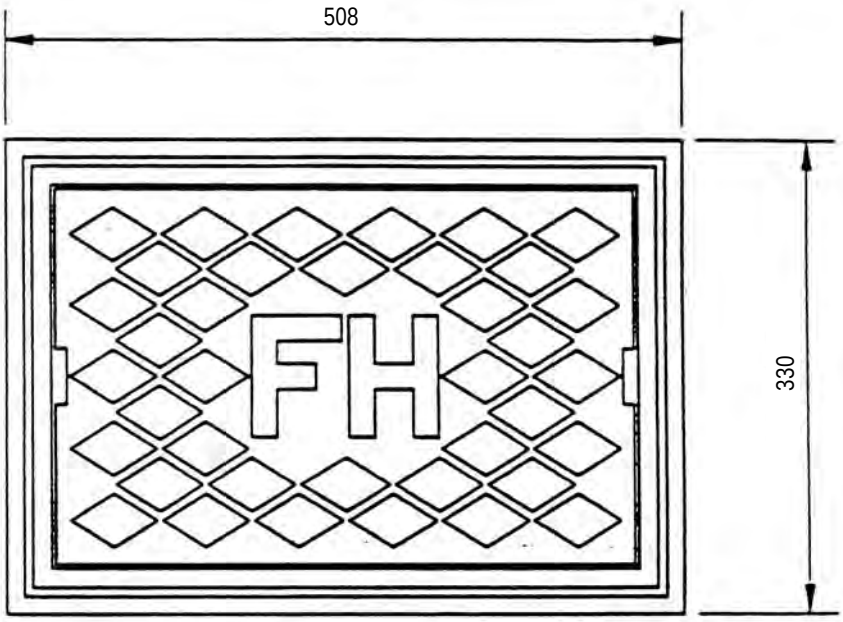
Notes:

1. Frost drain point to be plugged.
2. When mains are constructed in PVC use standard cast iron hydrant tee (rrj)
3. Allow to paint lid with 2 coats road marking paint. Yellow to TNZ Specifications.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Fire Hydrant Installation	WS 02



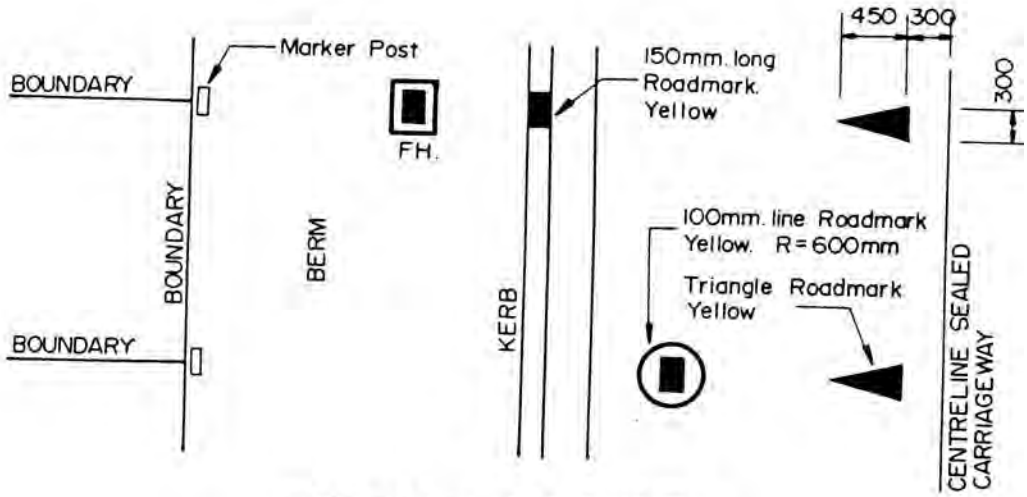
SECTION THRU FRAME & COVER



PLAN

APPROXIMATE WEIGHT FRAME: 22 KG.
COVER: 8 KG.

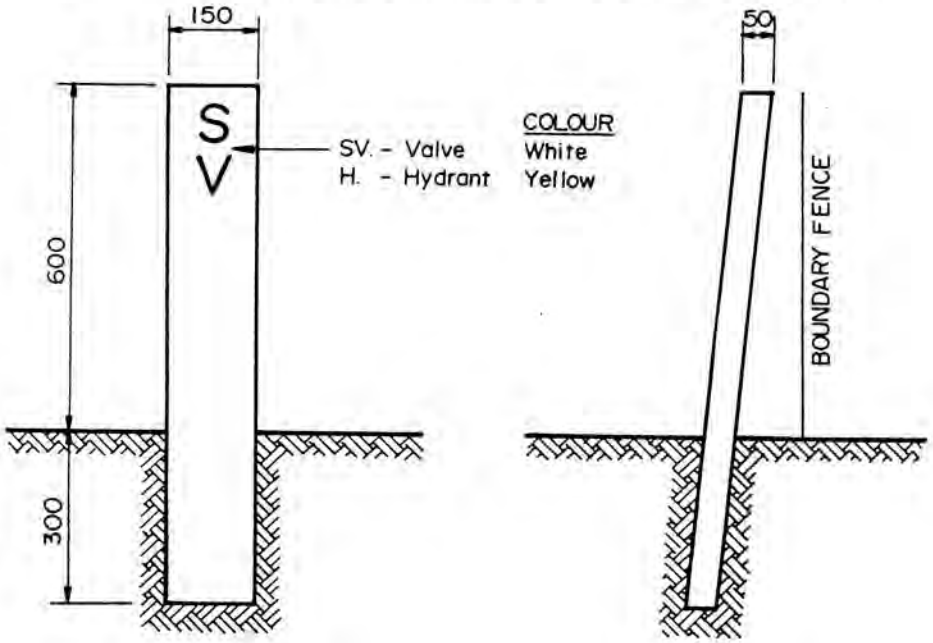
Opotiki District Council	Standard Drawings	*Not to Scale*
	Hydrant Box	WS 03



HYDRANT MARKING

NOTE:

1. Endeavour to position Hydrant adjacent to Property Boundary.

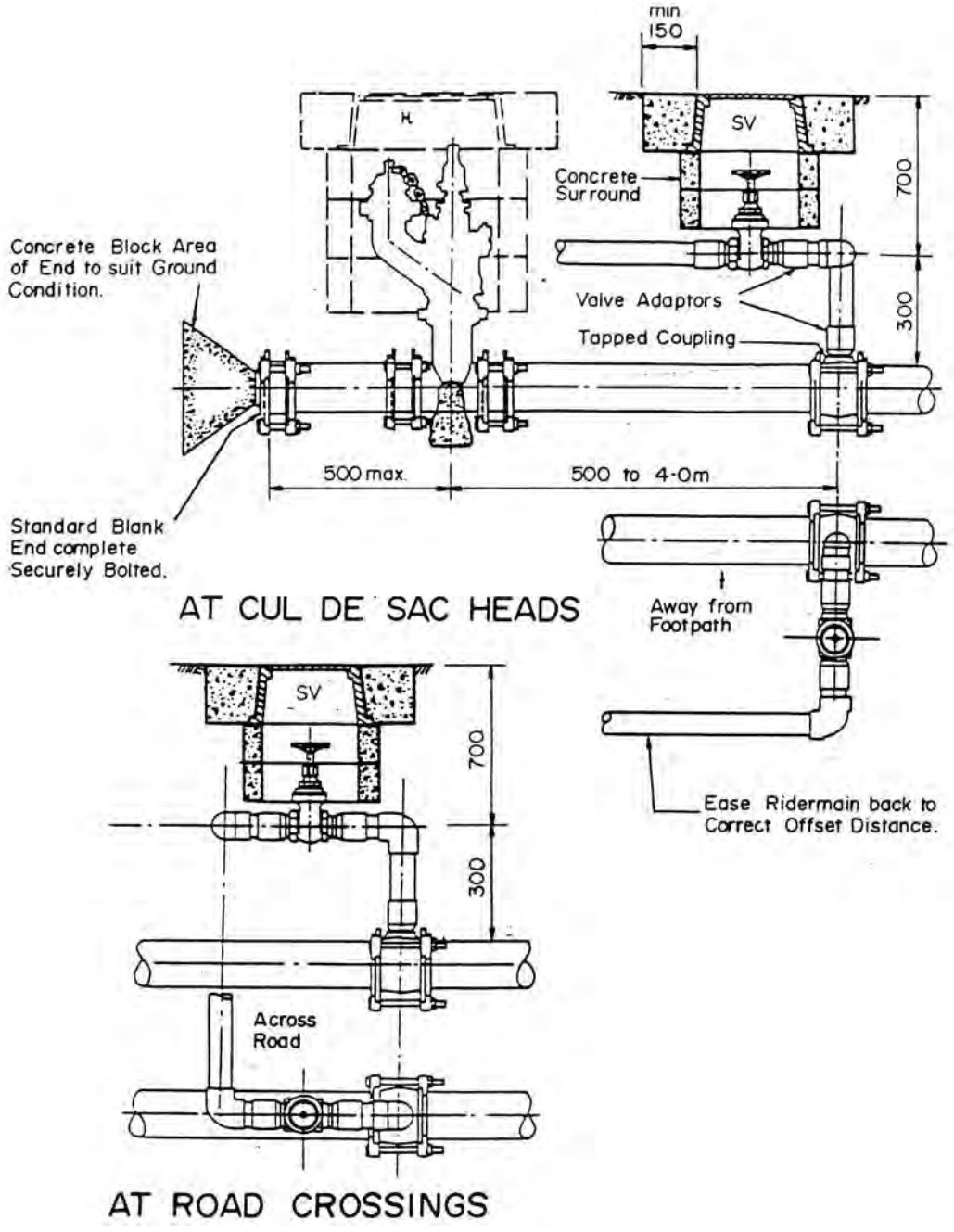


HYDRANT/SLUICE VALVE MARKER POST

NOTE:

1. To be made using Precast 50mm thick Concrete

Opotiki District Council	Standard Drawings	*Not to Scale*
	Valve and Hydrant Markers	WS 04



Note:

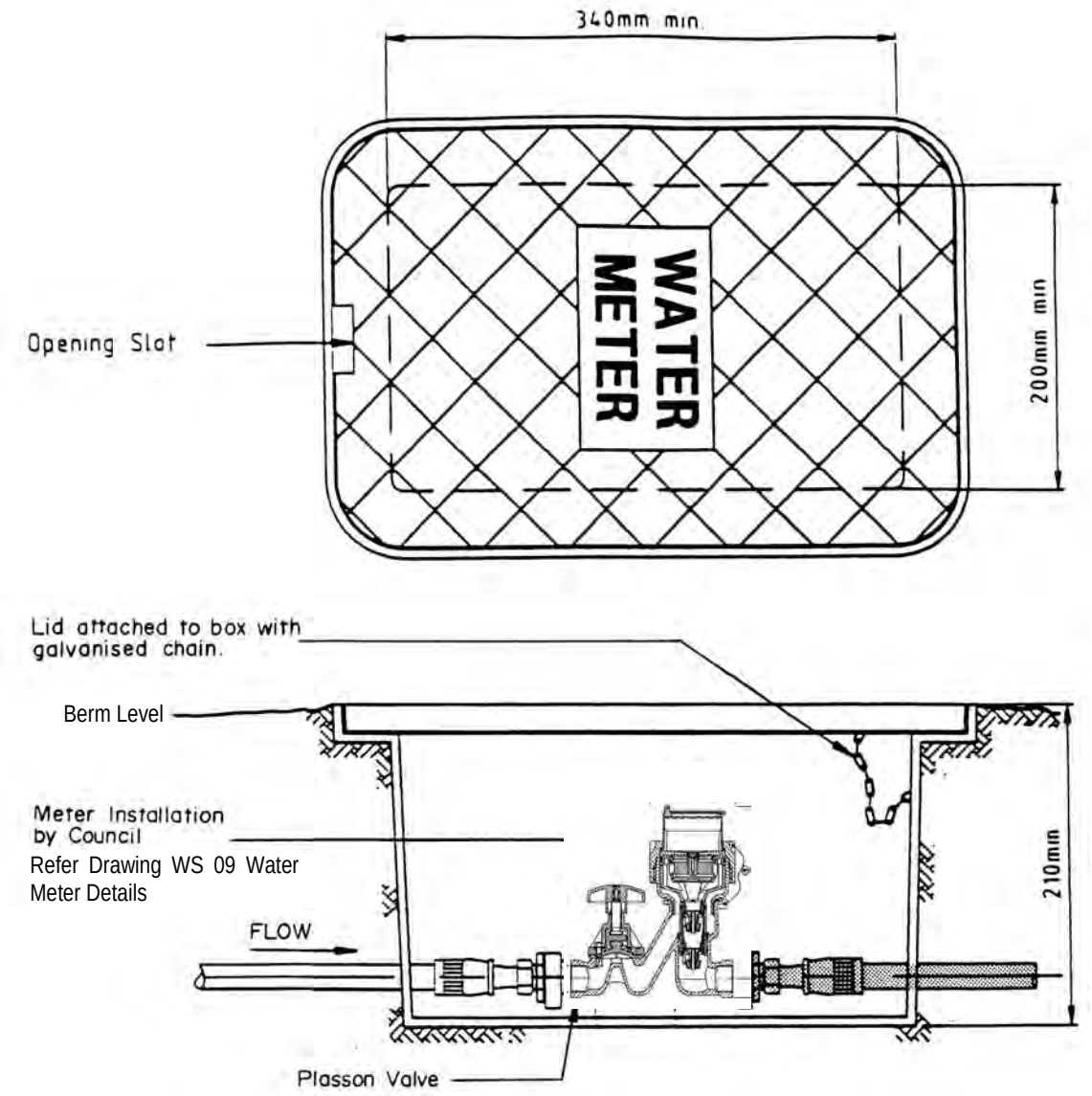
1. Actual configurations may alter due to circumstances and logics.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Ridermain Connection to Main	WS 05

Notes:

1. All fittings to be Non Ferrous.
2. For new subdivisions independent of existing mains the subdivider shall connect and provide all service connections as shown. For infill subdivisions the subdivider shall arrange for ODC approved waterworks contractor to carry out this work.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Service Connection	**WS 06**

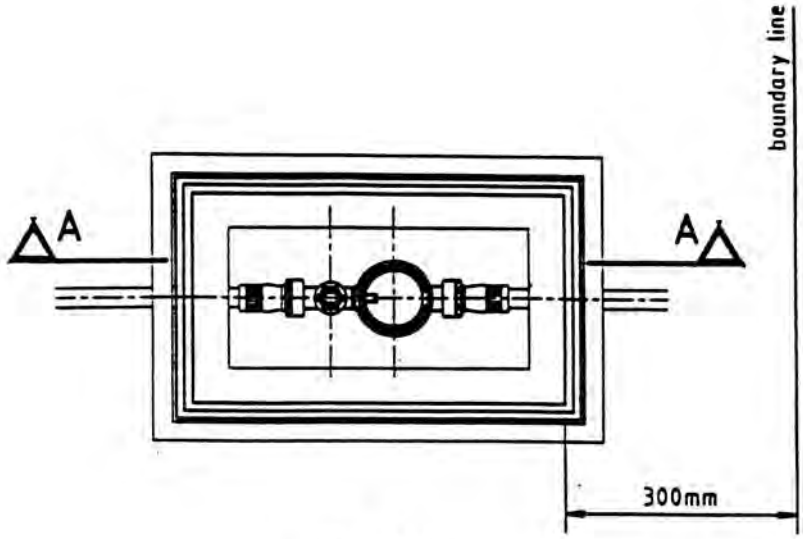


Notes:

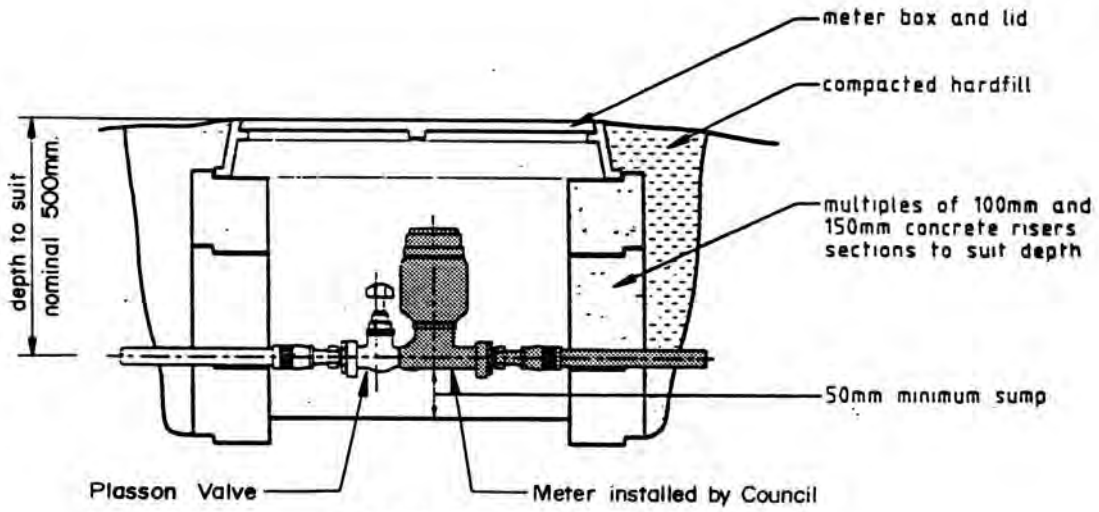
The Standard Meter Box shall comply with the following:

1. To be manufactured from HDPE, uPVC or similar approved material.
2. Must be able to withstand light vehicular traffic.
3. Not to be used in carriageways, industrial/commercial areas or where regular vehicular traffic is present.
4. To be fitted with internal or external backflow prevention.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Light Duty Metered Connection	WS 07



PLAN

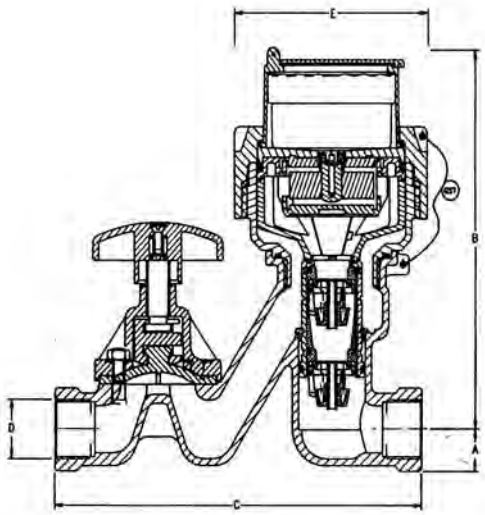


SECTION A-A

Notes:

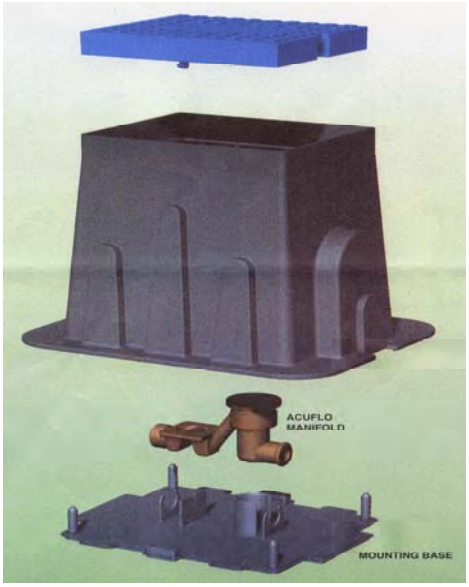
1. Meters to be fitted with internal or external backflow prevention.
2. Refer to Standard Drawing WS 09 Water Meter Details

Opotiki District Council	Standard Drawings	*Not to Scale*
	Heavy Duty Metered Connection	WS 08

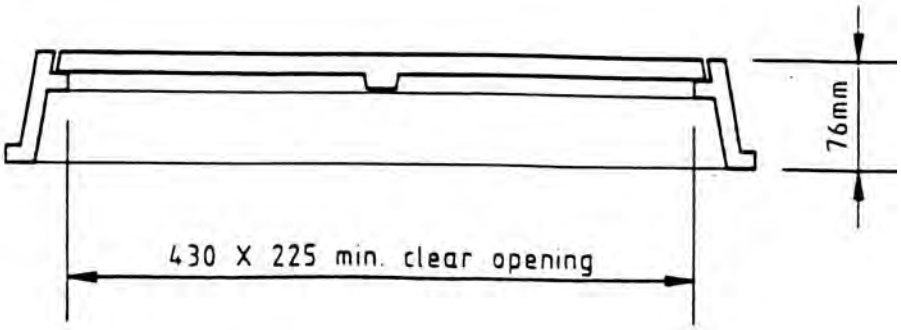


Physical & Metrological Data

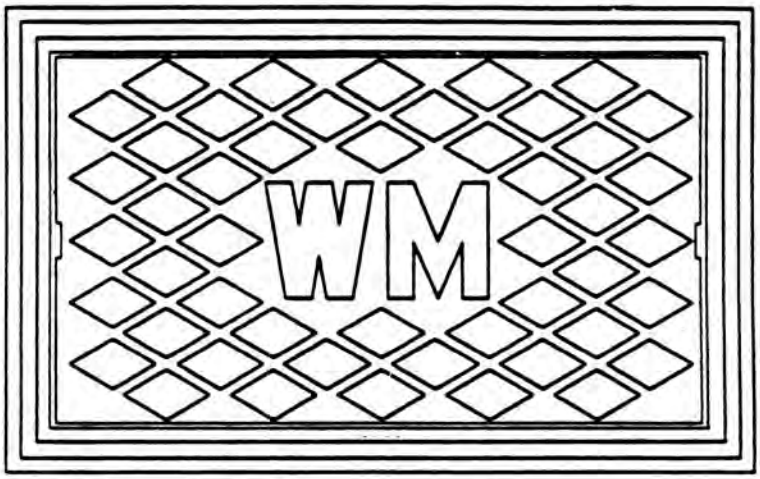
A – Centreline height	20 mm
B – Height above centreline	160 mm
C – Overall length	185 mm
D – Thread	3/4" BSP Internal
E – Overall width	96 mm
Q_n – Nominal flow rate	2.5 kL/h
Q_{max} – Maximum flow rate	5.0 kL/h
Q_{min} – Minimum flow rate	AS3565 & ISO 4064 - 0.05 kL/h
Metrological class	B



Opotiki District Council	Standard Drawings	*Not to Scale*
	Water Meter Details	WS 09



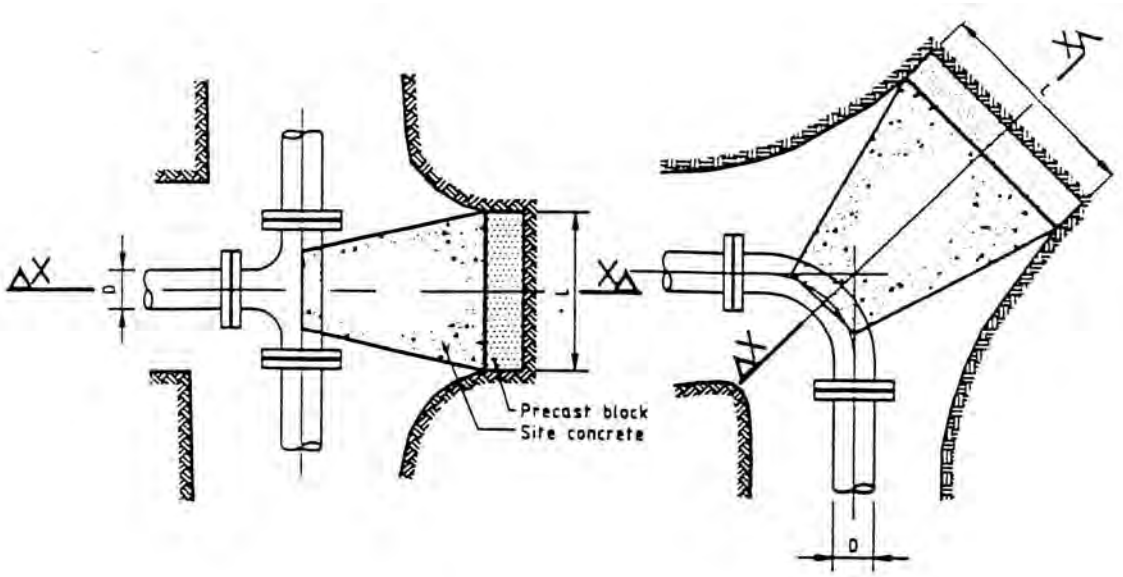
SECTION THRU FRAME & COVER

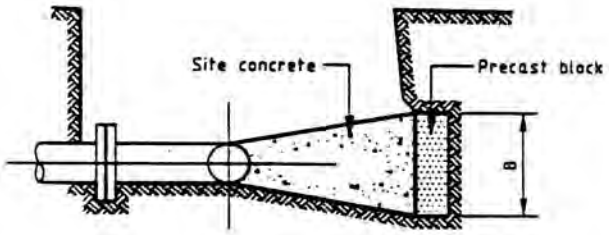


PLAN

APPROXIMATE WEIGHT FRAME AND COVER – 19·0 KG.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Cast Iron Water Meter Box	WS 10



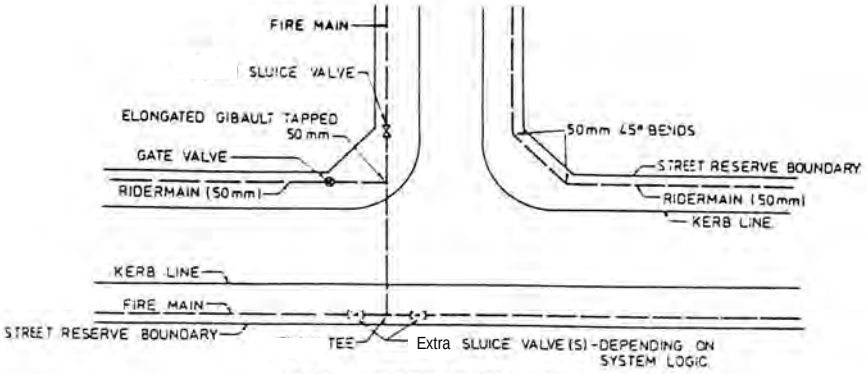


SECTION X-X

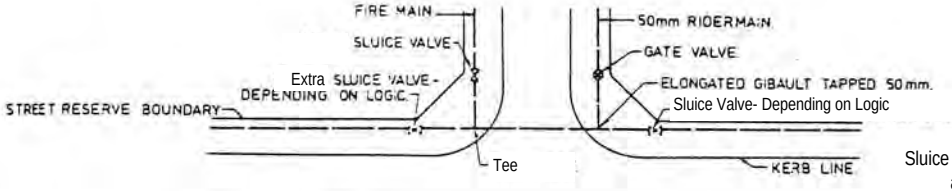
	Tee		90°		45°		22.5°		11.25°		BEC	
D	L	B	L	B	L	B	L	B	L	B	L	B
40	150	150	150	150							150	150
50	300	150	300	150	150	150	150	150	150	150	300	150
100	450	300	600	300	300	300	300	150	150	150	450	300
150	600	300	600	600	600	300	450	300	300	300	600	450
200	600	450	1000	600	600	450	600	300	450	300	600	600
225	600	600	1300	600	600	600	900	300	450	300	900	600
250	1000	600	1300	600	900	600	900	300	600	300	1000	600
300	1150	900	1300	900	1000	600	1000	300	600	300	1150	900
375	1150	1000	1600	1000	1000	1000	1000	450	600	450	1150	1000

Notes:
1. Concrete strength 17.5 MPa
2. Concrete thickness 150mm
3. Bedding against solid Natural Ground

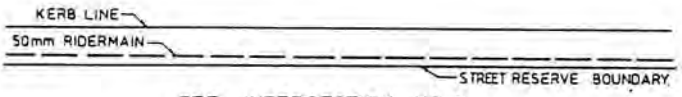
Opotiki District Council	Standard Drawings	*Not to Scale*
	Thrust Block Details	WS 11



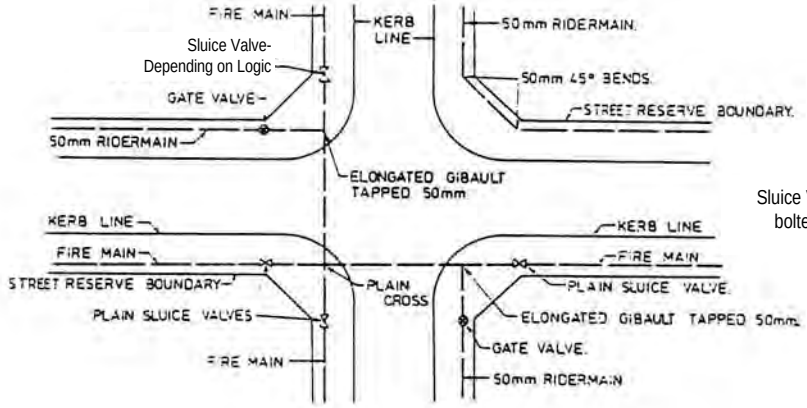
TEE INTERSECTION NO 1



Sluice Valves and Tees all Flanged



TEE INTERSECTION NO. 2



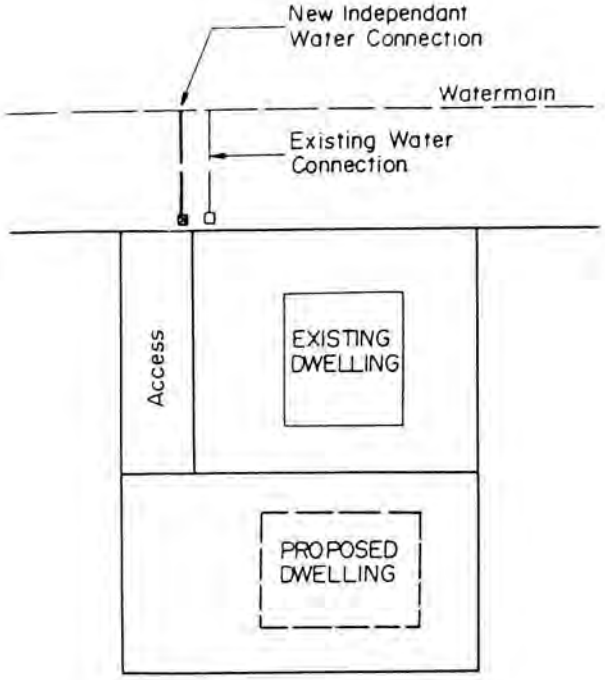
Sluice Valves to be bolted to Tees

CROSS INTERSECTION

Note:

1. Valves to be located adjacent to changes in boundary direction where practicable.
2. Depending on the circumstances and logic Council may require extra sluice valves to be able to better control water.

Opotiki District Council	Standard Drawings	*Not to Scale*
	Watermain Locations at Intersections	WS 13



OPTION A

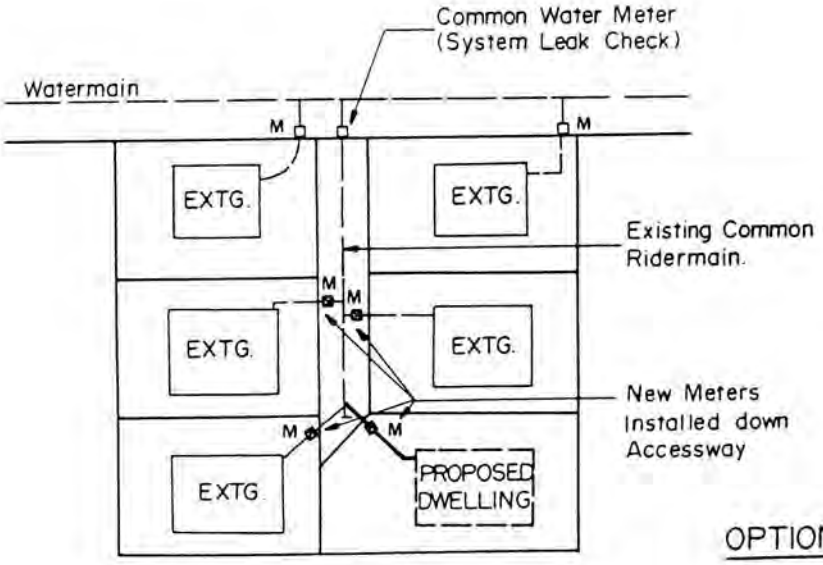
Water Connection Options:

Option A:

- Provide independent separate supply for each dwelling.

Option B:

- Arrange for compensation certificate to Council standard to allow access to read meters on private property.
- Arrange for water supply contract agreement to affected parties so that any discrepancies in overall consumption observed by the check meter at the street will be cost shared by the parties concerned.
- Arrange for establishment of domestic meters to each dwelling.



OPTION B

Opotiki District Council	Standard Drawings	*Not to Scale*
	Watermain Connections	WS 14