MINIMUM STANDARDS FOR ROADS AND STORMWATER DESIGN

July 2014
Version 2

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

TDA
CAPE TOWN
The City of Cape Town's Transport and Urban Development Authority

Minimum standards for civil engineering services in townships

Schedule of amendments

No	Date	Section	Description

1. Introduction

1.1 Purpose of These Guidelines

This document has been prepared in response to the need to lay down minimum standards for Township Developments within the City of Cape Town. A township development is defined as the planning, design and construction (including alterations to existing) of the roads and utility services infrastructure that is required to service a residential or commercial or industrial urban community.
The objectives of the document are to:

a) Give guidance to where relevant specifications and guidelines can be found
b) Highlight and in some instances repeat important aspects of such relevant documentation
c) Lay down minimum specifications relevant to the City's needs
d) Make designers aware of the City's adopted policies
e) Strive towards uniformity in terms of design criteria and material specifications

This document will be available to all developers and consultants as a quick guide to assist with the design and construction of urban infrastructure. The vision is to expand the document in future to include all services in one easily distributable and concise document.

1.2 Discrepancies

Any discrepancies which become apparent must be referred to the Director: Roads and Stormwater (hereinafter referred to as "D: R&S"). In such cases the more restrictive requirements shall apply, unless otherwise approved by the D: R&S.

1.3 Applicability

These Standards are applicable to all residential, industrial and commercial township developments in the City of Cape Town, with the exception of low-cost government subsidised residential developments, where other standards may be used by prior written agreement with the Director: R&S.

1.4 Deviations

Where existing infrastructure and site specific conditions require deviation from this document such deviations must be approved by the D: R&S.

1.5 Site Specific Conditions and Future Developments

Where abnormal site conditions exist or where a development needs to service existing or future developments the D: R&S may require a higher standard of the services to be provided.

Special or unique design situations must be addressed on a case by case basis.

1.6 Design Approval

The approval of the design by the D: R&S in no way absolves the developer from any responsibilities or liabilities in respect of the design.

1.7 Legal Background

1.7.1 Acts

a) Municipal Structures Act
b) National Road Traffic Act, 1996
c) Municipal Systems Act
d) National Road Traffic Act, 1996
e) Constitution of the Republic of South Africa, 1996

1.7.2 By-Laws

a) Standard Streets By-Law
b) Streets, Public Places & Prevention of Nuisance
c) Graffiti By-Law
d) Informal Trading
e) Outdoor Advertising & Signage By-Law
f) Parking
g) Parking Areas By-Law
h) Stormwater Management By-Law
i) Zoning Schemes[1]

1.7.3 Ordinances

a) Roads Ordinance No 19 of 1976

1.8 Definitions

Refer to applicable document

2. Road planning

2.1 Bibliography of Relevant Codes of Practice, Policies and Guidelines

a) City of Cape Town Zoning Scheme Regulations, Fourth Draft, November 2007
b) CoCT: TR&S: Specification 01: Construction of Vehicular, Pedestrian and Wheelchair Access Crossings and Access Ramps.
c) CoCT: Trees Policy
d) Footways Policy and Guidelines, CoCT Transport, Roads & Planning.
e) Geometric Design Manual – PAWC (1996)
f) Guideline for the Formalising of Parking Areas on Verges, Director: TR&S 2003-07-21.
g) Guidelines for Human Settlement Planning and Design (Published by CSIR Building and Construction Technology, 2000, Boutek Report No. BOU/E2001 (known as "Red Book")
h) Guidelines for the Erection of Balconies, Canopies and Columns on the Verge (CoCT Roads & Stormwater, 2006-08-15).
i) Pedestrian and Bicycle Facility Guidelines. Department of Transport, August 2003)
j) Road Access Guidelines (Second Edition – May 2001)

[1] *Various Zoning Schemes are still in effect in parts of the City – refer to the City's website in this regard. A unified Zoning Scheme is being drafted.*

k) Roundabouts: An Informational Guide, at the Turner Fairbank Highway Research Centre website: www.tfhrc.gov/safety/00068.htm
l) TGS 1,5,9,12,14 (Transport Planning Guidelines)
m) UTG 1: Geometric Design of Urban Arterials
n) UTG 10: Guidelines for the Geometric Design of Commercial and Industrial Local Streets.
o) UTG 5: Geometric Design of Urban Collector Roads
p) UTG 7: Geometric design of Local Residential Streets.
q) Road Traffic signs Manual (June 1999)
r) CoCT : NMT Plan
s) CoCT : Integrated Transport Plan
t) Guidelines for sliding gates – D R&S August 1995
u) Guidelines on landscaping and road reserves 2004
v) CoCT Guidelines on Fencing
w) Stormwater Documents (refer to paragraph 10.2)
x) SANS 784 - 2008
y) COLTO 1998 Edition

2.2 General

This section of the guidelines covers primarily local Class 3, 4 and 5 roads. The Directorate of Transport Planning should be consulted for the planning and design of Class 1 and 2 roads.
Road Planning cannot be seen in isolation by the Engineering profession but must be dealt with in close co-operation with the Town Planners.
The planning process needs to respond to the following inputs:

a) Environment
b) Community it needs to serve
c) Modes of transport
d) Public transport needs
e) Integration with public transport network
f) Recreational and community facilities

Priority should be given to the needs of transport modes in the following order of precedence:

a) Walking
b) Cycling
c) Public transport (that includes mini-bus taxis)
d) Commercial vehicles
e) Private cars

2.3 Town Planning

2.3.1 Access to Properties

Access restrictions on properties need to be established at the planning stage and the rules need to be incorporated in Overlay Zone regulations applicable to a particular area or land unit.

2.3.2 On Site Parking Requirements

The provision for on-site parking is covered in Zoning Scheme for the relevant area. Refer to CoCT's webpage links

CTZS_Regulations_Sept_2012.pdf

CTZS_Appendix_Sept_2012.pdf

CTZS_Table_A_Sept_2012.pdf

2.3.3 Setbacks for Garages, Carports and Security Gates

The minimum required building line setback as prescribed in the relevant Zoning Scheme must be adhered to at all times. Any relaxation of the street building line needs to be approved by the DR&S.

A minimum street building line of 1.5m is recommended to safeguard buildings from pipe-bursts or services excavations within the road reserve. In addition the distance from the road kerb line to the garage/carport will be at least 5.5m to 6.5m, depending upon the class of road whether pedestrians need to be accommodated within the setback.

Building Line Setback for Garages and Carports needs to be correlated with zoning scheme(s)

a) In cases where dedicated pedestrian or cycle lanes exist or where a high volume of pedestrian traffic is expected, the minimum distance of 5.5 m shall be measured from the back of such lanes or paths in order not to interfere with pedestrian or bicycle movements.
b) On roads with high vehicular traffic (typical middle and higher order links) it should be a requirement that all security gates be set back 5.5 m from the road kerb line or pedestrian and cycle lane. Such requirements can be enforced as part of the plans approval process for boundary walls.

2.3.4 Setbacks for Access Gates at 'High Generator' Driveways

The stacking space in front of access gates to developments shall be as follows, measured from the edge of the closest lane or shoulder or footway or cycle lane as applicable:

Stacking Space in Front of Access Gates.		
	No. of units served	Required Stacking Space
1.	< 15	6m
2.	15 – 40	12m
3.	> 40	Site Specific Requirements

2.3.5 Gates: general requirements

a) No part of any gate shall be installed within road reserves. Gates on a boundary must be completely on the private side thereof.
b) Gates shall not open into road reserves, but inwards away from the road. Gates opening towards the road must be set back so that the open gate is completely outside the road reserve.
c) The location of gate control devices within the road reserve is not supported.
d) No part of a gate's mechanism may be accessible from the road reserve. Suitable protection must be in place where necessary.

Also refer to Guidelines for Sliding Gates, Director: Roads and Stormwater, 1995-08-08

Sliding Gates Guideline.pdf.

2.4 Road Planning Standards

2.4.1 Road Classification and Hierarchy

Designers should read these Minimum Standards in conjunction with Chapters 5 and 7 of the Red Book: Guidelines for Human Settlement Planning and Design where the emphasis is on Movement Networks rather than the conventional hierarchical structure. Designs should be based on the functions that each Link within a Movement Network needs to perform to determine the appropriate road reserve widths, footway and on-street parking provisions. Innovation should be the key principle rather than merely opting for the minimum standard solution.

2.4.2 Design Speed

At a Road planning stage it is important to establish whether the design standards for a given speed can be maintained within the chosen road layout. Steep terrains require special attention from a road planning perspective.

Residential streets should also be designed such that speed control and extraneous traffic control is inherent in the layout. "Add-on" measures such as speed humps are not favoured).

2.4.3 Road Reserve Characteristics

The cross section of the road reserve must provide for all functions that the road is expected to fulfil, including:

a) Safe and efficient movement of all users
b) Provision for parked vehicles
c) Provision for utility services both under and above ground
d) Street lighting
e) Landscaping
f) Traffic signs and signals
g) Street name and direction signs

In addition to the above the selected roadway and road reserve should comply with the following:

a) The safety and convenience of pedestrians and cyclists must be ensured by providing sufficient on or off road paths or sidewalks.
b) The roadway width must allow for vehicles to proceed safely at the operating speed intended for the class of road.
c) The road reserve width should be sufficient to provide adequate access to individual erven. The word "adequate" must be read in context with the mode of transport that is expected to dominate each specific road or pedestrian access way.
d) Widening of the roadway and road reserve may be required at strategic locations to allow for wider heavy vehicle paths.

e) Widening of the verge and subsequent road reserve may be required to ensure adequate sight distances around horizontal curves and at intersections. The use of mirrors to ameliorate sight line problems is not allowed.
f) Appropriate verge width must be provided to enable the safe location, construction and maintenance of required utility services e.g. electricity, water, telecommunication, street lighting. See Section 3 on Road Verges, for more information.

2.4.4 Parking

Provision for parking shall form an inherent part of any new development. It is important that vehicles should not be parked within sight triangles at intersections or bends. Designers should consider the provision of on or off street parking in conjunction with other issues such as driveway access, waste collection etc. In developments with narrow frontages on-street parking may be problematic and setbacks of entrances and garages need to be considered to avoid parking back-up into the street system.

Property owners adjoining roadways should provide sufficient on-site or off street parking as per the guidelines as set out by the Department of Transport or the City of Cape Town Zoning Scheme Regulations, whichever is most applicable. The minimum recommended parking requirement for single residential erven is as follows:

Recommended Minimum Parking Requirements for Single Residential Erven		
	Income Group	Parking Spaces (includes garages and carports)
1.	High	4
2.	Medium	3
3.	Low	2
4.	State Subsidised	1

Also refer to the relevant *Zoning Scheme* in this regard.

CTZS_Regulations_Sept_2012.pdf

CTZS_Appendix_Sept_2012.pdf

CTZS_Table_A_Sept_2012.pdf

Provision for on-street parking should be considered at the following locations:

a) At Public Amenities

2.4.5 Waste Collection and Emergency Vehicles

Access for waste collection and emergency vehicles is one of the most important aspects in the planning of any new development. Road layouts and reserve widths should be designed to accommodate typical waste collection and emergency vehicles. Designs should be based on the SU type vehicle as specified in Table 7.2 of the Red Book: Guidelines for Human Settlement Planning and Design.

Refuse vehicles generally do not enter pedestrian only routes and short dead end streets unless these roadways are designed for such vehicles with ample provision for turning.

In Low Cost Housing developments large turning circles are generally not affordable. In such cases collection points need to be provided adjacent to the roadway at the nearest passing point. As a rule the distance from the collection point to the furthest service point should not exceed 45 m.

A typical collection point can consist of a demarcated and surfaced or paved area behind the road kerb, at least 1.5m wide with a length equal to the number of service points in meters. Such collection areas should be carefully selected to avoid being too close to or opposite residential frontages or accesses, and to ensure that sight lines for road users are not obstructed.

Before any waste removal is contracted out, the applicant must submit a solid waste management plan with specific reference to waste minimisation.

2.4.6 Public Transport

On designated bus routes (or potential bus routes) provision needs to be made for bus facilities including bus stops, shelters and bus embayments. Such provisions should include consideration for pedestrian access, driveway locations and geometric design at intersections.

Street networks should be planned to bring everyone within a convenient walking distance (not more than 400m) of public transport stops, especially in low cost housing areas. See chapter 8.4 of the Road Access Guidelines for the optimal location and minimum guidelines for bus and minibus taxi stops. Refer to *Pedestrian and Bicycle Access.pdf*

The minimum roadway (surfaced) width for bus routes shall be 7.4m.

Bus stops in bus bay: Dimensions should be as shown on the standard drawing. Locating the bus stop so that the entry or exit end coincides with an intersection, a carriageway crossing or a no parking zone, may save space.

Bus stops in the driving lane (on low order roads only): Where space is not available for a full bus bay and the stopping time is short, a bus stop in the traffic lane may be considered. In this case a minimum length of 12m must still be reserved and marked on the road.

2.4.7 Intersections

Street layouts must be planned for maximum safety. The aim should be to minimize the number of intersections required for any township development. Skewed intersections must be avoided and in no case should the angle be less than 70°.

The provision of vehicle access close to intersections and roundabouts needs to be carefully examined. Operational and safety considerations may warrant restrictions on access.

Land uses that generate large volumes of traffic should have access points well away from intersections.

2.4.8 Traffic Control at Intersections

Intersections where more than 100 vehicles per hour (all movements combined) are expected need to be analysed at design stage to establish the type of control measure to be implemented. Roundabouts are in many cases preferred to signalised intersections because of the inherent safety and efficiency benefits, and lower maintenance cost.

Roundabouts are also excellent traffic calming measures especially if these form part of an overall traffic calming plan.

Three or four way stop control at busy intersections is not acceptable, and should also be avoided at minor intersections.

2.4.9 Traffic Calming

The layout of streets must be designed in such a way that traffic calming is a natural result and the requirement for "add-on" measures (such as speed humps) is obviated. This can be achieved by reducing block lengths as far as possible and by avoiding unnecessary through routes. On collector roads speed reducing measures such as roundabouts and pedestrian crossings with median islands could form part of an inherent traffic calming strategy.

Stop or yield control may not be used for the sole purpose of traffic calming; the warrants for stop or yield control must be met.

2.4.10 Road Widening for Recreational Purposes ("Woonerf" Concept)

In low order and pedestrian only links in low cost housing areas, road designs should allow for road widening at convenient locations to allow space for recreational purposes within the road reserve. These areas can typically be in the middle of a "super block" or opposite an entry or exit point to a Pedestrian Only Link. It typically needs to perform one or more of the following functions:

a) Recreational purposes (children's play area)
b) Refuse collection (wheelie bin or black bag storage space)
c) Turning space for vehicles
d) Parking space for visitors
e) Access for service and emergency vehicles

These areas should be large enough to have the necessary impact. Widening shall not be less than 3m per road reserve side and the entire area shall be surfaced. The widened areas may be in contrasting paving.

2.4.11 Fences

Urban streets are not provided with fences. Where these exist, they are part of the abutting land, and should therefore not be located on the road side of the road reserve boundary. Refer to the City's guideline on fencing. *Fencing Draft Policy Rev 6.pdf*.

Fences are allowed to assist in the control of non-motorised transport movements.

2.4.12 Guardrails

Guardrails within the road reserve for the sole purpose of protecting anything other than legitimate road users shall not be permitted. Guardrails and other measures for the

protection of private property, if desired, must be located outside the road reserve. Guardrails shall not be provided solely for access control purposes.

It must always be borne in mind that guardrails and other barriers next to the roadway are in themselves hazards to traffic and should only be installed when the off road hazard is greater than the hazard posed by the barrier.

The following guideline documents should be referenced to determine the warrants and installation details when designing roadside barriers.

The WCG Geometric Design Manual. (Yellow Book)
South African Road Safety Manual Volume 6, Part C: Traffic Barriers

Some situations where guardrails may be required are as follows:

a) A drop-off next to the road with a slope steeper than 1:1 and height greater than 1 m
b) Large boulders, permanent bodies of water deeper than 0,6m next to the road and large trees close to the roadside
c) Bridge piers, abutments, balustrades and large steel sign supports
d) Highway embankment
e) At the outer edge of substandard curves, or wherever vehicles often leave the road, and where the hazard to the vehicle occupants leaving the road is greater than that of the guardrail

On narrow medians:

a) When installing a guardrail the following must be adhered to
b) Guardrails should not be used where it will be struck head on or at an angle less than 45° to perpendicular. It is designed to take a glancing blow only
c) Minimum length: the minimum length of guardrail is 30m

End treatment:

a) Where possible use a flare with a bullnose end piece
b) End wings or dipped ends may only be used on the downstream end of a one way condition where there is no danger of it being hit end on
c) The guardrail must be installed at the prescribed height
d) Anchoring section: At each end an 11,43m section of the guardrail shall have posts spaced at 1,905 m instead of the normal 3,810m
e) Spacer blocks must not be omitted
f) Successive lengths of guardrails must be lapped so that the upstream section overlaps the downstream section along the adjacent traffic stream.
g) The guardrail must be provided with all its bolts including the shear bolts
h) Guardrail posts must be replaced where they have become rotten or structurally unsound.
i) Reflectors are only required where there is no street lighting
j) Interruptions in continuity should only be introduced if this is strictly necessary. Wherever possible such interruptions shall be so designed to make it impossible for a vehicle to hit the start of a section end-on. Where interruptions are introduced no section should be less than 30m in length

Do not erect guardrails one above the other. Normal guardrail poles are not strong enough to resist the additional moment on impact and this practice is therefore not recommended.

2.4.13 Bollards

The use of bollards to control vehicular movements is not supported.

2.4.14 Street Name Signs

Street name signs can be either on pole mounted name plates or embossed on kerbs (the preferred option in theft risk areas). In each case the detail as shown on the standard drawing must be used. Exceptions will only be allowed in special cases, at the discretion of the D: R&S. Free standing street name kerbs are not favoured, but where these are unavoidable, they should be situated against the road reserve boundary.

Street names shall comply with the City's Street Naming, Renaming and Numbering policy.

2.5 Cross Section Requirements

Recommended minimum standards are given in the tables below for the different classes of roadways:

2.5.1 Mixed (Higher Order) Link District (Distributor) – Class 3

		Income Groups	High and Medium	Low
Direct property access is not recommended.	1.	Road Reserve Width (m)	40	40
	2.	Roadway Width (channel excluded)	2 x 3.4 Lanes per direction with 5.0m Median	2 x 3.4m Lanes per direction with 5.0 Median
	3.	Parking Arrangement	1 x 2.5 m Lanes/ direction / Combination Parking//Cycle Lane	1 x 2.5m Lanes/ direction/Combination Parking/Cycle Lane
	4.	Verge Width (m)	7.9	7.9
	5.	Kerb Type	BK2 / BK4	BK2 / BK4
	6.	Cross fall / Camber	Camber	Camber

2.5.2 Mixed (Middle- Order) Link (Class 4 Local Distributor)

Refer to standard drawing

	Income Groups	High/Medium	Low
1.	Road Reserve Width (m)	20	18
2.	Roadway Width	2 x 3.7m lanes (channel excluded)	2 x 3.7m lanes (channel excluded)
3.	Parking Arrangement	2 x 2.5m Combination Parking/Cycle lane	2 x 2.5m * Combination Parking/Cycle lane
4.	Verge Width (m)	3.3	2.3
5.	Kerb Type	BK2	BK2 #
6.	Cross Fall/ Camber	Camber	Camber
7.	Minimum Erf Splay Dimensions at Intersections	5 x 5	5 x 5

*E

or low cost housing areas the parking/cycle lane shall be separated from the roadway by means of a V-Channel arrangement

 # For low cost housing areas with narrow frontages MK10 kerbs or CK5 combination kerb and channel sets may be used along parking an embayment to facilitate vehicular access.

2.5.3 Mixed (Lower Order) Link (Class 5 Access Street)

Refer to standard drawings

	Income Groups	Medium/Low	Low	Low
1.	Road Reserve Width (m)	12	10	8
2.	Roadway Width	5.5m (channel excluded)	5.5m (channel excluded)	4.5m (channel excluded)
3.	Parking Arrangement			
4.	Verge Width (m)	1.25	2.5	1.75
5.	Kerb Type *	MK10 / CK5	MK10 / CK5	MK10 / CK5
6.	Cross Fall/ Camber	Cross Fall	Cross Fall	Cross Fall
7.	Minimum Erf Splay Dimensions at Intersections	5 x 5	5 X 5	5 x 5

***Barrier kerb to be placed on radii. BK 2 or BK 4*

2.5.4 Pedestrian Link / NMT Facility

Refer to standard drawing

	Income Groups	All
1.	Road Reserve Width (m)	6
2.	Roadway Width (surfaced) (m)	3.0
3.	Verge Width (m)	1.4
4.	Maximum Length (m)	50
5.	Kerb Type	CK5/E1 or E1 both sides
6.	Cross fall (CF) / Camber(CA)	Depends on site conditions

a) Limited vehicular ownership
b) Restricted vehicular access

c) No kerbed entrance (bell mouth) from adjoining roadways - roadways and pedestrian links to be separated by kerbs
d) To be accessible for emergency and service vehicles
e) No through traffic allowed
f) Ensure multi-directional pedestrian circulation
g) No turning area necessary
h) Allow widening for recreational purposes (Woonerf Concept)

2.5.5 Lower Order Link (Class 5 Access Street for LIC)

Refer to standard drawings.

2.6 Vertical Clearance

The vertical clearance required over all portions of the road reserve accessible to vehicles is as stated in Geometric Design of Urban Arterial Roads Manual (UTG 1) of 1986:

"The standard minimum vertical clearance from any point in a roadway to an overhead structure is 5.1m. If the structure is light such as a pedestrian overpass, then the vertical clearance required is 5.5m or more. Future overlays must be taken into account when determining clearances."

3. Road design

3.1 General

This section of the guidelines covers primarily local streets up to Class 3 roads. The Director: Transport shall be consulted for the geometric design of higher order roads.

The Red Book: Guidelines for Human Settlement Planning and Design, Chapter 7: Geometric Design and Layout Planning, gives a detailed coverage of the geometric design for roads. Other documents in the Bibliography can be referred to for items not covered in the Red Book: Guidelines for Human Settlement Planning and Design.

For Roundabouts reference should be made to Chapter 6 of 'Roundabouts: An Informational Guide' from the Turner Fairbank Highway Research Centre, which exhaustively covers all the basic elements of geometric design. (This reference document will require adaptations for South African use).

3.2 Road Design

3.2.1 At Grade Intersections

The following basic criteria for intersections shall apply:

a) Intersecting roads should where possible meet at 90°. Skewed intersections must be avoided and in no case shall the angle of intersection be less than 70°.
b) Intersections shall preferably not be positioned in or near horizontal curves of small radii, on the inside of any horizontal curves or on or close to sharp crests. Safe shoulder sight distance shall be the deciding criterion.
c) The maximum grade for approach legs to an intersection is 5%, for a minimum distance of 20m from the edge of the intersection. Normally the grade of the

major road should be carried through. A maximum grade of 3% to 4% for intersections is recommended.

d) All turning movements shall be checked for compliance with the swept path of the design vehicle applicable to the intersection.
e) Even where mountable kerbs are used along roads, the kerbs around intersection corners, including 2m either end of the curve including the transition, shall always be barrier kerbs.
f) For radii less than 10m, short kerbs shall be used. In all other cases long kerbs must be used.
g) The minimum distance between intersections shall be as prescribed in the Guidelines for Human Settlement Planning and Design.

3.2.2 Curve Radii

Minimum curve radii shall preferably be as follows:

Minimum Curve Radii			
	Road Category	Bellmouth Radii (m)	Horizontal inside Curve Radii (m)
1.	Mixed (higher order) Link (Class 3District Distributor)	10 - 12	350
2.	Mixed (middle order) Link (Class 4, Local Distributor)	10 - 12	80
3.	Mixed (lower order) Link (Class 5, Access Collector)	8 - 10	50
4.	Mixed (lower order) Link (Class 5, Access Street)	6 -8	35

3.2.3 Roundabouts

Refer to standard drawing
Roundabouts shall be classified as follows:

Roundabout Types				
	Type or Use	Design Vehicle Red Book Table7.2	Design Speed (km/h)	Inscribed Circle Diameter(ICD)(m)
1.	Mini Roundabout Mixed (middle order) Link Class 4	Single unit truck (SU)	25	13 – 25
2.	Urban Compact Mixed (middle order) Link Class 4	SU and BUS	30	25 – 30
3.	Urban Single Lane Mixed (higher order) Link Class 3	Semi–trailer (WB15)	35	30 – 40
4.	Urban Double Lane Mixed (higher order) Link Class 3	Semi–trailer (WB15)	35	45 – 55

Roundabouts need to be designed for site specific and traffic conditions. In order to create some uniformity within the City the following is prescribed: See standard drawing for Kerb detail.

a) The kerbing used on the perimeter of roundabouts shall generally be Barrier Kerbs (BK2 or BK4). For Mini Roundabouts on Lower Order Links the kerb type may match the kerbing used on the major approaching road.
b) The physical layout and size of the central island will determine the amount of deflection that is imposed on the through vehicle. A mountable apron may have to be added to achieve the desired deflection in order to reduce vehicular speed.
c) Barrier kerbs (BK2 or BK4) to be used for splitter islands. Where splitter islands are small and where no pedestrian crossings are envisaged, Semi Mountable Kerbs (MK2 or MK10) may be considered.
d) The minimum width for splitter islands at pedestrian crossing points shall be 1.8m, set back at least one vehicle length (6.0m) from the entrance line with provision for dropped kerbs for wheelchairs and prams. Tactile warning surfaces shall be provided at all pedestrian crossings – see Drawings for details.
e) Central islands which vehicles are not supposed to traverse shall have semi mountable kerbs (MK2).
f) Where an apron is required a special mountable kerb (MK11) shall separate the apron from the circulatory roadway with a height difference of approximately 75mm.
g) Central and splitter islands shall have paved surfaces and kerbs painted matt black and retro reflective white alternately to clearly distinguish the islands from the roadway.

3.2.4 Minimum cross slope

A cross slope of 2.5% shall apply to all cross-fall or cambered roads.

4. Road verges

TRH 27 South African Manual for Permitting Services in Road Reserves - Version 1 0 Aug 2012.pdf

4.1 General

The verge needs to perform a number of functions including:

a) Providing space for under- and above ground services.
b) Providing space for street furniture items, such as bus shelters etc.
c) Provide for the safe movement of pedestrians, wheelchairs and cyclists where applicable.
d) Provide for off-street parking where required.
e) Provide for adequate sight distance around curves and at intersections.
f) Provide space for landscaping approved by the Director Transport, Roads and Stormwater.
g) Provide space for overland stormwater drainage.

The verge width should therefore be sufficient to incorporate the above functions.

In low cost housing areas where windblown sand is a problem, all verges shall be provided with a 1.5m wide x 75mm thick (compacted thickness) gravel wearing surface on both sides of the road.

Loose / unbound stones (of any size) on verges and islands shall not be allowed.

4.2 Relevant Codes of Practice, Policy and Guidelines

a) South African Road Traffic Signs Manual
b) Non-Motorised Transport
DoT Pedestrian & Bicycle Facility Guidelines
c) CoCT: Integrated Transport Plan
AnnexureK_IntegratedTransport_Plan_Revised.pdf

4.3 Verge Cross Section

Factors that determine the verge cross section are:

4.3.1 A cross slope of not less than 1% is required for surface drainage

4.3.2 The verge cross fall shall not exceed 17%, unless suitably designed measures (retaining structures, landscaping, surface hardening) are taken to ensure the stability and functionality of the verge.

4.3.3 The area between the property and the road verge shall be sufficiently higher than the top of kerb to ensure that overland stormwater flow stays within the road prism, preferably 110 mm plus 3% of the verge width to a maximum of 150mm. In the case of a BK4 kerb it shall be the height of kerb face minus the channel invert plus 3% of the verge width.

4.3.4 An area of approximately 1.5m wide is required immediately adjacent to kerb with a maximum cross slope of 3% towards the kerb to allow:

(i) the safe passage of pedestrians and cyclists,
(ii) to allow wheel bin placement and
(iii) to allow driveway access without vehicles scraping.

4.4 Underground Service Reservations

4.4.1 Stormwater Drainage

Stormwater pipelines should preferably be located underneath the roadway, or in steep terrain on the high side behind the kerb line, if possible. The minimum reserve width is the outside diameter of the pipe plus 800mm. For pipes smaller than 600mm Ø, the minimum reservation width is the outside diameter of the pipe plus 1000mm. For deep pipes and poor ground conditions this may be increased.

4.4.2 Sewer Drainage

Sewer pipes should preferably be located under the centre line of the roadway, or slightly offset on cambered roads. In steep sloping terrain sewer lines should, if possible, be located on the high side of the road reserve, underneath the roadway, which permits relatively short connections. The minimum reservation width is 1000mm.

4.4.3 Water Mains

Water mains should be located on the high side of the road reserve to ensure that in the event of a burst water main flooding of properties is minimized. The minimum reservation width is 700mm, or the pipe diameter plus 600mm for pipes up to 300mm in diameter.

Water mains should preferably not be located underneath roadways or below surfaced footways to ensure easy access for maintenance and water connections and disconnections.

4.4.4 Electricity and Telecommunication Services

4.4.4.1. General Requirements

It is generally preferred that Electrical and Telecommunication Services be installed on opposite sides of the road reserve, especially in the case of high voltage electrical cables. The minimum reservation width is 1000mm for both services with a clearance from the property boundary of 400mm for Telecommunication cables and a minimum of 500mm for Electrical services.

Overhead Telecommunication and Electrical poles shall generally be located as close as possible to the property boundary with a minimum clearance of 300mm.

4.4.4.2. Manholes

All telecommunication and electrical manholes, whether these are in the roadway or not, must be designed to withstand traffic loading and they must have a chimney of at least 300mm between the manhole lid and the top of the roof slab. For the specification of Telkom manholes refer to the Red Book. A 300mm chimney allows some flexibility should an adjustment or widening be needed to the road levels. It also provides for at reasonable layer works over the roof slab and minimises the likelihood of reflective cracking caused by differential settlement. *Refer to CoCT Standard 2010 Manhole Cover and Frame.pdf*

4.4.5 Subsoil Drains

Subsoil drains, where required, should preferably be installed both sides of the road reserve directly behind the kerb line.

4.4.6 Curved Road Reserves

Services along curved alignments, particularly those which need to be laid in a series of straights (Sewer and Stormwater lines), may require additional space and the road reserve should be widened where necessary.

4.4.7 Reinstatement of Trenches in Road Reserves

Refer to Specification for the Reinstatement of Trenches in Road reserves

COCT Trench Reinstatement Spec Rev 2 Aug 04.pdf

4.5 Above Ground Service Reservations

4.5.1 Electrical Plant and Street Lighting

Where street lighting is mounted on separate poles the minimum clear space between the pole and roadway shall be as follows:

Roadway clearance for Street Lighting Poles (measured from back of kerb to face of pole)			
1.	Barrier Kerb BK2 and BK4	Next to parking bay or shoulder	0.8m
2.	Barrier Kerb BK2 and BK4	Next to Traffic Lane	2.0m
3.	Mountable Kerb CK5 and MK10	Next to parking bay	0.8m
4.	Mountable Kerb CK5 and MK10	Next to Traffic Lane	2.0m

Streetlights, power poles, substations and electrical kiosks should be placed clear of future driveways, and preferably opposite common erf boundaries and of the shoulder site distance triangle at intersections and T-Junctions.

4.5.2 Landscaping in Road Reserves

In township layouts where the planting of large trees along roads form part of the development a reservation width of at least 1200mm should be allowed.

It is generally accepted that the care and maintenance of the verge surfaces be carried out by the adjacent land owners and that no special reservation be made for the planting of trees and shrubs. Trees and shrubs that obstruct sight lines may be removed or trimmed by Council.

Refer to the City's Guidelines for Designing or Approving Hard and Soft Landscaping in the Urban Road Reserve, 2004. *Guidelines Landscaping revised Jan 2005.pdf*

Attention is drawn to the *City's Tree Policy (Council, 2002-11-01)* which, inter alia, regulates the planting of trees in road reserves, and provides guidance with respect to positioning of trees in relation to utility services.

5. Pedestrian and cycle ways

5.1 Non-motorised Transport

Pedestrian and cycle facilities should form part of any new development. *DoT Pedestrian & Bicycle Facility Guidelines*

Surfaced footways shall be provided along roadways where pedestrian traffic is expected to be high, e.g. at churches, schools, public amenities, commercial areas, and along main routes.

Appropriate pedestrian crossing points at schools, community amenities, opposite expected pathways, at busy intersections and at places of attraction need to form part of any development proposal. These crossings together with other measures such as roundabouts should form part of a built-in traffic calming strategy.

A satisfactory level of service should be provided that includes users with disabilities and those with limited mobility.

The provision of these facilities should be such that it encourages the use of these modes of transport.

5.2 Pedestrian and Cycle Way Design

5.2.1 Footway and Cycle Lane Widths

Also refer to COCT's footways implementation policy – Version 2008-03-07. *Footways Policy and Guidelines 2008-03-17.pdf*

The minimum width for surfaced pedestrian paths and cycle lanes shall be as follows:

Prescribed Footway/cycle Lane Width				
	Road Type	Usage	Minimum Width (m)	
	Anticipated Volume		High	Low
1.	Mixed (lower order) Link Class 5	Pedestrian	2.0	1.5
2.	Mixed (middle order) Link Class 4	Pedestrian	2.0	1.8
3.	Mixed (middle order) Link Class 4	Pedestrian/Cyclists	3.0	2.5
4.	Mixed (higher order) Link Class 3	Pedestrian	2.5	2.0
5.	Mixed (higher order) Link Class 3	Pedestrian/Cyclists	3.0	2.5

5.2.2 Road Crossings

5.2.3 Designers should note the safety and operational issues that arise where pedestrians and cycling routes cross certain types of intersections or roadways.

5.2.4 At major signalised intersections footpaths and cycle ways should preferably be combined to one crossing point with special pedestrian and cycle phases provided for.

5.2.5 Provision must be made for pedestrian and cycle crossing points in the splitter islands at roundabouts.

5.2.6 On-road cycling at multi-lane roundabouts should not be allowed.

5.2.7 Where a pedestrian road crossing is provided with a median island (for refuge and traffic calming purposes), the width of the island shall be at least 2m and barrier kerbed all round. The median island (kerbed section) shall be at least 30m long with appropriate painted tapers and barrier lines on either side to prevent vehicles from overtaking on the wrong side of the road.

5.2.8 Tactile Warning Surfaces (Also refer to SANS 784)

Tactile warning surfaces to accommodate blind and partially sighted persons shall be installed at all pedestrian crossing points, splitter and median islands, and shall meet the following requirements:

a) The tactile surface shall consist of raised truncated domes with a nominal diameter of 23mm, a height of 5mm and a center to center spacing of 60mm.
b) The tactile surface shall contrast visually with adjoining surfaces, either light-on-dark or dark-on-light.
c) Tactile surfaces shall be placed behind the kerb line and extend into the pedestrian refuge area a distance of 990mm. On narrow median and splitter islands the tactile surface shall be reduced to 660mm with a contrasting section of normal paving surfacing in between.
d) The width of tactile surface shall have with a minimum width of 990mm
See standard drawing for details of concrete tactile slabs. Refer to drawing R17A.

6. Driveways

6.1 General

Driveways (also known as carriageway crossings) must be constructed where vehicles are crossing over the footway or verge in order to enter private property from a road having a non- mountable kerb, kerb and channel, or dish channel in front of the property.

In designing driveways the primary consideration must be the safety of all users, especially pedestrians and cyclists on pathways and traffic on the road from which access is gained.

A driveway (or carriageway crossing) is an encroachment of vehicular traffic across a pedestrian way, and not the other way around, and the design thereof should convey this principle. Driveways with kerb arrangements which make these resemble normal road intersections are therefore not favoured. Refer to Drawing R21.

6.2 Driveway Design

Driveways should be designed to allow vehicles to enter the site by turning at slow speed from the traffic lane nearest to the site without intruding into other traffic lanes, especially on higher order roads. Where two-way traffic is expected the driveway should be of sufficient width to allow two vehicles to pass to avoid queuing on public roads. Refer to CoCT's Specifications for the Construction of Vehicular, Pedestrian and Wheelchair Access Crossing and Access Ramps Carriageway Crossing Guideline & Spec Nov 2003.doc.

Driveways should be designed for the most common vehicle that will be using them. The following table can be used as a guide:

TYPE OF SURFACE		BITUMINOUS PREMIX (ASPHALT)				CLAY BRICK OR CONCRETE BLOCK			
Type of crossing		Pedestrian	Carriageway			Pedestrian	Carriageway		
Duty of crossing			Light	Heavy	Extra heavy		Light	Heavy	Extra heavy
USAGE OF CROSSING		Pedestrian only	Single residential	Flats, Church, School, etc	Warehouse, Factory, Loading area, Service Station	Pedestrian only	Single residential	Flats, Church, School, etc	Warehouse, Factory, Loading area, Service Station
TYPE OF EDGING		Brick stretcher on edge Or 150 x 75 mm precast concrete (side and boundary edging)			250 x 100mm precast concrete	Brick stretcher on edge Or 150 x 75 mm precast concrete (side and boundary edging)			250 x 100mm Precast concrete
THICKNESS OF	Premix Bricks Blocks Concrete	30mm	30mm	40mm	50mm	73mm 80mm (Classlo)	73mm 80mm	73mm 80mm 200mm	73mm 80mm 250mm
SAND BED THICKNESS (Uncompacted)		Nil	Nil	Nil	Nil	25mm	25mm	25mm	25mm
THICKNESS OF GRANULER BASE COMPACTED	(G5)* (G3)*	75mm	100mm	150mm	250mm (two 125mm layers)	75mm	75mm	100mm	200mm
OVERALL DEPTH OF COMPACTED LAYERS AND OF EXCAVATION	Premix Bricks Blocks	100mm	125mm	190mm	300mm	175mm 180mm	175mm 180mm	200mm 205mm	300mm 305mm
		0mm	150mm	150mm	200mm	0mm	150mm	150mm	200mm

ADDITIONAL EXCAVATION WHERE CLAYEY MATERIAL IS ENCOUNTERED Separated by a sand/stone layer enclosed in a geofabric sock									
Compaction of pavement layers	Subgrade (mod.aashto)	93%**	93%**	93%**	95%**				
	Sandfill (mod.aashto)	95%	95%	95%	100%				
	Subbase (mod.aashto)	95%	95%	95%	98% 95%	93%** 95%	93%** 100% 95%	93%** 100% 95%	95%** 100% 98%
	Btb layer (rice)			92%	92%		95%	95%	95%
	Bituminous premix (rice)	>40mm	92%	92%	92%				

** The standard for Subbase (G5) and Base (G3) shall be in accordance with the Technical Recommendations for Highways – TRH 14.*

*** 100% for sand.*

High volume driveways (generally all except those serving single residential properties) shall be designed with sufficient stacking length to avoid queuing in the public street.

6.3 Relevant Codes of Practice, Policy and Guidelines

a) CoCT: TR&S: Specification 01: Construction of Vehicular, Pedestrian and Wheelchair Access Crossings and Access Ramps.
b) City of Cape Town Zoning Scheme Regulations, Fourth Draft, November 2007.
c) UTG 5: Geometric Design of Urban Collector Roads
d) UTG 7: Geometric design of Local Residential Streets.
e) UTG 10: Guidelines for the Geometric Design of Commercial and Industrial Local Streets.
f) Road Access Guidelines (Second Edition – May 2001)
g) National Building Regulations
h) Footways Policy and Guidelines (CoCT)

6.4 Design Parameters

Even if there is no surfaced footway the verge and driveway must still accommodate the movement of pedestrians and perform a drainage function. Design considerations are as follows:

a) An area of approximately 1.5m wide is required immediately adjacent to kerb with a maximum cross slope of 3% towards the kerb to allow (i) the safe passage of pedestrians and cyclists,(ii) to allow wheel bin placement and (iii) to allow driveway access without vehicles scraping.
b) Ramps across drainage channels are not allowed. Where the shape of the road leaves no alternative, a ramp may be constructed which leaves the drainage channel open and accessible, as shown on standard drawing in this case the alignment of the road must be carefully designed to avoid sudden changes.
c) A cross slope of not less than 1% is required for surface drainage.
d) Surfaces must be skid resistant, even when wet.
e) The change in grade between the carriageway crossing and the road must not exceed 17%.
f) The back of footway level is to be sufficiently higher than the top of kerb to ensure that overland flows stay within the road reserve. (Refer to paragraph 4.3.3)
g) Distance from nearest intersection must comply with Road Access Guidelines.
h) Access restrictions on certain classes or sections of road apply.
i) Unobstructed sight lines must be maintained.
j) In determining gradients for a driveway, designers must apply the clearances of a typical South African Vehicle to the longitudinal section in order to avoid scraping.

7. Parking

7.1 General

This section covers some basic parking layout design guidelines.

For new commercial developments parking shall be provided in terms of Chapter 19, of the *City of Cape Town Zoning Scheme* Regulations.

Parking areas shall have a pavement structure for a class UD road as specified in Section 7 of this document. Areas which are also used by heavy vehicles (loading areas) shall have a pavement structure for a class UC (Major Bus Route) road. See table 8.3.2.

7.2 Relevant Codes of Practice, Policies and Guidelines

a) City of Cape Town Zoning Scheme Regulations, Fourth Draft, November 2007.

CTZS_Regulations_Sept_2012.pdf

CTZS_Appendix_Sept_2012.pdf

CTZS_Table_A_Sept_2012.pdf

b) Parking Standards – Department of Transport
c) Land Use – Department of Transport

7.3 Geometric Design

7.3.1 Angled Parking

The recommended dimensions for angled parking layouts are indicated in the table below. The dimensions referred to are those as given in Figure 6.3.1. [check the reference.]

Dimensions for Parking Area Layouts						
	Parking Angle (ø)	Width (m)	Depth (m)	Aisle Width (m)		
				Ideal	Acceptable	Abs. Min.
1.	90°	2.5	5.0	7.5	7.0	6.5*
2.	60°	2.9	5.3	5.4 Two Way 4.4 One Way	=	=
3.	45°	3.5	4.9	5.2 Two Way 4.2 One Way	=	=
4.	30°	5.0	4.2	3.5	=	=

The absolute minimum values given in the table should be used with caution and in limited applications only, such as private parking areas.

7.3.2 Parallel Parking

For parallel parking the dimensions as given on the standard drawing will apply. Along highly trafficked roads the clear space between two consecutive bays shall be increased to 1.5m.

7.4 Parking Areas

7.4.1 Parking Layout

The parking layout recommended is 90° bays with two-way movement in aisles. Angled parking and one-way movements should generally be avoided. Parking layout must be such that all bays can be entered or exited without difficult or potentially hazardous manoeuvres, such as long reversing paths, or difficult manoeuvres involving kerbs, bollards, poles and columns. To achieve this additional clear space beyond end bays may be required to allow turning movements.

Kerbs shall be low enough to allow vehicle overhangs and easy opening of doors.

7.4.2 Safety

Car parks should be designed to provide a safe environment for its users. The design should minimize vehicle-to-vehicle and vehicle-to-pedestrian conflicts. Careful consideration shall be given to the placement of poles, trees, and columns. Direct access via pedestrian paths to destinations should be provided. Adequate lighting should be provided. Vertical clearances shall be adequate for pedestrians and cyclists.

7.4.3 Parking for Disabled Persons

Adequate parking provision, near end destinations, needs to be made for vehicles used by disabled people. Such parking bays shall be provided with a 1.5m minimum width access aisle between vehicles to allow easy wheelchair access between parked vehicles, Kerbs at these aisles shall be dipped.

Parking bays for disabled persons shall be clearly marked as prescribed by the SARTSM (R323-P).

7.4.4 Landscape Elements

Landscaping is an important element of a car park. A well-designed car park, shaded by trees, screened by hedges, shrubs or grassed mounds provides a stark relief from the expanses of a featureless paved area.
The following design principles should be adopted:

a) Avoid stand-alone trees planted within car park (hard) surfaces. Rather use groups of trees in special planting areas.
b) Choose appropriate ground surfaces for open areas and around trees. These could include mulch, natural gravel, porous paving, groundcover plants and grass. Grassed surface areas should however not be steeper than 1:4. Loose stone beds are not an acceptable surfacing medium.
c) Pedestrian routes need to be carefully planned, e.g. make provision for paths through garden beds etc. Vertical clearance of at least 2,2m (2,5m preferred) over the entire width of all pedestrian ways, and preferably over all areas accessible to pedestrians, is required.

d) Co-ordinate surface lighting with tree planting
e) No tree or shrub planting should take place where car overhang (up to 0.8m from kerbs) is expected.
f) Shrubs and trees shall be chosen to require minimal maintenance.
g) Incorporate paved areas to break the surface texture and to provide colour enhancements.

Refer to "Guidelines for Designing or Approving Hard and Soft Landscaping in the Urban Road Reserve: Requirements from Transport Roads & Stormwater", Director: Roads &Stormwater, January 2005. *Guidelines Landscaping revised Jan 2005.pdf*

Attention is drawn to the City's Tree Policy (Council, 2002-11-01) which, inter alia, regulates the planting of trees in road reserves, and provides guidance with respect to positioning of trees in relation to utility services. *Tree Policy July 2002 -1.pdf*.

8. Pavement design

8.1 General

Pavement design is a process of selecting appropriate pavement and surfacing layers to ensure that the pavement will carry the traffic for the structural design period, at an acceptable service level without any major structural distress.

Designers should base their design on a life cycle strategy comprising of high initial standards followed by very low or minimal maintenance needs over the analysis period.

In areas where mole or mole-rat activity is evident, and where open, unhardened space along a road is going to be a permanent or semi-permanent feature, the installation of mole barriers will be required to protect the road pavement layers. Materials used for mole barriers must be environmentally acceptable. Mole barriers shall be placed in such a way that there is no gap between these and the road pavement structure.

In areas where a high water table exists, especially during the rainy season, sufficient subsurface drainage must be provided to protect the pavement layers against ingress of water.

8.2 Relevant Codes of Practice, Policy and Guidelines

a) Red Book – Guidelines for Human Settlement, Planning and Design.
b) TRH 4 – Structural Design of Flexible Pavements for Inter-urban and Rural Roads.
c) TRH 14 – Guidelines for Road Construction Materials
d) SABS 1200 M:1996 – Roads (general)
e) SABS 1200 ME:1981 – Subbase
f) SABS 1200 MF:1981 – Base
g) SABS 1200 MFL:1996 – Base (Light Pavement Structures)
h) SABS 1200 MH:1996 – Asphalt Base and Surfacing
i) SABS 1200 MJ:1984 – Segmented Paving
j) COLTO 1998 Edition

8.3 Pavement Design

8.3.1 Level of Service

The level of service should be related to the function of the street. A higher order, or more important road, should have a higher level of service. Its physical properties and standards should be higher with a reduced risk of failure. Therefore it is inevitable that every road pavement has to be designed according to conditions applicable.

For all formal roads within the City of Cape Town a basic minimum level of service (LOS) of 5 as per Table 8.2 of the Guidelines for Human Settlement Planning and Design is required, unless such roadways forms part of interim measures where only rudimentary services are provided. Formal roadways with open lined storm water channels are generally not acceptable because of the windblown sand problems.

8.3.2 Minimum Pavement Design Guidelines

Where possible, designers must base their design on the estimated equivalent E80s over the design period. A minimum catalogue standard as given in Table 7.3.2 at the end of this section shall apply for categories UB, UC and UD roads as defined in chapter 8 of the Guidelines for Human Settlement Planning and Design Table 8.1.

The structural design periods for all road categories shall be 20 years.

As a guideline pavement layers shall comply with the following minimum standard:

Minimum Standard for Pavement Layers.			
	Road Category	Surfacing	Pavement Layers
1.	UB (District Distributor) Class 3	40mm medium continuously graded Asphalt	150mm G2 Basecourse / 80 mm BTB 150mm C4 Cemented Subbase 150mm G7 Subgrade 150mm G9 Subgrade
2.	UC (Major bus route) Class 4	40mm medium continuously graded Asphalt	150mm G3 Basecourse / 80mm BTB 150mm C4 Cemented Subbase / 225mm G3 150mm G7 Subgrade 150mm G9 Subgrade
3.	UC (Minor bus route) Class 4	40mm fine continuously graded Asphalt	150mm G4 Basecourse / 80mm BTB 150mm G5 Subbase / 150 mm G3 150mm G7 Subgrade 150mm G9 Subgrade
4.	UD (Access Street) Class 5	30mm Pavement mix	150mm G4 Basecourse 150mm G7 Subgrade
5.	UD (Access Street) Class 5	80mm Interlocking Concrete Paver or 73 mm Clay Paver	150mm C4 Cemented Subbase 150mm G7 Subgrade
6.	UD (Access Street) Class 5	140mm Concrete	100mm C3 Subbase In-situ G9

7.	Pedestrian Only Links Class 5	30mm Pavement Mix	125mm G4 Basecourse 150mm G7 Subgrade
8.	Sidewalks and Cycle Ways	30mm Pavement Mix	100mm G5 Basecourse 150mm G7 Subgrade
9.	Parking areas	30mm medium continuously graded Asphalt/ 80mm interlocking pavers	150mm C4 Cemented Subbase 150mm G7 Subgrade
10	Parking areas: Loading areas	200mm concrete	100mm C3 Subbase In-situ G9

8.3.3 Subgrade bearing capacity

The bearing capacity and quality of the in situ subgrade or fill material is very important in the selection of the appropriate pavement layers. Designers should conduct a proper soil survey to determine the in situ CBR within the material depth specified in Table15 of TRH 4. The classification of the subgrade material shall be based on the soaked California Bearing Ratio (CBR) at 93% of Mod. AASHTO max. density (100% for sand).

8.3.4 Compaction Densities and Material Specifications

Pavement layers and material shall comply with the following:

Pavement Material Specifications							
	Layer	Class	Material Type	Min CBR at Spec Density	Max PI	Min Compaction	Grading SABS-1200M
1.	Basecourse	G2 G3 G4	Crushed stone Crushed stone Crushed stone	80 80 80	6 6 6	85% BRD 98% Mod AASHTO 98% Mod AASHTO	Tbl 8, Column 2 Tbl 8, Column 3 Tbl 8, Column 4
2.	Subbase	G5	Crushed stone	45	6	95% Mod AASHTO	None specified
3.	Selected layer (upper 300mm)	G7	In-situ or Imported sand	15	12	93% Mod AASHTO or 100% for sand	None specified
4.	Subbase for sidewalks	Surfaced Un-surfaced	Crushed Stone Natural Gravel or Crushed Stone wearing course	45 45	6 6	95% Mod AASHTO 95% Mod AASHTO	None specified None specified

8.3.4.1. Crushed rubble shall only be used in cases where the consistency of the material can be

guaranteed and with special approval from the D: R&S. It shall further only be used in subbase or fill applications.

8.3.5 Surfacing Specifications and Densities

Bituminous surface treatments in the form of chip and spray, slurry or Cape Seals are not acceptable. All surfacing shall be in the form of continuous graded, hot asphalt, spread with a self-propelled mechanical spreader (paver). Special permission must be obtained from the Director Transport, Roads and Stormwater to use Warm Mix Asphalt.
Surfacing layers shall comply with the following:

Premix Surfacing Specifications				
	Road Category	Surfacing	Min Compaction Strength	Grading
1.	UB (District Distributor)	40mm medium continuously graded Asphalt	93% Rice	COLTO Table 4202/7
2.	UC (Major bus route)	40mm medium continuously graded Asphalt	93% Rice	SABS 1200MH Table 2 Column 6
3.	UC (Minor bus route)	40mm medium continuously graded Asphalt	93% Marshall	SABS 1200MH Table 2 Column 6
4.	UD (Access Street)	30mm Pavement mix (Residential Mix)	93% Marshall	SABS 1200MH Table 2 Column 6
5.	UD (Access Street)	80mm Concrete Pavers/ 73mm Clay pavers / Concrete Slab	35MPa	
6.	Pedestrian Only Links	30mm Pavement mix (Residential Mix)	95% Marshall	SABS 1200MH Table 2 Column 7
7.	Sidewalks and Cycle Ways	30mm Pavement mix (Residential Mix)	95% Marshall	SABS 1200MH Table 2 Column 7

Modified bituminous binders shall be used on steep roads with high incident of turning movements, where there is a strong possibility of deformation e.g. braking zones, acceleration / deceleration zones. Such asphalt shall comply with UTG2.

8.3.6 Compaction Equipment

Pavement layer compaction during construction has a major effect on the structural bearing capacity of the pavement. The higher the construction density of a layer, the higher the strength and resistance to deformation.

Designers should therefore not only specify the minimum compaction rates but also the type of plant to be used for the different material types. For the compaction of base, sub-base and subgrade (sand) layers a 9 ton vibratory roller should be regarded as the minimum requirement.

Please note that static rolling compaction will be required when working in closed proximity to sensitive services. Such static rolling compaction shall be designed.

8.3.7 Labour Intensive Construction

Relevant Codes of Practice, Policy and Guidelines

a) Guidelines for the implementation of labour-intensive infrastructure projects under the Expanded Public Works Programme – Second Edition July 2005.

On projects where labour intensive methods are specified, a critical review of the specifications for road pavement layers needs to be made. All road construction activities cannot be labour intensive.
The activities that can be labour-based are the following:

a) Spreading, levelling of a Macadam layer
b) Excavation up to 1.5m in depth, in material suitable for hand excavation
c) Spreading of homogeneous or coarse graded materials
d) Kerb laying and ancillary works
e) Paving of sidewalks, walkways and road surfaces (Paving of roadways in asphalt must be undertaken using an asphalt finishing paver)
f) Placing of concrete on road surfaces
g) AOT

The construction methods chosen should result in the same standard as specified in COLTO. For labour intensive projects, segmented concrete block pavements, concrete pavements (JCP) or the use of Waterbound Macadam as a base layer for granular pavements is recommended.

8.3.8 Selected Layers

Designs for all categories of roads should assume that all subgrades are brought to at least equal (G7) support standard. Subgrade conditions that are below a G7 standard shall be treated as per Table 22 of TRH 4, or be replaced with suitable material.

Catalogue Specification for Pavements									
Road Category				Pavement Class	E80's / Lane (mil)	Granular Bases	Macadam Bases	Block Pavements	JCP (Concrete)
UA	UB	UC	UD						
				ES0.003	**<0.003**	30mm AC 150mm G4 150mm G7	30mm AC 150mm WM2 150mm G7	80mm/73mm S-A 20mm SND 100mm G5 150mm G7	140mm JCP 100mm C3 G9 In-situ
				ES0.01	**0.003 - 0.01**	30mm AC 150mm G4 150mm G7	30mm AC 150mm WM2 150mm G7	80mm/73mm S-A 20mm SND 125mm G5 150mm G7	140mm JCP 100mm C3 G9 In-situ
				ES0.03	**0.01 - 0.03**	30mm AC 150mm G4 150mm G7	30mm AC 150mm WM2 150mm G7	80mm/73mm S-A 20mm SND 150mm G5 150mm G7	150mm JCP 100mm C3 G9 In-situ
				ES0.1	**0.03 - 0.10**	30mm AC 150mm G4 100mm G5 150mm G7	30mm AC 150mm WM2 100mm G5 150mm G7	80mm/73mm S-A 20mm SND 150mm G4 150mm G7	150mm JCP 150mm C2 G9 In-situ
				ES0.3	**0.10 - 0.30**	30mm AC 150mm G4 125mm G5 150mm G7	30mm AC 150mm WM2 100mm G5 150mm G7	80mm/73mm S-A 20mm SND 150mm G4 150mm G7	160mm JCP 150 C2 G9 In-situ

Catalogue Specification for Pavements									
Road Category				Pavement Class	E80's / Lane (mil)	Granular Bases	Macadam Bases	Block Pavements	JCP (Concrete)
UA	UB	UC	UD						
				ES1	**0.30 - 1.0**	30mm AC 150mm G4 150mm G5 150mm G7	30mm AC 150mm WM2 150mm G5 150mm G7	80mm/73mm S-A 20mm SND 150mm C4 150mm G7	
				ES3	**1.0 - 3.0**	40mm AC 150mm G3 150mm C4 150mm G7	40mm AC 150mm WM1 150mm C4 150mm G7		
				ES10	**3.0 - 10.0**	40mm AC As Per TRH 4 As Per TRH 4 As Per TRH 4	40mm AC 150mm WM1 125mm C4 125mm C4 150mm G7		
Sidewalks and Cycle Ways						20mm AC 100mm G5 150mm G7		80mm/73mm S-A 20mm SND 75mm G5 150mm G7	
Pedestrian Only Links						25mm AC 125mm G4 150mm G7		60mm/73mm S-A 20mm SND 100mm G5 150mm G7	

8.4 Additional Requirements for Steep Terrains

8.4.1 General

The following additional requirements apply to all roads steeper than 1:8 (12,5%), unless otherwise specified.

a) Portions of private driveways which fall within a public road reserve must also comply
b) The length of steep road sections shall be kept as short as possible. It is advisable to have a reasonably level section of road at most every 50m
c) The stability of abutting slopes, walls and fences must be ensured
d) Utility services must be adequately protected, and access thereto ensured, in consultation with the relevant service authority or service owner

8.4.2 Minimum Standards

a) Steepest longitudinal grade: 27%
b) Minimum width as specified hereinbefore
c) Approach to intersection: Maximum longitudinal grade 5% over a length of at least 10m (5m for a private driveway)
d) Maximum cross fall 5%

8.4.3 Pavements for Steep Gradients

a) The pavement structure must be constructible on steep slopes
b) The maximum gradient at which asphalt surfacing can be placed is 14%. All roadways with steeper gradients shall therefore have Block or Concrete pavements, with support beams at regular intervals
c) Surface roughness must be adequate in wet conditions over the full expected life of the road

8.4.4 Pedestrian facilities on steep terrain

a) Where road width is less than 5m, or where there is a risk involved in pedestrians using the roadway, a separate footway shall be provided
b) Maximum longitudinal slope for a footway is 15%. For steeper sections steps must be provided, which must conform to the following
c) Minimum width of steps: 1,5m
d) Maximum no of steps between landings: 12
e) Landings must be at least 1 m long
f) Maximum rise per step is 170mm
g) Minimum step depth is 250mm
h) Step rise and step depth shall be uniform for each section between landings

9. Traffic control devices and signage

9.1 General

For all forms of traffic control devices reference should be made to latest edition of the South Africa Development Community Road Traffic Signs Manual (SADC-RTSM).

For detailed design and construction of traffic signals reference needs to be made to the specifications as laid down in the CMA Specification for Traffic Signals.

Traffic control devices shall comply in all respects with the requirements of the National Road Traffic Act 1996 (Act No. 93 of 1996) and the National Road Traffic Regulations 2000, promulgated in terms of the Act. It is therefore important that professionals with experience and knowledge of the subject undertake the design, installation and operation of traffic signals and signage.

9.2 Relevant Codes of Practice, Policy and Guidelines

1. SARTSM and SADC-RTSM Manuals
   - Volume 1: Uniform Traffic Control Devices (SADC-RTSM)
     Detailing signing policies and design principles together with specific information on the meaning and application of all traffic control devices
   - Volume 2: Traffic Control Device Applications (SARTSM)
     This volume covers the use of sets of signs, markings and signals for specific applications
   - Volume 3: Traffic Signal Design (SARTSM)
     Detailing in depth, requirements for the selection and installation of traffic signals and their methods of control
   - Volume 4: Traffic Signs Design (SADC-RTSM)
     Dimensional details for all road traffic signs and sign face components
2. The CMA Specification for Traffic Signals

9.3 Traffic Signals Design

With each proposal for traffic signals the following is required:

a) A scaled drawing (1:250) of the intersection or junction with the road layout, lanes and road markings
b) Ducting and draw box layout for underground cabling
c) Positions of controllers
d) The number, type and layout of signal faces and pole positions
e) The number, type and location of pedestrian and cyclist facilities, including the position of push buttons
   i. The phasing, time plans and offset settings
   ii. The layout of loop detectors
   iii. The proposed date of implementation

10. Stormwater design standards

10.1 General

Designers shall base their design on a sustainable stormwater management system and all factors that will impact on the future operation and maintenance of the system must be considered. Maintenance requirements shall be kept to an absolute minimum.

For a more detailed approach to Stormwater Management reference needs to be made to the guidelines as set out below.

The Stormwater drainage design is to be based on the concept of Minor and Major systems as prescribed in the Guidelines for Human Settlement Planning and Design.

10.2 Standard Reference Documents, Codes of Practice, Policies and Guidelines

a) Floodplain Management Guidelines – City of Cape Town document, September 2003 – Transport Roads & Stormwater Directorate.
b) Stormwater Management Planning and Design Guidelines for New Developments – City of Cape Town document – July 2002 – Transport Roads & Stormwater Directorate.
c) Floodplain and River Corridor Management Policy, Version 2.1, May 2009
d) Management of Urban Stormwater Impacts Policy, Version 1.1, May 2009
e) Requirements of a Local Stormwater Management Plan, Draft 3, Feb 2006
f) Requirements of a Stormwater Impact Assessment, Draft 2, Feb 2006
g) Stormwater Management on Slopes Adjacent to Natural Areas, Version 1.0 , November 2003
h) Stormwater Management Planning and Design Guidelines for New Developments, Version 1.0, July 2002
i) City of Cape Town Rainfall Intensity – Duration – Frequency Curves, Updated 2011.
j) City of Cape Town: Servitudes for non–pressure sewer &stormwater systems October 2006.
k) TRH 15 – Subsurface Drainage for Roads.
l) Guidelines for Human Settlement Planning and Design – (Red Book).
m) Guideline for the Provision of Engineering Services in Residential Townships (Blue book).
n) CoCT Minimum Standards for Civil Engineering Services in Townships Draft 2013-02-05
o) SANRAL Road Drainage Manual
p) SANS 1200 DB : 1989 – Earthworks (Pipe Trenches)
q) SANS 1200 GA : 1982 – Concrete (Small Works)
r) SANS 1200 GE : 1984 - Precast Concrete (Structural)
s) SANS 1200 LB : 1983 – Bedding (Pipes)
t) SANS 1200 LE : 1982 - Stormwater Drainage

10.3 Stormwater Design

10.3.1 General Design Principles:

The following elements must be incorporated in stormwater drainage design:

a) The main stormwater routes should be located along natural drainage routes.
b) Major systems shall be free draining and local low points in roads will generally not be allowed.
c) Runoff from adjoining properties must be adequately accommodated. This includes runoff from upstream properties, where applicable.
d) During major storm events (greater than 1:2 year in the case of residential areas), the traffic function of residential and lower order roads is interrupted and the full Stormwater carrying capacity of the roads can be utilised. The maximum allowable inundation of Mixed (Higher order) and class 4 Local Distributors above road crown during 1:50 year storm events is 150mm.
e) Where localised low points are unavoidable and where provision has be made for emergency overland escape routes, the number of catchpits and conduit size shall be increased to accommodate a 1:10 year return storm. Where such overland escape routes are not possible, the intakes and/or catchpits and conduit system serving the area shall be capable of accommodating at least a 1:50 year storm. Overland and pipe routes shall be accommodated in a servitude registered in the name of the City of Cape Town and provide for adequate access to enable maintenance activities to be carried out.
f) Debris and pollutant removal facilities (SUDS) shall be designed and constructed to protect downstream facilities and infrastructure.
g) Appropriate measures shall be put in place to minimise scour and erosion.
h) Stormwater discharge shall not be concentrated on any downstream property, except where such concentration of flow occurred previously, or if the flow is discharged via a servitude, in favour of the upstream property.
i) The post development runoff shall not exceed the pre development runoff. Stormwater storage facilities will need to be designed to restrict the runoff from developments where the post-development runoff exceeds that of the pre- development. Refer to the Management of Urban Stormwater Impacts Policy document.
j) Due consideration is to be taken at design stage of all future maintenance requirements and activities.
k) All materials used in the works shall, where such mark has been awarded for a specific type of material, bear the SANS Mark. The manufacturer must be in a position to furnish the current valid SABS Mark Permit for such materials. Where materials are proposed for incorporation in the works that do not bear the SANS Mark prior approval shall be obtained for the use of such materials from the City's Project Manager.
l) For any proposed developments, designers will take into consideration the existing and any future development plans. The Local Catchment Manager must be consulted in this regard.

10.3.2 The Minor System

The minor system provides for the convenience of the community by rapidly removing runoff caused by storms of relatively frequent recurrence intervals (2 to 5 years) from the drainage area, mainly via an underground pipe network. The system includes catchpits, manholes, road-edge channels and open channels.

The applicable minor system design storm return period varies according to land use. The return periods to be applied are as listed in the table below.

Design Storm Recurrence Interval per Development Type		
	Development	Design storm recurrence interval (years)
1.	Residential	2
2.	General commercial & industrial	5
3.	Public buildings	5
4.	High value CBD	5 to 10

10.3.3 The Major System

The flood plan management system for all new townships will be designed to safely contain floods up to the 1:20 year flood without the flooding of properties, i.e. within the road reserve boundaries. Conditions shall also be checked for the 1:100 year event to assess the risk of floor levels being inundated. Floor levels are to be 300mm (minimum) above the 1:100 flood levels. (Consultants to calculate the theoretical energy levels)

The major system is the trunk system that receives stormwater discharge from the minor system. It also functions as the emergency system that operates during overflow from, or failure of the minor system. The system includes watercourses, large conduits, roads, stormwater attenuation facilities (ponds), drainage servitudes and flood plains. Public open spaces, sports fields and parking areas, can also be utilised to form part of the major system.

The major system fulfils a flood control function only during major, infrequent storm events. During such events, temporary disruption of many normal activities within the catchment will occur, owing to the intensity and magnitude of the event. The loss of convenience is tolerable, if no inundation of private property occurs and the disruption is restricted to the following:

a) Residential and lower order roads
b) Recreational areas and public open space
c) Parking areas
d) The minor underground pipe system shall be assumed to be flowing full during a major storm event. The effect/ramifications of blockages occurring in the minor system must be checked at design stage.

10.3.4 Rainfall and Modelling Criteria

Rainfall gauging stations are operated by the City and the location of these and other gauging stations are listed in *Stormwater Management Planning and Design Guidelines for New Developments.* The City has developed IDF curves for the stations listed based on the data collected and these are available from the Transport, Roads and Stormwater Directorate. The IDF curves were updated in 2011 with additional curves being determined for Atlantis, Hout Bay, Goodwood Greens, Noordhoek, Potsdam, Simons Town and Vergelegen.

Stormwater design shall be based on the IDF (intensity-duration-frequency) figures obtained from rainfall monitoring stations. It is noted that precipitation in the city environs is greatly influenced by wind direction, elevation of the catchment and proximity to geophysical features. Either the Thessen Diagram is to be used to determine which rainfall monitoring station data set should be utilised, or data shall be used from

the rainfall monitoring station most suitably located in relation to catchment area under consideration.

For the calculation of Stormwater runoff and storage capacities reference should be made to *Stormwater Management Planning and Design Guidelines for New Developments (Annexure E – page 74 to77)*,which documents the recommended techniques and modelling tools in detail.

10.4 Physical Design Criteria

The physical criteria and requirements for the various stormwater design elements are set out in the sections below.

10.4.1 Stormwater Pipes and Box Culverts (Underground Conduits)

Stormwater Conduit Design Criteria		
1.	Mannings coefficient of friction (n)	0.012
2.	Minimum diameter – catchpit connections	300 mm (nominal dia.)
3.	Minimum Diameter – Main lines	375 mm (nominal dia.)
4.	Pipe / culvert material	Reinforced concrete (Bearing SANS mark)
5.	Pipe joint type	Spigot and socket (including rubber ring)
6.	Pipe class: (all diameters)	Generally 100D (Loading conditions for each application to be confirmed, particularly construction loadings on the smaller diameter pipes)
7.	Culvert Class	Generally 100S (Loading conditions for each application to be confirmed)
8.	Bedding type	Class B (SANS 1200 LB)
9.	Position in road reserve	1.70m, North or East from road centre line
10.	Minimum slope: Connections	1:60 (1.67 %)
	375mm dia.	1:360 (0.28 %)
	450mm dia. and larger	Minimum velocity criteria applies
11.	Minimum velocity (80% full flow)	0.9 m/s
12.	Maximum velocity (Without checking for hydraulic jump)	3.5 m/s
13.	Maximum velocity (Checking for hydraulic jump)	5.0 m/s (Minimum pipe class 100D)
14.	Anchor blocks	375mm to 450mm dia pipes steeper than 1:6 (16.67%) 450mm dia and larger pipes steeper than 1:8 (12.50%)

15.	Minimum cover (road intersections)	1000mm
16.	Minimum cover (general)	750mm
17.	Maximum distance between manholes	90m

a) Underground conduits are to be laid within the road reserve or in public open spaces. Where crossing private property is unavoidable, the conduit must be protected by a servitude, in favour of the City.
b) Generally, structures are not permitted within half the pipe diameter or culvert width, plus working area (generally 300mm) plus depth to invert, measured from the centreline of the pipe. However, each case must be assessed to allow for equipment and machinery requirements.
c) Stormwater pipes are generally to be laid shallower than sewers.
d) Free flowing junctions (i.e. 45° junctions) should be detailed where possible and 90° junctions avoided. Connections from catchpits to the main line are to be as close to 60° to the road centreline as possible.
e) Only reinforced concrete with rubber ring seals are permitted. Interlocking joint (ogee) pipes shall not be used in any application.
f) Where cutting of pipes is required, the pipe is to be cleanly cut, with any exposed reinforcing being adequately treated and protected against corrosion.
g) Box culverts are to have V-shaped inverts to accommodate low flows.
h) The vertical clearance between Stormwater conduits and other services is to be a minimum of 150mm.
i) Steeper gradients shall be used at the head of the system, where full flow is not yet achieved.
j) In sandy areas consideration should be given to increasing the coefficient of friction (n) in calculations to compensate for the partial siltation of the of the underground conduits.
k) Where underground conduits enter rivers, canals or ponds:

i. the invert must be above normal wet season water level
ii. the soffit must be above the water level achieved during minor storm.
iii. the discharge points shall be provided with adequate erosion protection measures such as rock filled gabion mattresses and stilling basins

Anchor blocks in 20MPa concrete are to be provided on steep slopes as follows:

Anchor Block Spacing		
	Grade (%)	Spacing for 2,44m pipe lengths
1.	Over 50%	every joint
2.	30% to 50%	alternate joints
3.	20% to 30%	every fourth joint
4.	10% to 20%	every eighth joint

a) Spacing for intermediate grades can be interpolated.
b) Refer to the Standard Stormwater Details for Anchor block requirements.
c) Box culverts are to have dished inverts to accommodate low flows.
d) Where the box culvert height is less than 1,2m, Width to Height (W:H) ratio is not to exceed 2:1.

e) The minimum height of box culvert shall be 600mm.

10.4.2 Catchpits

The maximum flow capacity of the road cross-section at the particular gradient is to be used to determine the required positions of catchpits.

Street capacity and kerb flow interceptions are to be based on the charts developed by Zwamborn, Wessels, Lotter and Grobler as published in the Road Drainage Manual, SANRAL. Reference can also be made to the charts developed by Forbes and Rooseboom. Designers are to provide calculations on request.

The percentage flow bypassing a catchpit shall not exceed 20%.

Catchpits with double kerb inlet - gully grid are preferred. The use of gully grid type entry only is limited to instances where double flat channels are required.

Where gully grids are utilised, grids with the slots are in the same direction as the channel flow are preferred. In instances where the grid slots are at right angles to the flow (e.g cycle lanes), due to the tendency of the upstream grid to block with debris, a longer chamber with additional grid and frame should be installed to ensure the same intake capacity, i.e instead of the usual two grids, three grids should be installed.

Gully grid inlets and frame, shall be manufactured from ferrous materials or polymer concrete. For ferrous materials the grid is to be fixed to the frame by means of stainless steel (304) bullet hinges. The frame and grid shall be able to withstand the loading requirements of SANS 50124, capable of bearing a test load of 250kN.

At trapped low areas, the number of catchpits is to be increased to manage the trapped flows adequately. Where trapped low areas occur on high order roads, additional catchpits should also be provided above the low area, to limit the area of flooding due to blockage of those catchpits serving the trapped low.

Length of channel flow until the first catchpit will not exceed 120m.

Distance between catchpits shall not exceed 90m, unless hydraulic calculations indicate that alternative distances can be accommodated.

Careful consideration should be given to the placing and spacing of catchpits in low cost housing areas as the catchpits are frequently used for rubbish and sewerage disposal.

Catchpits are to be located to prevent surface flows across roads and intersections. Particular attention is to be taken in placing inlets where the road cross falls roll over.

Catchpits may not be positioned on intersection radii due to wheel and tyre damage.

The location of vehicular entrances, (carriageway crossing) are to be taken into account when positioning catchpits.

Catchpit to catchpit connections are not permitted.

Combination catchpit/manholes are not permitted.

Catchpit connection lengths may not exceed 15m.

Kerb inlet openings are to be 100mm in height.

Inlet kerbs are to be of same profile and height as adjoining kerbs.

Catchpits should not be less than 750mm in depth and may not exceed 1000mm in depth.

A chamfer to the opening around the connection pipe socket shall be provided to improve the hydraulic efficiency and prevent debris from snagging.

In windblown sandy areas catchpits shall not be benched, but the floor shall be at the same level as the outlet invert.

Skew catchpits shall be used where the road gradient exceeds 8% and must be offset to the road centreline by 600.

In areas with a high incidence of litter and debris, a horizontal Y16 galvanised trash bar is to be installed across the kerb inlet opening, to prevent the ingress of bottles and cans.

Alternatively, kerb inlet screens may be installed as a debris barrier. Only screens with vertical bars are permitted, and no horizontal bars may be used in conjunction with the vertical bars across the opening.

In locations where kerb inlet screens have been installed, the number of kerb inlet openings is to be doubled.

Trash bar/screen installations are not advisable in trapped low spots or in high vegetation areas.

Bricks used in the construction of catchpits to comply with the specifications for masonry units. Refer to paragraph 10.4.10.

10.4.3 Manholes

Manholes will be provided at all horizontal and vertical changes in direction, and at all pipe junctions.

Junction boxes are not permitted.

At manholes where there is a change in conduit size on the main line, the conduits are to be aligned crown to crown.

In areas with flat grades the designer is to check for head-loss in the manhole, where upstream and downstream conduits are the same size.
Downstream conduits may not be of smaller size than those upstream although a change of grade may indicate this hydraulically. This requirement is to prevent large objects conveyed in the upstream conduit blocking the conduit downstream.

Maximum spacing between manholes is not to exceed 90m.

Maximum chimney height is to be 400mm.

Manhole access shafts to be located in such a manner as to permit free access for bucket machine cleaning cables and equipment.

Widening must be provided on outside curves of benching to accommodate bucket cleaning.

Bricks used in the construction of manholes are to comply with the specifications for masonry units. Refer to paragraph 10.4.1.

Where the manhole depth is greater than 1,0m but less than 1,8m, the cover and frame are to be placed directly onto the reducer slab i.e. No access shaft is required.

Avoid large drops (greater than 1.0m) from incoming lateral pipes to limit erosion of the manhole floor.

The standard manhole cover and frame is to be the Cape Town Standard 2010 Manhole Cover and Frame as indicated in the Standard Stormwater Details.

In road carriageways, hard shoulders, parking areas and pedestrian areas, Cast Iron or Ductile Iron manhole covers and frames should be initially installed, followed by polymer products in the event of theft.

10.4.4 Subsurface Drains

Subsurface drainage is required to ensure that pavement and subgrade layers are well-drained at the material depth as defined in TRH 4, but to at least 800mm below the road surface.

Subsurface drainage systems shall be installed in all areas where a high water table can be expected in the wet season.

Subsurface drains shall generally to be installed along a road on the upstream side of the road reserve to form a cut-off drain, directly behind the kerb line.

Subsurface drains shall have dual filter mediums that consist of a combination of granular and synthetic materials.

In areas of high clay content, geo-textile is to be omitted and the stone surround to be as detailed on typical Standard Stormwater Detail, for Subsurface Drains.

All Subsurface drains shall be provided with piped systems that are connected by means of manholes. The pipes shall have a stone bedding and geotextile blanket with the perforations or holes in the pipe being laid according to the manufacturer's guidelines.

The geo-textile indicated in the Standard Stormwater Detail for Subsurface Drains is a general purpose type.

Designers are to ensure that the geofabric specified, is suitable for use in the specific in-situ soil conditions.

Sub-surface Drain Design Criteria		
1.	Minimum internal manhole diameter	1000mm
2.	Maximum manhole spacing	60m
3.	Maximum depth	1000mm where practical
4.	Drainage medium	19mm stone complying with SABS 1083 or particular grading as specified
5.	Synthetic filter (general purpose)	Geo-textile Grade A2
6.	Minimum drainage pipe diameter	100mm
7.	Pipe type	HDPE Double Walled slotted pipe (with smooth internal surface)

**Note: Sausage or fin type subsurface drains are not permitted.*

Open Stormwater Channels

Open Stormwater channels are generally not accepted in areas where windblown sand and debris are prevalent. Where unavoidable, the following minimum standards will apply:

Open Stormwater Channel Design Criteria			
	Criteria	Unlined	Lined
1. 2. 3.	Minimum longitudinal slope Maximum flow velocity Maximum side slopes	1:200 (0.50 %) 1.0m/s 1: 5	1:400 (0.25 %) 2.5m/s Varies depending on material. * see note

** Note: Acceptable linings include: grouted stone pitching, concrete, rock filled gabion mattresses, concrete blocks (flexible) etc.*

The low flow area of the channel must be lined to facilitate cleaning operations, unless the channel has the dual role of a treatment facility.

10.4.5 Stormwater Ponds

The number of stormwater ponds must be kept to a minimum to reduce maintenance requirements. Numerous small ponds must be avoided.

Where possible, stormwater ponds are to be designed as dual purpose facilities, i.e. for parking or recreational areas.

Subsurface drains are to be installed to allow efficient drainage of the ponds.

Grassed ponds shall have an irrigation system installed.

Maintenance requirements are to be taken into account at design stage and could include measures such as lined low flow channels, etc.

Dry stormwater ponds are preferred. Where this is not possible, the following additional conditions apply:

a) Wet ponds are only permissible where the water depth can be sustained at a minimum depth of 1.2 m throughout the dry season.
b) Adequate warning signs and safety measures such as fencing are to be provided around wet ponds to protect the public from drowning.

Stormwater Pond Design Criteria		
1.	Minimum invert slope	1 : 250 (0.40%) lined 1 : 50 (2,00%) unlined
2.	Minimum outlet diameter	375mm* see note
3.	Minimum backdrop at outlet structure to allow subsoil drainage(Invert level below pond bottom)	800mm
4.	Maximum embankment slope (grassed)	1: 5 (20%)

**Note: Special outlet design may be required to limit flow, in order to meet downstream system constraints.*

10.4.6 Flood Escape Routes

Trapped low point must be avoided through good layout and planning practice. Where trapped low points are unavoidable the flood escape routes shall be accommodated through one of the following systems:

a) Public open spaces provided along drainage routes.
b) Underground drainage is to allow for the 1:50 year storm event.
c) Registered servitudes for escape routes over private properties - no structures or boundary walls shall be erected within such servitudes. This option is not recommended and should only be used in exceptional circumstances.

10.4.7 Road Drainage Considerations

Runoff from side roads must be controlled. In cases where the side street length exceeds 80m, the runoff must be collected on the side road before the intersection to avoid overrun onto intersection.

Grid inlet type gullies may only be used in the following circumstances:

a) Unsurfaced roads
b) Where double flat channels are used
   i. Unsurfaced roads are to be provided with lined side drains when the flow velocity exceeds 1.0m/s.
   ii. Energy dissipation measures are required when flow velocities in roadside channels exceed 2.5m/s.
   iii. Roads with steep gradients that terminate downhill in a T-junction must be avoided.
   iv. Double flat channels/ dish drains may not be constructed across the intersections of roadways.
   v. On dual carriageway roads a paved raised median island is preferred. Where this requirement cannot be met, the unpaved median island shall

be provided with effective subsoil drainage systems to prevent water from entering the adjacent pavement layers.

10.4.8 General Development Considerations

Erven, where the impervious area exceeds 600m², shall be served by an underground connection (min 300mm dia).

The drainage of "backyards" serving attached houses/structures is to be taken into account at design stage, preferably by the installation of an underground system.

Private developments with stormwater pond/treatment facilities must have a servitude, registered over such facilities in favour of the City.

Access for river cleaning equipment is to be considered at design stage, for developments in the vicinity of river corridors.

Where developments are to be handed over to the City, on completion of construction, all Stormwater conduits (including connections) are to be inspected by means of a CCTV inspection camera and a report submitted to the local District office together with a copy of the recorded footage (Ms Windows Media Player compatible). The report is to be in WRc (UK) format. Any faults found during the camera inspection are to be made good to the City's approval prior the acceptance of the development.

Interceptor traps are to be provided at taxi ranks to facilitate the removal of oil and other pollutants resulting from the washing down of vehicles.

10.4.9 Specification for Masonry Units (Bricks)

Burnt Clay Masonry Units (to SANS 227:2007)
Underground Infrastructure (Manholes, catchpits, etc.)

a) Class: NFXE (Engineering unit)
b) Solid (un-perforated)
c) Nominal compressive strength: 21MPa,
d) Dimensions: Imperial 222 X 106 X 73,
e) Limits for cold water absorption: Not more than 12%
f) Efflorescence: special grade

Surface Infrastructure (wingwalls, headwalls, etc.)

a) Class: FBXE (Engineering unit)
b) Solid (un-perforated)
c) Nominal compressive strength: 21MPa
d) Dimensions: Imperial 222 X 106 X 73
e) Limits for cold water absorption: Not more than 12%
f) Colour and Texture: Uniform
g) Efflorescence: special grade

Concrete Masonry Units (to SANS 1215:2008)
Surface Infrastructure (wingwalls, headwalls, etc.)

a) Solid (un-perforated) (structural and load bearing)
b) Nominal compressive strength: 21MPa
c) Dimensions: Imperial 222 X 106 X 73
d) Colour: 'Cement grey'
e) Texture: Plain face
f) Ave drying shrinkage: 0.06% (Normal shrinkage unit)

Annexure A

Development check-list

	Item		Check	N/a
General design principles				
1	Main stormwater routes located along natural drainage routes			
2	Localised low points to be avoided			
3	Runoff from adjoining properties must be accommodated in the design			
4	Up to 1:20 year storm events to be contained within road reserve			
5	Where localised low points are unavoidable provision shall be made for emergency overland escapes routes. Alternatively, Pipe system to accommodation at least a 1:50 year storm			
6	Post development runoff shall not exceed the pre development runoff			
7	Material to bear the SANS mark (where applicable)			
Design storm return period per development type				
	Development	Return period (years)		
8	Residential	2		
9	General Commercial & Industrial	5		
10	Public Buildings	5		
11	High Value CBD	5 TO 10		
Stormwater conduit design criteria				
12	Mannings Coefficient of friction (n)	0.012		
13	Minimum diameter (Connections)	300mm (nominal dia)		
14	Minimum diameter (Main Lines)	375mm (nominal dia)		
15	Pipe/culvert material	Reinforced concrete (Bearing SANS mark)		
16	Pipe joint type	Spigot and socket with rubber ring seals		
17	Pipe class (all diameters)	Generally 100D (Loading conditions for each application to be confirmed		
18	Minimum Slope	Connections: 1:60 (1.67%)		
		375mm dia: 1:360 (0.28%)		
		450mm dia. and larger: Minimum velocity criteria applies		
19	Minimum 80% full flow velocity	0.9m/s		
20	Maximum velocity (Without checking for hydraulic jump)	3.5m/s		
21	Maximum velocity(Checking for hydraulic jump)	5.0 m/s (Min pipe class 100D)		
22	Anchor blocks	375mm to 450mm dia pipes steeper than 1:6 (16.67%) 450mm dia and larger pipes steeper		

		than 1:8 (12.50 %)		
23	Minimum cover (road intersections)	1000mm		
24	Minimum cover (general)	750mm		
25	Maximum distance between manholes	90m		
26	Culvert Class	Generally100S (Loading conditions for each application to be confirmed)		
27	Bedding Type	Class B (SANS 1200 LB)		

	ITEM		CHECK	N/A
STORMWATER CONDUIT DESIGN CRITERIA (continued)				
28	Position in road reserve	1.70m, North or East from road centre line		
29	Pipe / culvert systems are to be laid within the road reserve or in public open spaces			
30	Avoid 90 degree junctions			
31	Vertical clearance between Stormwater conduits and other services : 150mm minimum			
32	Box culverts are to have dished inverts			
33	Box culverts, Width to Height (W:H) ratio not to exceed 2:1			
34	Minimum box culvert height to be 600mm			
Catchpits				
35	Percentage flow bypassing a catchpit shall not exceed 20%			
36	Double kerb inlet – gully grid are preferred.			
37	Length of channel flow until the first catchpit will not exceed 120m			
38	Distance between catchpits ,: maximum 90m			
39	Catchpits are to be located to prevent surface flows across roads and intersections			
40	Catchpits may not be positioned on intersections radii			
41	Catchpit to catchpit connections are not permitted			
42	Combination catchpit/manholes are not permitted			
43	Catchpit connection lengths may not exceed 15m			
44	Kerb inlet openings are 100mm in height			
45	Catchpit not to be less than 750mm and may not exceed 1000mm in depth			
46	Windblown sandy areas catchpits shall not be benched. Floor to be at same level as the outlet invert			
47	Catchpits served by gully grids , only in exceptional circumstances			
48	Areas with a high incidence of litter and debris, horizontal Y16 galvanised trash bar to be installed across opening			
49	Kerb inlet screens can be used as an alternative to 48 above.- Only screens with vertical bars are permitted			
50	In locations with trash bars or screens, kerb inlet openings are to be doubled			
51	Trash bar/screen installations are to be avoided in trapped low spots or			

	high vegetation area		
Manholes			
52	Manholes will be provided at horizontal and vertical changes in direction plus at all pipe junctions and end points		
53	Junction boxes are not permitted		
54	Conduits to be aligned crown to crown		
55	Downstream conduits may not be of smaller size than those upstream		
56	Maximum spacing between manholes : 90m		
57	Maximum chimney height : 400mm		
58	Manhole depth is greater than 1,0m but less than 1,8m, cover and frame to be placed directly onto reducer slab		

	ITEM			CHECK	N/A
Subsurface drains					
59	Minimum internal manhole diameter	1000mm			
60	Maximum manhole spacing	60m			
61	Maximum Depth	1000mm where practical			
62	Drainage medium (General purpose)	19mm stone complying with SABS 1083 or particular grading as specific			
63	Synthetic filter(general purpose)	Geo-textile Grade A2			
64	Minimum drainage pipe diameter	100mm			
65	Pipe Type	HDPE double walled slotted pipe(with smooth internal surface)			
66	Sausage or fin type subsurface drains are not permitted				
Open stormwater channels					
		Unlined	Lined		
67	Minimum longitudinal slope	1:200 (0.50%)	1:400 (0.25%)		
68	Maximum flow velocity	1.0m/s	2.5m/s		
69	Maximum side slopes	1:5	Varies depending on material		
70	Acceptable linings: grouted stone pitching, concrete, rock filled gabion mattresses, concrete blocks (flexible) etc.				
71	Low flow area of the channel must be lined to facilitate cleaning operations				
Stormwater ponds					
72	Numerous small ponds must be avoided				
73	Must serve dual purpose, where possible				
74	Subsurface drains are to be installed				
75	Grassed ponds to have an irrigation system				
76	Dry ponds are preferred, wet ponds only permissible where water depth can be sustained at minimum depth of 1.2m throughout dry season				
77	Minimum invert slope	Unlined	Lined		

	ITEM			CHECK	N/A
		1:50 (2%)	1:250 (0.40%)		
78	Minimum outlet diameter	375mm(Special outlet design may be required to limit flow, in order to meet downstream system constraints)			
79	Minimum backdrop at outlet structure to allow for subsurface drainage(Invert level below pond bottom)	800mm			
80	Maximum embankments slope(grassed)	1:5 (20%)			
	Flood escape routes				
81	Flood escape routes to be provided at all trapped low areas				
	General developments considerations				
82	Where impervious area exceeds 600m² shall be served with underground connection (min 300mm dia.)				
83	Drainage of "backyards" serving attached houses/structures to be taken into consideration.				
84	Private developments with pond/treatment facilities: servitude registered over such facilities in favour of the City.				
85	Access for river cleaning equipment				
86	Stormwater conduits (including Connections) are to be inspected by means of CCTV prior to taking over the development				
87	Oil/grease interceptor traps, to be provided at taxi ranks to facilitate the removal of oil and other pollutants.				
	Masonry bricks				
89	Burnt Clay Masonry Units (to SANS 227:2007) Underground Infrastructure (Manholes, catchpits, etc) Class: NFXE (Engineering Unit), Solid (un-perforated), Nominal compressive strength : 21MPa, Dimensions: Imperial 222 x 106 x 73, Limits for cold water absorption: Not more that 12% Effloresecence; special grade Surface Infrastrucure (wingwalls, headwalls, etc) Class: FBXE (Engineering unit), Solid (un-perforated),), Nominal compressive strength : 21Mpa, Dimensions: Imperial 222 x 106 x 73, Limits for cold water absorption: Not more that 12% Colour and Texture : Uniform, Efflorescence: special grade				
90	Concrete Masonry Units (to SANS 1215:2008) Surface Infrastructure ONLY (wingwalls) headwalls Solid (un-perforated) (structural and load bearing), Nominal compressive strengths: 21 Mpa Dimensions: Imperial 222 x 106 x 73, Clour. 'Cement grey', Texture; Plain face Ave drying shrinkage : 0.06% (Normal shrinkage Unit)				

	ITEM	CHECK	N/A

Certified that plans had been examined in accordance with the checklist above:

PROJECT TITLE:				
	Official	Consultant	Date Official	Date Consultant
Checked by				
Signed by				

11. Sewers

11.1 Relevant Codes of Practice, Policy and Guidelines

Guidelines for Human Settlement Planning and Design (Red Book)
Service Guidelines and Standards – CoCT document – October 2010 Version 3.0

12. Water reticulation

12.1 Relevant Codes of Practice, Policy and Guidelines

a) Guidelines for Human Settlement Planning and Design (Chapter 9).
b) CoCT document – Service Guidelines and Standards – October 2010 version 3.0

13. Ducts

13.1 General

Refer to drawings R24 A, B, C, D, and R25

Engineering drawings for proposed roadways shall make provision for ducts for the various services in order to prevent roadways from being dug up in future for the laying of cables etc.

At design stage the service providers shall be contacted and their needs for ducts for future cables or other services shall be obtained from them in writing.

13.2 Relevant Codes of Practice, Policy, Guidelines and Specifications.

a) SABS 1200

13.3 Design Criteria

Ducting Design Criteria			
1.	Duct to extend beyond kerb line (minimum distance)		1.0m
	Minimum depth below finished road surface	High voltage cables	1000mm
2.		Medium voltage cables	800mm
		Low voltage cables	600mm
3.	Minimum trench width		600mm
4.	Minimum side clearance (between trench wall and duct)		200mm
5.	Minimum horizontal clearance between adjacent ducts		150mm
6.	Minimum vertical clearance between ducts		100mm

13.3.1 Draw wires (nylon rope) to be installed in all ducting, with a 2m free length at each end.

13.3.2 Duct ends shall be sealed at end with uPVC end caps.

13.3.3 Ducting for Traffic Signals shall be provided with Cable Inspection Chamber at duct ends as per detailed drawing R24.

13.4 Ducting Pipe Materials

	Ducting Pipe Materials		
	Service Provider	Pipe Diameter (mm Ø)	Specification
1.	Telecommunication	110	HDPE Class 16, type 5 complying with SABS 533 using compression fittings and joints.
2.	Electrical: Low Voltage	110	uPVC Class 400 KPa complying with SANS 1601 using spigot and socket rubber ring joints.
3.	Electrical: High Voltage	160	
4.	Traffic Signals	110	
5.	Irrigation (parks)	110	uPVC Class 34 heavy duty complying with SABS 791 using spigot and socket rubber ring joints

Pipes for electrical ducts must be encased in 10MPa concrete.

All pipe ends shall have all sharp edges and irregularities removed prior to installation. Pipe ducts are to be arranged as shown on drawings R23A, R23B, R23C, R23D, R23E and R23F. The maximum allowed deviation in any direction is 30 mm. Before the installation of end caps, all pipes shall be checked for obstructions, which shall be removed by using a "pig".

13.5 Duct Marking Details

Electrical duct crossings shall have danger tape installed on top of the concrete duct section just below the pavement structure of a road.

	Services Type	Lettering	Colour	Specifications
Ducts				
1.	Telkom	T	Green	Cut lettering on kerb face with grinder, 75mm high x 5mm thick Precast recessed kerbs are preferred
2.	Electrical	E	Red	
3.	Traffic	R	Yellow	
4.	Parks (Irrigation)	P	Black	
Watermains				
1.	Valve	V	Blue	Blue cover for chamber. Cut V on kerb face (75mm x 75mm)
2.	Fire hydrant	H	Yellow	Yellow cover for chamber. Paint one kerb (1000mm) yellow
House connections				
1.	Sewer		Brown	Cut single groove on kerb face with grinder 75mm high x 5mm thick and install 75mm x 150mm x 1 000mm concrete edging stone protruding 100mm above finished ground level at connection point
2.	Water		Blue	Cut single groove on kerb face with grinder, 75mm high x 5 mm thick
3.	Electrical		Red	Cut single groove on kerb face with grinder, 75mm high x 5 mm thick

13.6 General

Designers' and Developers' attention is drawn to the City's requirement in terms of private developments.

These requirements shall apply in all cases where changes, alterations, new or additions to infrastructure and services that need to be taken over by the City at completion of the works.

This section gives only a brief summary of the requirements.

13.7 Relevant Codes of Practice, Policy, Guidelines and Specifications

a) Guidelines for Human Settlement Planning and Design (Red Book)
b) Standard Conditions for the Construction or Alteration of Transport, Roads and Stormwater Infra-structure by Private Developers
c) SABS 1200
d) SARTSM and SADC-RTSM Manuals

13.8 Legal Requirements

a) The Developer is responsible for ensuring compliance with applicable legislation including City of Cape Town by-laws. Certain activities may be subject to permit approvals by national and provincial government departments.

13.9 Site Development Plan

A fully detailed Site Development Plan (conceptual design) to an acceptable scale must be submitted to the relevant Director for approval prior to the submission of a detail design. This is to allow for the setting of further requirements, specifications and conditions relating to Transport, Roads, Stormwater, Sewer and Water infrastructure which must be considered in the detail design. Attention must be given to the existing, planned and potential development in the vicinity of the development.

13.10 Detailed Design

The detailed design must be in accordance with the requirements of this document.

The design must be carried out and certified by an Engineering Professional registered with the Engineering Council of South Africa in terms of the Engineering Professionals Act, 46 of 2000 with competence in the relevant field.

13.11 Construction, Supervision and Testing

13.11.1 No construction work may commence before an approval of the detailed design (in writing) is obtained from the D:R&S.

13.11.2 No work may commence without wayleaves from the various Departments for Stormwater, Sewer, Water, Electricity and Telecommunication services. The Developer's contractor must acquaint himself with the exact position of all underground services before commencing any excavation work.

13.11.3 The D: R&S must be informed in writing not less than 5 working days before construction is due to commence.

13.11.4 The standard of workmanship and the materials used shall be in accordance with SABS 1200. The City may however specify amendments to SABS 1200.

13.11.5 Adequate supervision by a Registered Professional Engineer must be provided for the full duration of the works. In this regard a proposal for site supervision must be submitted to the D:R&S for approval before construction work commences. The proposal shall include the name (or names where a team is required) of the individuals proposed, their CVs and the time that they will devote to site supervision on the project. Failure to adhere to the approved proposal may jeopardise clearance for separate registration of the properties. The Registered Professional Engineer may have no direct financial

interest in the development, other than payment of standard professional fees for the work performed.

13.11.6 The necessary testing as prescribed in SABS 1200 shall be carried out and the results thereof shall be made available to the D: R&S.

13.12 Supply of Water for Construction Purposes

The Developer shall note that water for construction purposes shall be obtained via metered standpipes. The use of erf or house leadings for the supply of construction water shall not be permitted.

13.13 Maintenance Guarantee

The developer shall furnish Council with a bank guarantee equal to 5% of the agreed estimated value of the roads and infrastructure to be constructed. The guarantee shall be to the satisfaction of the D:R&S and valid for the 12 month maintenance period, which shall commence from the date of the certificate of completion.

14. Drawing standards and as-built requirements

14.1 General

Designers' and Developers' attention is drawn to the City's requirement in terms of drawing standards and as-built requirements.

14.2 Symbols, Line Styles and Colour

Drawings supplied by consultants for Civil Engineering Services shall have the same symbols, line types and colours set out on drawing R2-1782.

14.3 Layers

Drawings shall be produced in the following layers:

Drawing Layers		
1.	Layer	Includes
2.	Roads	Kerb lines, road edge lines, V-channels
3.	Sidewalks	Edging stone lines
4.	Stormwater	Manholes, catchpits, pipelines
5.	Subsoil drainage	Manholes, pipelines
6.	Sewer	Manholes, pipelines
7.	Water	Valves, hydrants, pipelines
8.	Irrigation	Valves, sprinkles, pipelines
9.	Electrical	Surface boxes, electrical poles, light poles, cables, overhead lines
10.	Telecommunication	Surface boxes, poles, manholes, cables, overhead lines
11.	Cadastral	All erf lines, road reserves, erf numbers.

14.4 Plan Layouts

Plan layouts shall include the following information:

a) Survey information, contour layout of existing surfaces
b) All existing service and cadastral information
c) Manhole numbers, cover levels and invert levels of all branches
d) Co-ordinate list of all members
e) Pipe diameters, classes and slopes
f) Finished road surface contours of all intersections
g) Grid positions (y, x) at regular intervals
h) Legend for Services
i) North point
j) Locality plan with sufficient information to uniquely identify the location

14.5 Longitudinal Sections

Longitudinal sections of all underground services and roads to be constructed shall be provided, and shall include the following information:

a) Existing ground profile
b) Depth and position of existing services to be indicated
c) Manhole numbers
d) Pipe diameters, length and slope
e) Stake values and final centre line road levels at regular intervals and at vertical and horizontal curve details.

14.6 As-Built Information

As-built information supplied by the developer's engineering consultants at the completion of a project shall be in the following 2 formats:

14.6.1 As Built Plans

a) Three (3) sets of as built services layout plans (to a scale not smaller than 1:500) including longitudinal sections printed on A0 or A1 paper size be provided.
b) All drawings must be referenced in WGS84 coordinate system.

14.6.2 Electronic As Built Data

a) An electronically produced ASCII file in LYXZ format supplied by an independent surveyor (post construction survey) of the centre points of all surface boxes (manholes, catchpits, valves, fire hydrants etc.), and kerb face positions at beginning and end points of all curves and changes in direction be provided as part of As Built information. Drawings must be adapted where the difference between Design and As Built exceeds the tolerance of 50mm in XY position and 10mm in Z (height).
b) An ASCII or ACCESS (dbf file) in LYXZ-format of the cover and invert levels of sewer and stormwater manholes, catchpits, hydrants and valves. The project name, company name and contact details must appear on the data set.
c) As-Built drawings: electronic Allycad.drg format is preferred, or alternatively AutoCad.dxf (version 2000 or older). Grid positions to be indicated on all drawings. [is this really the preferred format?]

d) All attribute data, i.e. pipe sizes, materials, slopes, cover, lengths and invert levels, clearly indicated on the layout drawings, positioned at the entity.
e) Drawings produced in different layers for each service.

15. Standard detail drawings

15.1 List of Standard Drawings

Description	Date of Drawing	Drawing Number
Roads		
Precast Concrete Kerb, Channel and Edging Details		R1A
Precast Concrete Kerb, Channel and Edging Details		R1B
Precast Concrete Kerb, Channel and Edging Details		R1C
Typical IRT Cross Section,		R2A
Typical IRT Cross Section		R2B
Typical Cross Section (Preferred), 18m Road Reserve of Mixed Middle-Order Link (Class 4 Local Distributor) –		R3A
Typical Cross Section, 18m Road Reserve of Mixed Middle-Order Link (Class 4, Local Distributor)		R3B
Typical Cross Section, (Preferred) 12m Road Reserve of Mixed Lower-Order Link (Class 5, Access Street)		R4A
Typical Cross Section, (Preferred) 12m Road Reserve of Mixed Lower-Order Link (Class 5, Access Street)		R4B
Typical Cross Section, 10m Road reserve of Mixed Lower-Order Link (Class 5, Access Street)		R5
Typical Cross Section, 8m Road reserve of Mixed Lower-Order Link (Class 5, Access Street)		R6
Typical Cross Section - Labour Intensive Construction, 18m Road Reserve of Mixed Middle-Order Link (Class 4, Local Distributor)		R7A
Typical Cross Section - Labour Intensive Construction, 10m Road Reserve of Mixed Lower-Order Link (Class 5, Access Street)		R7B
Typical Cross Section – Labour Intensive Construction 6m Road Reserve of Pedestrian Only Link		R8A
Typical Cross Section – Labour Intensive Construction, 6 m Road Reserve of Pedestrian Only Link		R8B
Typical Cross Section , 6m Road Reserve of Pedestrian Only Link		R9
Details of curve Widening on Class 5 Road Reserves		R10
Typical Roundabout (Urban Compact) at Middle and Lower Order Link Roads		R11
Section of Typical Urban Compact Roundabout		R12
Typical Mini Roundabout at Middle & Lower Order Link Roads		R13
Section of Typical Mini Roundabout		R14
Typical Raised Pedestrian Crossing		R15

Description	Date of Drawing	Drawing Number
Typical Speed Hump		R16
Typical Pedestrian Crossing for Disabled Persons		R17A
Typical Pedestrian Crossing for Disabled Persons and the Blind		R17B
Typical Taxi and Bus Embayment		R18
Parallel Parking Bays		R19
Road Name Kerb Details		R20
105mm Streetname Plate Specification and Detail		R21
Precast Concrete Bollard		R22
Survey Mark		R23
Specification for Installation of Duct Sections		R24A
Specification for Installation of Duct Sections		R24B
Specification for Installation of Duct Sections		R24C
Specification for Installation of Duct Sections		R24D
Cable Inspection Chamber		R25
Council Handrailing		R26A
Standard for Channel Section Fence		R26B
Guardrails		R27A
Guardrail Details		R27B
Guardrail Detail with Posts in Concrete Side Drain or Paved areas.		R27C
Cabel Fence Detail		R28
Typical Mole Barrier Installation Detail		R29
Typical Raised Intersection		R30
Ground Mounted Signs – Braced Support Detail		R31
Stormwater		
Subsurface drains		SW1
Manhole for subsurface drainage		SW2
Stormwater manhole for pipes up to ø600mm		SW3
Stormwater manhole – section for ø675mm pipes and larger		SW4A
Stormwater manhole – plan for ø675 pipes and larger		SW4B
Stormwater manhole for pipes ø675and larger benching options		SW4C
Sweep manhole for dia 750ø and larger		SW5A
Sweep manhole for dia 750ø and larger		SW5B
Double Kerb Inlet – Gully Grid Catchpit		SW6
Catchpits on Steep Slopes (Gradients greater than 8%)		SW7
Double gully grid catchpit		SW8
Typical stormwater headwall		SW9
Box culvert inlet and outlet details		SW10A
Reinforcement for wingwalls and floor slabs of box culverts		SW10B
Standard 2010 Manhole Cover and Frame		SW11A
Standard 2010 Manhole Cover and Frame		SW11B
Standard 2010 Manhole Cover and Frame		SW11C

Description	Date of Drawing	Drawing Number
Gully grid and Frame Detail		*SW12*
Light Duty stormwater non-return Flap		*SW13*
Anchor Blocks for Pipes on Steep Slopes Oil/Petrol intercepting trap		*SW14* *SW15*
Water		
Valve Chamber		*W1*
Hydrant Chamber		*W2*
Typical Water Connection		*W3*
Typical Water Meter Chamber (Based on Sensus Meitwin & WPVD Meters)		*W4A*
Typical Water Meter Chamber (Based on Sensus Meitwin & WPVD Meters)		*W4B*
DRAWING STANDARDS Legend and pen thickness for the various municipal utility services		*R2-1782*