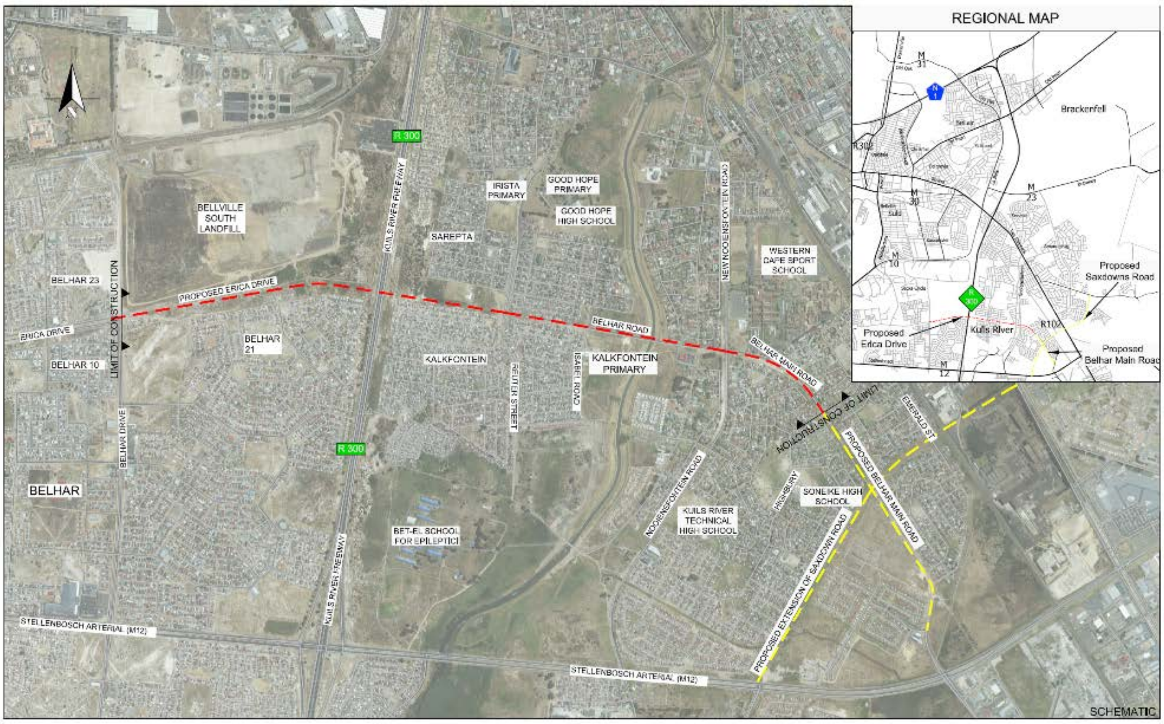
Preliminary Design of Erica Drive between Belhar Drive, across the R300 to just before Highbury Street, Kuils River

Preliminary Design Report, Draft 1b

Kuils River, Cape Town

08 October 2018



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SUMMARY SHEET

Report Type	Preliminary Design Report, Draft 1b
Title	Preliminary Design of Erica Drive between Belhar Drive, across the R300 to just before Highbury Street, Kuils River
Location	Kuils River, Cape Town
Client	City of Cape Town
Reference Number	ITS 3785.4
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- Stormwater Management Report, Draft, June 2018 prepared by Ingerop
- Report on Geotechnical Investigations for the Belhar Road Bridge, Kuils River, 2018 prepared by Kantey & Templer
- Report on Geotechnical Investigations for the R300 Bridge, Kuils River, 2018 prepared by Kantey & Templer
- Freshwater Ecological Impact Assessment for the proposed extension of Erica Drive, Belhar to Oakdene over the Kuils River, prepared by EcoImpact, dated 12 September 2017.
- Botanical Assessment for the proposed Erica Drive Expansion in Belhar and Kuils River area, prepared by EcoImpact, dated September 2017.
- Steyn Wilson Laboratories, Test Reports, reference SWL01227, dated 14 August 2018.

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LIST OF ABBREVATIONS

BAR	Basic Assessment Report
BTB	Bituminous treated base course
CBR	California Bearing Ratio
CoCT	City of Cape Town
DCP	Dynamic Cone Penetrometer
EAP	Environmental Application Practitioner
EIA	Environmental Impact Assessment
GFIP	Gauteng Freeway Improvement Project
IPTN	Integrated Public Transport Network
IRT	Integrated Rapid Transport
LILO	Left-in/ left-out
MOD AASHTO	Modified American Association of State Highway and Transportation Officials
NEMA	National Environmental Management Act
NMT	Non-Motorised Transport
PD	Pragmatic Densification
PHF	Peak Hour Factor
SARTSM	South Africa Road Traffic Signs Manual
TIA	Transport Impact Assessment
Veh	Vehicles
Vph	vehicles per hour
WUA	Water Use Authorisation

LIST OF DOCUMENTS

The following list of documents all form part of the preliminary design investigation.

- **Preliminary Design Report (this document)**
- Book of Drawings

1 INTRODUCTION

1.1 Background

The City of Cape Town (CoCT) developed the Congestion Management Strategy for Cape Town which aimed to quantify congestion in Cape Town, develop strategies to manage the congestion and identify road-based projects which would improve and manage the congestion experienced on the metropolitan road network of Cape Town. These projects were ranked in accordance with the most optimal use of resources. This process resulted in the development of a Medium Term Implementation Plan as included in Table A-1 and further illustrated in Figure A-1 in Annexure A.

Erica Drive Extension across the R300 to Belhar Main Road was ranked number 8 out of 102 projects. The CoCT also made a budget of R750 million available for the road infrastructure projects identified through the Congestion Management Strategy.

Erica Drive was identified as an important road in the Kuils River and Belhar street network, as well as important link in the metropolitan road network and the completion of this currently missing link, will bring about congestion relief on some of the metropolitan road in the greater Kuils River and Belhar areas.

Accordingly the CoCT initiated the preliminary design of the Erica Road link between Belhar Drive in Belhar, across the R300 up to Highbury Street in Kuils River. The initial portion of Erica Drive identified for implementation include the following:

- Construction of the southern carriageway between New Nooiensfontein to just west of Reuter Street
- Construction of a single carriageway link across the R300 up to Belhar Drive

Future improvements can include a half-diamond interchange with the R300 (northern ramps only) or a Partial Clover providing connectivity to the south, should it be required in the future.

1.2 Study Area Description

The study area includes Erica Drive from the intersection with Belhar Drive in the west, across the R300 and continues further east to the intersection with Highbury Street. Refer to Figure B-1 in Annexure B.

1.3 Objectives

The objective is to undertake a preliminary design of the proposed dual carriageway from Belhar Drive to Highbury Street. These include assessing the following:

- To investigate options, evaluate and develop an appropriate road alignment, cross-section and access management strategy, including intersection form and control to ensure that
    - The facility will cater for projected traffic volumes for all transport modes in the design year of 2032.
    - The selected alignment is feasible in terms of financial, environmental and technical constraints and that the appropriate geometry, access and safety standards are adopted.
    - The proposed bridges across the R300 and the Kuils River is technically sound and provides the required connectivity across the Kuils River and the R300.
    - The preferred option takes into account regional and local planning, land use objectives and to ensure a high degree of integration between transport and land use objectives.
    - The local supporting road network is adequate in distributing traffic onto and from the Erica Drive.
    - The non-motorised transport (NMT) users and public transport (PT) services are safe and adequately provided for
    - The preferred option and the phased construction thereof, is the most economically beneficial.
- To establish and provide coordinates for the road reserve of Erica Drive and identify land acquisition and expropriation requirements, where needed.
- To allow for stages construction and identify phasing options and timing.
- To ensure adherence to the principles of integrated environmental management and obtain the necessary authorities required to construct the road improvement.
- To obtain all other authority approvals so that the design may be implemented timeously.
- To ensure that future access on Erica Drive is managed in accordance with an agreed road access management plan that takes into account the functional road classification and surrounding development (existing and planned).
- To ensure where possible, the design philosophy will encompass the broader objectives of the CoCT, encapsulated in the five pillars in Figure 1-1.

Figure 1-1: City's Five Pillars

2 PROJECT OVERVIEW

2.1 Scope of work

The following services will form part of this project:

- Transport Assessment the objective of this study will be to determine the long - and short term lane configuration for the new road section. Intersection lane configurations and their controls will be included. Traffic volumes will be sourced from the existing EMME model for various design scenarios. It will also serve to understand how these upgrades could impact on traffic and congestion in the Kuils River area.
- NMT and public transport will be addressed in the assessment.
- Geometric Design - the geometric design will be according to the UTG1 (Urban Arterial Roads), UTG5 (Urban Collector Roads) and City of Cape Town standard details. NMT design will be undertaken in accordance with the Department of Transport NMT Design Guidelines of 2016, in accordance with the City of Cape Town NMT Masterplan. The following services will be included as part of geometric design:
    - Road layout (Erica Drive between Belhar Drive and Highbury Road and access to the R300 Freeway)
    - Road Long sections and Cross Sections
    - Road Markings, standard road signs and directional signage
    - Pavement (layer works) design
    - Road Drainage design
    - Non-Motorized & Public Transport facilities
    - Services: All existing services will be obtained and indicated on the services drawings. Possible relocation of existing services forms part of the scope of work.
- Road Drainage - the road drainage will be done according to the SANRAL Road Drainage Manual and the City of Cape Town standard details. The Stormwater Masterplan for the area will be used as part of the design for the stormwater system.
- Bridge Design – The existing Kuils River Bridge will be utilized for the east bound carriageway. A second bridge over the Kuils River will be designed for the new west bound carriageway. A new bridge over the R300 will be designed to accommodate the west bound carriageway (phase 1) which will be widened to accommodate the east bound carriageway as part of a future phase.
- Street Lighting – the street lighting designed will be done according to SANS 098 and City of Cape Town standards.
- Environmental Impact Assessment - This assessment includes an EIA Basic Assessment application and Water Use Authorization (WUA) for the Erica Drive construction and bridge over Kuils River. The necessary Public Participation Processes will automatically be covered.
- Landscaping

2.2 Project Deliverables

The project deliverables include the following:

- A complete Preliminary Design Report (this report) for the dualling of Erica Drive from Belhar Drive in the west to Highbury Street in the east.
- A complete Book of Drawings that contain the preliminary design drawings
- All the necessary specialist reports undertaken as part of this investigation.
- An Authorisation for the proposed scope of work obtained from the Department of Environmental Affairs and Development Planning and Heritage Western Cape, where applicable.

3 TRANSPORT STATUS QUO

3.1 Methodology

3.1.1 Data Collection

Traffic counts were undertaken at the following intersections:

- Stellenbosch Arterial/ New Nooiensfontein
- Stellenbosch Arterial/ R300 ramps West interchange
- Stellenbosch Arterial/ R300 ramps East interchange
- Erica/ Symphony Way
- Stellenbosch Arterial/ Erica
- Stellenbosch Arterial/ Symphony Way
- Stellenbosch Arterial/ Belhar Drive/ Delft Main
- Erica/ Belhar Drive
- Belhar Main/ Reuter
- Isabel/ Belhar Main
- Belhar Main/ Highbury
- New Nooiensfontein/ Belhar Main
- Access to Western Cape Sports School/ Belhar Main

The traffic counts were undertaken a typical weekday from 06:00 to 09:00 during the AM peak period and from 16:00 to 18:00 during the PM peak period. Refer to Table 3-1 for the dates of the traffic counts.

Table 3-1: Dates of traffic counts at various intersections

INTERSECTION	DATE OF TRAFFIC COUNTS
Stellenbosch Arterial/ New Nooiensfontein	20 June 2017
Stellenbosch Arterial/ R300 ramps West interchange	
Stellenbosch Arterial/ R300 ramps East interchange	
Erica/ Symphony Way	
Stellenbosch Arterial/ Erica	
Stellenbosch Arterial/ Symphony Way	

INTERSECTION	DATE OF TRAFFIC COUNTS
Stellenbosch Arterial/ Belhar Drive/ Delft Main	
Erica/ Belhar Drive	18 May 2015
Isabel/ Belhar Main	19 June 2018
Belhar Main/ Western Cape Sports School	19 June 2018
Belhar Main/ Reuter	11 May 2017
Belhar Main/ Highbury	
New Nooiensfontein/ Belhar Main	

Traffic analyses was undertaken using Traffix traffic analyses software.

3.1.2 Transport modelling

The CoCT's EMME model was assessed for the following scenarios:

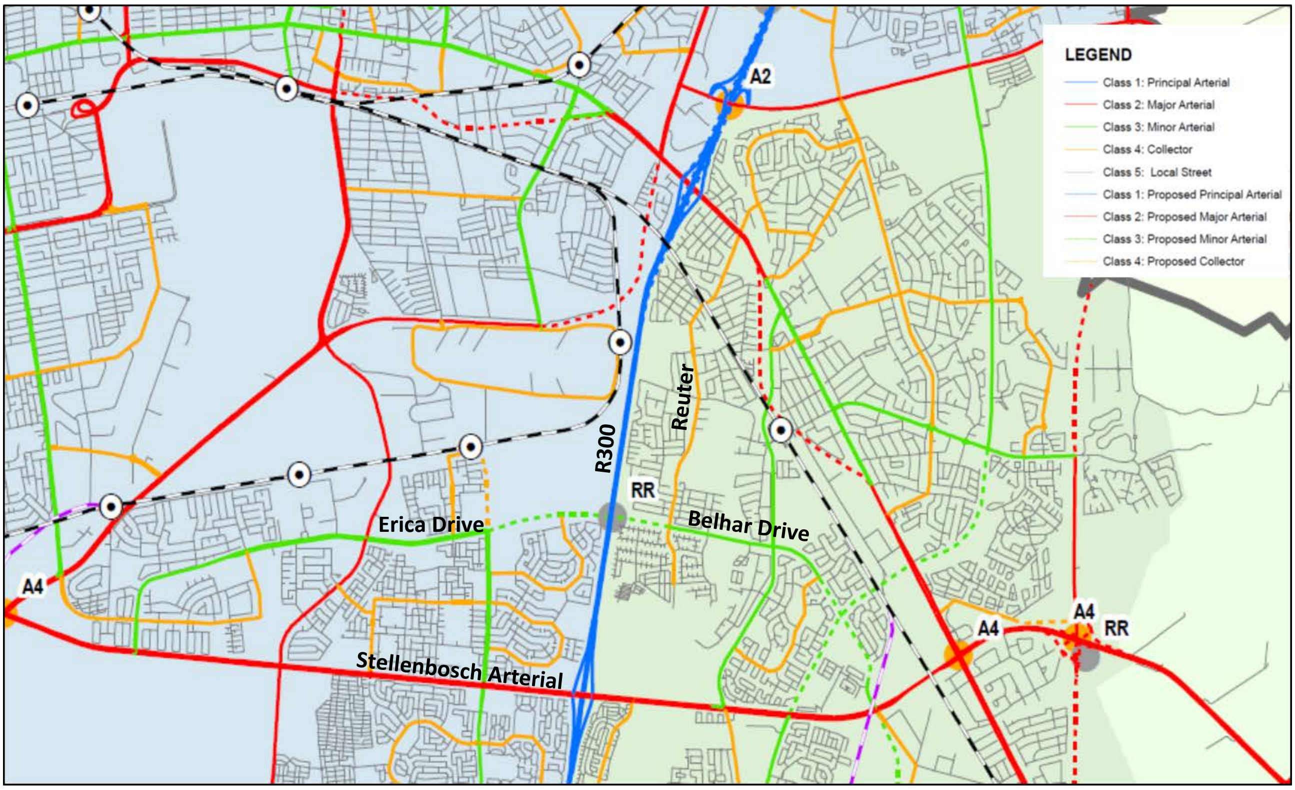
- 2016 Base Network with Present Land Use, Private Transport Variable Demand Assignment (AM Vehicles/ Hour)
- Future Kuils River Network with 2032 Pragmatic Densification (PD) Land Use, Private Transport Variable Demand Assignment (AM Vehicles/ Hour). In the future network, the following links were assumed to be in place in the Kuils River area
  - Dualling of Amandel Road from Bottelary Road to Church Street
  - Dualling of Langverwacht from Zevenwacht Link to Amandel Road
  - Dualled link of Erica Drive across the R300 from Belhar Main Road in Highbury to Belhar Drive in Belhar.
  - Saxdowns from Langverwacht Road to Stellenbosch Arterial

3.1.3 Intersection Analyses

Intersection analyses was done with Traffix for the AM and PM peak hours. It should be noted that the AM turning movements for future scenarios was developed using the EMME model output as reference. The PM turning movements was developed by just mirroring the AM turning movements. This is an over-estimation of the PM traffic volumes as a comparison of the 2017 surveyed AM and PM traffic volumes at the Belhar Drive, Reuter Road, New Nooiensfontein Road and Highbury Drive intersections with Erica Drive, indicate that the PM traffic volumes is on average 10% less than the AM traffic volumes.

3.2 Existing road network

The existing road network surrounding the site is discussed below in Figure 3-1 with reference to the City of Cape Town's Road Classification map dated 2015.



Source: City of Cape Town –Draft Roads Masterplan – 2017

Figure 3-1: City of Cape Town's Road Classification

3.2.1 Erica Drive

West of the R300, Erica Drive is a class 3 minor arterial road. It currently extends from the signalised intersection with Symphony Way, through the Belhar suburb and terminates in the 90-degree bend with Belhar Drive. A paved sidewalk is provided on the norther side of the road only. A NMT facility is also provided along the southern side of Erica Drive between Symphony Way and Belhar Drive and makes provision of both cyclists and pedestrians.

The speed limit is 60km/hr and streetlighting is provided along the northern side of the road. A cycle lane is also provided along Erica Drive.

Figure 3-2: Existing cycle lane along Erica Drive, Belhar

Figure 3-3: Erica Drive terminating at Belhar Drive intersection

The proposed Erica Drive Extension extends from Belhar Drive in Belhar across the R300 up to Reuter Street.

3.2.2 R300

The R300 is a class 1 freeway connecting the N1 in the north with the N2 and the M7 (Jakes Gerwel Drive) further south. Various pedestrian bridges are provided across the R300. Access control is formal with interchanges located at Strand, Bottelary and Stellenbosch Arterial in the vicinity of Erica Drive. The R300 also falls within the jurisdiction of SANRAL.

3.2.3 Belhar Drive

East of New Nooiensfontein Drive, Erica Drive is referred to as Belhar Main Road. Belhar Main Road is a single carriageway road and is a class 3 minor arterial road. It currently only extends from Reuter Street (3-way STOP-controlled intersection), across the Kuils River and terminates at the existing T-intersection of Highbury Road and Belhar Main Road. A paved sidewalk is provided on the northern side of the road only.

The speed limit is 60km/hr and streetlighting is provided along the northern side of the road.

3.2.4 Reuter Street

Reuter Street is a class 4 local distributor street and is a single carriageway road. It runs north-south from Nooiensfontein Road in the south, extend across Erica Drive, until Mission Road. After Mission Road it becomes Sarepta Street which extends across the railway line and intersects with Van Riebeeck Road at a signalised intersection.

The speed limit is 60km/hr.

For the section south of Belhar Main Road, a surfaced sidewalk is provided along the western side of the road along its entire length. North of Belhar Main Road, the sidewalks are located on both sides of the road up to Rietvlei Road. Further north, sidewalks are only provided on the western side.

Figure 3-4: Belhar Main Road terminating at Reuter Street/ Belhar Main Road intersection

3.2.5 New Nooiensfontein Road

New Nooiensfontein Road is a class 3 minor arterial road. It is a single carriageway road and runs north-south from Hindle Road in the south up to Van Riebeeck Road in Kuils River. A sidewalk is provided along Erica Drive east of New Nooiensfontein Drive.

The speed limit is 60 km/hr and streetlighting is provided along its entire length.

3.3 Existing intersection configurations

In the study area the Erica/ New Nooiensfontein Road is signalised and Erica/ Reuter is 3-way STOP-controlled. The following intersections are STOP-controlled with Erica Drive or Belhar Main Road having priority:

- Belhar Main/ Highbury
- Belhar Main/ access to Western Cape Sports School
- Erica/ Isabel

All other intersections are priority-controlled with the Erica Drive – Belhar Main Road link having priority.

3.4 Intersection spacing

The spacings between intersections are shown in Table 3-2 below and also in Figure B-2 in Annexure B.

Table 3-2: Access spacing along Erica Drive

INTERSECTING STREET WITH ERICA – BELHAR MAIN ROAD LINK	LINK DISTANCE	EXISTING INTERSECTION CONTROL
Reuter		3-way STOP controlled
Isabel	365	Priority-controlled
Frost	410m	Priority-controlled
New Nooiensfontein	218m	Signalised
Access to Western Cape Sports School	190m	Priority-controlled
Highbury Street	340m	3-way STOP controlled

The Western Cape Road Access Guideline[1] (RAG) recommends intersection spacings along Class 3 roads in suburban environments to be as follows:

- Spacing between signals – 540m
- Median openings – 180m
- Equivalent side streets – 180m

3.5 Existing intersection operations

3.5.1 Intersection peak hours

The peak hours for all the intersections surveyed are tabled in Table 3-3 along with the Peak Hour Factors (PHF).

Table 3-3: Intersection peak hours and PHFs

INTERSECTION	ACTUAL PEAK HOUR		PEAK HOUR FACTOR	
	AM	PM	AM	PM
Erica/ Belhar Drive	7:00 - 8:00	16:30 - 17:30	0.97	0.98
Erica/ Reuter	7:15 - 8:15	16:45 - 17:45	0.86	0.96
Erica/ Belhar Main/ New Nooiensfontein	7:00 - 8:00	16:45 - 17:45	0.93	0.92
Belhar Main/ Highbury	7:00 - 8:00	16:30 - 17:30	0.92	0.96

3.5.2 Vehicle delay and capacity

The capacity analysis is based on the existing lane configurations and 2017 surveyed traffic counts as shown in **Figure C-1 and Figure C-2, Appendix C**. According to the peak hour analyses most intersections in the study area are operating at acceptable Level of Service (LOS).

3.5.3 Pedestrian crossing at Isabel/ Erica

During the environmental pre-application Basic Assessment Report (BAR) process the need was expressed for a signalised pedestrian crossing facility at Isabel/ Erica intersection due to the learner crossing desire line across Erica Drive, to and from Kalkfontein Primary School.

Warrants for signalisation

Pedestrian surveys and traffic counts were undertaken at this location. Traffix analyses confirms that the side streets are operating at acceptable LOS during the peak hours. A 4Q/6Q warrant assessment in accordance with the South Africa Road Traffic Signs Manual (SARTSM) Volume 1[2], was also undertaken to determine the need for signalisation of the intersection. The 4Q/6Q Warrant 1 states that the installation of a traffic signal is deemed warranted at a junction or pedestrian or pedal cyclist crossing when *"The average length of ANY individual queue equals or exceeds four (4) over any one hour of a normal day"* are met.

The analyses indicated that signalisation is not warranted as the average queue is not greater than 4. Refer to *Table 3-4*. Further discussions in section 13.2 confirms that the intersection spacing is insufficient for signalisation of this intersection and that a full priority-controlled intersection is proposed.

Table 3-4: Belhar Main/ Isabel Warrant for Signalisation

APPROACH	MOVEMENT	TIME PERIOD	D, AVE DELAY (S/VEH)	Q, FLOW RATE (VPH)	N (AVE QUEUE, m)
Isabel: NB	Total approach	AM	9.2	60	0.2
		Mid	8.3	90	0.2
		PM	8.8	48	0.1
Isabel: SB	Total approach	AM	8.5	71	0.2
		Mid	7.7	51	0.1
		PM	8.2	52	0.1
Erica Drive: WB	Total approach	AM	11.4	268	0.5
		Mid	8.7	218	0.9
		PM	10.4	299	0.9
Erica Drive: EB	Total approach	AM	10.3	365	0.5
		Mid	8.7	189	1.0
		PM	10.2	338	1.0

Warrants for pedestrian crossing

The SARTSM warrants for a pedestrian crossing was also investigated and was plotted on Graph 6.13[3] for a single carriageway road. Refer to Figure B-2 in Annexure B. Warrant 4 states that *"…a mid-block pedestrian crossing is warranted if or each of any four consecutive hours of any normal weekday, which includes a peak period, the flow of vehicles per hour falls into the area designate for signal control when on plotted on the appropriate chart…."*. This assessment indicated that the warrant for a signalised pedestrian crossing is not met.

However, as shown in **Figure B-3** in **Annexure B**, 2 points fall within the area that indicate that a form of mid-block crossing is warranted. So although a pedestrian crossing is not fully warranted at this stage, it is our recommendation that yield-control pedestrian crossing be implemented.

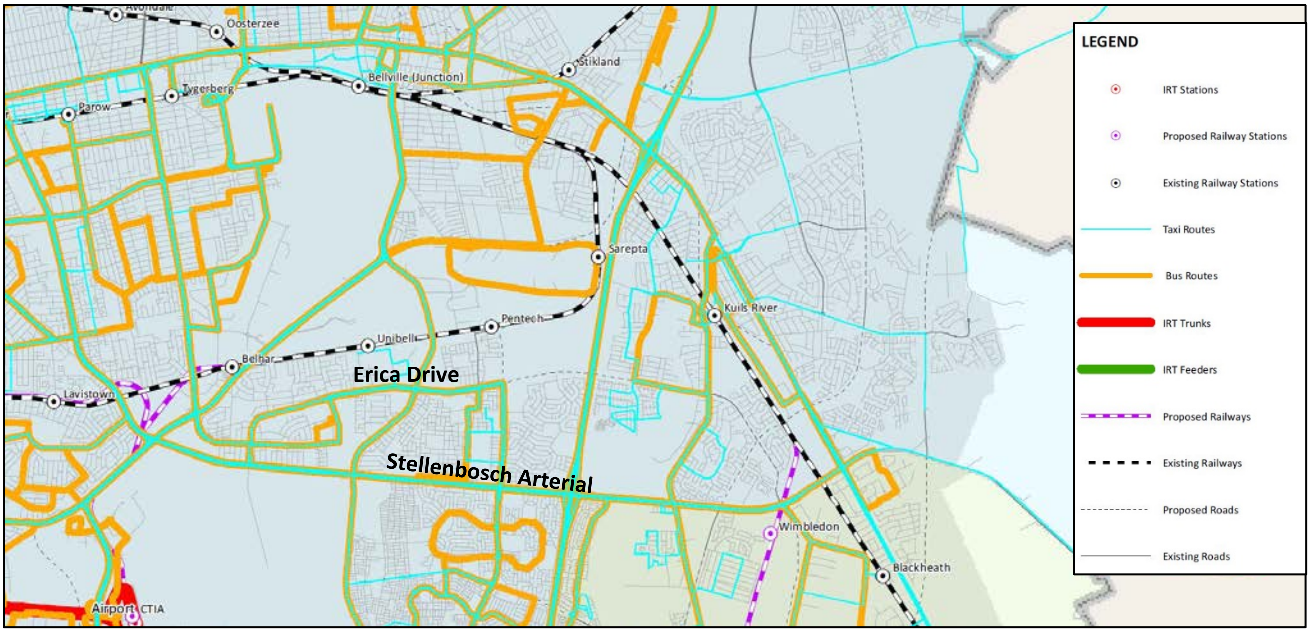
3.5.4 New Nooiensfontein/ Belhar Main Road/ Erica Drive

The congestion currently experienced at the signalised intersection of the New Nooiensfontein/ Belhar Main Road/ Erica Drive intersection was also identified as a particular focus area with long queues being experienced on the northbound and southbound approaches of New Nooiensfontein Road. Analyses of the existing traffic volumes indicated that the intersection is operating acceptably during the PM peak hour. However, during the AM peak queues develop along the northbound (8 veh) and southbound (6 veh) approaches.

3.6 Public transport

3.6.1 Existing services

Currently buses and taxis operate along Erica Drive, west of the R300, between the intersections with Stellenbosch Arterial. East of the R300, taxis and buses operate along New Nooiensfontein between Belhar Main and Van Riebeeck Street. Some services are also provided along Reuter Street, between Belhar Main and Mission Road. Refer to Figure 3-5.



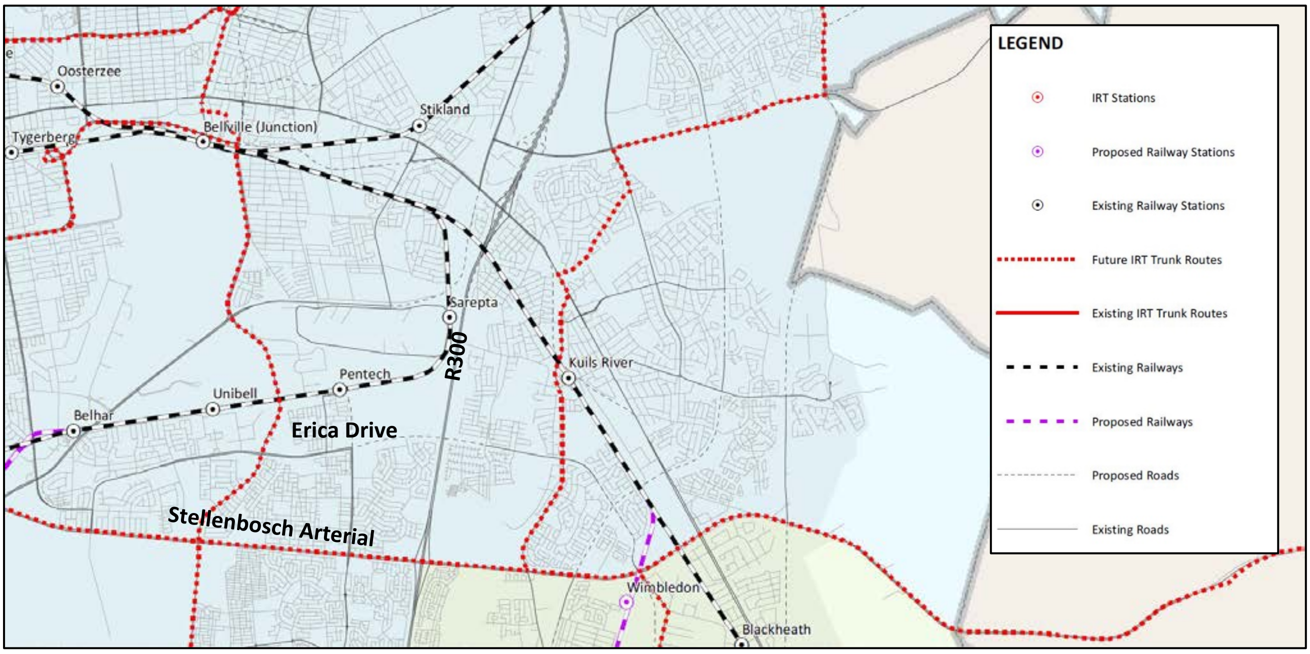
<u>Source</u>: City of Cape Town, Existing Public Transport Services, PRoW Plan PT1-1.1

Figure 3-5: Existing Bus and Taxi routes

3.6.2 Proposed upgrade to the public transport service

Future public transport services are planned in accordance with the CoCT's Integrated Public Transport Network (IPTN) as shown in Figure 3-6. This indicates that the CoCT's Integrated Transport Services (IRT) are expected to operate along Symphony Way, Stellenbosch Arterial and New Nooiensfontein Road. These are future IRT Trunk Services.

The design of the New Nooiensfontein/ Erica intersection should take this into consideration.



<u>Source</u>: City of Cape Town, Integrated Rapid Transport, PRoW Plan PT1-1.1

Figure 3-6: Proposed IPTN routes

3.7 Non-motorised transport (NMT)

The open spaces along Erica Drive are cross-crossed with pedestrian desire lines as shown in the Google Earth extract shown in Figure 3-7 and Figure 3-8.

Figure 3-7: Pedestrian desire lines along the existing Belhar Main Road

Figure 3-8: Pedestrian desire lines at Reuter/ Belhar Main Road intersection

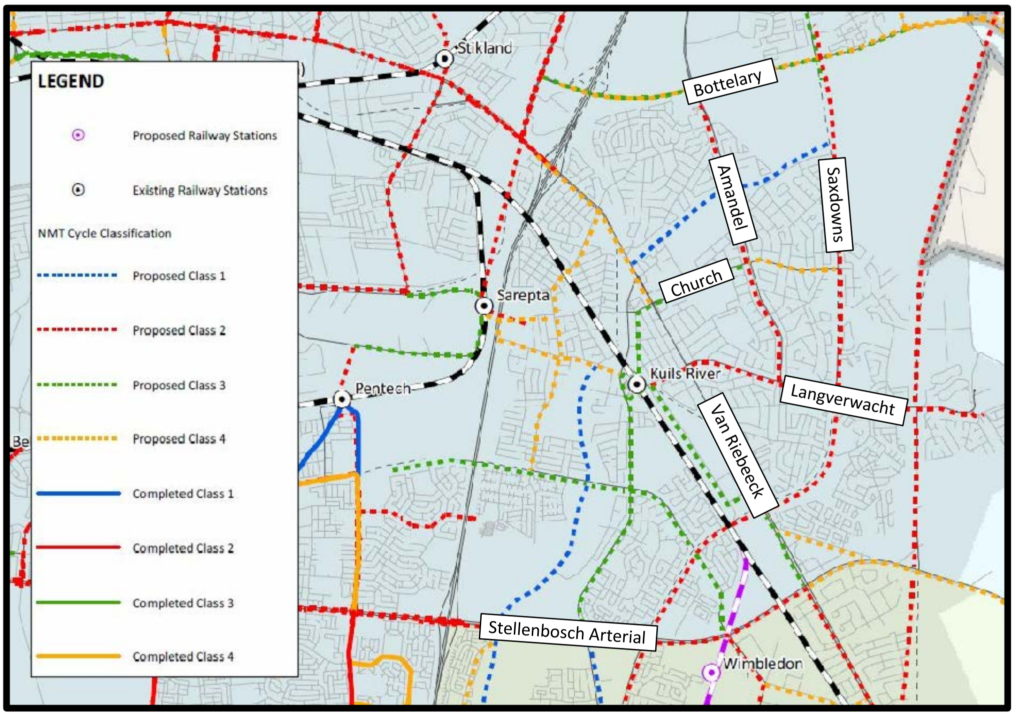
Cattle grazing along the Kuils River canal has also been observed. Refer to *Figure 3-9*.

Figure 3-9: Cattle crazing along the Kuils River canal

Figure 3-10 indicates that a class 3 cycle lane is proposed along Erica Road, from Belhar Drive in the west to Stellenbosch Arterial further east. This will connect with proposed cycle paths along the following routes:

- A class 1 cycle way along the Kuils River
- A class 4 cycle route along Reuter
- A class 3 cycle lane along Nooiensfontein Road up to Van Riebeeck Street
- A class 3 cycle lane along Saxdowns Road in the east
- A class 4/ 2 cycle route along Symphony Way.

A class 3 cycle already exists along Erica Drive, west of Belhar Drive, as mentioned in Section 3.7. Also refer to Figure 3-10. The design of the Erica Drive should take this into consideration.



Source: City of Cape Town –Non-Motorist Transport Network (Cycle Routes) NMT – 1.1, 2013

Figure 3-10: Proposed NMT Planning

3.8 Future road network planning

Along with the Erica Road link between Belhar Drive and Reuter Street being proposed, with reference to Figure 3-1, the following road links are also form part of the CoCT overall Roads Masterplan:

- Completion of Saxdowns from Stellenbosch Arterial to Langverwacht Road
- Extension of Belhar Main Road to Stellenbosch Arterial
- Re-alignment of Van Riebeeck Street
- Extension of Belhar Drive northwards

The full extent of the R300/ Bottelary Interchange, for which the design was undertaken by BKS, was also considered in the concept development for the R300/ Erica interchange. The full interchange includes PARCLO ramps with a CD road system as illustrated in Figure 3-11.

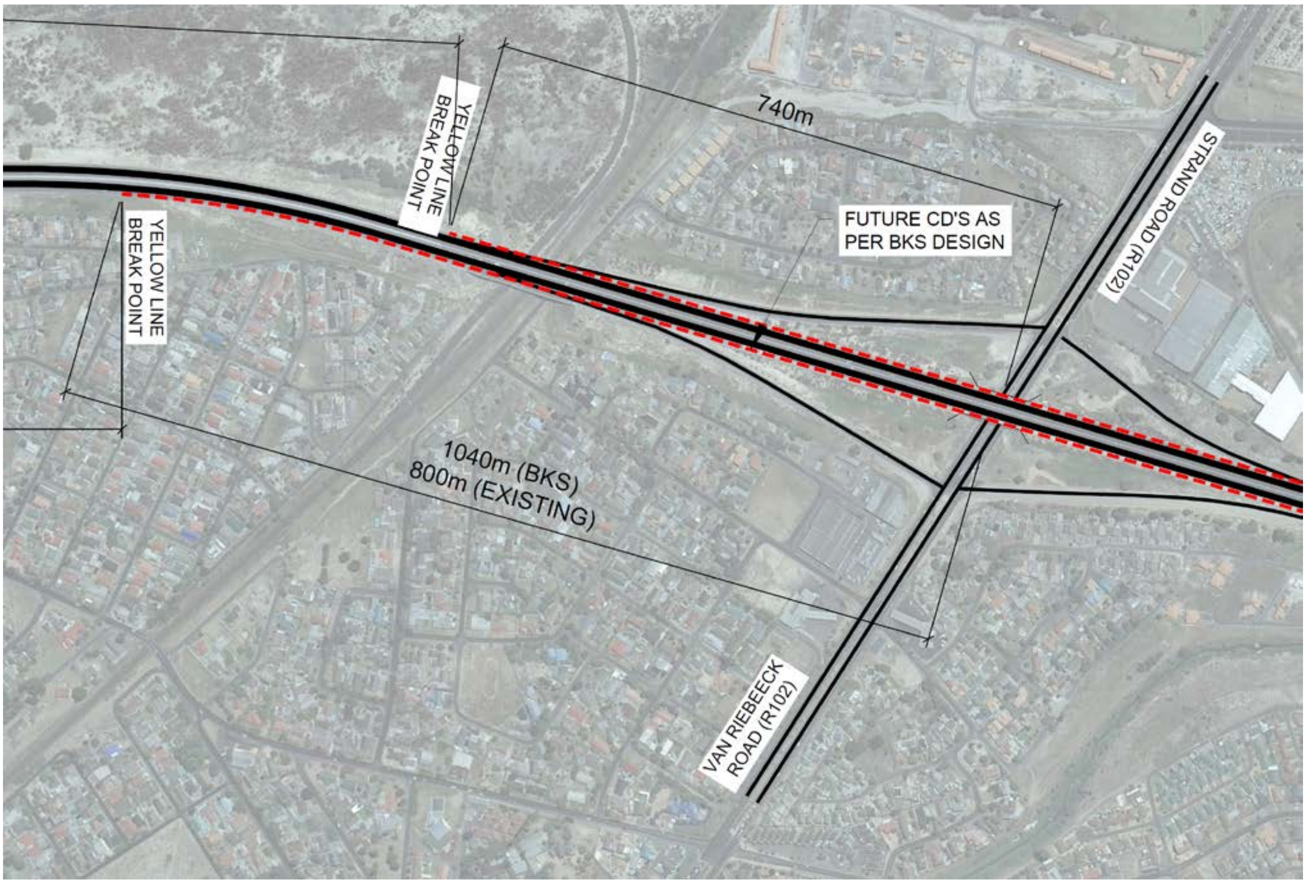


Figure 3-11: Future planning for R300/ Bottelary PARCLO interchange

This information was used to assist with the interchange spacing between the proposed R300/ Erica Drive Interchange and the R300/ Strand Road Interchange.

3.9 Future traffic demand

The future traffic demand was estimated from the EMME2 model output using the 2032 PD Land Use scenario. Refer to **Figures D-10 and D-19** in **Annexure D**. This indicates that capacity conditions can be expected for the section of Erica Road between Symphony Way and Reuter Street in the peak direction (westbound) during the AM peak hour. The section further south will experience v/c ratios of 0.7-0.8 during the peak direction in the AM peak hour. The peak period is expected to be 1-2 hours long in the peak direction. In the off-peak direction it is less than 1 hour.

4 LAND USE OVERVIEW

4.1 Existing land use

The existing land use in the area surrounding Erica Drive is primarily residential land use and it is not expected that it will change in the foreseeable future.

4.2 Future land use planning

Significant opportunities for development exists in the vacant land to the east of Saxdowns Road. This is primarily expected to be residential land use, referred to as New Urban Infill in the Tygerberg District Plan[4]. Refer to Figure 4-1. This is also primarily residential development and is taken into consideration in the EMME 2 model of the 2032 PD land use scenario.

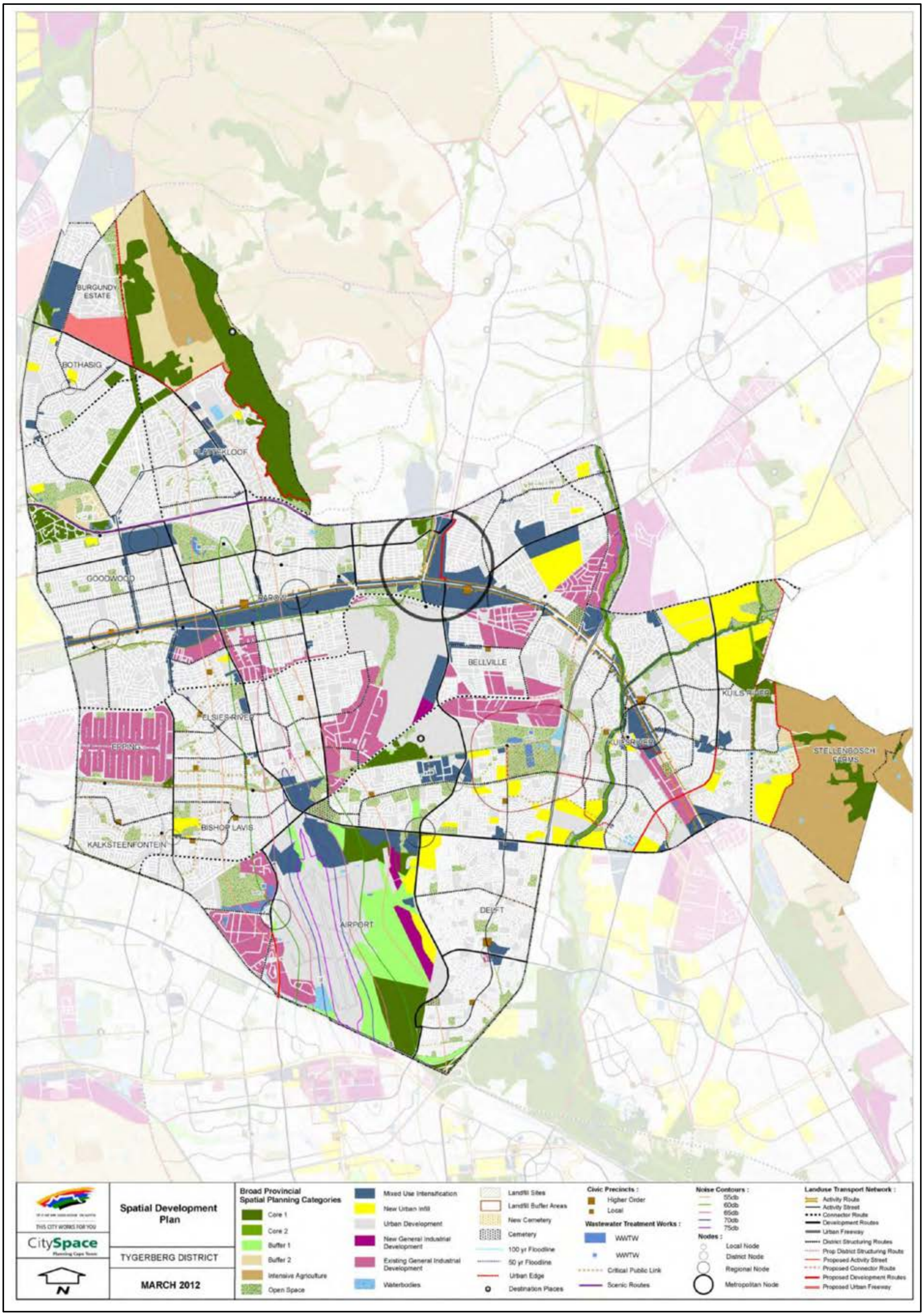


Figure 4-1: Future Land Use Planning

5 OVERALL STORMWATER MASTERPLANNING

The stormwater masterplanning was undertaken by Malcolm Cerfonteyn of Ingerop. Refer to the detailed specialist study, Draft Stormwater Management Report dated June 2018, included in Annexure E.

The PCSWMM stormwater modelling software was used to determine the stormwater attenuation requirements based on the available stormwater systems in the vicinity of this development.

5.1 Catchment Area

The catchment area considered is shown in *Figure 5-1*.

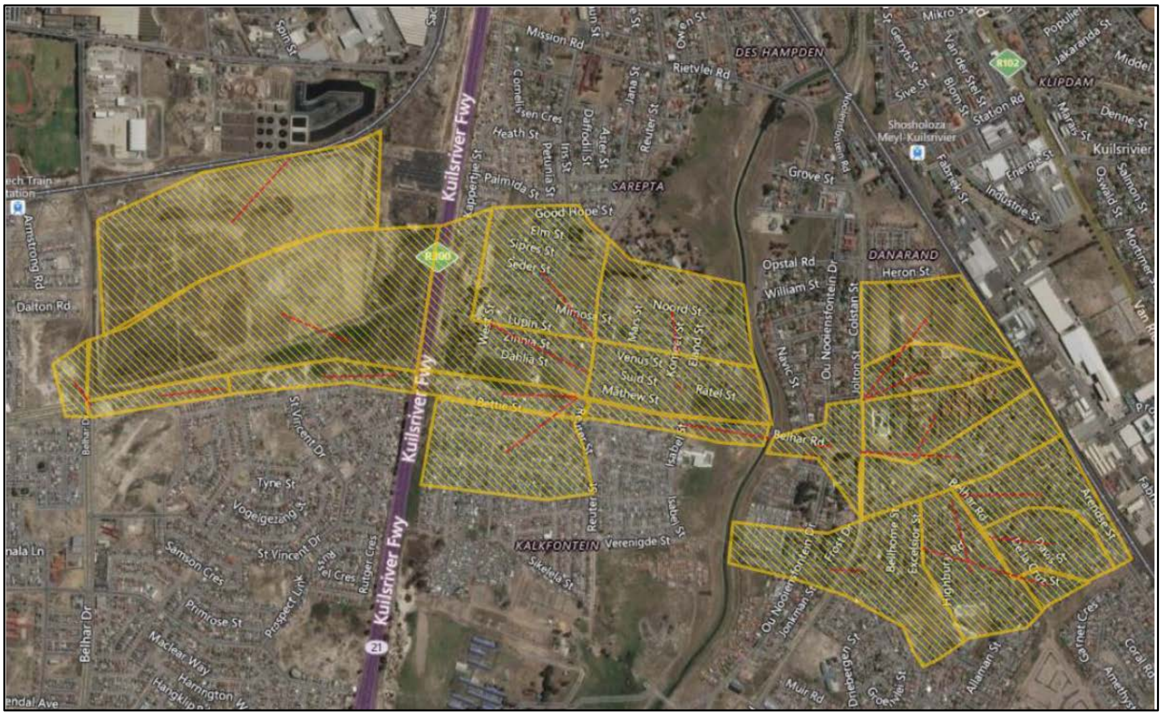


Figure 5-1: Catchment area considered in stormwater masterplanning

5.2 Results

The 5-year, 10-year, 20-year and 50-year recurrence periods were modelled and the results are shown on drawing TT1224/SW1 in the Ingerop Stormwater Masterplan Report. Due to the fact that the stormwater system crosses the R300 freeway and that it forms a major cut-off stormwater system, it is proposed that

- The pipes are sized for the 50-year flows and therefore drawing TT1224/SW1 proposes preliminary pipe sizes based on the 50-year flows.

The stormwater masterplan report recommends the following:

- A new system is installed and that all existing systems should tie into the new system.
- Where possible attenuation ponds (bio-retention ponds) should be constructed.
- The new system should discharge into the existing Kuils River at the concrete canal level.

6 EXISTING SERVICES INVESTIGATION

The existing services were obtained from all the necessary service providers. The services information received are indicated on the existing services layouts (**drawing no 3785.4/SV/01 to 04 in the Book of Drawings).**

The existing services will be affected by the new road infrastructure. The relevant information was obtained and incorporated into the preliminary design, but can only fully be confirmed once construction commences.

The existing services information that has been obtained are discussed hereafter.

6.1 Stormwater

Information regarding the stormwater network for the area was obtained from the City of Cape Town. In addition, the stormwater planning for the extension of Erica Drive south east of Highbury Road was obtained from APEC Consulting Engineers (Mr Riaan Swiegers) and was taken into consideration.

The available information indicates that the existing stormwater systems on the eastern side of the R300 discharges into the Kuils River canal. On the western side of R300 a number of attenuation ponds and stormwater systems within the residential areas, were identified.

Refer to **drawing no 3785.4/SV/01 to 04 in the Book of Drawings.**

6.2 Water and Sanitation

The Water & Sanitation network for the area was received from the City of Cape Town (District 4 – Reticulation Branch Kuils River Offices – Mr Marcus Swart). The new proposed sewer rising main in the Highbury area was also received from Lukhozi Consulting Engineers (Pty) Ltd and is included in the services layout.

Refer to **drawing no 3785.4/SV/01 to 04 in the Book of Drawings.**

6.3 Electricity (Eskom)

The Eskom services information for the area between Belhar Drive and Reuter Street was obtained from Nickey de Koker at ESKOM.

The following should be noted:

- The proposed Erica Drive and Interchange affects the Belhar / Sarepta 1 132 kV Overhead Powerline and the Cisco / Sarepta 1 132 kV Overhead Powerline.
- The minimum required vertical clearance is 7,5m.
- The ESKOM overhead services were surveyed and were taken into account in the road design.
- The detail design was submitted to ESKOM to obtain approval for the vertical and horizontal alignment of Erica Drive.

Refer to **drawing no 3785.4/SV/01 to 04 in the Book of Drawings.**

6.4 Electricity (City of Cape Town)

The City of Cape Town's information with respect to local power supply services were obtained from Electricity Generation & Distribution.

The following should be noted:

- The underground services run within the road reserve with a number of road crossings.
- The exact position of these services will be determined by the contractor on site.
- The possible relocation or protection will be determined with the service provider present.

Refer to **drawing no 3785.4/SV/01 to 04 in the Book of Drawings.**

6.5 Telecommunications

We have received the services from DFA and Telkom (open serve).

The following should be noted:

- The underground services run within the road reserve with a number of road crossings.
- The exact position of these services will be determined by the contractor on site.
- The possible relocation or protection will be determined with the service provider present.

Refer to **drawing no 3785.4/SV/01 to 04 in the Book of Drawings.**

7 KUILS RIVER BRIDGE STATUS QUO ASSESSMENT

The existing Belhar Road is a single carriageway road which crosses the Kuils River stormwater canal at SV 2615.27. Based on the preliminary evaluation, the proposed final option was to upgrade this road to a divided dual carriageway road by constructing a second carriageway on the south side of the existing road. This will necessitate the construction of a new bridge over the existing canal adjacent to the existing Kuils River Bridge to accommodate the additional roadway width and capacity requirements.

As part of the project preliminary report, an assessment inspection of the Kuils River Bridge (B5941) was undertaken on 25 March 2018.

7.1 Structure Details

The existing Kuils River Bridge is a 3-span continuous structure which has a central span of 17.0m length and two equal end spans of 14.7m and crosses the existing Kuils River Stormwater Canal at an 84° skew angle. The bridge was reportedly constructed in 1995 as an in-situ cast voided deck structure with cantilevers, supported on wall type piers and closed abutments, with New Jersey concrete parapets, claw/modular expansion joints and elastomeric rubber bearings. All substructure elements are supported on precast driven piles.

The existing single carriageway bridge deck width of approximately 11.0m between parapets accommodates the 2-lane carriageway, comprising a lane configuration of 1.6m shoulder (adjacent to New Jersey concrete parapet), 2 x 3.7m wide traffic lanes and a 2.0m sidewalk.

A Basic General Arrangement Drawing which was reproduced from the as–built drawing, as well as the bridge survey, is provided in **drawing C013R5110** in the Book of Drawings.

Typical upstream elevation

Western approach to the bridge

Figure 7-1: Kuils River Bridge view

Inspection photos have been provided for the various inspection items where defects have been recorded during the inspection, together with the proposed remedial measures that could be adopted. These are all included in the specialist report.

7.2 Findings

A summary of the various bridge inspection items where defects have been recorded at the Assessment Inspection, together with the proposed remedial measures that could be adopted, are summarized in Table 7-1 below.

Table 7-1: Summary of Defects and Remedial Work Required for the Existing Kuils River Bridge

INSPECTION ITEM	DEFECTS INCLUDING REMEDIAL WORK ACTIVITIES NOTED	PROPOSED REMEDIAL MEASURES
Item 01 (Approach Embankment)	• Erosion at end of parapets – EA, WA ($20m^2$) • Crocodile cracking/potholes – EA, WA (15m) • Missing cover plate to meter box – EA, WA (2 No)	• Backfill scour areas and compact. • Construct RC Ground beam at end of parapet endblocks • Repair/patch asphalt surfacing. • Replace cover plates to meter boxes
Item 02 (Guardrails)	• Missing spacer blocks – EA, WA (2 No) • Missing bolts, washers – EA, WA (14 No) • Guardrail posts missing - EA, WA (4 No)	• Replace spacer blacks, bolts and washers. • Replace guardrail posts.
Item 03 (Waterway)	• Building rubble/debris below deck – S3 ($8m^3$) • Broken/missing gabion mattresses – EA, WA ($50m^3$)	• Clear rubble/debris. • Repair/replace Gabion mattresses
Item 04 (Approach Embankment Protection Works)	• No defects noted	• No work required.
Item 05 (Abutment Foundations)	• Unable to inspect	• No work required.
Item 06 (Abutments)	• Concrete spalling/ plaster stripping off patch – WA (20litre)	• Repair concrete spalling.
Item 07 (Wing/Retaining Walls)	• No defects noted	• No work required.
Item 08 (Surfacing)	• No defects noted	• No work required.
Item 09 (Superstructure Drainage)	• Scupper drains partially silted up – AS (7 No) • Scupper drains flush with deck soffit – AS (14 No)	• Clear scupper drains. • Extend scuppers below deck soffit.
Item 10 (Kerbs/Side Walks)	• Vegetation in walkway behind kerb – EA ($20m^2$) • Asphalt stripping off surface – S2 ($1m^2$)	• Clear vegetation/debris. • Repair/patch asphalt surfacing.

INSPECTION ITEM	DEFECTS INCLUDING REMEDIAL WORK ACTIVITIES NOTED	PROPOSED REMEDIAL MEASURES
Item 11 (Parapet)	• Sealant missing from parapet joints – S3 (5m) • Water leakage through parapet joints – S2, S3 (1m)	• Replace joint sealant.
Item 12 (Pier protection works)	• Not Applicable	• No work required.
Item 13 (Pier Foundations)	• Unable to inspect	• No work required.
Item 14 (Piers and Columns)	• Concrete spalling to pier face (fire damage), and end of pier – P2 (25litre)	• Repair concrete spalling.
Item 15 (Bearings)	• No defects noted	• No work required.
Item 16 (Support Drainage)	• No defects noted	• No work required.
Item 17 (Expansion Joints)	• Broken/loose gland to claw joint – EA (0.5m) • Missing joint cover plates at parapets – EA, WA (4 No) • Missing joint cover plates at kerb face – EA, WA (4 No)	• Clean joint of loose material. • Repair gland of claw joint. • Replace joint cover plates.
Item 18 (Longitudinal Deck Members)	• Not Applicable	• No work required.
Item 19 (Transverse Deck Members)	• Not Applicable	• No work required.
Item 20 (Decks and Slabs)	• Concrete spalling to edge of deck soffit – S2 (2litre)	• Repair concrete spalling.
Item 21 (Miscellaneous)	• Missing/broken cover plate to street light – S2 (1 No)	• Replace cover plates to street lights.

In summary, the bridge is in a generally good structural and durable condition. The observed defects are not of any major significance or concern. The proposed remedial measures should be undertaken to existing bridge as part of the bridge doubling contract.

8 TOPOGRAPHICAL SURVEY

The topographical survey was conducted by Matt Pepe & Associates cc.

8.1 Scope of Survey

The topographical survey included the following:

- Existing Belhar Drive / Erica Drive Intersection
- 100m of St Vincent Drive Intersection
- 500m north and south of the Erica / R300 intersection
- Existing Belhar / Reuter Intersection
- Isabel Intersection
- New Nooiensfontein Dr Intersection
- Highbury Road Intersection
- Extend 400 south east of Highbury Intersection
- Land strip between Belhar and Reuter as indicated for the Erica Road Extension
- Electrical overhead services
- Full half-diamond area, as well as the 2 bio retention dams – still to be undertaken.

The survey information required was as follows:

- All cadastral information (road reserves / erf boundaries and servitudes)
- Road markings and Road signs
- All visible services including manhole invert levels, culvert sizes, invert levels, traffic signal poles, sidewalks, street lighting, overhead services etc.
- Detail road levels (left edge, centre, right edge and median islands) and natural ground levels up to road reserves or as indicated, etc.
- Detail survey of bridge structure including canal upstream (100m) and downstream (100m).

9 GEOTECHNICAL INVESTIGATION

Geotechnical assessments were undertaken for both the Kuils River Bridge crossing, as well as the R300 bridge crossing. The conclusions from the report are summarised hereafter, but the more detailed investigation results are contained in the Report on Geotechnical Investigations for the Belhar Road Bridge, Kuils River, July 2018, and the Report on Geotechnical Investigations for the proposed New Erica Road Bridge over National Route R300, Kuils River, July 2018, prepared by Kantey & Templer.

The following specific aspects were assessed:

- Nature of the underlying soils
- Site Geohydrology
- Excavation Conditions
- Materials Utilisation Potential
- Founding Conditions

Although every effort has been made to ensure the accuracy of the information contained in the report, the results of the investigation are based upon fieldwork which provides a limited view of the subsoil conditions. Natural soil/rock is never uniform. Its properties change from point to point while our knowledge of its properties are limited to those few spots at which the samples have been collected. As a precautionary measure, it is imperative, due to the potential geotechnical variations in the subsoils and Malmesbury rock strength, that pile founding conditions should be inspected and approved by a geotechnical engineer.

9.1 Kuils River Bridge assessment

9.1.1 Nature of underlying soils

The site is underlain by a mantle of reworked soils that overlies naturally deposited transported soils of predominantly alluvial origin. These soils are underlain by residual soils and strata of the Malmesbury Group, which tend to be deeply weathered.

9.1.2 Site Geohydrology

The site is characterised by a shallow groundwater system, which was measured between 0.85 to 1.13m below existing ground level. The groundwater levels are directly influenced by the seasonal periods and the levels within the Kuils River. For this bridge, groundwater seepage water is likely to remain present irrespective of the timing of construction and should be allowed for at all times.

9.1.3 Excavation conditions

Given the predominantly non-cohesive nature of the sandy material, conventional earthmoving equipment will satisfactorily remove the alluvium horizons. Excavations deeper than 1.00 metres will require suitable battering or temporary lateral support (especially in winter conditions) to ensure safe working conditions. It is preferable that excavations and the installation of foundations be planned for the drier summer months when the groundwater (and river) levels are far more favourable.

9.1.4 Founding conditions

In terms of the founding conditions for the bridge site, conventional foundations seated from 2.0m depth are possible for the abutments. Modified foundations incorporating the use of geosynthetic reinforcement seated in high shear strength material to create a reinforced soil raft are required for the pier positions provided the specified bearing pressures can be achieved. If the specified reduced bearing pressures cannot be met, then piled foundations would be required.

9.2 R300 bridge crossing

9.2.1 Nature of underlying soils

The site is underlain by naturally deposited sandy transported soils of predominantly alluvial origin. These soils are underlain by residual soils and strata of the Malmesbury Group, which tend to be deeply weathered.

9.2.2 Site Geohydrology

The site is characterised by a shallow groundwater system, which was measured between 1.32 to 2.45m below existing ground level. The groundwater levels are directly influenced by the seasonal periods. For this bridge site, groundwater seepage water is likely to remain present irrespective of the timing of construction and should be allowed for at all times.

9.2.3 Excavation conditions

Given the predominantly non-cohesive nature of the sandy material, conventional earthmoving equipment will satisfactorily remove the sandy horizons. Excavations deeper than 1.50 metres will require suitable battering or temporary lateral support to ensure safe working conditions. It is preferable that excavations and the installation of piled foundations be planned for the drier summer months when the groundwater levels would be more favourable.

9.2.4 Founding Conditions

In terms of the founding conditions for the bridge site and in view of the anticipated heavy structural loading of the ground, conventional foundations are not suitable at shallow depth. In order to construct conventional foundations, pad foundations would need to be taken through the upper subsoils and founded well into the lower dense to very dense transported soils or very stiff residual Malmesbury material at depths greater than 4.0 metres, which is not practically feasible, therefore piled foundations are recommended.

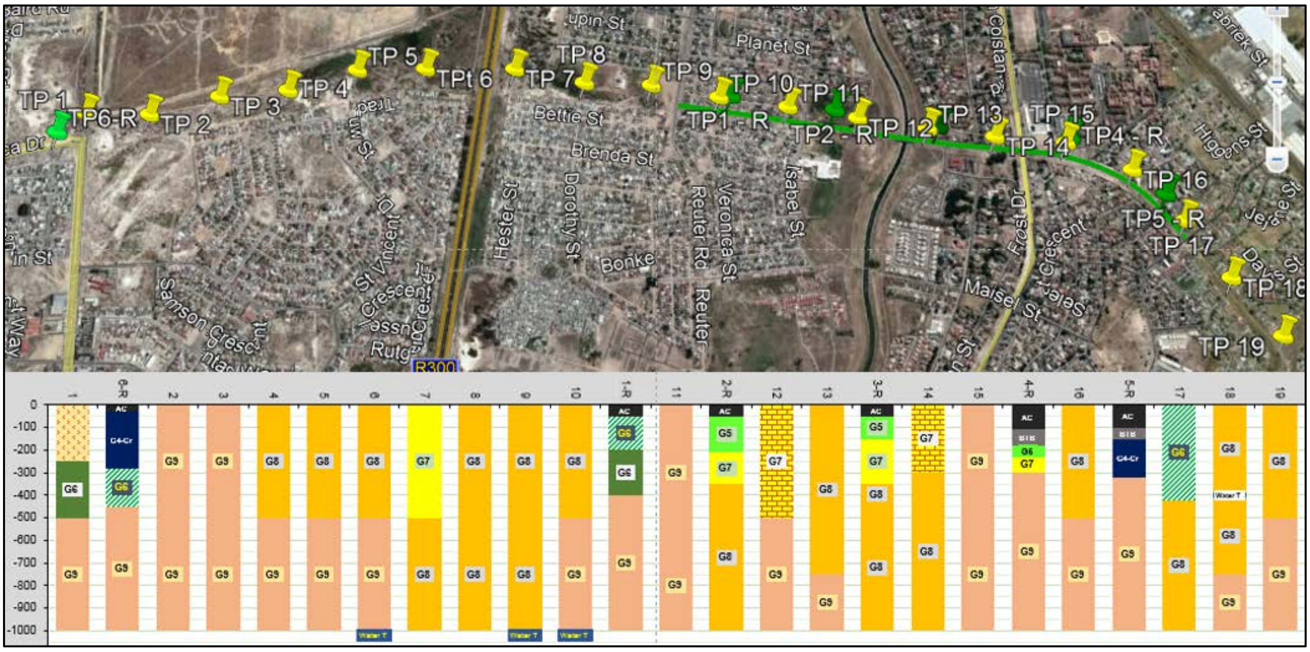
10 PAVEMENT INVESTIGATION

The pavement investigation along the proposed road alignment was conducted by Steyn-Wilson Laboratories during the month of July 2018. The specialist laboratory report is included in Annexure E.

10.1 Methodology

Test pit locations in Erica Drive road reserve, between Belhar Drive and Reuters Street, were spaced 200m apart aligned with the road design centre line. Refer to Figure 10-1. Test pits in the road reserve section of Erica Drive up to the future extension of Saxdowns Road were located in both the existing roadway and in the road reserve, also to a 200m spacing.

A total of 19 test pits in the road reserve and 6 in the existing road were identified. Test pits up to a depth of 1m were done in both the in-situ sands and existing pavement layers.



Source: Google & ITS

Figure 10-1: Test Pit Locations and Pavement Layer Composition

The following field and laboratory tests were conducted according to SANS 3001:

- Visual Material Classification
- DCPs up to 1m from surface level
- Sieve Analysis
- Atterberg Limits
- Soil- Mortar Percentage
- MOD AASHTO
- C.B.R.

10.2 Site Geology

The section of Erica Drive between Belhar Drive and Reuters Street falls on a section of calcareous coastal dune sand which is a white, light brown to grey, fine to medium grained sand. These sands forms part of the so called "*Witzand formation*" and covers quartz sands of the so called "*Springfontein formation*" (Source: Cape Farm Mapper. 2018. *CapeFarmMapper ver 2.1.0.4*. [ONLINE] Available at: https://gis.elsenburg.com/apps/cfm/. [Accessed 6 September 2018]. The presence of calcium carbonate which originates from sea shells reacts to hydrochloric acid as indicated in the test results.

Figure 10-2: Typical Coastal Dune Sand Test Pit

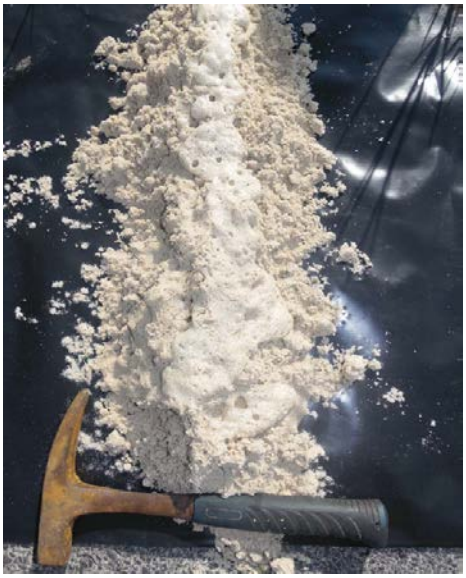


Figure 10-3: In-Situ Calcareous Sand reacting with HCL

The section of Erica Drive between Reuters Street and the future extension of Saxdowns Road falls within a section of quartz sands of the "*Springfontein formation"* but also has a presence of the calcareous coastal dune sands of the "*Witzenberg formation*" likewise to section explained above (Source: Cape Farm Mapper).

Figure 10-4: In-situ Quartz Sand Test Pit

Figure 10-5: Quartz Sand

10.3 Groundwater Conditions

In this section of the report, groundwater conditions up to a depth of 1m below the ground level, is reported on. For more detail on groundwater at greater depths, refer to Section 9.

- Ground water was found at either the bottom or middle of 4 test pits. The first 3 test pits are all located adjacent to the wetland areas/detention ponds, west and east of the R300 with water at the bottom of the 1m deep test pit.
- The 4th test pit is located in the section of road reserve between Highbury Road and the Saxdowns Road reserve. At this location the water table was found at a depth of 650mm below the surface.

The road is expected to be in fill in the wet areas adjacent to the wetlands. It is also proposed that subsoil drains and pioneer layers be used. Accordingly, the groundwater should not have an impact on the road.

10.4 Existing Pavement Layer / In-Situ materials investigation

The results of the In-situ Material Investigation and the Existing Pavements Layers in the existing road are discussed.

10.4.1 In-situ Material Investigation

Erica Drive road reserve between Belhar Drive and Reuters Street

The results show that the in-situ material are homogenous sand with MODs ranging from approximately 2120 kg/m^3 to 1620 kg/m^3 and C.B.Rs at 93% ranging from 7% to 15% which places the material in a G9 to G7 category. The in-situ sand are of such a quality that it should be used for fill. The calcareous sands has a good cementing ability which should not be removed from site, but is a good in-situ material for fill.

Groundwater was found at the bottom of the test hole located adjacent to the retention pond, west of Reuters Street.

Erica Drive between Reuters Street and the future extension of Saxdowns Road

The results show that the in-situ material is sandy with MODs ranging from approximately 2100kg/m^3 to 1700 kg/m^3 and C.B.Rs at 93% ranging from 7% to 25% which places the material in a G9 to G6 category.

There are sections where building rubble was found in the top 500mm of the existing road reserve, specifically between Reuter Street and New Nooiensfontein Road. These materials is of low quality and should be removed.

At the bottom of the test pit south east of Highbury Road, ground water was found at a depth of approximately 650mm below the existing ground level. A pioneer layer is recommended.

10.4.2 Existing Pavement Layer Investigation

The existing pavement layer investigation was undertaken for the section of road between Reuter Street and Highbury Street, as well as the existing 90 degree bend at Erica Road/Belhar Main Road intersection. The results are as follows:

- With reference to Figure 10-6, the section of Belhar Main Road between Reuter Street and New Nooiensfontein Road, is constructed of the following varying material layers:
  - 50mm Asphalt
  - Either 100mm or 300mm (in two layers) G5 base or 200mm to 350mm (in two layers) G6 base
  - 600mm - 650mm in situ G9 as subbase/selected layers.

- The section of Belhar Main Road between New Nooiensfontein Road and Highbury Road is constructed with the following material layers:
    - 100mm - 110mm Asphalt
    - 50mm - 70mm BTB
    - Either a 170 mm G4 subbase or 120mm G7 subbase.


Figure 10-6: Test pit in existing road at Belhar Main Road

- The existing 90-degree bend at the Erica Drive/Belhar Drive intersection, west of the R300, is constructed with the following pavement layers:
    - 50mm Asphalt
    - 250mm G4 as base
    - 170mm G6 as subbase
    - 650mm in-situ G9 sand.

Since this section of road will accommodate a new signalised intersection, it is proposed to completely rebuild the pavement layers to the same specification as the new section of Erica Road. Refer to Figure 10-7.

The existing pavement layer investigation shows that the pavement layers are varying and there are no consistency in layer thickness. It is also evident that the existing pavement layers are in a deteriorating state which necessitates a complete reconstruction of the pavement layers for the entire length of Belhar Main Road between Reuter Street and Highbury Road.

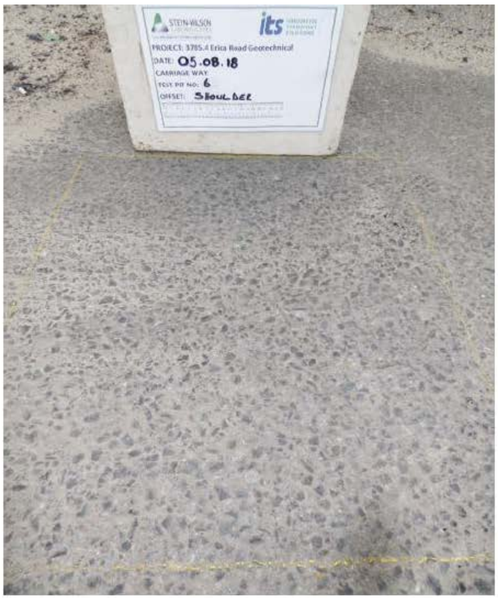


Figure 10-7: Test pit at Erica Drive/Belhar Drive intersection

11 ENVIRONMENTAL IMPACT ASSESSMENT & HERITAGE ASSESSMENT

Eco Impact was appointed as the Environmental Assessment Practitioner to conduct an Environmental Impact Assessment (EIA) Basic Assessment application with a Water Use Authorisation (WUA) for the Erica Drive road construction and the Kuils River bridge crossing, Cape Town. This was undertaken as a single process to run simultaneously, dealing with all the activities for which an Environmental Authorization (EA) and Water Use Authorization (WUA) associated with the project, are required.

11.1 Applicable legislation

An appropriate Application for an Environmental Authorisation is developed and submitted in terms of the National Environmental Management Act (NEMA) Act 107 of 1998 and a WUA in terms of the National Water Act (NWA) Act 36 of 1998.

Note that the Department of Environmental Affairs published the amended Environmental Impact Assessment Regulations, 2014 in GN R.982 published in GG 38282 on 04 December 2014. The new EIA Regulations give effect to the "Single Environmental System". The Ministers (Environmental Affairs, Mineral and Resources and Water and Sanitation) agreed to a "Single Environmental System" under NEMA.

The Minister responsible for the environment sets the regulatory framework. The Provincial Minister responsible for the environment is the competent authority on this application.

The Ministers agreed to align timeframes for regulated processes. This agreement was captured in amendments to National Environmental Management Act (NEMA), the MPRDA & the National Water Act.

11.2 Specialist Studies

The following specialist studies were undertaken in response to the pre-application BAR for this project:

- Freshwater Ecological Impact Assessment
- Terrestrial Botanical Impact Assessment
- Hydrological Overview
- Peer Review, Wetland Delineation and Offset Calculation

The results of these studies are summarised hereafter.

11.2.1 Freshwater Ecological Impact Assessment

The assessment was undertaken by Mr Nicolaas Hanekom of Eco Impact Legal Consulting (Pty) Ltd (Eco Impact). The detailed findings are contained in the specialist report.

Methodology

Input into this report was informed by a combination of desktop assessments of existing freshwater ecosystem information for the study area and catchment, as well as by a more detailed assessment of the freshwater features at the site.

The site was visited in September 2017. During the field visit, the characterisation and integrity assessments of the ecological features were undertaken. Mapping of the features was undertaken using Google Maps with GPS tracker. The features were mapped while doing the field survey. The SANBI Biodiversity GIS website was also consulted to identify any constraints in terms of fine-scale biodiversity conservation mapping as well as possible freshwater features mapped in the Freshwater Ecosystem Priority Areas maps. This information/data was used to inform the resource protection related recommendations.

Summary of Assessment Findings

The Kuils River flows through the proposed Erica Drive dualling from north to south. The ecological features on the site have been totally modified and channelled. On the site, surrounding land use, the channel of the river and the existing constructed bridge has resulted in all of the indigenous riparian vegetation being removed from the river and streams. In terms of the importance and sensitivity of the features, the numerous impacts have greatly reduced their species richness and diversity.

In order to maintain what remains of the ecological functioning of the systems on the site, it is recommended that construction methodology be provided by the civil contractor to the freshwater ecologist and approval first be granted before construction commences to ensure that the construction activities are mitigated and to prevent any further degradation of the Kuils River.

The construction activities must be monitored by an Environmental Control Officer.

The pillars of the expanded bridge must be in line with the existing bridge pillars in order to not affect or impact on the existing hydrology or river flow.

Three of the identified wetlands on site will be impacted upon. The impacted wetlands have largely modified wetland integrity as a large loss of natural habitat, biota and basic ecosystem functions has occurred. The Wetland Health Present Ecological Status of the impacted wetlands was assessed to be largely modified and in a moderate ecological importance state and sensitivity. Refer to Figure 11-1.

It is clear that the route will definitely impact, on a permanent basis, on an extent of depressional wetland. The former impacts are not mitigatable, and **the report has recommended offset mitigation to account for wetland loss**. A no-development alternative is not considered a necessary or useful recommendation to avoid these impacts, taking into account the level of degradation and fragmentation of the affected wetlands, as well as the opportunity for offset mitigation to create a better quality of habitat than that lost.

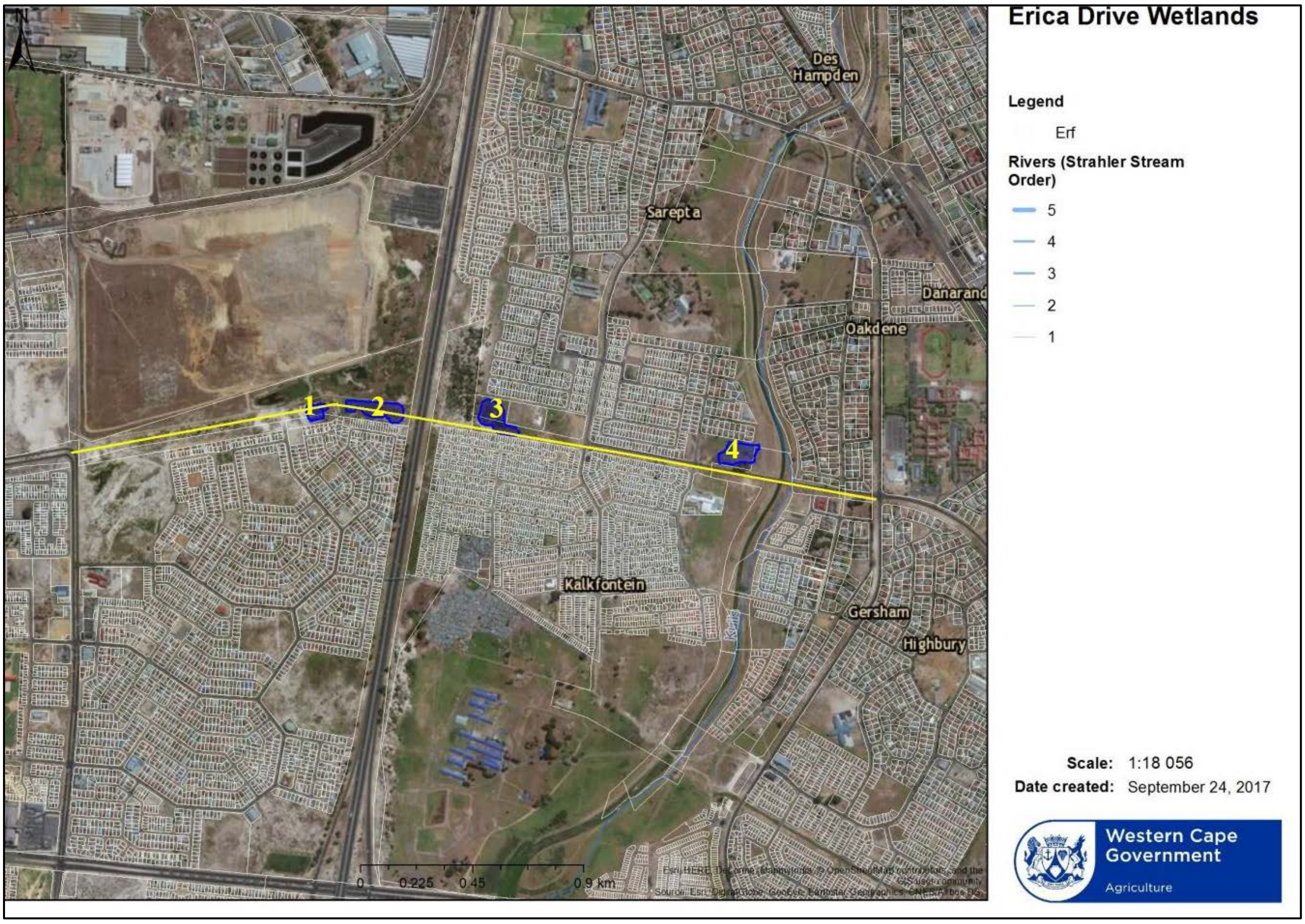


Figure 11-1: Wetlands identified in the study area

11.2.2Terrestrial Botanical Impact Assessment

The botanical assessment was commissioned in order to help inform the possible development and environmental authorisation process for the proposed road expansion as described above. The assessment is intended to provide baseline botanical information that can be used to guide the potential development process.

Methodology

The study area was visited on 8 September 2017. Relevant references are noted in the text, and conclusions were drawn based on this documentation and professional experience in the area. Areas were measured using Google Earth Pro. For purposes of this assessment the No Go alternative is assumed to be a continuation of the status quo, which in this case is vacant un-used land on the entire study area. This study does not address wetland or freshwater issues at all, as this was not part of the brief, and a separate freshwater ecosystem impact assessment will in fact be conducted to address these issues.

Summary of Assessment Findings

The vegetation and ecology within the study area has been heavily disturbed for a long time and no significant patches of intact natural vegetation remain within the non-wetland areas. Terrestrial botanical diversity is generally very low compared to what it was prior to human disturbance.

Two vegetation types would originally have been present in the area, all of which are now regarded as threatened on a national basis (one Critically Endangered and one Endangered).

Of the Critically Endangered Cape Flats Sand Fynbos vegetation mainly none to very little indigenous vegetation remains, therefore these areas have been indicated as **Low terrestrial botanical sensitivity**, presenting no constraints to the proposed development. Loss of this area would be of **negligible botanical significance at a regional scale**.

The remaining proposed development area represents significantly disturbed secondary Endangered Cape Flats Dune Strandveld vegetation. Limited indigenous vegetation diversity remains within the areas marked as Medium terrestrial botanical sensitivity areas, with no plant Species of Conservation Concern. The loss of the **Medium sensitivity vegetation** in the study area is likely to be of **Medium to Low negative significance** at a regional scale, before and after mitigation.

No specific botanical mitigation is required for this project, other than demarcating and restricting the proposed development area throughout the construction phase and ongoing alien invasive vegetation management and removal in the disturbed areas around the development footprints.

Although development of the Medium terrestrial botanical sensitivity area has been rated as having a potential Medium negative significance at a regional scale if other factors such as ongoing human disturbances and urban development, alien plant encroachment, low ecological connectivity etc. are taken into consideration, it is believed that the entire proposed development will have a Low negative significance on the terrestrial habitat of the site and surrounds. If is therefore concluded that the proposed development could therefore be authorised without causing significant negative terrestrial botanical impacts.

11.2.3 Hydrological Overview

Refer to Section 9 for the hydrological overview.

11.2.4 Heritage Impact Assessment

This was not undertaken for this project, but a Notice of Intent to Development (NID) was submitted to Heritage Western Cape.

11.2.5 Peer Review, Wetland Delineation and Offset Calculation

To be summarised when completed.

12 INTERCHANGE WITH THE R300

Two interchange configurations were assessed; namely a half-diamond interchange and that of a PARCLO interchange with the R300.

12.1 Future PARCLO at R300/ Bottelary Interchange

The future planning for the R300 road network undertaken by BKS was also sourced. The BKS designs were done as part of the Oostenberg Road Network review and included the R300/ Bottelary Interchange. This design includes one additional lane per direction on the R300, as well as amendments to the Strand Road Interchange on- and off-ramps to the south. The BKS design at the R300/ Bottelary Interchange was taken into consideration for the R300/ Erica Drive Interchange design. Refer to Figure 3-11.

The most important factor is the current spacing between the interchanges and the possibility of adding an additional interchange as part of Erica Drive. Both the Stellenbosch Arterial Interchange and the Strand Road interchange are access interchanges with distances of 3180m (northbound) and 2700m (southbound) between yellow line breakpoints of the on- and off-ramps.

12.2 Interchange spacing

Two interchange proposals were considered as part of this design; a half-diamond interchange with ramps on the northern side, as well as a PARCLO interchange.

SANRAL's Geometric Design Guideline recommends that access to access interchanges in urban be spaced 1.3km between the yellow line breakpoints of on- and off-ramps. This is to accommodate signage requirements. The spacing between the interchanges are as follows:

Table 12-1: Spacing between interchanges adjacent to Erica Drive Interchange (half-diamond)

Segments between interchanges along the R300	Northbound	Southbound
Stellenbosch Arterial / R300 – Erica/ R300	Stellenbosch Arterial on-ramp YLBP to Erica off-ramp YLBP = 1.62km	YLBP of the Erica off-ramp to YLBP of the Stellenbosch Arterial off-ramp = 1.56km
Erica/ R300 - Strand Road/ R300	YLBP of Erica on-ramp to YLBP of Strand off-ramp – 1.45km	YLBP of the southbound C-D road[1] to YLBP of Erica off-ramp = 1.3km

<u>*Notes:*</u>

1. *The future CD road at Strand/R300 interchange is in accordance with a conceptual design undertaken by BKS.*

Access to the R300 in a northern direction (half diamond interchange) can be achieved within the prescribed design parameters (1300m minimum between the yellow line break points of consecutive ramps and ramp length requirements for acceleration and deceleration). Also refer to drawing number 3785.4/ IS/01 dated 31 July 2018, revision A.

Access to the south is more problematic. The spacing between Stellenbosch Arterial and Erica Road (1600m) is not sufficient for standard on and off-ramps. In addition, the area south of Erica Drive is a fully developed residential area and no space was reserved for future interchange ramps. Access to the south can only be achieved with a PARCLO interchange and collector-distributor (CD) roads system between Stellenbosch Arterial and Erica Drive. The introduction of loop ramps and CD roads will extend the Erica Drive northern ramps. The distance between the northbound yellow line breakpoints from Erica Drive to Strand Road will be 1450m. The distance between the southbound yellow line breakpoints between Strand Road and Erica Drive will be 1070m and therefore short of the required minimum of 1300m.

The construction of loop ramps at Erica Drive and CD roads between Erica Drive and Stellenbosch Arterial will be expensive and will include two additional bridges over Stellenbosch Arterial. First order cost estimates for the interchange options forms part of this report. Refer to Sections 15.9 and 20.

13 ACCESS MANAGEMENT

13.1 Guideline spacing between intersections

The Road Access Guideline recommends intersection spacings along Class 3 roads in suburban environments to be as follows:

- Spacing between signals – 540m
- Median openings – 180m
- Equivalent side streets – 180m

13.2 Proposed intersection spacings

The spacings between intersections after the dualling of Erica Drive are shown in Table 13-1 below. It is also illustrated in Figure B-2 in Annexure B.

Table 13-1: Access spacing along dualled Erica Drive after upgrading

<table>
<tr><th rowspan="2">INTERSECTING STREET WITH ERICA DRIVE</th><th rowspan="2">LINK DISTANCE (M)</th><th rowspan="2">DISTANCE BETWEEN TRAFFIC SIGNALS/ ROUNDABOUTS (m)</th><th colspan="3">INTERSECTION CONTROL AFTER UPGRADING</th></tr>
<tr><th>Phase 1: Interim Upgrading (Dualled Between New Nooiensfontein and Reuter</th><th>Phase 2: Full Dual Carriageway Upgrading</th><th>Phase 2: Full Dual Carriageway Upgrading with half-diamond interchange</th></tr>
<tr><td>Belhar Drive</td><td></td><td rowspan="3">1 045m</td><td>-</td><td>Signalised</td><td>Signalised</td></tr>
<tr><td>St Vincent</td><td>710m</td><td>No access</td><td>LILO</td><td>LILO</td></tr>
<tr><td>R300 Interchange terminal West</td><td>335m</td><td>-</td><td>-</td><td>Signalised</td></tr>
<tr><td>R300 Interchange terminal East</td><td>268m</td><td>268m</td><td>-</td><td>-</td><td>Signalised</td></tr>
<tr><td>Reuter</td><td>425m</td><td>425m</td><td>Signalised</td><td>Signalised</td><td>Signalised</td></tr>
<tr><td>Isabel</td><td>365</td><td rowspan="3">993m</td><td>Priority-controlled</td><td>Priority-controlled</td><td>Priority-controlled</td></tr>
<tr><td>Frost</td><td>410m</td><td>LILO</td><td>LILO</td><td>LILO</td></tr>
<tr><td>New Nooiensfontein</td><td>218m</td><td>Roundabout</td><td>Roundabout</td><td>Roundabout</td></tr>
<tr><td>Access to Western Cape Sports School</td><td>190m</td><td rowspan="2">520m</td><td>LILO</td><td>LILO</td><td>LILO</td></tr>
<tr><td>Highbury Street</td><td>340m</td><td>Roundabout</td><td>Roundabout</td><td>Roundabout</td></tr>
</table>

Note: LILO left in/ left out intersection

The following should be noted:

- The spacings of the signalised intersections at the R300 interchange ramp terminals and Reuter is sub-standard. It is recommended that this be synchronised to improve traffic flow in the peak direction.
- St Vincent Street should not connect to Erica Drive in Phase 1 as it is highly likely that signalisation will be warranted and insufficient access spacing is available between the future R300 on-ramp/ Erica signalised intersection and St Vincent.
- The intersection spacing of 190m between Frost, New Nooiensfontein Road and the Western Cape Sports School is sub-standard. Accordingly, the Access to Western Cape Sports School is converted to a LILO. With the proposed roundabout at the New Nooiensfontein Road intersection, a LILO access will be acceptable.
- The rest of the intersection spacings are adequate.

14 TRANSPORT IMPACT ASSESSMENT

14.1 Proposed Road Upgrading

It is proposed to upgrade the Erica-Belhar Main Road link by providing the missing link across the R300. The initial portion of Erica Drive identified for implementation include the following:

- Construction of the southern carriageway between New Nooiensfontein to just west of Reuter Street
- Construction of a single carriageway link across the R300 up to Belhar Drive

Future improvements can include a half-diamond interchange with the R300 (northern ramps only).

14.1.1 Layout and Phasing

Erica Drive will be dualled, start from just north of the Highbury intersection, across the R300 (interchange provided in the future) and connect with Belhar Drive in the west. Refer to the layout drawings included in the Book of Drawings. However, this will be undertaken in phases. The phasing is also diagrammatically shown in Figure 14-1.

- **Phase 1** will include the construction of the southern carriageway from just north of Highbury Street. The existing road will then function as a second carriageway in the interim. This will continue to just west of Reuter Street, after which it will transition to a single carriageway road. The single carriage road will continue across the R300 to Belhar Drive. Refer to the layout plans included as 3785.4/LP/01- 3785.4/LP/04 in the Book of Drawings.
  Although a single carriageway road is built for the section of road between Highbury and just north of Reuter Street, in practical terms it will function as a dual carriageway road. This is due to the following reasons:
    - The current Kuils River bridge crossing is too narrow to accommodate the Phase 1 cross-section (2 x westbound through lanes and 1 x eastbound lane, along with sidewalks). Accordingly, a second bridge is required across the Kuils River in Phase 1.
    - The intersections of New Nooiensfontein Road and Reuter Street must be widened to provide additional capacity as required. This widening continues over the eastern and western sides of the intersections where it tapers back to a single carriageway standard, resulting in very short sections of road in between intersections that is of single carriageway standard.
    - The existing road exists and through completing the dual carriageway cross-section between the intersections, the link capacity along this section of road increases as well.
- **Phase 2** will include the dualling of the remaining portion of the road with the provision of a half-diamond interchange with the R300 with only the northern on-ramp and off-ramp being

provided. Refer to the layout plans included as 3785.4/LP/05- 3785.4/LP/07 in the Book of Drawings. This is proposed as 2 stages:

  - **Phase 2a**: The dualling of Erica Drive across the R300 without the half-diamond interchange.
  - **Phase 2b**: The implementation of the R300 on and off-ramps to upgrade the crossing to the required half-diamond interchange.

- **Phase 3** considers the opportunity to provide connectivity to the south via a PARCLO ramp configuration. Refer to the layout drawings 3785.4/LP/09 and 3785.4/LP/09 in the Book of Drawings. The CoCT is not intending to construct a PARCLO interchange, but the road reserve boundaries required for a PARCLO interchange was identified and the half-diamond interchange also cited accordingly, to ensure that a PARCLO interchange can be accommodated in the future, should it be required in the future. As previously discussed with SANRAL, it is accepted that this option is not supported by SANRAL due to the limited interchange spacing, need for C-D roads and the resulting compromise of the mobility function of the R300.

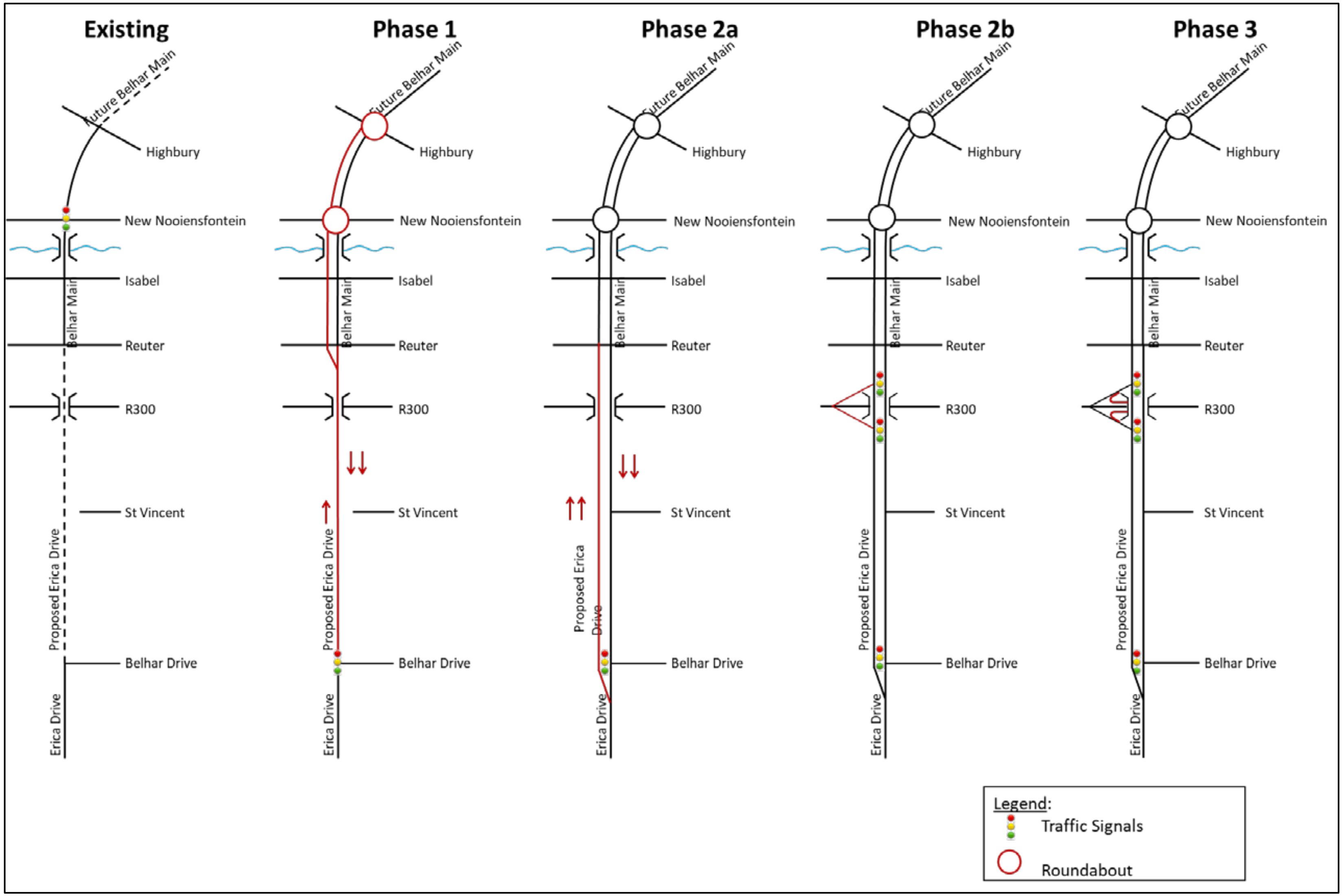


Figure 14-1: Proposed phases shown diagrammatically

14.1.2 Cross-section

Ultimate dual carriageway cross-section

With reference to Figure 14-2, the proposed cross-section will comprise the following:

- Dual carriageway road
- 2x3.4m lanes in both directions, excluding the 300mm channel
- 5m central median
- 2.4m cycle lane on both sides of the road
- 2m walkway on the northern side of the road and a 3m walkway on the southern side of the road. This is because 3m walkways are required for Phase 1.

With reference to Figure 14-3, across the **R300 Bridge** the cross-section changes to:

- 2x3.4m lanes in both directions, excluding the 300mm channel
- 4.6m central median
- 2.4m cycle lane on both sides of the road
- 2.050m walkway on both sides of the road

With reference to Figure 14-4, across the **Kuils River Bridge** the cross-section changes to:

- 2x3.4m lanes in both directions, excluding the 300mm channel
- 4.8m central gap (face of parapet to face of parapet)
- 1.4m cycle lane eastbound and 2.4m westbound
- 1.892m walkway on along the eastbound carriageway (new bridge) and 2m along the westbound carriageway (existing bridge)

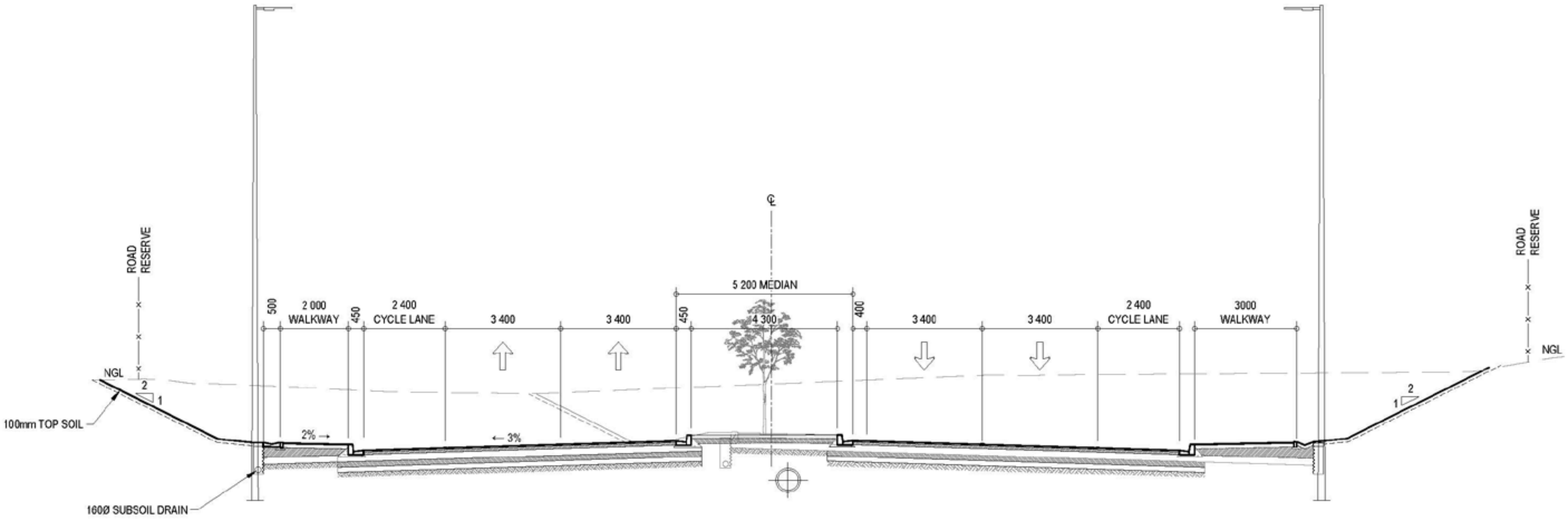


Figure 14-2: Ultimate dual carriageway cross-section

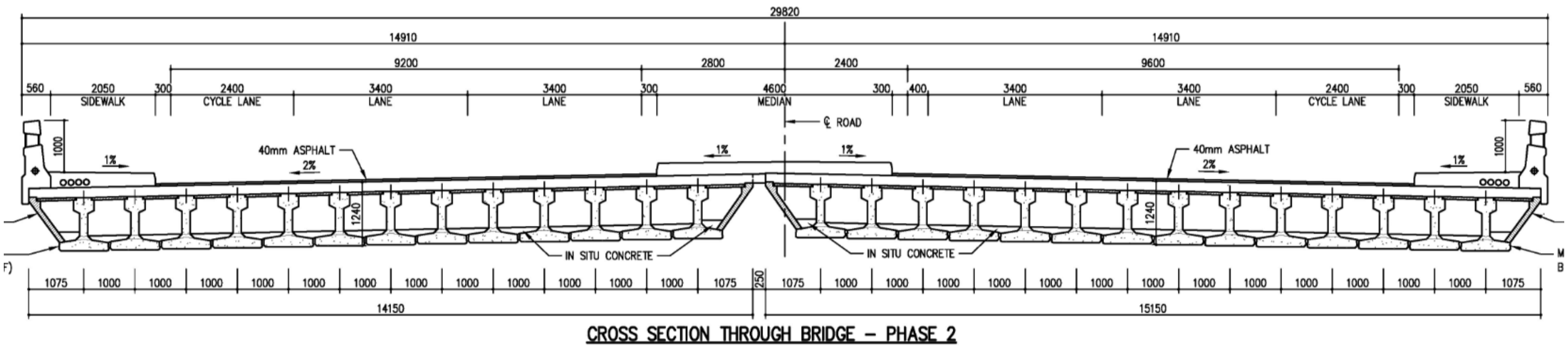


Figure 14-3: Ultimate dual carriageway cross-section across the R300

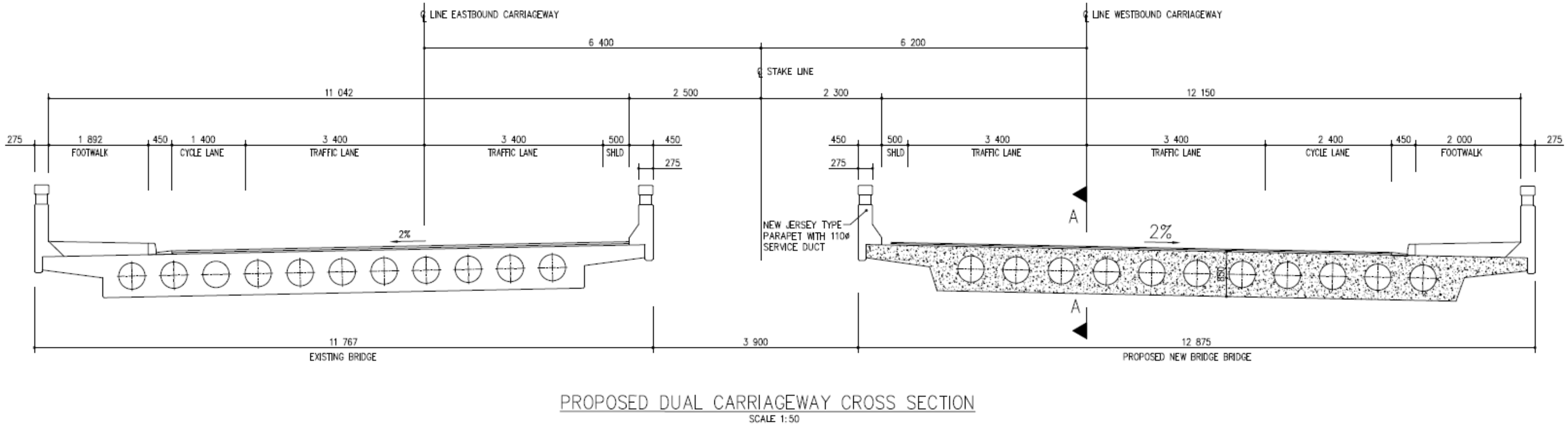


Figure 14-4: Ultimate dual carriageway cross-section across the Kuils River

Phase 1 single carriageway cross-section

- Erica Drive between New Nooiensfontein Road to just west of Reuter Street – dual carriageway section

  With reference to Figure 14-5, during Phase 1 this section of Erica Road will be a dual carriageway road and will comprise the following:

  - 2 x carriageways with 9.2m black top each, excluding 300mm channel
  - 5m wide median
  - 2x3.4m lanes in each direction, excluding 300mm channel
  - 2.4m cycle lane on both sides of the road
  - 2m walkway on both sides of the road

- Erica Drive, west of Reuter and east of Belhar Drive – single carriageway section

  With reference to Figure 14-6, during Phase 1 the proposed cross-section will comprise the following. This cross-section will only be applicable along the single carriageway section.

  - 9.6m black top
  - 3.1m lane in the eastbound direction and a 3.1m and 3.4m lanes in the westbound direction, excluding the 300mm channel
  - 3m walkway/ cycle lane on both sides of the road

With reference to Figure 14-7, across the R300, the cross-section across the bridge comprise the following:

- Single carriageway bridge
- 3.1m lane in the eastbound direction and a 3.1m and 3.4m lanes in the westbound direction
- 2.05m shared cycle and walkway on both sides of the bridge

The second bridge of the Kuils River Bridge will be constructed as part of Phase 1 and will comprise the ultimate cross-section as shown in Figure 14-4.

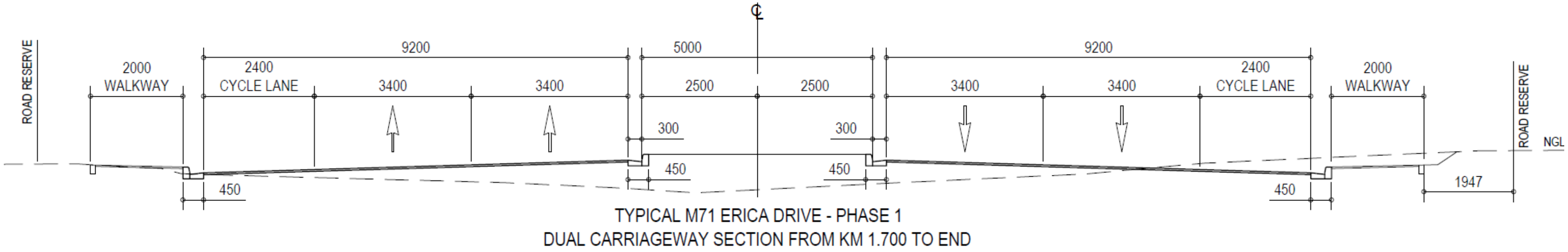


Figure 14-5: Cross-section for Erica Drive between New Nooiensfontein Road to just west of Reuter Street – dual carriageway section in Phase 1

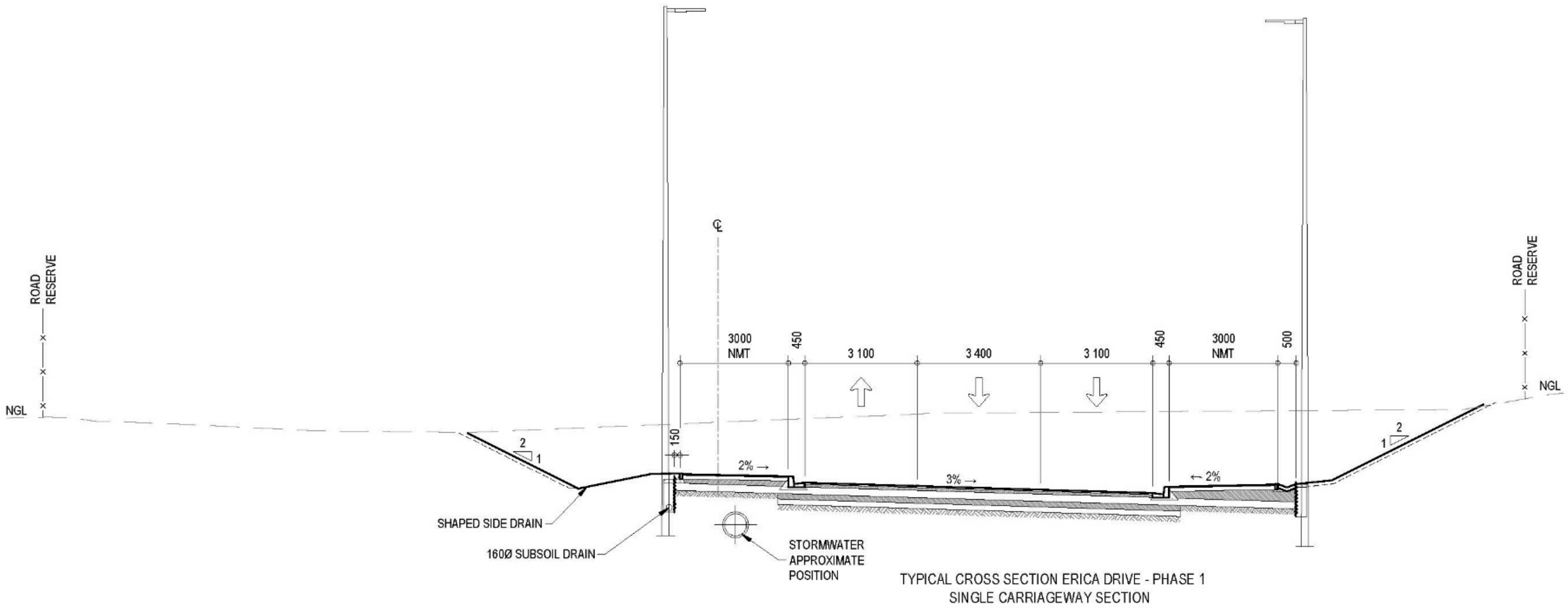


Figure 14-6: Phase 1 single carriageway cross-section

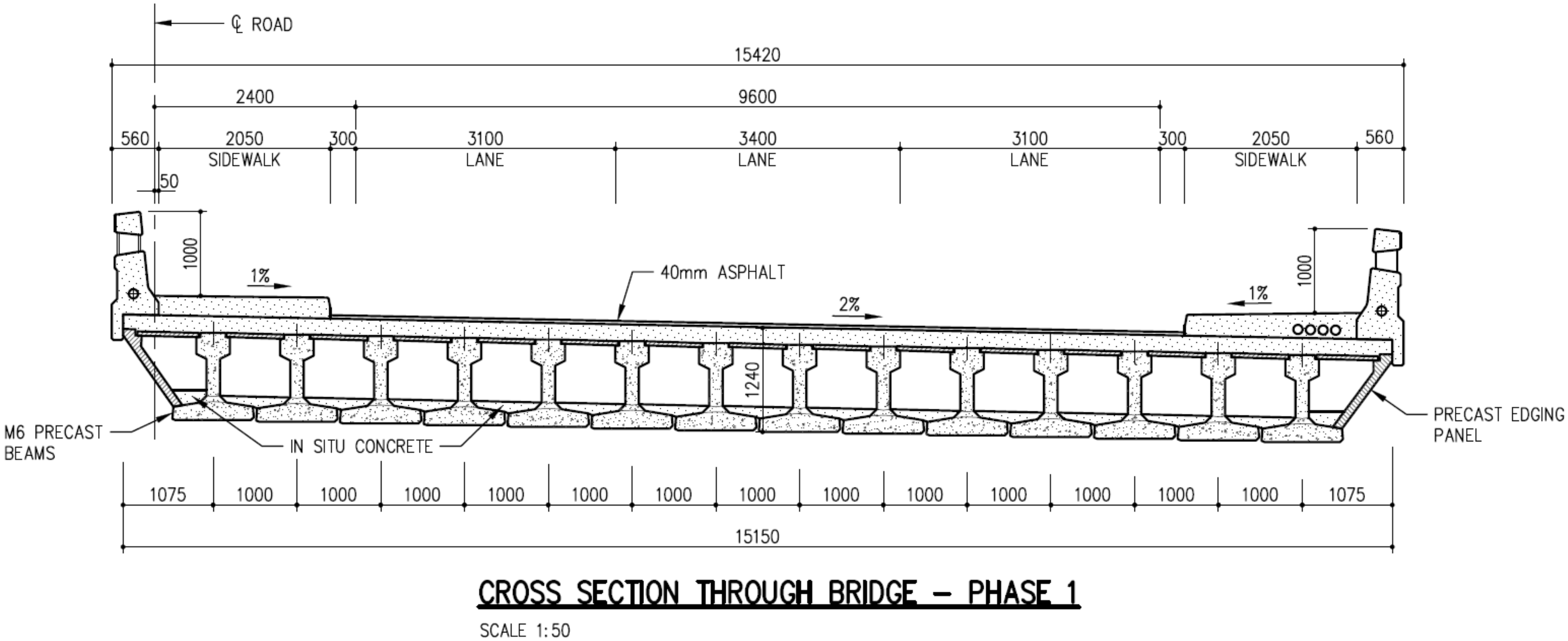


Figure 14-7: Phase 1 single carriageway cross-section across the R300 bridge

14.1.3 Upgrading of intersections

Roundabouts and signalisation were considered as potential upgrades at the various intersections. After consideration of the geometry, access spacing and intersection operations, the intersection configurations as outlined in Section 14.2 are proposed.

14.2 Public transport

Public transport embayments are proposed along Erica Drive at the following locations:

- Isabel/ Eland/ Erica
- New Nooiensfontein/ Belhar Main
- Reuter/ Erica
- St. Vincent/ Erica
- Belhar Drive/ Erica

The embayments will be located downstream of each intersection along both carriageways. Refer to the layout drawings in the Book of Drawings.

14.3 Universal Accessibility

14.3.1 Phase 1

During Phase 1, a 3m sidewalk on both side of the road will be shared by pedestrians and cyclists. Pedestrians and cyclists will share a 2.050m wide NMT sidewalk across the R300 bridge deck on both sides of the bridge.

As the cross-section across the Kuils River will be the full dual carriageway cross-section, the ultimate 2.4m cycle lane along both sides of the road, will continue across the bridge deck over the Kuils River.

All intersections will have dropped kerbs and pedestrian push-buttons are provided all signalised crossings.

14.3.2 Future phases

A 2m walkway is proposed on the northern side and a 3m sidewalk on the southern side of the road and will be for pedestrians with a 2.4m cycle lane in each direction.

All intersections will have dropped kerbs and pedestrian push-buttons are provided all signalised crossings.

Our assessment of the pedestrian crossing warrant at the Isabel/ Erica Drive intersection in the future

(2032 traffic volumes) with a dual carriageway road, indicates that a signalised pedestrian crossing is not warranted in 2032 as only 2 points plot in the region for a signalised pedestrian crossing. Refer to Figures B-4 in Annexure B.

14.4 Impact on transport operations

The following scenarios were investigated:

- 2016 transport model with base (existing) road network with present land use (Figures D-1, Annexure D).
- 2016 transport model with base road network with the Erica Drive link across the R300 included, with present land use (Figures D-2 to D-9, Annexure D).
- 2032 traffic volumes with the entire network in place and Erica Drive dualled (Figures D-10 to D-12, Annexure D).
- 2032 traffic volumes with the entire network in place, Erica Drive dualled with the R300 half-diamond interchange (Figures D-13 to D-17, Annexure D).
- 2032 traffic volumes with the entire network in place, Erica Drive dualled with the R300 PARCLO interchange (Figures D-18 to D-19, Annexure D).

The results of the various analyses scenarios are discussed hereafter.

14.4.12016 Base Network with Present Land Use

Refer to Figure D-1 in Annexure D for the EMME model output.

The model results indicate that close to capacity or capacity conditions are being experienced on most of metropolitan roads in the Kuils River and Belhar areas.

14.4.22016 Base Network with Erica Drive link across the R300 included, with Present Land Use (Phase 1)

Impact on the overall network

Refer to Figures D-2 and D-3 in Annexure D for the EMME model output.

The model results indicate that the new Erica Drive link (single carriageway) across the R300 can be expected to attract a significant amount of traffic during the AM peak period, about 1000 vph westbound and 300 vph eastbound. This is equivalent to capacity conditions in the westbound direction; i.e. peak direction.

Figures D-7 and D-8 in Annexure D indicates that if Erica Drive and Symphony Way are dualled across the R300 up to New Nooiensfontein, then a v/c ratio of 0.7 can be expected.

Intersection Operations

Refer to the intersection configurations in Table 13-1. This is also schematically indicated in Figure C-1 in Annexure C.

Traffix analyses of the 2016 modelled traffic volumes indicate that the intersections are expected to operate at acceptable LOS. However, capacity conditions are expected at Erica/ Belhar Drive, Reuter/ Erica during the PM and Highbury/ Erica intersections.

The implementation of the Erica Road link and the upgrading to the Erica Drive / New Nooiensfontein is expected to bring about relief on the northbound approach of New Nooiensfontein Road. However, additional traffic is attracted to the southbound link. A roundabout is proposed at this intersection which will improve the LOS to A during the peak hours.

Further analyses also confirms that the proposed signalisation of Reuter/ Erica is warranted as the expected queues areas greater than 4 in the PM.

14.4.3Traffic Growth

A 3% per annum growth rate was determined based on the 2016 modelled traffic volumes (single carriageway road across the R300) and the 2032 modelled traffic volumes (dual carriageway road across the R300).

14.4.42022 with the Phase 1 upgrade of Erica Drive

A 3% per annum growth rate was applied to the 2016 modelled traffic volumes over a 6-year period. Refer to Figure C-2 in Annexure C for the Traffix results. The analyses indicate that acceptable traffic operations, but close to capacity conditions, can still be expected.

14.4.52032 traffic volumes with the entire network in place and Erica Drive dualled up to New Nooiensfontein Road

Impact on the overall network

The completion of the overall network in the immediate vicinity of the project include the following upgrades:

- Dualling of Amandel Road from Bottelary Road to Church Street
- Dualling of Langverwacht from Zevenwacht Link to Amandel Road
- Dualled link of Erica Drive across the R300 from Belhar Main Road in Highbury to Belhar Drive in Belhar.
- Saxdowns from Langverwacht Road to Stellenbosch Arterial

Figures D-10, D-11 and D-12 in Annexure D indicate that the introduction of the Erica Road link across the R300 and dualled between Erica Drive and New Nooiensfontein, continuing as a single carriageway road up to Stellenbosch Arterial, will result in an expected v/c ratio of 0.7-0.9 and the peak period between 1-2 hours.

Intersection Operations

Refer to the intersection configurations in Table 13-1. This is also schematically indicated in Figure C-4 in Annexure C. Traffix analyses indicate that the intersections are expected to operate at acceptable LOS. However capacity conditions are expected at Belhar Drive/ Erica in the PM, Reuter/ Erica in the AM and Highbury/ Erica in the PM.

14.4.62032 traffic volumes with the entire network in place, Erica Drive dualled with the R300 half-diamond interchange

Impact on the overall network

Refer to Figures D-13 to D-17 in Annexure D for the EMME model output.

The analyses indicate that the introduction of a half-diamond interchange (links to the north only) with the R300 will bring about reduction in traffic volumes along the portion of the R300 between Erica Drive and Stellenbosch Arterial, Belhar Drive south of Symphony Way, Stellenbosch Arterial east of the R300 and Reuter Street. It also attracts approximately 700 vph to the northbound off-ramp and about 750 vph to the southbound off-ramp. Additional trips are also attracted to the Erica Drive. Also notably, the introduction of half-diamond interchange does not bring about a reduction in trips on Van Riebeeck Street; only along the section between Reuter and the R300.

Intersection Operations

Refer to the intersection configurations in Table 13-1. This is also schematically indicated in Figure C-5 in Annexure C. Traffix analyses indicate that capacity conditions can be expected at Erica/ Belhar Drive, the New Nooiensfontein roundabout and the R300 southbound off-ramp. During the PM peak hour, the New Nooiensfontein roundabout is expected to operate at capacity levels with a queue of 38 veh on the eastbound approach. However, it should be noted that the PM traffic volumes is over-estimated.

Further analyses also confirms that the proposed signalisation of the R300 on – and off-ramps with Erica Drive are indeed warranted as the expected queues are greater than 4.

14.4.7 2032 traffic volumes with the entire network in place, Erica Drive dualled with the R300 PARCLO interchange

Impact on the overall network

Refer to Figures D-18 and D-19 in Annexure D for the EMME model output. The impact of a PARCLO interchange at providing southern connectivity was also assessed; however, this was assessed assuming that the southern connection at the R300/ Bottelary interchange is in place. The model results indicate that the southern connectivity attracts about 600 vph on the off-ramp and similarly on the on-ramp.

Intersection operations

Refer to the intersection configurations in Table 13-1. This is also schematically indicated in Figure C-6 in Annexure C. Traffix analyses indicate that capacity conditions can be expected all intersections with the exception of Highbury/ Erica roundabout and the R300 ramp terminal intersections. However, these capacity conditions are expected to last only 1-2 hrs which is in line with the recommendations of the CoCT Congestion Management Strategy.

14.4.8 Overall Summary of Intersection Operations

A summary of intersection operations are included in Table 14-1. The results are also presented schematically in Annexure C. Also note that in Annexure C the vehicle delays at the critical movements at the proposed roundabouts are identified and highlighted. In Table 14-1 the average intersection delays for roundabouts are listed.

The summary of results indicate that the dualling of Erica Drive across the R300 will result in significant improvements of intersections along Erica Drive. However, the proposed roundabout at New Nooiensfontein/ Erica will experience increased delays during the PM peak hours because of the high eastbound through volumes during the PM peak periods.

The introduction of interchange opportunities at the R300 ramp terminals bring about additional congestion along Erica Drive with the introduction of additional stop delays at the traffic signals at these ramp terminal intersection. This is especially problematic with the PARCLO interchange as the additional westbound right turn movements at these terminal intersections, increase the delays at these intersections.

Table 14-1: Summary of Intersection Operations

INTERSECTION	AVERAGE INTERSECTION DELAY (SEC/VEH)											
	2017 EXISTING VOLUMES WITH BASE ROAD NETWORK AND PRESENT LAND USE		ERICA PHASE 1 - ONLY LINK ACROSS R300, 2016 MODELLED TRAFFIC VOLUMES		ERICA PHASE 1 - ONLY LINK ACROSS R300, 2022 MODELLED TRAFFIC VOLUMES (3% growth rate)		ERICAL PHASE 1 - ONLY LINK ACROSS R300, 2032 MODELLED TRAFFIC VOLUMES		ERICA PHASE 2 - ERICA DUALLED WITH HALF-DIAMOND INTERCHANGE AT R300, 2032 MODELLED TRAFFIC VOLUMES		ERICA PHASE 2 - ERICA DUALLED WITH PARCLO INTERCHANGE AT R300, 2032 MODELLED TRAFFIC VOLUMES	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Erica/ Belhar Drive			LOS = B	LOS = A	LOS = B	LOS = B	LOS = C	LOS = B	LOS = C	LOS = B	LOS = C	LOS = B
			Del = 12,8	Del = 9,8	Del = 11,9	Del = 10,7	Del = 26,4	Del = 16,2	Del = 28,9	Del = 19,3	Del = 26,4	Del = 17,7
			V/C = 0,68	V/C = 0,61	V/C = 0,77	V/C = 0,96	V/C = 0,83	V/C = 0,68	V/C = 0,91	V/C = 0,76	V/C = 0,90	V/C = 0,77
Erica/ R300 on-ramp	**Future Intersection**	**Future Intersection**	**Future Intersection**	**Future Intersection**	**Future Intersection**	**Future Intersection**	**Future Intersection**	**Future Intersection**	LOS = A	LOS = B	LOS = B	LOS = F
									Del = 1,7	Del = 19,7	Del = 17,3	Del = >80
									V/C = 0,72	V/C = 0,91	V/C = 0,84	V/C = >1,0
Erica/ R300 off-ramp	**Future Intersection**	**Future Intersection**	**Future Intersection**	**Future Intersection**	**Future Intersection**	**Future Intersection**	**Future Intersection**	**Future Intersection**	LOS = C	LOS = D	LOS = C	LOS = F
									Del = 26,7	Del = 36,9	Del = 34,4	Del = >80
									V/C = 0,96	V/C = >1,0	V/C = 0,90	V/C = >1,0
Erica/ Reuter	LOS = B	LOS = A	LOS = B	LOS = B	LOS = B	LOS = C	LOS = C	LOS = B	LOS = B	LOS = C	LOS = D	LOS = C
	Del = 12,5	Del = 9,1	Del = 10,8	Del = 17,0	Del = 12,2	Del = 38,3	Del = 28,6	Del = 10,7	Del = 17,1	Del = 26,2	Del = 44,2	Del = 32,8
	V/C = 0,48	V/C = 0,23	V/C = 0,65	V/C = 0,90	V/C = 0,74	V/C = ,84	V/C = 0,94	V/C = 0,68	V/C = 0,91	V/C = 0,89	V/C = 0,95	V/C = 0,96
Erica/ New Nooiensfontein	LOS = B	LOS = A	LOS = A	LOS = A	LOS = A	LOS = A	LOS = A	LOS = A	LOS = A	LOS = D	LOS = A	LOS = D
	Del = 11,4	Del = 9,8	Del = 5,7	Del = 5,4	Del = 8,9	Del = 8,0	Del = 8,0	Del = 5,4	Del = 9.8	Del = 28.2	Del = 9.8	Del = 30.5
	V/C = 0,51	V/C = 0,55	V/C = 0,55	V/C = 0,70	V/C = 0,69	V/C = 0,81	V/C = 0,65	V/C = 0,70	V/C =	V/C =	V/C =	V/C =
Erica/ Highbury	LOS = B	LOS = B	LOS = B	LOS = A	LOS = A	LOS = A	LOS = A	LOS = A	LOS = A	LOS = A	LOS = A	LOS = A
	Del = 14,7	Del = 11,5	Del = 139	Del = 2,7	Del = 2,7	Del = 3,0	Del = 2,6	Del = 2,9	Del = 6	Del = 5	Del = 4,7	Del = 4.7
	V/C = 0,61	V/C = 0,53	V/C = 0,79	V/C = 0,45	V/C = 0,43	V/C = 0,50	V/C = 0,39	V/C = 0,48	V/C =	V/C =	V/C = 0,67	V/C =
Figure No in Annexure C:	**C-1**		**C-2**		**C-3**		**C-4**		**C-5**		**C-6**	

15 GEOMETRIC DESIGN

The following elements form part of the geometric design and are discussed in more detail where applicable:

- New dual carriageway section of Erica Drive between Behar Drive and Reuter Street including the R300 Bridge.
- New westbound carriageway between Reuter Street and Highbury Road including a new Kuils River bridge.
- Interchange on the R300 Freeway

The geometric design drawings are contained in the Book of Drawings that form part of the Preliminary Design Report.

15.1 Design Speed

The design speed for Erica Drive is 80 km/h and will have a posted speed limit of 60 km/h.

15.2 Horizontal Alignment

The new Erica Drive extends from the existing Reuter Street in the east and Belhar Drive in the west. With both these intersection fixed, the horizontal alignment is very much pre-determined.

The existing road between Reuter Street and New Nooiensfontein Road and the road section between New Nooiensfontein Road and Highbury Road will become the eastbound carriageway. The position of the new westbound carriageway between Reuter Street and Highbury Road is therefore fixed as it is off-set from the existing road alignment.

This horizontal alignment will extend across the R300 and connect with the existing Belhar Drive / Erica Drive intersection with the existing Reuter Street / Erica Drive intersection.

The horizontal alignment of the future dual carriageway will be impacted at the New Nooiensfontein Intersection. Currently no sight distance concerns are experienced by drivers travelling along New Nooiensfontein Road in a northern direction towards the Erica Drive intersection. When the second carriageway (westbound) is constructed and becomes operational, drivers can expect sub-standard shoulder sight distance to the east (inside of a 450m horizontal curve) as the northbound stop line is re-positioned further south. In terms of the recommendations in the UTG5, shoulder sight distances of 250m – 300m is required along a road with a design speed of 80km/hr. With the introduction of the westbound carriageway the available shoulder sight distance is reduced to 175m.

Converting the existing signalised intersection of New Nooiensfontein Road and Erica Drive to a roundabout, reduces the required sight distance (sight distance to conflicting vehicles) to between 50m and 70m due to reduced speeds through the circle.

15.3 Vertical Alignment

The vertical alignment is fixed at the current Belhar Drive Intersection in the west. The road section from Reuter Street to Highbury road is also fixed because the eastbound carriageway already exists (i.e. the existing road).

The vertical alignment is impacted by various factors which are discussed hereafter.

15.3.1 ESKOM Overhead services

From the topographical survey information it seems though the ESKOM overhead services considered the alignment of a future road crossing over the R300. The ESKOM overhead services cross the new Erica Road twice (at km 1.170 and km 1.450). The Eskom overhead services cross the southbound off-ramp at km 0.330 and the northbound on-ramp at km 0.055 and km 0.330. The minimum vertical clearance of 7.5m required by ESKOM has been achieved, except at the northbound on-ramp crossing at km 0.055. An additional pylon might be required to increase the vertical clearance. A final interchange design submitted to ESKOM will provide clarity on vertical clearances prior to construction.

The positions of the ESKOM pylons also impact the design. ESKOM requires a clear space of 10m around the pylons. The current design allows for a minimum clear distance of 7m between the pylon and the edge of road. The design submitted to ESKOM will also provide clarity on the clear space prior to construction.

Depending on the feedback received from ESKOM the additional pylon referred to might be included in either Phase 1 or Phase 2 of the project. Currently, the inclusion of the additional pylon has been included in the infrastructure cost estimate for Phase 2 contained in Section 15.9.

15.3.2 Erica Drive crossing of the R300

The options of crossing the R300 below or above grade were investigated. From a vertical alignment point of view both options were possible. However, existing attenuation ponds and wetland areas on the western side of the R300 indicated that groundwater could be expected. The management of groundwater with an underpass design would have become problematic. Accordingly, the above grade crossing of the R300 became the preferred option.

15.4 Road crossfall

The existing road has various "flat" sections with longitudinal gradients of 0.5% or less. The section between the Kuils River Bridge and Nooiensfontein Road has a longitudinal gradient of 0,2%. The existing longitudinal gradient between the New Nooiensfontein roundabout and Highbury Street is 0,5%. The new road section between Belhar Drive/ Erica intersection and St Vincent Drive/ Erica intersection is 0,4%.

Where possible, a 3% crossfall is proposed along the flat sections, else a 2% cross fall is maintained.

15.5 Sight Distances

The critical sight distances which were taken into consideration in the design are Stopping Sight Distance, Decision Sight Distance and Shoulder Sight Distance.

Stopping Sight Distance

Stopping Site Distance for an 80 km/h design speed is 115m. Crests are the critical areas along the vertical alignment. All vertical curves have a minimum K value of 33 for 80 km/h design speeds and the stopping sight distance requirement of 115m has been met.

Decision Sight Distance

Decision Sight Distance (DSD) for an 80 km/h design speed is between 235m and 315m. DSD for 60km/h is between 170m and 235m. The critical area is at the interchange where intersections are signalized with turning lanes. DSD to traffic signals of 235m can be achieved.

Sight Distance to Conflicting Vehicles at roundabouts

Sight Distance to Conflicting Vehicles at roundabouts is 54.2m for a 30 km/h design speed and 72.3m for 40 km/h design speeds. The New Nooiensfontein Roundabout design speed is 30 km/h and the available sight distance is in excess of 54.2m. Accordingly, sufficient sight distance is available.

Shoulder Sight Distance

Shoulder sight distance for a single unit and trailer for an 80 km/h design speed is 300m. Sufficient shoulder sight distance is available at all intersections, excluding the R300 interchange terminals.

Shoulder sight distance at the interchange terminals are influenced by the vertical curve across the R300. Shoulder Sight Distances between 170m and 200m is available which is sufficient for passenger vehicles at 60 km/h (posted speed). However shoulder sight distance of 225m is needed for a single unit and trailer at 60 km/h. In this case Stopping Site Distance on Erica Drive of 115m for 80 km/h is sufficient to bring a vehicle to a stop in an effort to avoid a collision with a possible turning vehicle.

15.6 Summary of geometric design parameters

A summary of the geometric design parameters are provided in *Table 15-1* and *Table 15-2*.

Table 15-1: Summary of the horizontal geometric design parameters

HORIZONTAL ALIGNMENT						
ERICA DRIVE (DESIGN SPEED - 80 KM/H)						
HORIZONTAL CURVE	CHAINAGE		RADIUS		CROSS FALL	NOTES
	BCC	ECC	Design Radius (m)	Min Radius - m (UTG 1)		
CURVE NO 1	1077.506	1295.537	600	425 (-2%)	-2%	Normal cross fall
CURVE NO 2	2637.935	2866.666	3000	425 (-2%)	-3%	Normal cross fall. Because of the flat longitudinal grade (0,24%) the cross fall is
CURVE NO 3	3014.448	3411.217	450 (existing radius between New Nooiensfontein Dr and Highbury Rd	425 (-2%)	3%	The existing eastbound carrigeway has a super elevation of 2,5%. Because of the flat longitudinal grade (0,54%) the cross fall for the new westbound carriageway is increased to 3%
PARCLO INTERCHANGE						
RAMP A & D (DESIGN SPEED - 80 KM/H)						
HORIZONTAL CURVE	CHAINAGE		RADIUS		CROSS FALL	NOTES
	BCC	ECC	Design Radius (m)	Min Radius - m (G2 - SANRAL)		
CURVE NO 1 - RAMP A	585.000	698.000	250	250 (6%)	6%	Superelevation
CURVE NO 2 - RAMP A	770.000	912.000	250	250 (6%)	6%	Superelevation
CURVE NO 1 - RAMP D	97.000	226.000	210	250 (6%)	6%	Superelevation. In an effort to negotiate the ESKOM pylons it was required to use a smaller radius. The vehicle speeds in the area should be in the order of 70 km/h and therefore the smaller radius is suggested.
CURVE NO 2 - RAMP D	770.000	912.000	250	250 (6%)	6%	Superelevation
RAMP E & H (DESIGN SPEED - 40 KM/H)						
HORIZONTAL CURVE	CHAINAGE		RADIUS		CROSS FALL	NOTES
	BCC	ECC	Design Radius (m)	Min Radius - m (G2 - SANRAL)		
CURVE NO 1 - RAMP E	111.000	255.000	46	50 (6%)	6%	Superelevation.
CURVE NO 1 - RAMP H	138.000	306.000	46	50 (6%)	6%	Superelevation.

Table 15-2: Summary of the vertical geometric design parameters

VERTICAL ALIGNMENT					
ERICA DRIVE (DESIGN SPEED - 80 KM/H)					
VERTICAL CURVE	CHAINAGE		Vertical Curve Length (m)	K Value	NOTES
	BVC	EVC			
CURVE NO 1	885.690	985.690	100.00	85 (Crest)	
CURVE NO 2	1115.796	1229.616	113.82	16 (Sag)	The K Value is sufficient for comfort . The min headlight K Value is 31. With street lighting on Erica Drive the K Value of 16 is in order
CURVE NO 3	1244.230	1574.770	330.54	33 (Crest)	
CURVE NO 4	1751.188	1865.493	113.61	31 (Sag)	
CURVE NO 5	2270.000	2370.000	100.00	416 (Sag)	
CURVE NO 6	2790.000	2810.000	20.00	19 (Sag)	Low Point and therfore the short vertical curve
CURVE NO 7	2962.390	2997.610	35.00	31 (Sag)	
CURVE NO 8	2962.390	2997.610	35.00	31 (Sag)	
CURVE NO 9	3070.000	3170.000	100.00	70 (Crest)	
PARCLO INTERCHANGE					
RAMP A & D (DESIGN SPEED - 80 KM/H)					
VERTICAL CURVE	CHAINAGE		Vertical Curve Length (m)	K Value	NOTES
	BVC	EVC			
CURVE NO 1 - RAMP A	535.000	635.000	100.00	84.3 (Sag)	
CURVE NO 2 - RAMP A	897.000	947.000	50.00	75.1 (Sag)	
CURVE NO 1 - RAMP D	75.000	125.000	50.00	80.8 (Crest)	
CURVE NO 2 - RAMP D	336.000	436.000	100.00	106.8 (Sag)	
RAMP E & H (DESIGN SPEED - 40 KM/H)					
VERTICAL CURVE	CHAINAGE		Vertical Curve Length (m)	K Value	NOTES
	BVC	EVC			
CURVE NO 1 - RAMP E	86.000	136.000	50.00	63.4 (Crest)	
CURVE NO 2 - RAMP E	235.000	335.000	100.00	34.7 (Sag)	
CURVE NO 1 - RAMP H	113.000	163.000	50.00	78.2 (Sag)	
CURVE NO 2 - RAMP H	164.000	196.000	31.72	17.6 (Sag)	
CURVE NO 3 - RAMP H	304.000	354.000	50.00	26.1 (Crest)	

15.7 Road Signs, Road Markings and Traffic Signals

15.7.1 Road signs and Markings

Only indicative road signs and markings are shown as part of the preliminary designs and are compliant with the South African Road Traffic Signs Manual. A more detailed roads signs and markings design will be undertaken as part of the detail design process.

Conceptual proposals for the directional signage are also indicated on the road layouts.

15.7.2 Traffic Signals

The Traffic Signal Designs will be undertaken as part of the detailed design process.

15.8 Stormwater Drainage

15.8.1 Stormwater Management

The Stormwater Management Report for the Erica Drive area between Belhar Drive in the west and Saxdowns Road in the east was prepared by Ingerop (Pty) Ltd and is included in Annexure E.

In the Stormwater Management Report a new stormwater system is proposed to accommodate the 1:50 year flood frequency with attenuation west of the R300 within the interchange area and attenuation west of Kuils River.

The area west of the R300 consists of the existing landfill site which drains towards 3 attenuation dams and discharges into an existing stormwater pipe. A new stormwater pipe in the median of Erica Drive is proposed and will drain the undeveloped property south west of the Belhar Drive / Erica Drive intersection, the Eskom servitude and the Erica Drive Road reserve. This new pipe will discharge into a new proposed attenuation dam within the interchange area.

The area between the R300 and Kuils River consists of neighbouring property north of Erica Drive between the R300 and Reuter Street, neighbouring residential property on the southern side of Erica Drive and the Erica Drive road reserve. A new stormwater pipe in the median will collect stormwater from the attenuation dam on the western side of the R300 (a new 750mm pipe will be jacked underneath the R300) and discharge at the proposed attenuation dam on the eastern side of Eland Street. The attenuation dam will in turn discharge into Kuils River. The pipe will discharge directly through the concrete section of the river.

The area on the eastern side of Kuils River consists of neighbouring residential areas, the college at the New Nooiensfontein/ Belhar Main (extension of Erica Drive) and the road reserve. A new stormwater pipe in the median will connect to the new stormwater system (done by APEC Consulting

Engineers) at the Highbury Road Intersection, connect with various existing pipe systems and drain the road reserve. The pipe will discharge at Kuils River through the existing concrete section.

15.8.2 Road Drainage

The road drainage design accommodates the 1:20 year flood frequency. The low points in the road make provision for the 1:50 year flood frequency.

Using the Rational Method peak flows for the 20 year and 50 year flood frequency were determined:

- 1:20 - 4l/s/10m (halve the road reserve width)
- 1:50 - 5l/s/10m (halve the road reserve width)

Based on the peak flows and road capacities, kerb inlet spacing was determined and is summarized in Table 15-3 below.

Table 15-3: Drainage Design Parameters

Longitudinal Grade (%)	Cross Fall (%)	Kerb Inlet Spacing (m)	Flow Rate (l/s)	Flow Depth (mm)	Flow Width (m)	Velocity (m/s)	Notes
0.2	3	80	32.04	100	2.467	0.34	New westbound carriageway between the Kuils River Bridge and Nooiensfontein Road
0.43	3	70	28.04	86	2	0.44	
0.6	2	70	27.95	76	2.05	0.47	
0.45	2.5	20	8.08	58	0.92	0.36	New Nooiensfontein - Highbury, super elevation on existing road, KI's along median island
1	2.5	30	12.05	58	0.92	0.53	New Nooiensfontein - Highbury, super elevation on existing road, KI's along median island
1.5	2.5	30	12.19	55	0.8	0.63	New Nooiensfontein - Highbury, super elevation on existing road, KI's along median island
0.86	2	60	24.58	70	1.75	0.53	
1.4	2	60	24	60	1.5	0.64	
4.1	2	40	19.97	54	0.95	1.00	
4.5	2	40	1.03	51	0.8	1.03	
4.86	2	40	20.25	53	0.9	1.08	

Erica Drive, between Belhar Drive and the R300 in the west, is mainly in cut. 500mm wide concrete side drains have been included behind the 2m walkways to assist with drainage of the batters.

15.9 Cost Estimate for Roads and Stormwater Infrastructure

A high-level cost estimate of the Roads and Stormwater Infrastructure for the various phases is provided in Table 15-4 - Table 15-7.

Table 15-4: High-level cost estimate of the Roads and Stormwater Infrastructure for Phase 1

Erica Drive Roads Cost Estimate (Phase 1)							
Item	**Description**	**Quantity**	**Rate / m³**	**Rate / m²**	**Rate / m**	**Rate**	**Amount**
1	New Road Construction including walkways and stormwater	40700		R1 000.00			R40 700 000.00
2	Widening of Existing Roads	6790		R1 150.00			R7 808 500.00
3	Kerb line alterations at the Behar Drive Intersection	400			R350.00		R140 000.00
4	Fill for R300 Bridge approaches	106000	R120.00				R12 720 000.00
5	Concrete Side Drains	135	R1 300.00				R175 500.00
6	Sub Soil Drains	1600			R170.00		R272 000.00
7	500mm Pioneer Layer incl Cut	5000	R600.00				R3 000 000.00
8	Traffic Accommodation during Construction						R2 200 000.00
9	Location and Protection / Relocation of Existing Services						R5 600 000.00
10	Relocation of Existing concrete palisade fence	200			R500.00		R220 000.00
11	Stormwater Pipe Jacking (R300)						R750 000.00
12	Attenuation Dams	6400	R350.00				R2 240 000.00
13	Guardrails	1160	R500.00				R580 000.00
14	Rehabilitation of the existing road	14000			R250.00		R3 500 000.00
15	Reconstruction of Existing Service Road for Landfill site	200	R500.00				R100 000.00
16	Signalizing of intersection	2				R550 000.00	R1 100 000.00
	TOTAL (excl Vat)						**R81 106 000.00**

<u>*Note:*</u>

The cost estimate excludes Contingencies, Preliminary and General Expenses, VAT and Professional Fees.

Table 15-5: High-level cost estimate of the Roads and Stormwater Infrastructure for Phase 2A

Erica Drive Roads Cost Estimate (Phase 2A)							
ITEM	**DESCRIPTION**	**Quantity**	**Rate / m³**	**Rate / m²**	**Rate / m**	**Rate**	**Amount**
1	New Road Construction including walkways and stormwater	17290		R950.00			R16 425 500
2	Fill for R300 Bridge approaches	70000	R120.00				R8 400 000
3	Concrete Side Drains	70	R1 300.00				R91 000
4	Sub Soil Drains	800			R170.00		R136 000
5	500mm Pioneer Layer incl Cut	4000	R600.00				R2 400 000
6	Traffic Accommodation during Construction						R2 750 000
7	Location and Protection / Relocation of Existing Services						R300 000
	TOTAL (excl Vat)						**R30 502 500.00**

Table 15-6: High-level cost estimate of the Roads and Stormwater Infrastructure for Phase 2B

Erica Drive Roads Cost Estimate (Phase 2B)							
ITEM	**DESCRIPTION**	**Quantity**	**Rate / m³**	**Rate / m²**	**Rate / m**	**Rate**	**Amount**
1	Half Diamond Interchange Ramps	9800		R2 500.00			R24 500 000
2	R300 Traffic Accommodation						R1 000 000
3	Guardrails	480	R500.00				R240 000
4	Alterations to the ESKOM Overhead Services (additional Pylon)						R2 500 000
5	Relocation of the Existing Veriable Message Signs on the R300	2				R250 000.00	R500 000
6	New Overhead Directional Signage on the R300						R2 000 000
7	Relocation of Existing concrete palisade fence	1000			R400.00		R400 000
8	Reconstruction of Existing Service Road for Landfill site	540	R500.00				R270 000
9	Signalizing of intersection	2				R550 000.00	R1 100 000
	TOTAL (excl Vat)						**R32 510 000**

Table 15-7: High-level cost estimate of the Roads and Stormwater Infrastructure for Phase 3

Erica Drive Roads Cost Estimate (Phase 3)							
ITEM	**DESCRIPTION**	**Quantity**	**Rate / m³**	**Rate / m²**	**Rate / m**	**Rate**	**Amount**
1	New Road Construction including stormwater - Loop Ramps	4800		R2 500.00			R12 000 000
2	New Road Construction including stormwater - CD Roads	68000		R1 750.00			R119 000 000
3	Alterations to the Existing Erica Road Northbound Ramps	2900		R1 750.00			R5 075 000
4	CD Road Bridges over Stellenbosch Arterial	756		R28 000.00			R21 168 000
5	Alterations to Stellenbosch Arterial Ramps	3200		R1 750.00			R5 600 000
6	Alterations and Additions to the Overhead Directional Signage on the R300						R5 000 000
7	Traffic Accommodation during Construction						R3 000 000
6	Location and Protection / Relocation of Existing Services						R2 000 000
	TOTAL (excl Vat)						**R172 843 000**

16 PAVEMENT DESIGN

16.1 Design Traffic

The design traffic volumes were based on the EMME model for 2016. From this model the section of the new Erica Drive with the highest link volume during the AM peak hour was used. These link volumes equates to 3494 vehicles per hour. From these traffic volumes the Average Annual Daily Traffic (AADT) was calculated using the assumption that the peak hour traffic is 10% of the AADT, which results in 22070 vehicles. The percentage heavy vehicles and buses used in the calculations were surveyed as 1.2% and 0.8% respectively, which totals to 2% heavy vehicles. The Average Annual Daily E80's (AADE) were subsequently calculated as 441 vehicles. Given that the new section of Erica Drive is planned to be operational by 2022 and a design period of 20 years are accepted, the AADE calculated over the design period equate to 1090 vehicles in 2042.

16.2 Design Parameters

The Draft TRH4: 1996 manual was used as guideline and by means of a sensitivity analysis, the preliminary pavement design were performed. Based on the City of Cape Town Road Network Classification, Erica Drive is a class 3 Minor Arterial and it was therefore decided to classify Erica Drive as a Category B road as described in TRH4, Table 1. Although the

The following parameters were used in the sensitivity analysis:

- As stated in the previous section, the percentage heavy vehicles were surveyed as 2%.
- The annual growth in AADE were taken as 3.55% which is similar to the annual traffic growth volumes calculated for Erica Drive.
- The assumption is made that the directional split on heavy vehicles (Highest % per direction) is 50%.
- Generally, for a two lane per direction road, heavy vehicles drive in the most outer left lane therefore the Lane Distribution were taken as 70% (highest % in lane).

16.3 Design Proposal

From the sensitivity analysis the total E80's over the design period equates to approximately 2.76 Million E80's over the 20 year design period. This number of E80's places the road in an **ES3 category**. Refer to Figure 16-1.

Furthermore, from discussions with City officials at the Pavement Materials and Rehabilitation department and at the Roads District Office it was concluded that a Bitumen Treated Base (BTB) of at least 80mm thick is required. The preliminary pavement design was amended accordingly.

SENSITIVITY ANALYSIS - BASELINE TRAFFIC ex ITS Traffic Volumes

FOR PRELIMINARY DESIGN REPORT FOR ERIKA ROAD

INPUT DATA		
Average Annual Daily E80's (AADE)	2016	442
Average Annual Daily E80's in opening year	2022	545
AADE growth rate up to year of opening		3.55%
Percentage Heavy Vehicles (%)		2.00%
Direction Split on Heavy Vehicles (Highest % direction)		50
Lane Distribution (Highest % in lane)		70

DESIGN TRAFFIC ANALYSIS			Growth in Heavy vehicles (%) Low	Probable	High
			0.5	1	1.5
Growth in E80's per Heavy Vehicle	Low (%)	0.5	1.0	1.5	2.0
	Probable(%)	1.0	1.5	2.0	2.5
	High (%)	1.5	2.0	2.5	3.0
Design Period	20	years	Total E80s over design period (Million E80s)		
Total E80's	Low (%)	0.5	2.48	2.62	2.76
	Probable(%)	1.0	2.62	2.76	2.92
	High (%)	1.5	2.76	2.92	3.09

EQUIVALENT 80kN AXLE ANALYSIS		E80 Factors	Total E80's
Number of Heavy Vehicles per Lane	191		
Percentage of vehicles with 2-axles	40	0.70	53
Percentage of vehicles with 3 & 4-axles	40	1.80	138
Percentage of vehicles with ≥ 5 axles	20	3.00	115
Average E80s per vehicle			1.60

Data Entered

Key to Traffic Category:

- ES0,1 = < 100 000
- ES0,3 = 100 000 to < 300 000
- ES1 = 300 000 to < 1 000 000
- ES3 = 1 000 000 to < 3 000 000
- ES10 = 3 000 000 to < 10 000 000

Figure 16-1: Sensitivity Analysis Results for Pavement Design

Since a section of the new road will run along existing wetlands which result in the road bed not to be compacted, a 500mm thick pioneer layer, contained in a bidum or similar pocket will be used as a drainable roadbed.

16.3.1 Overall pavement structure

From the analysis and discussions the following preliminary pavement design is therefore proposed:

- 40mm Continuous Graded Asphalt compacted to a minimum of 93% Rice Density
- 80mm Continuously Graded BTB compacted to a minimum of 93% Rice Density
- 200mm C3 compacted to 98% MOD AASHTO using imported crushed G4 quality material from commercial sources.
- 150mm G4 compacted to 98% MOD AASHTO using imported crushed material from commercial sources – Upper Selected Subgrade
- 150mm G7 hardening layer compacted to 95% (100% if sand) MOD AASHTO – Lower Selected Subgrade

- 150mm In-situ Roadbed compacted to 93% MOD AASHTO

16.3.2 R300 on and off-ramps

The following pavement design is proposed for the SANRAL sections of the on/off-ramp:

- 40mm Continuous Graded Asphalt compacted to a minimum of 93% Rice Density
- 120mm Continuously Graded BTB compacted in 2 layers of 60mm to a minimum of 93% Rice Density
- 150mm C3 compacted to 98% MOD AASHTO using imported crushed G4 quality material from commercial sources.
- 150mm C4 compacted to 96% MOD AASHTO using imported crushed G6 quality material from commercial sources.
- 150mm G5 compacted to 95% MOD AASHTO using imported crushed material from commercial sources – Upper Selected Subgrade
- 150mm G7 hardening layer compacted to 95% (100% if sand) MOD AASHTO – Lower Selected Subgrade
- 150mm G7 fill compacted to 93% (100% if sand) MOD AASHTO – Lower Selected Subgrade
- 150mm In-situ Roadbed compacted to 90% MOD AASHTO

16.3.3 Sidewalks

The following pavement design is proposed for the sidewalks

- 30mm Fine Graded Asphalt compacted to a minimum of 94% Rice Density
- 100mm G5 compacted to 96% MOD AASHTO using imported crushed material from commercial sources
- 100mm G7 hardening layer compacted to 95% (100% if sand) MOD AASHTO

16.3.4 Areas adjacent to wetland

In areas where the road is located adjacent to the wetland it is proposed that the in-situ roadbed compaction to 90% MOD AASHTO, is replaced with a 500mm pioneer layer encased in 8A bidum or similar.

16.3.5 Mole Barriers

The pavement design recommends stabilized layers that counteracts the impact of moles, but mole barriers should be installed at selected problematic areas.

17 DESIGN OF KUILS RIVER BRIDGE

The proposed new Kuils River Bridge is to be located on the downstream southern side of the existing Kuils River Bridge which will carry the new westbound traffic of the divided dual carriageway. The new separate westbound carriageway of the proposed dual carriageway road will comprise of a 2.0m sidewalk on the southern edge, 2.4m cycle lane, 2 x 3.4 m traffic lanes and a 0.5m outer shoulder adjacent to a New Jersey concrete parapet.

17.1 Hydraulics

The hydrology and hydraulics applicable to the new bridge will be based on the flood values which was used for the assessment of the existing bridge. From the as-built plans of the existing Kuils River Bridge previous hydraulic calculations indicated a catchment area of 150km^2 and a 1:50 year design flood of 250m^3/s before canalization. A summary of the hydraulics after canalization are provided in Table 17-1.

Table 17-1: Hydraulic Assessment of Proposed Kuils River Bridge

Description	Unit	Value
Effective catchment area	Km2	150
1:50 year peak discharge	m3/s	250
Slope of riverbed at bridge		1:1400
Maximum Flood Level in existing river (Banks overtopped)	m	4 150
Backing up as result of bridge after canalization	mm	150
Calculated Maximum Flood Level with bridge after canalization	m	3 965
Maximum observed flood level :	m	unknown
Calculated flow velocity in natural channel	m/s	26
Calculated flow velocity under bridge after canalization	m/s	375
Required freeboard for design flood	m	1 008
Minimum deck soffit level: Actual Designed	m m	40.947 41.430
Minimum road shoulder level: Actual Designed	m m	40.950 42.350

17.2 Foundation Investigations

The geotechnical information on the as-built plans of the existing Kuils River Bridge indicated loose to dense fine sand underlain by stiff silty clay and very soft rock shale. Refer to Section 9.1.4 for a summary of the founding conditions.

17.3 Design Loading

The design notes on the as-built plans of the existing bridge shows that the bridge was designed for NA and NB36 traffic loading. The proposed new westbound carriageway bridge will be designed for the full NA and NN36 and NC traffic loading in accordance with TMH7:1985, Parts1 and 2 (as amended in 1988) and TMH7: 1989.

17.4 Description of Structural Solution for the new Kuils River Bridge B5941

The proposed new bridge structure is shown on the Preliminary Site Plan (drawing C013R5101 in the Book of Drawings) and Preliminary General Arrangement (drawings C013R5111 and C013R5112 in the Book of Drawings).

17.4.1Superstructure

The superstructure consists of a 3-span continuous cast in-situ, voided deck slab with cantilevers. The deck has a main span of 17,1m and two approach spans of 14,78m and a structural depth of 0,85m. The overall deck width is 12,875m and a skew angle of 82.6 degrees. The deck will be supported on elastomeric rubber bearings at both abutments and piers.

Armored nosing type single element expansion joints will be provided at both abutment deck ends. In-situ cast standard concrete parapets (New Jersey type on the road side and vertical type on the sidewalk side) will be used to match the existing bridge.

The proposed deck will be constructed on temporary staging, including a pre-camber to minimize long term deflection.

17.4.2Substructure

The piers are of the solid concrete wall type of similar width and matching shape of cutwaters to the existing bridge all supported on piles.

The abutments are the closed cantilever type with return walls and supported on spread footings in combination with piles.

The proposed piling system consists of 600mm diameter Auger piles, socketed at least 2,5m into soft rock.

17.4.3 Traffic Accommodation

The construction of a new westbound carriageway on the south side of the existing 2-way road does not pose any serious challenge for accommodating road user traffic as the proposed new Kuils River Bridge can be constructed without impacting on the traffic flow on the existing Kuils River Bridge.

17.5 Construction Materials

The environmental classes of exposure at the existing and proposed Kuils River bridges relates to a carbonation exposure for the various elements of the structure. In order to increase the durability of the structures, the recommended cover will be determined from Table 6000/1: Concrete Durability Specification Targets (Civil Engineering Structures only).

17.5.1 Aggregates

Concrete aggregates must comply with the SANS 1083:2014 specifications and shall be sourced from approved specification compliant commercial sources. Concrete may be obtained from commercial batch plants or mixed on site as may be approved.

17.5.2 Cement

Only cements complying with the latest SABS ENV 197-1 Codes for Cement shall be used. Concrete placed in a moderate condition of exposure at a temperature <30oC shall be preferably a CEM I or CEM II W, with a strength class of 42,5 and a requisite set and hydration retarding admixture used so as not to induce unnecessary bleeding. All durability requirements shall be met and adhered to as may be required in the specifications. Durability Concrete ‘W’ class is specified for all structural concrete.

17.5.3 Reinforcement

Steel reinforcement compliant with SANS 920: 2011 shall be used and each batch shall be accompanied to site with a certificate from a recognized laboratory.

17.6 Cost Estimate

The total cost estimate for the construction of the proposed new Kuils River Bridge B5941B, as well as the estimate of the recommended rehabilitation/repair works to the existing Kuils River Bridge B5941 bridges, have been summarized in Table 17-2 and Table 17-3, respectively. The rates used for the detailed estimates were based on new and rehabilitated bridges that were completed recently.

Table 17-2: Cost Estimate for Rehabilitation/repairs to Existing Kuils River Bridge B5941A

Existing Kuils River Bridge (B5941A) Rehabilitation – Cost Estimate		
SECTION	**DESCRIPTION**	**AMOUNT**
5100	Pitching, Stonework and protection against erosion	R27 500,00
5200	Gabions	R76 600,00
6300	Steel Reinforcement for Structures	R9 750,00
6600	No-fines Concrete, Joints, Bearings, Bolt groups for Electrification, Parapets and Drainage for Structures	R4 500,00
8100	Testing Materials and Workmanship	R10 000,00
12100	Access for Bridge Rehabilitation	R25 000,00
12300	Surface and Structural Repair of Concrete Members	R28 000,00
12600	Protective Coatings and Treatments for Concrete	R111 300,00
12800	Replacement and Repair of Ancillary Bridge Elements	R13 825,00
	TOTAL (Excl Vat)	**R306 475,00**

Note:

The cost estimate excludes Contingencies, Preliminary and General Expenses, VAT and Professional Fees.

Table 17-3: Cost Estimate for Proposed New Kuils River Bridge B5941B

New Kuils River Bridge (B5941B) – Cost Estimate		
SECTION	**DESCRIPTION**	**AMOUNT**
3400	Pavement Layers of Gravel Material	R12 000,00
4100	Prime Coat	R1 625,00
4200	Asphalt Base and Surfacing	R34 375,00
5100	Pitching, Stonework and protection against erosion	R135 500,00
5200	Gabions	R386 950,00
5400	Guardrails	R91 500,00
6100	Foundations for Structures	R5 561 600,00
6200	Falsework, Formwork and Concrete Finish	R976 650,00
6300	Steel Reinforcement for Structures	R1 498 350,00
6400	Concrete for Structures	R1 876 750,00
6600	No-fines Concrete, Joints, Bearings, Bolt groups for Electrification, Parapets and Drainage for Structures	R763 700,00
8100	Testing Materials and Workmanship	R50 000,00
	TOTAL (Excl Vat)	**R11 389 000,00**

Note:

The cost estimate excludes Contingencies, Preliminary and General Expenses, VAT and Professional Fees.

18 DESIGN OF R300 BRIDGE

The new bridge will be located between Belhar and Kuils River where Erica Drive Extension crosses over R300 to Belhar Main Road. The GPS co-ordinates for the bridge location are 33 56 25.7S 18 39 36.8E. See the locality plan on figure 1 below. The bridge crosses the R300 at an angle of 1.4°.

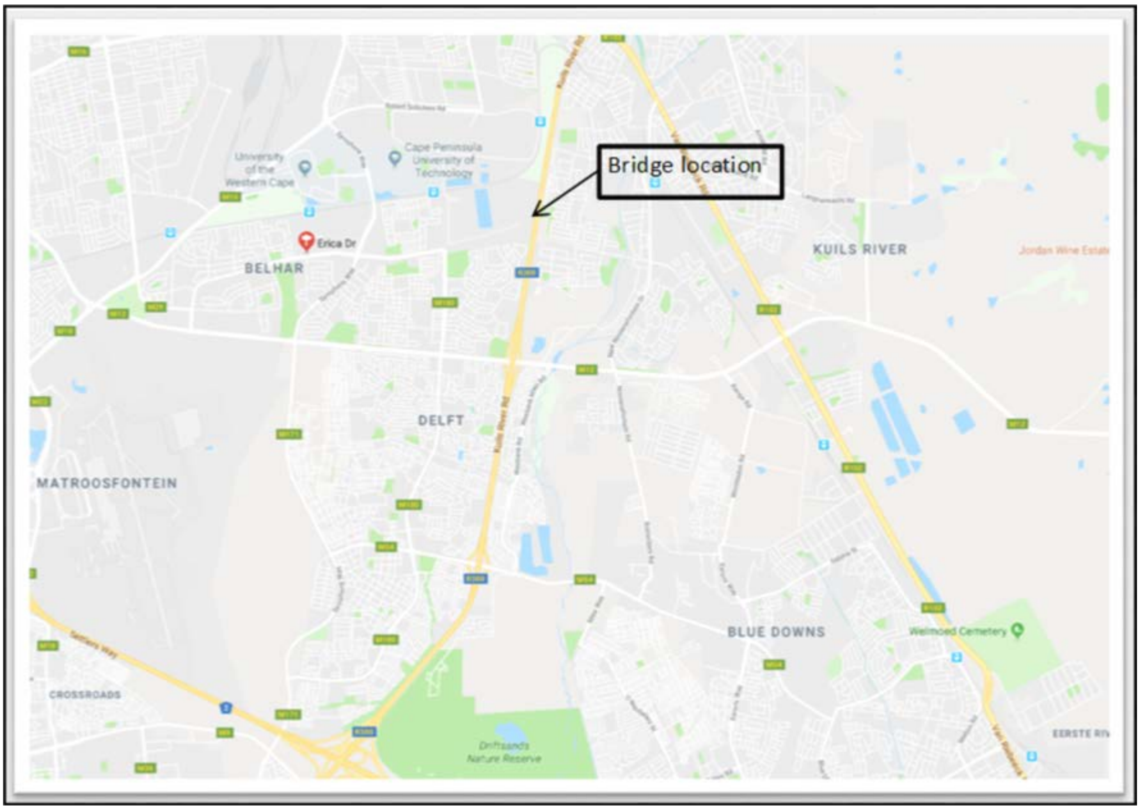


Figure 18-1: Locality of the Erica Road bridge across R300

Accommodation of the existing traffic flows on the R300 will be of critical importance during the construction of this bridge. The R300, falls under SANRAL, and experiences high volumes of traffic.

18.1 Structural Solutions

18.1.1 Applicable codes and standards

The bridge will be designed in accordance with TMH7 parts 1 and 2 1981 revised 1988 and TMH7 part 3 1989. The bridge will be designed by elastic methods and checked at the ultimate limit state. Computer software used for the analysis and design include Prokon and various design spreadsheets.

18.1.2 Possible structural solutions

Either a two span bridge or a four span bridge, i.e. a bridge with jack spans, can be provided. Refer to Figure 18-2 and Figure 18-3, respectively.

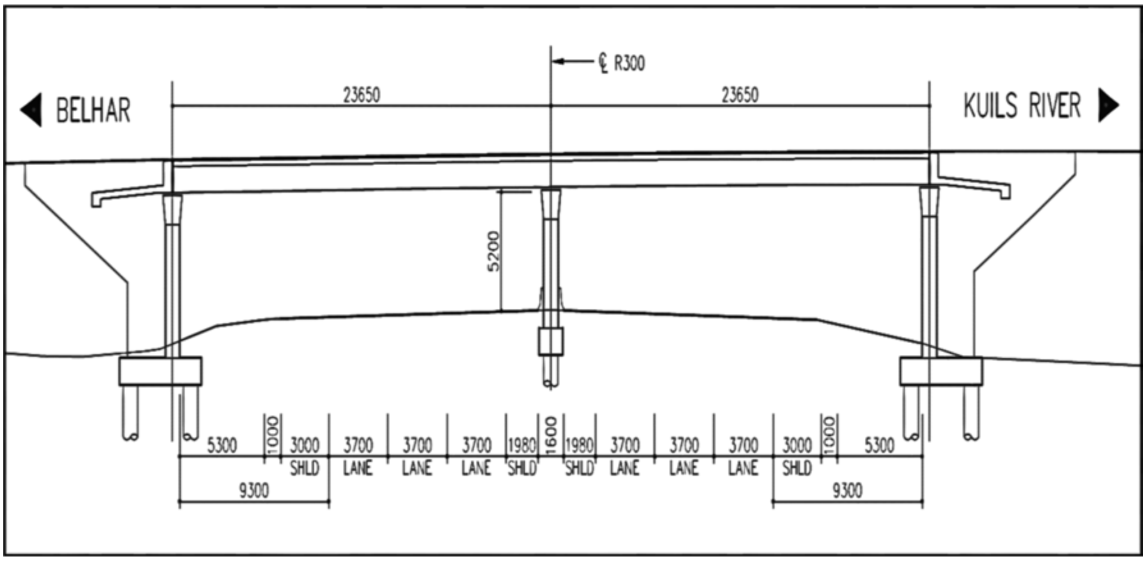


Figure 18-2: Longitudinal Section 2 Span Bridge

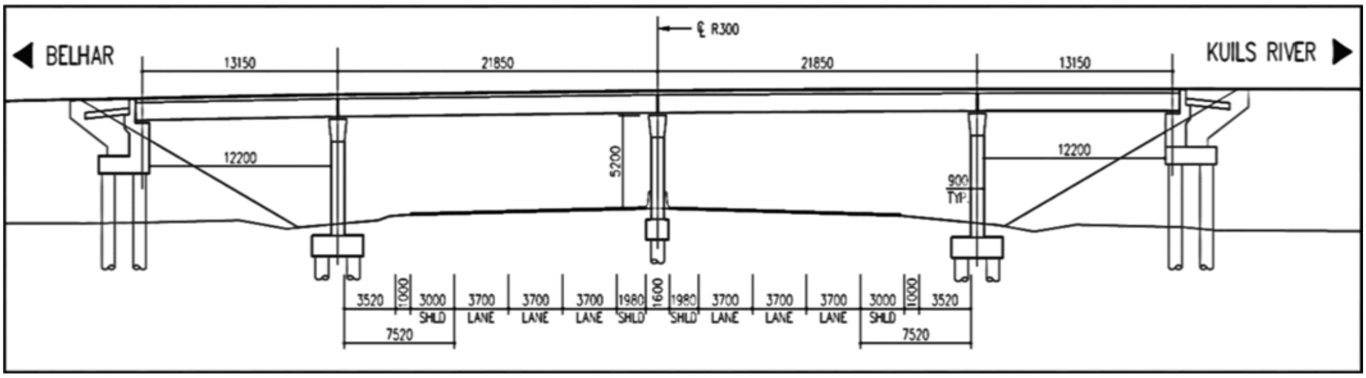


Figure 18-3: Longitudinal Section 4 Span Bridge

In accordance with the SANRAL's "Clearance diagrams for bridges" standard drawing for the two span case, the clearance to the abutments must be 9.3m, whilst for the 4 span case the clearance to the piers must be 7.5m. The two span bridge will have spans of 2 x 23.6m whilst the 4 span bridge will have spans of 13.15m + 21.85m + 21.85m + 13.15m.

Foundations

The bridge will be founded on piles.

Substructure

In the case of a two span bridge wall type abutments will be designed and in the case of a 4 span bridge perched abutments founded on piles are proposed. Pier columns will be designed that suite the deck structure.

Superstructure

The deck needs to be constructed over significant traffic which greatly affects the deck type that should be used. Precast beams probably provide the best option. Using precast beams the following needs to be considered:-

- I beams, forming a beam and slab deck, will require a minimum vertical clearance of 5.6m.
- U beams and M beams form spine beam decks or pseudo box decks and these can have a vertical clearance of 5.2m.

Parapets

F-shape parapets will be used on both sides of the bridge. Sidewalks are also to be provided on both sides. The parapets will be cast in-situ concrete using galvanized reinforcement. They will be designed to resist the 100kN design load.

18.1.3 Traffic accommodation during the construction of the bridge deck

The following is recommended to manage traffic accommodation during construction of a deck incorporating precast beams:

- The beams can be erected on a Sunday when the traffic flow is not that high.
- On the day of the beam erection a crane will be located in the R300 median.
- The fast lanes on both sides will need to be closed in order to provide space for the crane. Two of the three lanes, both ways, will however remain operational for most of the day. It will probably also be necessary to close the two inside lanes during the construction of the central pier.
- The new beams will be transported to the bridge in one of the closed inside lanes using a horse (truck) and dolly (trailer).
- During the actual lifting of the beam the operational two lanes of traffic on an affected carriageway will need to be stopped. The traffic can be opened again as soon as the beam is safely located on the support bearings. This should take no more than about 10 minutes.
- Should it be desired, a “rolling” road block could be implemented with the assistance of the metro police.

- Once the beams are in place construction of the deck can be completed with virtually no interruptions to the traffic other than short periods of lane closures when the precast planks or cantilever forms need to be put in position over a particular lane.

18.1.4Aesthetics

The shape, materials and finishes of the elements required for the bridge, i.e. the abutments, piers, deck and parapets will be such that they blend into the surrounding area. Typical and standardized members will be used. Refer also to Figure 18-4 below.

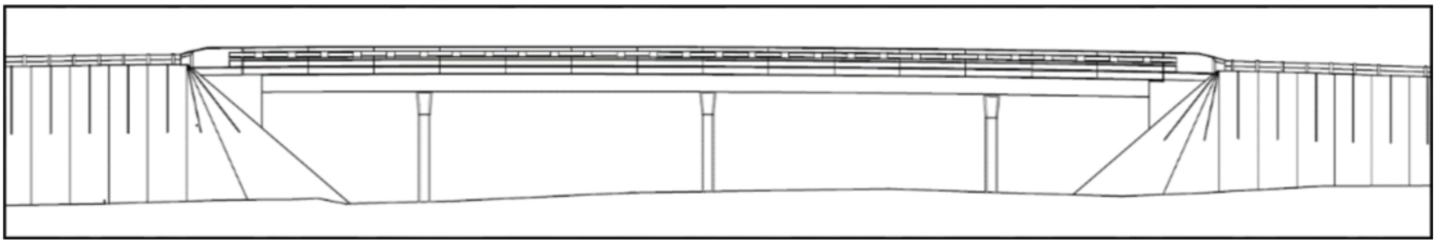


Figure 18-4: Proposed 4 span bridge in elevation

Note that it is proposed to provide a slight tapered head to the piers to give a slight "champagne glass" effect.

18.1.5Bridge Concept

Two bridge concepts need to be considered i.e. a two span bridge or a four span bridge.

- The two span bridge will have longer main spans (23.65m) than the four span bridge (21.85m) due to the difference in pier (7.5m) and abutment (9.3m) horizontal clearances.
- It is a requirement from the City of Cape Town that the most economical bridge possible be constructed now whilst simultaneously taking into consideration that allowance be made for the future planning that includes:-
    - Dualling of Erica Drive and thus the bridge (phase 2)
    - Future ramps under the bridge (possible phase 3) as part of a PARCLO with C-D option. This is not part of the City of Cape Town's future planning towards implementation, but the professional team was required to identify the land and interchange sizing requirements. Accordingly, the bridge design had to take this into consideration to ensure that the terminal intersections are located appropriately.

The advantages and disadvantages of the two options are indicated in Table 18-1.

Table 18-1: Comparison of 2-span vs 4-span bridge deck

	Disadvantage	Advantage
Two span bridge	• Large expensive abutments that must be provided • For the possibility of future phase 3 where ramps must be accommodated under the bridge the abutments must be designed to become piers sometime in the future. • Wingwalls must be designed as removable. • Erica drive will need to be closed one carriageway at a time so that the future phase 3 spans can be constructed resulting in traffic congestion etc. • Longer main span affecting the deck depth	• Shorter bridge, less deck area, less parapets etc. for the present planning
Four span bridge	• Larger bridge, greater deck area, more parapets etc. for the present planning. • Cost estimate shows that the two bridge types would cost more or less the same.	• Small economic perched abutment that must be built • Future ramps can be reasonably easily accommodated within the jack spans. • Shorter main span allowing a thinner deck.

18.1.6Deck options

Three possible deck solutions will be discussed:

- Deck option 1: A post tensioned, cast in-situ concrete deck incorporating spine beams.
- Deck option 2: A deck incorporating precast concrete pre-tensioned U beams.
- Deck option 3: A deck incorporating precast concrete pre-tensioned M beams (inverted T's).

Deck option 1: A post tensioned, cast in-situ concrete deck incorporating spine beams.

Refer to Figure 18-5 below.

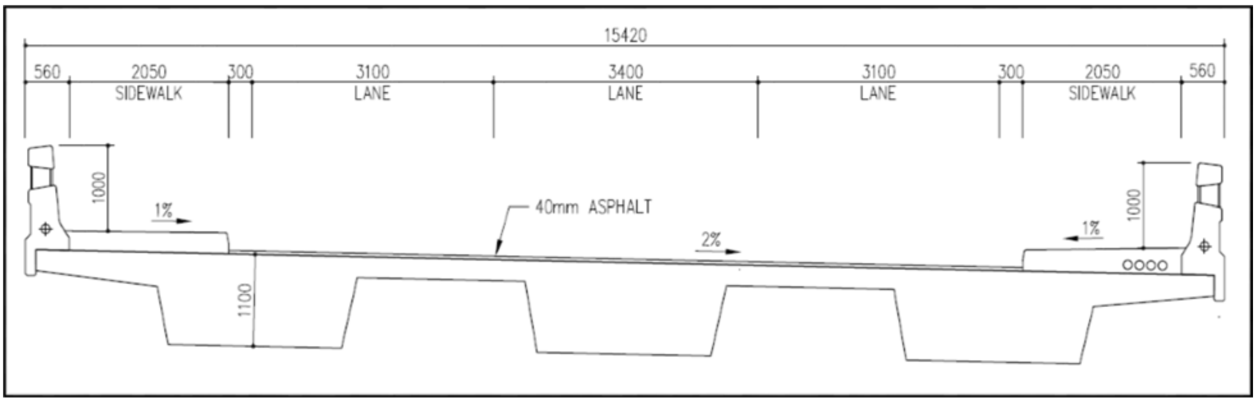


Figure 18-5: Cast in-situ concrete deck

For an in-situ deck construction, temporary steel bridging girders must be used over the R300 to enable the construction of the in-situ concrete deck. The temporary steel beams will require a minimum of 5.2m clearance. In order for this to work, considering the required clearances above and below, the deck would need to be temporarily built at a higher level and jacked down once the temporary bridge support works are removed.

The depth of an in-situ concrete deck would be about 1.1m.

This option has quite high inherent risks in that the temporary support works could be accidentally hit by a vehicle either above or on the side which could result in a catastrophe.

The higher level construction and the resulting down jacking process is also expensive.

Deck option 2: A deck incorporating precast concrete pre-tensioned U beams.

Refer to Figure 18-6 below.

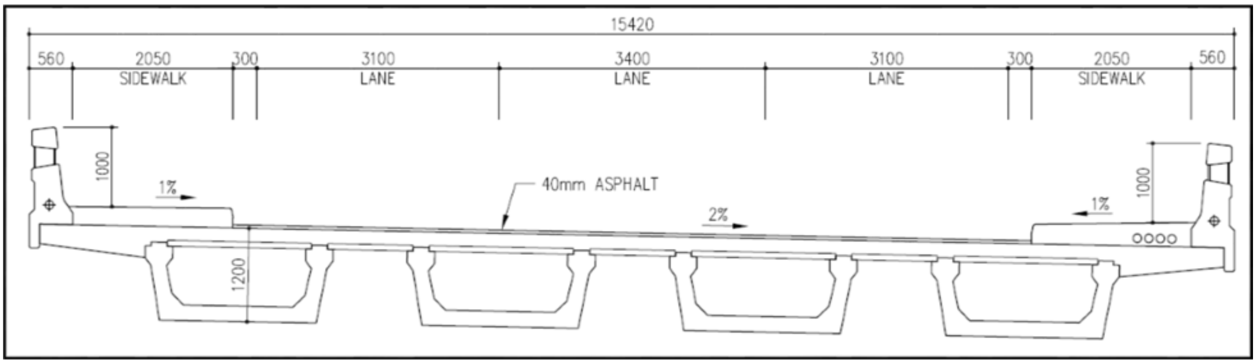


Figure 18-6: U beam deck

This type of deck was used extensively on the Gauteng Freeway Improvement Project (GFIP) in Gauteng. The U beams are non-standard and were developed in Gauteng specifically for the GFIP project. They work well and provide an aesthetically pleasing deck structure. Unfortunately the manufacturing infrastructure for these beams is in Gauteng meaning that if they are manufactured in Gauteng they would need to be transported to Cape Town which would be very expensive. The infrastructure could be set up in Cape Town but if this is done for this bridge only it would make the beams very expensive.

It should be noted that should the beams prove to be expensive, providing these over the R300 only and do the side span using in-situ cast concrete, can be considered. The shape of the U beams is such that matching this with in-situ construction would be quite easy. This principle was applied recently for a bridge over the N2 near Port Elizabeth.

Deck option 3: A deck incorporating precast concrete pre-tensioned M beams

Refer to Figure 18-7 below.

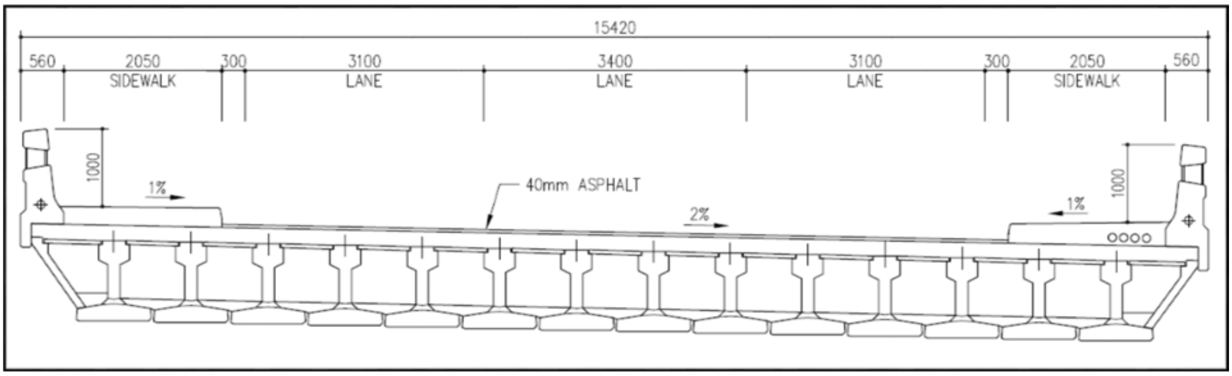


Figure 18-7: M beam deck

This type of deck was also used on the GFIP project in Gauteng, for example on the Annandale Road over N1 Bridge in Midrand and seems to work well. The infill concrete on the flange at the bottom and the deck slab over the top, together with the precast beams, form a pseudo box section which is structurally highly efficient. Precast concrete M beams are a standard beam type and there should be manufacturing facilities for this type of beam in Cape Town.

18.1.7 Continuity

All deck options will be designed as being continuous over the piers. This provides structural advantages as well as alleviates the need for numerous intermediate expansion joints.

18.2 Cost Estimate

Cost estimates for the various options have been prepared. A summary of the deck comparisons is given in Table 18-2 below. For this comparison an overall deck length of 47.3m (2 span bridge) has been assumed.

Table 18-2: Cost comparison between different deck types described in section 18.1.6

Item	Description	Amount (Rand Excl VAT)
Deck option 1	A post tensioned, cast in-situ concrete deck incorporating spine beams	**8,041,236**
Deck option 2	A deck incorporating precast concrete pre-tensioned U beams	**7,921,452**
Deck option 3	A deck incorporating precast concrete pre-tensioned M beams	**7,771,632**

The cost estimate shows that the three deck types cost more or less the same. Option 3, a deck incorporating precast concrete pre-tensioned M beams, is estimated as being slightly more economical than the other deck types. This option 3 type deck also poses the lowest safety risk, is the quickest to construct and the beams can be manufactured in Cape Town. It is therefore recommended that this deck type be implemented.

A summary of the comparison between the 2 span and 4 span bridge is given in Table 18-3 below.

Table 18-3: Cost comparison between 2 and 4 span bridge

Item	Description	Amount (Rand Excl VAT) 2 Span Bridge	Amount (Rand Excl VAT) 4 Span Bridge
1	Preliminary and general	3,506,158.00	3,689,438.00
2	Foundations for structures	3,627,060.00	3,816,660.00
3	Falsework, formwork and concrete finish	1,976,400.00	2,081,400.00
4	Steel reinforcement for structures	2,850,000.00	1,800,000.00
5	Concrete for structures	2,424,000.00	1,538,000.00
6	Precast beams	4,076,800.00	6,092,800.00
7	Exp. joints, bearings, parapets & sidewalks	763,000.00	1,210,000.00
8	Miscellaneous	604,510.00	636,110.00
9	Traffic accommodation	1,209,020.00	1,272,220.00
	Total Excluding VAT	**R21,036,948.00**	**R22,136,628.00**

Note:

The cost estimate excludes Contingencies, Preliminary and General Expenses, VAT and Professional Fees.

The cost per m^2 is given in Table 18-4 below.

Table 18-4: Cost estimate of 2 span and 4 span bridge per m2 deck plan area

Description	2 Span Bridge	4 Span Bridge
Length	47.30	70.00
Width	15.15	15.15
Area	716.60	1,060.50
Cost per m2	**R29,357**	**R20,874**

As can be seen from the above the 4 span bridge is about R1.1 million more expensive than the 2 span bridge. However, the 4 span bridge has a few advantages namely:-

- Open side span for better site distance (e.g. persons illegally crossing the road).
- Aesthetically more pleasing.
- Easier bearing inspections.
- Possibility of introducing new traffic ramps sometime in the future if necessary.

It is therefore recommended that the additional R1.1m (approx. 5%) be spent now and that the 4 span bridge is implemented.

18.3 Proposed Structural Solution

18.3.1 Bridge configuration

On the basis of the discussions and the cost estimates above it is proposed that the 4 span bridge be implemented.

18.3.2 Deck

Taking the discussions on the deck types into considerations as well as the cost estimates it is deemed best to employ the M beam deck. The deck will be a pseudo box girder deck. The precast beams will be pre-tensioned, the in-situ concrete in the deck will be normally reinforced and the deck will be made continuous over the piers.

18.3.3 Foundations

The substructure of the bridge will be founded on piles as discussed above. The pile type recommended are the large diameter (900mm dia) screwed in casing auger piles. To minimize disruption of traffic on the R300 it proposed that a single row piles be provided at the pier within the median of the R300. Structural stability of the pier will be enhanced by structurally tying in the top of the pier with the deck to obtain continuity.

18.3.4 Piers

The M beam deck design will necessitate the use of separate columns with a capping beam on top to support the M beams that will be located at 1m centres.

18.3.5 Abutments

For the 4 span bridge small abutments perched in the fill and founded on piles are proposed. For the perched abutment the "down drag" of the settling fill material will be considered in the design of the piles. The abutment wing wall will be designed for the 100kN impact load on the parapet end block. The abutments will be designed such that sometime in the future a possible soil nail wall could be incorporated that will open up the side spans for the introduction of PARCLO ramps.

18.3.6 Expansion Joints

Expansion joints are required at each of the abutments. Due to the length of the bridge, i.e. some 70m, it is felt that the more economic asphaltic plug type joint will not work. It is therefore proposed that the armoured nosing type expansion joint be implemented here. This was considered in the cost estimates.

The implementation of an integral bridge, where visible expansion joints are not required, will also be investigated. It may then be possible to provide a single row of piles at all the substructures with economic advantages.

18.3.7 Bearings

If the integral design is not carried out laminated elastomeric bearings would be proposed. These are durable and work well with precast beams. These bearings are also quite economical and require a minimum of maintenance. Fixity will be provided by the central pier that is monolithic with the deck.

18.3.8 Parapets

Cast in-situ concrete F-shape parapets, using galvanized reinforcement will be used on the bridge. The parapet, located alongside the sidewalk, will be designed for a 100kN impact load.

18.4 Recommendations

It is recommended that a 4 span bridge of length 70m be constructed using precast concrete pre-tensioned M beams. The design will be similar to the design recently implemented for the Allandale Interchange Bridges over the N1 in Midrand.

The precast concrete beams together with the upper in-situ deck and lower infill in-situ concrete will form a pseudo box section resulting in a structurally efficient design.

19 LANDSCAPING

The landscaping proposals were developed by Aspect Landscape Architects after consultation with the City of Cape Town. A more detailed Landscape Management Guideline has been prepared and some of the recommendations are summarized here.

19.1 Approach

The City of Cape Town non-motorised transport projects prioritise pedestrian, cycle and other modes of transport. It is more prudent to work with a long term strategic plan in mind to ensure optimal outcomes. The spatial design of these projects considers hard and soft landscaping elements in order to improve functionality, environmental quality and the aesthetic of the road reserve area. After meeting with the City of Cape Town – Parks Department official and the Client, we are clear on the approach to be followed, which is encompassed in the approach outlined.

19.2 Planting

19.2.1Types

The following species are recommended as illustrated in Figure 19-1.

Brachylaena discolor http://pza.sanbi.org/brachylaena-discolor

Syzygium guineense http://pza.sanbi.org/syzygium-guineense

Vachellia karroo (Sweet thorn) http://pza.sanbi.org/vachellia-karroo

Erythrina caffra (Coast Coral tree) http://pza.sanbi.org/erythrina-caffra

Figure 19-1: Planting types agreed with City of Cape Town

19.2.2 Trees

Trees are the most important element in this environment as resource for absorbing carbon dioxide and giving off oxygen for human life. They also provide shade for pedestrians, shelter from the elements and habitat for birds, insects and wildlife. Trees are the most substantial green vertical element in the landscape that mitigates “urban heat island effect” created by large paved surface areas and they soften an otherwise harsh or hard living environment. Trees also contribute to stormwater attenuation in the form of soil stabilization and absorption of water that seeps into the ground. Many trees have deep roots to stabilize them and shallow roots to absorb food & water for growth. These roots hold the ground in tact on slopes and surfaces that require “soft stabilization”.

19.2.3 Shrubs

Shrub planting is often not a consideration on these projects, as these may become litter traps. Thorny shrubs may be considered for the purpose of visual and acoustic screening or a vertical impenetrable barrier to guide and direct pedestrians.

Groundcover planting provides the benefit of soil stabilization and a horizontal plane green element with a similar function to trees. Shrubs may not currently be planted in the stormwater channel as this will impact on flows.

19.2.4 Plant selection

- Larger and fewer trees are preferred. The larger the size of trees and plants at time of sourcing the better chance of survival. Larger trees and plants can withstand more stress than smaller specimens, making it more preferable to plan for the ultimate long-term layout and strategically phase-in the tree planting.
- Indigenous species are preferred over exotic species. They are more adapted to the local climatic conditions such as wind and sun exposure, soils and drought. The species diversity is enormous, making selection and availability easier, improving the quality of habitat and chance of survival. Indigenous succulent species require minimal water and are ideal in drought conditions.
- Replace dead trees and removed trees with trees of a similar biomass.
- Ensure that planting does not obstruct views.

19.3 Water

Water, or the current scarcity thereof in the Cape Town Metro, is the most important constraint when considering the way forward in terms of implementation. Without a secure, alternative water source, planting will not be possible.

19.3.1 Watering options:

- Water using treated effluent water via filtered irrigation or water tanker.
- Water with recycled / harvested water via irrigation or a water tanker.
- Supplement such water with the use of water absorbent additives that release water slowly over time.

19.3.2 Level 6B water restrictions

- Agricultural users need to reduce usage by 60% compared with the corresponding period in 2015 (pre-drought).
- Should borehole / wellpoint water be used for garden irrigation, this must be limited to a maximum of one hour only on Tuesdays and Saturdays before 09:00 or after 18:00.
- Permission from the National Department of Water and Sanitation is required in order to sell or buy borehole/wellpoint water.
- Irrigation or watering with municipal drinking water is illegal.

19.3.3 Boreholes and wells

Government regulation

National Government gazetted new guidelines for all borehole and wellpoint use, effective from 12 January 2018 Government Gazette No. 41381 (Vol. 631). Borehole/well point water use must be metered and all users are required to keep records and have these available for inspection. Permission from the national Department of Water and Sanitation to sell or buy borehole/well point water. Using this water needs to be used responsibly as over-extraction harms the environment. Refer to the Water By-law (2010) and Water Amendment By-law (2018) .

Apply to sink a borehole or wellpoint and register your borehole or well point

Well points draw groundwater that is close to the surface, from about 8 – 10m. Boreholes can be shallow at a depth of about 30 m, or deeper at 100 m or more, and cost more than well points.

Use of groundwater

Not all groundwater is ideal for watering plants or indoor use, as it might have too much salt or iron in it. During the drought, limited irrigation is allowed in order to preserve groundwater. It should only be used if it has received the appropriate treatment e.g. removing heavy metals.

Groundwater (like all alternative water) may not generally be used for drinking, cooking or body washing according to the Water By-law (2010) and Water Amendment By-law (2018).

19.4 Hard Landscaping

19.4.1 Street Furniture

Street furniture items contribute to the sense of place and identity of a space. The benches below have been constructed in concrete, making them robust and weather proof. The design can range from the most simple, to a more playful and fun element in the landscape.

Figure 19-2: Proposed benches

19.4.2 Community Art

The concept for the very wide road reserve along Erica Drive, adjacent to the NMT facility, is to use the vacant, undeveloped land as a space with art / community art in robust materials, such as concrete. An artist / sculptor may be involved to engage the community and use their local talents and skills in design and construction.

Figure 19-3: Example of Community Art

19.4.3 Obstacle course

A second part of the concept would be to have a simple obstacle course, which would bring play and fun into a very mundane and unused space. This will also encourage exercise and activate the space.

Figure 19-4: Example of an Obstacle Course

19.5 Maintenance

To achieve the vision of a safe NMT facility, the key is maintenance and the success of any landscape installation is governed by the quality of after-care and maintenance. This applies to both hard and soft landscaping, buildings, roads and any other piece of infrastructure. Trees and planting requires a minimum of 24 months horticultural maintenance to ensure optimal growth. The challenge of vandalism and theft needs to be accounted for on all projects as a Provisional Sum.

19.6 Landscaping Cost Estimate

Cost estimates have been undertaken for various sections of Erica Drive and is shown in Table 19-1.

Table 19-1: Landscaping cost estimate per section

SECTION OF ROAD		COST ESTIMATE
A	Belhar Drive to St Vincent Drive	R2 027 862,04
B	St Vincent Drive to New Nooiensfontein Drive	R1 647 948,04
C	New Nooiensfontein Drive to Highbury Road	R1 011 379,69
	TOTAL	**R4 687 189.77**

The following is excluded from the cost estimate:

- Excludes contingencies
- Excludes removal / relocation of existing trees
- Excludes paving detailing
- Excludes street furniture
- Excludes major excavation
- Excludes provisional sums for theft, vandalism and maintenance materials

- Excludes ancillary items for hand watering or watering with a water tank such as connections, hosepipes, storage etc.
- Excludes artworks, special features
- Excludes escalation
- Professional fees

An allowance for R2M has been included in the cost estimates for Phase 1 of the project.

20 STREETLIGHTING

20.1 Introduction

The streetlight design is done within the following standards and guidelines:

- National Standard, SANS 10098 Parts 1 & 2
- Road geometric design and typical cross section
- City of Cape Town Public Lighting policy
- Tie-in with existing streetlights

The recommended lighting level and uniformity is specified in SANS 10098 Part 1, Table 1. It is a function of the maximum traffic volume per lane during darkness, operating speed and whether the road has a median or not.

Lighting design is included for Phase 1, Phase 2 (final phase) and typical cross sections are provided as relevant for each phase as per the following sub-sections.

20.2 Street lighting layout: Median vs Edge

Street lighting layout can be either median or edge based. Both have advantages and disadvantages. The Erica Drive design includes a median which would be suitable for streetlight installation. This would also be more cost effective than an opposite edge based scheme (2 poles opposite each other) due to a saving in number of poles and electrical cabling.

In particular between kilometres 0 and 1.95 it was investigated to install streetlight poles during Phase 1 along the edge, to coincide with the centre of the future Phase 2 median as a single edge installation for Phase 1. As part of the Phase 2 construction this will be upgraded with another luminaire per pole giving a median layout with double outreach and 2 luminaires per pole. The resulting design has the benefit of limited streetlight construction for Phase 2 and thus a cost saving.

After investigation it was however found that an opposite edge scheme (for both Phases 1 & 2) will have to be used due to the following reasons:

- The 3 lane configuration for Phase 1 (km 0 to 1.95) requires significant reduced spacing (28m) with a single edge installation, whereas an opposite edge installation allows spacing of 53m.
- Considering the R300 and Kuils River bridge decks, it is fairly easy to install streetlight poles on or in between the parapets along the sides. The bridge decks have no single barrier in the median and therefore preclude the installation of streetlight poles along the bridge median.
- The City of Cape Public Lighting policy prohibits changing from the edge to the median and otherwise unless this happens at an intersection.

Considering the above, street lighting for both Phases 1 & 2 therefore follows and opposite edge layout scheme.

20.3 Design Requirements

Table 20-1 below is a summary of the Erica Drive road properties relevant to streetlight design and includes the applicable SANS recommended lighting parameters. The preferred levels of lighting for pedestrian and cycle ways are also shown.

Table 20-1: Road classification and recommended lighting levels as per SANS 10098 Part 1.

Road properties		SANS 10098 Recommendation			
Description	**Value**	**Lighting Parameters**	**Symbol**	**Unit**	**Value**
Max. traffic volume during darkness: [vehicles/hour/lane]	> 600	Min average luminance	L_n	cd/m^2	1.0
Operating speed [km/hr]	60	Min overall luminance uniformity	U_O	%	40
Median	No	Min longitudinal luminance uniformity	U_L	%	60
SANS 10098 Road classification	A3	Max threshold increment	TI	%	20
Pedestrian and cycle way		**Lighting Parameters**	**Symbol**	**Unit**	**Value**
SANS 10098 Pedestrian and cycle ways Class 2 preferred by CoCT Public Lighting		Minimum average horizontal illuminance	$E_{H\ ave}$	Lux	10
		Minimum horizontal illuminance	$E_{H\ min}$	Lux	3

20.4 Phase 1: km 0 to km 1.95

Photometric simulations were done using the Ulysse 3 computational programme with the following input parameters as shown in Table 20-2.

Table 20-2: Photometric simulation parameters and values.

#	SIMULATION INPUT PARAMETER	VALUE
1	Roadway typical cross-section used (see 3785.4/SL/01 in Book of Drawings)	SV 500
2	Luminaire type (as per CoCT approved luminaires)	144W BEKA LEDlume Midi, 64 LED's with 5118 optics
3	Mounting height (CoCT standard 13.5m poles with 11.8m M-H)	11.8m
4	Luminaire inclination	0 degrees
5	Maintenance factor	0.8
6	Road surface reflectance table	CIE Standard R3007
7	Layout	Opposite edge mounted
8	Setback behind back of walkway	500mm (behind 500mm water channel)
9	Outreach arm used	No

The lighting pole and luminaire complies with the CoCT Public Lighting standard design and pre-approved luminaires. An opposite edge layout is chosen to allow installation of lighting on the bridge over the R300. The setback of 500mm allows poles to be installed behind the water channel that runs parallel to the back of walkway.

Simulation results reveal a maximum pole spacing of 53m is achieved while satisfying the SANS recommendations presented in Table 20-1*.* Simulation results can be found in Annexure F. At intersections with access roads the pole spacing is reduced in steps of 5m to raise the lighting levels to accommodate a wider road geometry including turning lanes. At the intersections with Belhar Drive and Reuter Street the spacing is reduced to 40m and at St. Vincent to 55m.

The cross-section and layout drawings are included in the Book of Drawings.

20.5 Phase 1: km 1.95 to km 3.45

Photometric simulations were done using the Ulysse 3 computational programme with the following input parameters as outlined in Table 20-3.

Table 20-3: Photometric simulation parameters and values.

#	Simulation input parameter	Value
1	Roadway typical cross-section used (see 3785.4/SL/03 in Book of Drawings)	SV 2 500
2	Luminaire type (as per CoCT approved luminaires)	144W BEKA LEDlume Midi, 64 LED's with 5118 optics
3	Mounting height (CoCT standard 13.5m poles with 11.8m M-H)	11.8m
4	Luminaire inclination	0 degrees
5	Maintenance factor	0.8
6	Road surface reflectance table	CIE Standard R3007
7	Layout	Opposite edge mounted
8	Setback behind back of walkway	300mm
9	Outreach arm used	2m

The lighting pole and luminaire complies with the CoCT Public Lighting standard design and pre-approved luminaires. An opposite edge layout is chosen to allow installation of lighting on the bridge over the Kuils River. *Simulation results reveal a maximum pole spacing of 38m is achieved while satisfying the SANS recommendations presented in* Table 20-1. Simulation results can be found in Annexure F. Note that where possible existing poles will be relocated and luminaires (LED) re-used.

The cross-section and layout drawings are included in the Book of Drawings.

20.6 Phase 2: km 0 to km 1.95

Photometric simulations were done using the Ulysse 3 computational programme with the following input parameters as shown in Table 20-4.

Table 20-4: Photometric simulation parameters and values.

#	Simulation input parameter	Value
1	Roadway typical cross-section used (see 3785.4/SL/05 in Book of Drawings)	SV 500
2	Luminaire type (as per CoCT approved luminaires)	144W BEKA LEDlume Midi, 64 LED's with 5118 optics
3	Mounting height (CoCT standard 13.5m poles with 11.8m M-H)	11.8m
4	Luminaire inclination	0 degrees
5	Maintenance factor	0.8
6	Road surface reflectance table	CIE Standard R3007
7	Layout	Opposite edge mounted
8	Setback behind back of walkway	500mm (behind 500mm water channel)
9	Outreach arm used	2m

The lighting pole and luminaire complies with the CoCT Public Lighting standard design and pre-approved luminaires. An opposite edge layout is chosen to allow installation of lighting on the bridge over the R300. The setback of 500mm allows poles to be installed behind the water channel that runs parallel to the back of walkway. *Simulation results reveal a maximum pole spacing of 36m is achieved while satisfying the SANS recommendations presented in* Table 20-1*.* Simulation results can be found in Annexure F. Note that poles installed under Phase 1 will be relocated and new poles will be installed. The cross-section and layout drawings are included in the Book of Drawings.

20.7 Phase 2: R300 Interchange ramps

Photometric simulations were done using the Ulysse 3 computational programme with the following input parameters as shown in Table 20-5.

Table 20-5: Photometric simulation parameters and values.

#	Simulation input parameter	Value
1	Ramp typical cross-section used (see 3785.4/SL/07 in Book of Drawings)	SV 400
2	Luminaire type (as per CoCT approved luminaires)	211W BEKA LEDlume Maxi, 96 LED's with 5117 optics
3	Mounting height (CoCT standard 13.5m poles with 11.8m M-H)	11.8m
4	Luminaire inclination	0 degrees
5	Maintenance factor	0.8
6	Road surface reflectance table	CIE Standard R3007
7	Layout	Edge mounted
8	Setback from yellow line	3.7m
9	Outreach arm used	0m

The same lighting pole is used as on Erica Road. The Luminaire is not subject to the CoCT's approval as the freeway ramps will be taken over by SANRAL. A luminaire fit for this purpose was chosen which provides optimum lighting distribution with a large setback from the yellow line. An edge layout is chosen, with poles installed on the outside of the ramp.

Simulation results reveal a maximum pole spacing of 50m is achieved while satisfying the SANS recommendations presented in Table 20-1. Simulation results can be found in Annexure F. At the intersection with Erica Drive the pole spacing is reduced to 40m in steps of 5m to raise the lighting levels and accommodate a wider road geometry which includes turning lanes. The cross-section and layout drawings are included in the Book of Drawings.

20.8 High level cost estimate

A high level cost summary for both phases is given below. The below costing is based on the following assumptions:

- Existing lighting along Erica Drive will be relocated to improve lighting at intersections with access roads.
- New lighting will be installed along Erica Drive Phase 1, i.e. existing lighting will not be re-used along Erica Drive.

- Phase 2: Poles installed along Erica Drive Phase 1 (km 0 to km 1.95) will be relocated. The shortfall will be new poles.

The high-level cost estimate is shown below in Table 20-6 and Table 20-7.

Table 20-6: Cost Estimate for Phase 1 Street Lighting

3785.4 Erica Dr Phase 1 Street light cost estimate					2018/08/24
ITEM	**DESCRIPTION**	**UNIT**	**QTY**	**RATE**	**AMOUNT**
	Excavation				
1	Trenches for electrical cable (300W X 950D)	m^3	2163	R 250.00	R 540 787.50
2	Streetlight pole (1.7m depth)	No	144	R 500.00	R 72 000.00
	Backfilling				R -
3	Trenches: Using excavated material	m^3	1480	R 200.00	R 296 010.00
4	Trenches: Sandbedding, using imported selected material	m^3	683	R 400.00	R 273 240.00
5	Street light poles using soil cement (5%)	No	144	R 300.00	R 43 200.00
	Poles & luminaires				R -
6	13.5m galvanised steel lighting pole (11.8m mounting height) including base plate to Drawings SL-11 & SL-27	No	149	R 10 000.00	R 1 490 000.00
7	11m galvanised steel lighting pole (9.3m mounting height) including base plate to Drawings SL-11 & SL-27	No	20	R 7 000.00	R 140 000.00
8	300mm galvanised steel spigot, single sided, with 0 deg rake angle to Drawing SL-36	No	88	R 400.00	R 35 200.00
9	2 000mm galvanised steel outreach arm, single sided, with 0 deg rake angle to Drawing SL-4	No	80	R 1 000.00	R 80 000.00
10	2 000mm galvanised steel outreach arm, double sided, with 0 deg rake angle to Drawing SL-4	No	1	R 1 500.00	R 1 500.00
11	Beka LEDlume-midi 48 LED/108W with 5068 optic	No	20	R 6 000.00	R 120 000.00
12	Beka LEDlume-maxi 64 LED/144W with 5118 optic	No	149	R 8 000.00	R 1 192 000.00
13	Relocation of existing poles to new position anywhere on site	No	30	R 7 500.00	R 225 000.00
14	Removing of existing street light poles to storage	No	20	R 500.00	R 10 000.00
	Electrical				
15	PVC PVC SWA PVC 600V/1000V 4 core stranded cable, 25mm² Al, installed	m	9497	R 85.00	R 807 249.25
16	Cable terminations; 4core 25mm2 Al	No	294	R 350.00	R 102 900.00
17	Cable joints; 4 core 25mm2 Al	No	15	R 500.00	R 7 500.00
18	Electrical application and connection fees	Lump	Sum	R 50 000.00	R 50 000.00
19	Streetlighting Kiosk Three Phase including MCB's, Photocell and contactor	No	3	R 15 000.00	R 45 000.00
20	Earthing	No	3	R 10 000.00	R 30 000.00
21	Testing & Commissioning	Lump	Sum	R 216 817.46	R 216 817.46
	TOTAL (excl. VAT)			**R**	**5 778 404.21**

Note:

The cost estimate excludes Contingencies, Preliminary and General Expenses, VAT and Professional Fees.

Table 20-7: Cost Estimate for Phase 2 Street Lighting

3785.4 Erica Dr Phase 2 Street light cost estimate					2018/08/24
ITEM	**DESCRIPTION**	**UNIT**	**QTY**	**RATE**	**AMOUNT**
	Excavation				
1	Trenches for electrical cable (300W X 950D)	m^3	1223	R 250.00	R 305 662.50
2	Streetlight pole (2m depth)	No	100	R 500.00	R 50 000.00
	Backfilling				R -
3	Trenches: Using excavated material	m^3	837	R 200.00	R 167 310.00
4	Trenches: Sandbedding, using imported selected material	m^3	386	R 400.00	R 154 440.00
5	Street light poles using soil cement (5%)	No	100	R 300.00	R 30 000.00
	Poles & luminaires				R -
6	13.5m galvanised steel lighting pole (11.8m mounting height) including base plate to Drawings SL-11 & SL-27	No	100	R 10 000.00	R 1 000 000.00
7	300mm galvanised steel spigot, single sided, with 0 deg rake angle to Drawing SL-36	No	50	R 400.00	R 20 000.00
8	2 000mm galvanised steel outreach arm, single sided, with 0 deg rake angle to Drawing SL-4	No	50	R 1 000.00	R 50 000.00
9	Beka LEDlume-maxi 64 LED/144W with 5118 optic	No	50	R 8 000.00	R 400 000.00
10	Beka LEDlume-maxi 96 LED/211W with 5117 optic	No	50	R 11 000.00	R 550 000.00
11	Relocation of existing poles to new position anywhere on site	No	69	R 7 500.00	R 517 500.00
12	Removing of existing street light poles to storage	No	10	R 500.00	R 5 000.00
	Electrical				
13	PVC PVC SWA PVC 600V/1000V 4 core stranded cable, 25mm² Al, installed	m	7350	R 85.00	R 624 750.00
14	**Cable terminations; 4core 25mm2 Al**	No	194	R 350.00	R 67 900.00
15	Cable joints; 4 core 25mm2 Al	No	15	R 500.00	R 7 500.00
16	Electrical application and connection fees	Lump	Sum	R 50 000.00	R 50 000.00
17	and contactor	No	2	R 15 000.00	R 30 000.00
18	Earthing	No	2	R 10 000.00	R 20 000.00
19	Testing & Commissioning	Lump	Sum	R 167 132.50	R 167 132.50
	TOTAL (excl. VAT)			**R**	**4 217 195.00**

__Note:__

The cost estimate excludes Contingencies, Preliminary and General Expenses, VAT and Professional Fees.

21 OVERALL INFRASTRUCTURE COST ESTIMATES

The infrastructure cost estimates have been undertaken per phase and amounts to a total of approximately R507M, excluding VAT, professional fees and site supervision. Refer to Table 21-1.

Table 21-1: Infrastructure Cost Estimates per Phase

Erica Drive - Cost Estimate Summary				
	Phase 1	**Phase 2A**	**Phase 2B**	**Phase 3**
Roads and Stormwater	R81 106 000	R30 502 500	R32 510 000	R172 843 000
Rehabilitation of the Existing Kuils River Bridge (B5941A)	R306 475	R0	R0	R0
New Kuils River Bridge (B5941B)	R11 389 000	R0	R0	R0
New 4 span R300 Bridge (excl P& G)	R18 447 190	R18 447 190	R0	R0
Streetlighting	R5 778 404	R4 217 195	R500 000	R500 000
Landscaping	R2 000 000	R500 000	R100 000	R100 000
Total per phase	**R119 027 069**	**R53 666 885**	**R33 110 000**	**R173 443 000**
Add: P&G expenses (20%)	R23 805 414	R10 733 377	R6 622 000	R34 688 600
Sub-Total 2	**R142 832 483**	**R64 400 262**	**R39 732 000**	**R208 131 600**
Add: Contingencies (10%)	R14 283 248	R6 440 026	R3 973 200	R20 813 160
TOTAL PER PHASE	**R157 115 731**	**R70 840 288**	**R43 705 200**	**R228 944 760**
ROUNDED TOTAL PER PHASE	**R157 116 000**	**R70 841 000**	**R43 706 000**	**R228 945 000**
TOTAL (ALL PHASES)	**R500 605 980**			
ROUNDED TOTAL (ALL PHASES)	**R500 700 000**			

<u>*Note:*</u>

The cost estimate excludes VAT, Professional Fees and Site Supervision, along with any other specialist studies or design input (not identified at this stage) that might be required during the detail design process.

22 ECONOMIC EVALUATION

Still to be undertaken

23 LAND ACQUISITION

During the design process various parcels of land have been identified for acquisition. The portions of erven as shown in drawing number 3785.4/RR/01-04 in the Book of Drawings must be acquired by the City of Cape Town.

24 PUBLIC PARTICIPATION

24.1 Process followed to date

The process followed to date include the following:

- A Pre-application BAR was submitted to the DEADP
- A Notice of Intent to Develop (NID) was submitted to the DEADP
- A Public Open Day was held on 27 March 2018

Comments have been received and addressed with the aim of submitting the Final BAR.

24.2 Next Steps

- Preparation of the Final BAR and submission thereof to DEADP
- Submission of the WUA

To be completed and updated as project progresses and an Authorization is obtained.

25 CONCLUSIONS AND RECOMMENDATIONS

25.1 Conclusions

From the transport investigation the following conclusions are reached:

25.1.1 Motivation for the project

Erica Drive was identified as an important road in the Kuils River and Belhar street network, as well as important link in the metropolitan road network and the completion of this currently missing link, will bring about congestion relief on some of the metropolitan road in the greater Kuils River and Belhar areas.

Erica Road has been identified for potential upgrade as part of the City of Cape Town's Congestion Management Strategy. The proposed upgrade includes the dualling of Erica Road along with possible capacity improvements at certain intersections. Erica Drive Extension across the R300 to Belhar Main Road was ranked number 8 out of 102 projects.

Accordingly the CoCT initiated the preliminary design of the Erica Road link between Belhar Drive in Belhar, across the R300 up to Highbury Street in Kuils River. The initial portion of Erica Drive identified for implementation include the following:

- Construction of the southern carriageway between New Nooiensfontein to just west of Reuter Street
- Construction of a single carriageway link across the R300 up to Belhar Drive

Future improvements can include a half-diamond interchange with the R300 (northern ramps only) or a Partial Clover providing connectivity to the south, should it be required in the future.

25.1.2 Existing transport operations

Intersection operations

According to the existing peak hour analyses most intersections in the study area are operating at acceptable Level of Service (LOS).

During the environmental pre-application BAR process the need was expressed for a signalised pedestrian crossing facility at Isabel/ Belhar Main intersection due to the learner crossing desire line across Belhar Main Road, to and from Kalkfontein Primary School.

An assessment of the warrants for signalisation confirmed that signalisation of the intersection is not warranted currently. Furthermore, although a pedestrian crossing is not fully warranted at this stage, it is our recommendation that a yield-control pedestrian crossing be implemented.

NMT and Public Transport

Bus and taxi services operate along various roads, more notably New Nooiensfontein and Reuter Street. New Nooiensfontein Road is also planned as an IRT trunk route in terms of the CoCT's IPTN. The routes under investigation also comprise various NMT proposals.

25.1.3 Phasing of the upgrades

Phasing of the upgrades were also investigated.

Phase 1 will include the construction of the southern carriageway from just north of Highbury Street. The existing road will then function as a second carriageway in the interim. This will continue to just west of Reuter Street, after which it will transition to a single carriageway road. The single carriage road will continue across the R300 to Belhar Drive. Although a single carriageway road is built for the section of road between Highbury and just north of Reuter Street, in practical terms it will function as a dual carriageway road.

- **Phase 2** will include the dualling of the remaining portion of the road with the provision of a half-diamond interchange with the R300 with only the northern on-ramp and off-ramp being provided. This is proposed as 2 stages:
  - **Phase 2a**: The dualling of Erica Drive across the R300 without the half-diamond interchange.
  - **Phase 2b**: The implementation of the R300 on and off-ramps to upgrade the crossing to the required half-diamond interchange.
- **Phase 3** considers the opportunity to provide connectivity to the south via a PARCLO ramp configuration. The CoCT is not intending to construct a PARCLO interchange, but the road reserve boundaries required for a PARCLO interchange was identified and the half-diamond interchange also cited accordingly, to ensure that a PARCLO interchange can be accommodated in the future, should it be required in the future. As previously discussed with SANRAL, it is accepted that this option is not supported by SANRAL due to the limited interchange spacing, need for C-D roads and the resulting compromise of the mobility function of the R300.

25.1.4 Future transport operations

Potential of interchange with R300

Two interchange configurations were assessed; namely a half-diamond interchange and that of a PARCLO interchange with the R300. The northern ramps of a half-diamond interchange can be accommodated between the existing Stellenbosch Arterial and the Strand Road Interchange. The distance to Stellenbosch Arterial interchange is insufficient to accommodate southern ramps of a half-diamond interchange. The introduction of PARCLO ramps, providing connectivity to the south, requires a collector-distributor (CD) road because the spacing between the Stellenbosch Arterial interchange and Erica Road is limited. The latter proposal is not supported by SANRAL.

Intersections and network performance

The land use scenario underpinning the proposed upgrades is the 2032 PD Land Use Scenario.

In 2032 capacity conditions can be expected for the section of Erica Road between New Nooiensfontein to beyond Symphony Way further west in the peak direction (westbound) during the AM peak hour. The dualling of Erica Road between Belhar Main and New Nooiensfontein reduces congestion during the AM peak hour in particular.

The introduction of a half-diamond interchange at the R300 attracts additional traffic to Erica Drive, but the intersections can still cope with the additional demand although capacity conditions will be experienced, especially at the New Nooiensfontein roundabout.

The further introduction of a PARCLO interchange also attracts additional traffic and increased congestion is also experienced at the R300 ramp terminal intersections due to the increased from the additional westbound right turn movements at these ramp terminal intersection.

The increased delays experienced as a result of the westbound right turn movements, along with the concerns about interchange spacing along the R300, it is concluded that the PARCLO interchange is not the most appropriate interchange format.

Public transport and NMT

Public transport embayments are proposed along Erica Drive and will be located downstream of each intersection along both carriageways.

During Phase 1, a 3m wide shared NMT facility is provided on both side of the road. This reduces to a 2.050m wide shared NMT facility (pedestrians and cyclists share the sidewalk) across the R300 bridge deck on both sides of the bridge. As the cross-section across the Kuils River will be the full dual carriageway cross-section, the ultimate 2.4m cycle lane along both sides of the road, will continue across the bridge deck over the Kuils River.

For future phases, a 2m walkway is proposed on the northern side and a 3m sidewalk on the southern side of the road and will be for pedestrians with a 2.4m cycle lane in each direction.

All intersections will have dropped kerbs and pedestrian push-buttons are provided all signalised crossings.

An assessment of the pedestrian crossing warrant at the Isabel/ Erica Drive intersection in the future (2032 traffic volumes) with a dual carriageway road, indicates that a signalised pedestrian crossing is not warranted in 2032.

25.1.5 R300 Bridge

It is recommended that a 4 span bridge of length 70m be constructed using precast concrete pre-tensioned M beams. The design will be similar to the design recently implemented for the Allandale Interchange Bridges in Midrand. The precast concrete beams together with the upper in-situ deck and lower infill in-situ concrete will form a pseudo box section resulting in a structurally efficient design.

25.1.6 Kuils River Bridge

The proposed new Kuils River Bridge is to be located on the downstream southern side of the existing Kuils River Bridge which will carry the new westbound traffic of the divided dual carriageway. The new separate westbound carriageway of the proposed dual carriageway road will comprise of a 2.0m sidewalk on the southern edge, 2.4m cycle lane, 2 x 3.4 m traffic lanes and a 0.5m outer shoulder adjacent to a New Jersey concrete parapet.

25.1.7 Stormwater

The 5-year, 10-year, 20-year and 50-year recurrence periods were modelled and the results are contained in the Ingerop Stormwater Masterplan Report. Due to the fact that the stormwater system crosses the R300 freeway and that it forms a major cut-off stormwater system, it is proposed that the pipes are sized for the 50-year flows and therefore drawing TT1224/SW1 proposes preliminary pipe sizes based on the 50-year flows.

The Stormwater Masterplan Report recommends the following:

- A new system is installed and that all existing systems should tie into the new system.
- Where possible attenuation ponds (bio-retention ponds) should be constructed.
- The new system should discharge into the existing Kuils River at the concrete canal level.

25.1.8 Street lighting

The streetlight design is done within the following standards and guidelines:

- National Standard, SANS 10098 Parts 1 & 2
- Road geometric design and typical cross section
- City of Cape Town Public Lighting policy
- Tie-in with existing streetlights

After investigation it was however found that an opposite edge scheme (for both Phases 1 & 2) is favoured.

25.1.9 Environmental Impact

Eco Impact was appointed as the Environmental Assessment Practitioner to conduct an Environmental Impact Assessment (EIA) Basic Assessment application with a Water Use Authorisation (WUA) for the Erica Drive road construction and the Kuils River bridge crossing, Cape Town. This was undertaken as a single process to run simultaneously, dealing with all the activities for which an Environmental Authorization (EA) and Water Use Authorization (WUA) associated with the project, are required.

An appropriate Application for an Environmental Authorisation is developed and submitted in terms of the National Environmental Management Act (NEMA) Act 107 of 1998 and a WUA in terms of the National Water Act (NWA) Act 36 of 1998.

The following specialist studies were undertaken in response to the pre-application BAR for this project:

- Freshwater Ecological Impact Assessment
- Terrestrial Botanical Impact Assessment
- Hydrological Overview
- Peer Review, Wetland Delineation and Offset Calculation

The results of these studies are summarised hereafter.

Freshwater Ecological Impact Assessment

The Kuils River flows through the proposed Erica Drive dualling from north to south. The ecological features on the site have been totally modified and channelled. On the site, surrounding land use, the channel of the river and the existing constructed bridge has resulted in all of the indigenous riparian vegetation being removed from the river and streams. In terms of the importance and sensitivity of the features, the numerous impacts have greatly reduced their species richness and diversity.

In order to maintain what remains of the ecological functioning of the systems on the site, it is recommended that

- Construction methodology be provided by the civil contractor to the freshwater ecologist and approval first be granted before construction commences to ensure that the construction activities are mitigated and to prevent any further degradation of the Kuils River. The construction activities must be monitored by an Environmental Control Officer.
- The pillars of the expanded bridge must be in line with the existing bridge pillars in order to not affect or impact on the existing hydrology or river flow.
- Three of the identified wetlands on site will be impacted upon. It is clear that the route will definitely impact, on a permanent basis, on an extent of depressional wetland. The former impacts are not mitigatable, and the report has recommended offset mitigation to account for wetland loss.

Terrestrial Botanical Impact Assessment

No specific botanical mitigation is required for this project, other than demarcating and restricting the proposed development area throughout the construction phase and ongoing alien invasive vegetation management and removal in the disturbed areas around the development footprints.

Although development of the Medium terrestrial botanical sensitivity area has been rated as having a potential Medium negative significance at a regional scale if other factors such as ongoing human disturbances and urban development, alien plant encroachment, low ecological connectivity etc. are taken into consideration, it is believed that the entire proposed development will have a Low negative significance on the terrestrial habitat of the site and surrounds. If is therefore concluded that the proposed development could therefore be authorised without causing significant negative terrestrial botanical impacts.

Heritage Impact Assessment

This was not undertaken for this project, but a Notice of Intent to Development (NID) was submitted to Heritage Western Cape.

Peer Review, Wetland Delineation and Offset Calculation

To be completed

25.1.10 Geometric Design

The geometric design was undertaken in accordance with the design requirements for an 80km/hr design speed.

The minimum vertical clearance of 7.5m required by ESKOM has been achieved, except at the northbound on-ramp crossing at km 0.055. An additional pylon might be required to increase the vertical clearance. A final interchange design submitted to ESKOM will provide clarity on vertical clearances prior to construction. Depending on the feedback received from ESKOM the additional pylon referred to might be included in either Phase 1 or Phase 2 of the project.

25.1.11 Economic Evaluation

Still to be completed.

25.1.12 Cost Estimates

The infrastructure cost estimates have been undertaken per phase and amounts to a total of approximately R500.7M. The cost estimate excludes VAT, Professional Fees and Site Supervision, along with any other specialist studies or design input (not identified at this stage) that might be required during the detail design process. The cost estimate per phase is shown below in Table 25-1.

Table 25-1: Summary of overall cost estimates

Erica Drive - Cost Estimate Summary				
	Phase 1	**Phase 2A**	**Phase 2B**	**Phase 3**
Total per phase	**R119 027 069**	**R53 666 885**	**R33 110 000**	**R173 443 000**
Add: P&G expenses (20%)	R23 805 414	R10 733 377	R6 622 000	R34 688 600
Sub-Total 2	**R142 832 483**	**R64 400 262**	**R39 732 000**	**R208 131 600**
Add: Contingencies (10%)	R14 283 248	R6 440 026	R3 973 200	R20 813 160
TOTAL PER PHASE	**R157 115 731**	**R70 840 288**	**R43 705 200**	**R228 944 760**
ROUNDED TOTAL PER PHASE	**R157 116 000**	**R70 841 000**	**R43 706 000**	**R228 945 000**
TOTAL (ALL PHASES)	**R500 605 980**			
ROUNDED TOTAL (ALL PHASES)	**R500 700 000**			

25.2 Recommendations

Based on the investigations undertaken and the conclusions reached, our recommendations are as follows:

- To be finalised once Economic Evaluation is completed.

Annexure A:

Extract from the Congestion Management Strategy for Cape Town

Annexure B:

Maps and Figures

Annexure C:

Traffix Results

Annexure D:

EMME Model Outputs

Annexure E:

Specialist Reports

- Stormwater Management Report, Draft, June 2018 prepared by Ingerop
- Report on Geotechnical Investigations for the Belhar Road Bridge, Kuils River, 2018 prepared by Kantey & Templer
- Report on Geotechnical Investigations for the R300 Bridge, Kuils River, 2018 prepared by Kantey & Templer
- Freshwater Ecological Impact Assessment for the proposed extension of Erica Drive, Belhar to Oakdene over the Kuils River, prepared by EcoImpact, dated 12 September 2017.
- Botanical Assessment for the proposed Erica Drive Expansion in Belhar and Kuils River area, prepared by EcoImpact, dated September 2017.
- Landscape Management Guideline prepared by Aspect Landscape Architects
- Steyn Wilson Laboratories, Test Reports, reference SWL01227, dated 14 August 2018.

Annexure F:

Streetlighting level detail design calculations