ARG Design

Stikland South Draft Development Framework

Civil Engineering Bulk Services Assessment Report

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Synopsis: HHO was requested to consider the impact of the proposed development's services demand on the existing infrastructure.

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GLOSSARY

AADD	Annual Average Daily Demand
ADWF	Average Dry Weather Flow
BMP	Best Management Practices
CBD	Central Business District
CICL	Cast Iron Cement Lined
CSIR	Council for Scientific Research and Industrial Research
DC	Development Charges
DN	*Diametre Nominale,* or nominal diameter in mm
DU	Dwelling Unit
FC	Fibre Cement
FSMP	Foul Sewer Master Plan
GIS	Geospatial Information System
GLA	Gross Leasable Area
ha	Hectare
kℓ	Kilolitre
kℓ/d	Kilolitre per day
ℓ	Litre
ℓ/d	Litre per day
ℓ/s	Litre per second
Mℓ/d	Megalitre per day
Mℓ	Megalitre
m^2	meter squared
m^3	cubic metres
m/s	meters per second
PF	Peak factor
RI	Recurrence Interval
SDF	Spatial Development Framework
SOW	Scope of Works
SS	Suspended Solids
SWMP	Stormwater Management Plan
TP	Total Phosporous
UCI	Urban Catalytic Investments
UPVC	Unplasticised Polyvinyl Chloride

DECLARATION OF INTEREST

The authors of this report hereby declare that HHO is an independent consultant appointed by ARG Design and has no business, financial, personal, or other interest in the activity, application, or appeal in respect of which they were appointed other than fair remuneration for work performed in connection with the activity, application, or appeal. There are no circumstances that compromise the objectivity of the specialist performing such work. All opinions expressed in this report are their own.

EXECUTIVE SUMMARY

This report outlines a civil engineering bulk services assessment for the proposed development of the site known as Stikland South. The site, located along Old Paarl Road in Stikland, Cape Town, spans approximately 114 hectares and is currently underutilized. The development aims to transform this area into a mixed-use precinct comprising residential units, retail, office spaces, and supporting infrastructure. This report evaluates the impact of the proposed development on potable water, foul sewer, stormwater, and solid waste systems, providing recommendations to ensure sustainable and efficient service delivery.

The development will generate an estimated potable water demand of 919.18kℓ/day. The existing water main (DN225 in De La Haye Avenue) and the City's bulk water supply system likely have sufficient capacity to meet this demand, but this must be confirmed through detailed demand assessments by the City.

The anticipated foul sewage demand of 840.62kℓ/day can be accommodated by the Bellville Wastewater Treatment Works, which has an unallocated treatment capacity of 15Mℓ/day. The capacity of the surrounding foul sewerage network must be confirmed through detailed demand assessments by the City.

The increase in impervious surfaces will necessitate upgrades to stormwater infrastructure to manage higher runoff volumes and improve water quality. The current 50-year storm peak flow of 2.41 m^3/s will rise to 3.60m^3/s post-development. To mitigate this, two large detention ponds located along the southwestern edge and northern edge of the site with a combined capacity of approximately 15 000m^3 over a 7 500m^2 area is proposed to attenuate flows and manage quality improvements. A swale of 17 200m^2 is also proposed to complement the detention pond. The area allocated to swale shown on the site layout is less than this, however in conjunction with the proposed detention pond is likely sufficient to achieve the required attenuation and water quality objectives.

Increased waste generation will require enhancements to waste management systems, but the existing municipal collection infrastructure and nearby disposal facilities are expected to handle the additional volume. Suitable on-site storage and recycling initiatives should be provided, and an Integrated Waste Management Plan must be developed for the future site.

1 INTRODUCTION

1.1 Background

In January 2022 ARG Design was appointed by the Department of Infrastructure to lead a team to provide a Contextual Framework and Precinct Plan for submission to the City of Cape Town in terms of S136 of the DMS: Package of Plans for the precinct known as Stikland North. More recently, the scope of the project was extended to also include the larger Stikland South landholding on the southern side of Old Paarl Road, which this report is focused on.

Stikland South (Erf 6300-0-1) is owned by the Western Cape Government under the auspices of the Department of Infrastructure - Special Programs Branch. Stikand South is located in the north-eastern sub-metropolitan area (Refer to Figure 1.1) of Stikland, Cape Town. It is bounded on its north side by Old Paarl Road (Provincial Main Road R101) linking Bellville (west) to Brackenfell and Kraaifontein (east). To the west, the site is flanked by De La Haye Avenue, to its south by the Kraaifontein rail line, and to the east by the residential suburbs of Heemstede and Groenvallei, separated from the site by Midmar Road.

The site is largely underutilised and accommodates Stikland Hospital, which includes the Western Cape College of Nursing, the Stikland Hospital Pharmacy, the Stikland Hospital Administration Building, and social functions which include assisted living facilities.

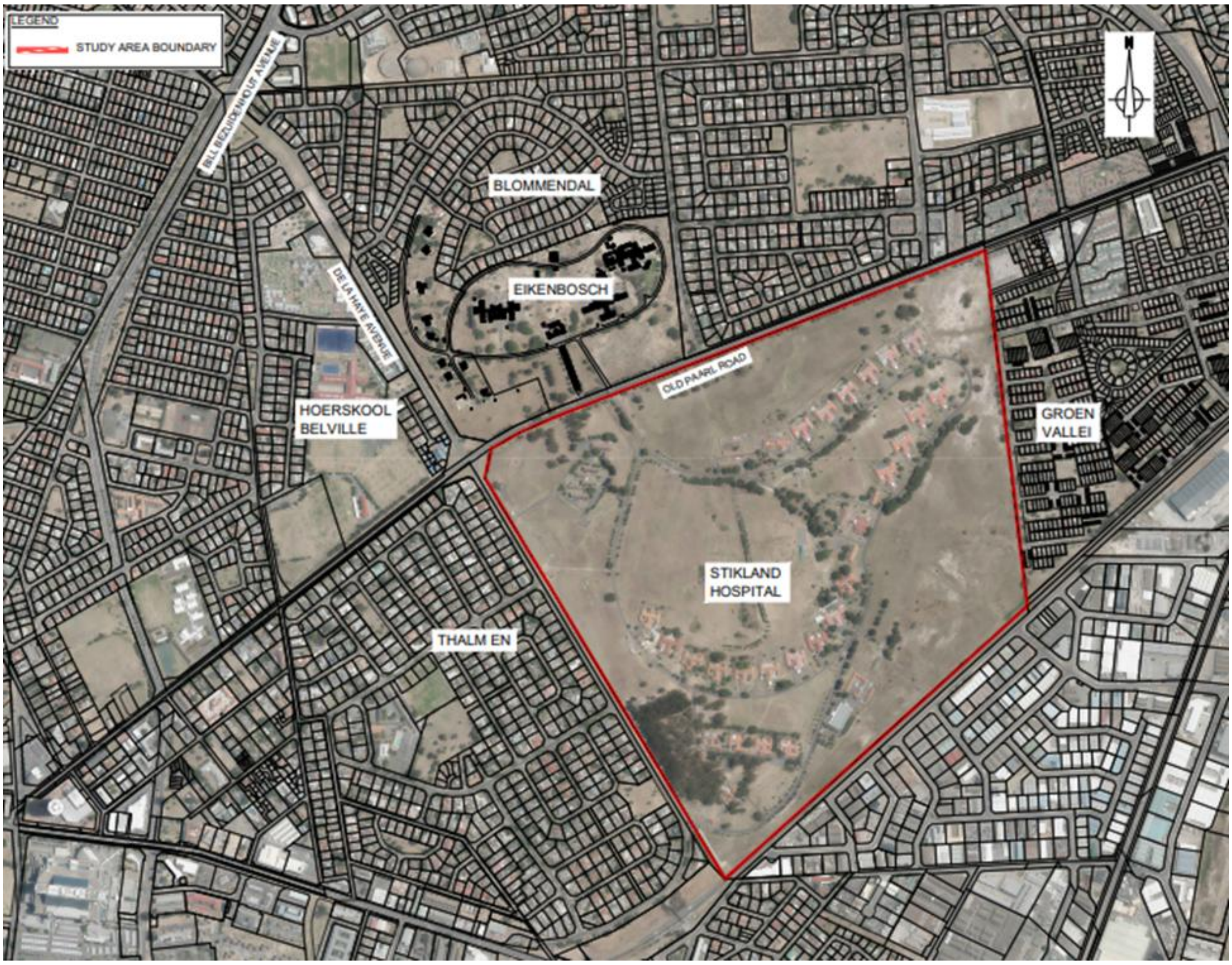

Figure 1.1: Locality Plan – Stikland South

1.2 Terms of Reference

HHO was appointed by the ARG Design to conduct the civil engineering baseline investigation which included the following:

- A site audit of the civil infrastructure via wayleave applications and communication with the respective services departments.
- Impact assessment of the availability and capacity of the existing civil infrastructure, in relation to the proposed development's services demand.

This investigation, together with the other specialists' reports will provide an analysis of the suitability of the development in terms of its intended land uses, as well as any recommendations.

1.3 Scope of the Report

This report considers the existing municipal infrastructure within the study area, and the performance of the existing services. This is, therefore, a status quo assessment. The proposed demands of the future development will be considered in a follow up report, following the finalisation of the development plan.

The following municipal services were investigated:

- Potable Water
- Foul Sewer
- Stormwater
- Solid Waste

This document should be considered together with the architectural submission and other specialists' reports, prepared under the auspices of ARG.

2 METHODOLOGY

The following methodology was adopted for the purposes of this study:

1) Obtain and confirm municipal services information;
2) Assess development proposals;
3) Calculate Services Demands, based on the information provided;
4) Undertake capacity assessment;
5) Prepare a high level Stormwater Management Plan for the proposed development;
6) Make recommendations;
7) Prepare a report and drawings

3 STATUS QUO ASSESSMENT

3.1 Existing Infrastructure

3.1.1 Potable Water

The Stikland South study area is well serviced with water infrastructure.

The area is bordered by the following existing underground potable water mains:

- A DN375 water pipe in De La Haye Avenue in the northwestern corner of the site, which may be the site's main water connection point.
- A DN300 water pipe along Old Paarl Road (R101) inside the northern boundary of the site.
- A DN225 water pipe on the western edge of the site, along De La Haye Avenue.
- A bulk DN750 water main south of the site along Strand Road.

The existing water network can be seen in *Drawing No. HHO-7515-702-1461 & 1462*, presented in **Annexure B**.

3.1.2 Foul Sewer

The Stikland South study area is well serviced by existing foul sewer infrastructure in the immediate vicinity.

The area is bordered by the following existing underground foul sewer pipelines:

- A DN150 along the northern edge of Old Paarl Road (R101).
- An DN200 sewer crossing from Stikland North to Stikland South in the vicinity of the Western Cape College of Nursing.
- A DN225 sewer line exiting the south western edge of the site onto De La Haye Avenue.

The foul sewer system ultimately discharges into the Belville WWTW.

The following high-level comments regarding the existing sewer network were received from the respective services departments:

- Belville WWTW has a maximum capacity of 75Ml, of which 15Ml is available for additional treatment. There are no foreseeable capacity constraints and there are no upgrades planned to the WWTW in the near future.

The existing external municipal sewer network can be seen in *Drawing No. HHO-7515-702-1401 & 1402*, presented in **Annexure C**.

3.1.3 Stormwater

The Stikland South study area is serviced with stormwater infrastructure, and given the large portions of undeveloped land, stormwater is not considered a significant issue for the existing development.

The following existing stormwater pipes traverse and border the site:

- A DN300 along the northern edge of Old Paarl Road (R101).
- Two transverse DN300 stormwater pipes on the northern edge of the site which convey stormwater from Stikland North to Stikland South, discharging into open (undeveloped) space.
- A transverse DN600 on the northern edge of the site which conveys stormwater from Stikland North into Stikland South, discharging into open (undeveloped) space.

- A bulk DN1800 stormwater main in the south eastern corner of the site at Cilmor Street.
- A DN375 stormwater pipe along De La Haye Avenue bordering the western edge of the site.

There are no existing detention ponds on the site, but several wetlands have been identified.

The existing stormwater network can be seen in *Drawing No. HHO-7515-702-1421 & 1422*, presented in **Annexure D**.

4 PROPOSED DEVELOPMENT

4.1 Land Use

The following land use breakdown has been proposed for the future development:

Table 4.1: Proposed Land Use

Land use	Unit	Quantity
Micro Business (Retail)	ha	2.9
Trip Attracting business (Office)	ha	4.1
Educational- School	ha	0.43
Roads	m^2	101 925
Residential (4-8 storey; 50m^2 units)	No.	2682

The proposed land uses above, together with the daily demands shown in Table 4.2 and Table 4.3 below, were used to calculate the proposed demand on potable water and foul sewer services for the development. Daily demands were based on *The Neighbourhood Planning and Design Guide* (The Red Book 2019)

4.2 Potable Water

The total estimated future demand for potable water has been summarised in Table 4.2 below:

Table 4.2 Stikland South Estimated Potable Water Demand

Land use	Unit	Quantity	W usage per unit (kℓ/day)	W AADD (kℓ/day)	W peak flow (l/s)	Minimum Fire Flow per hydrant (l/s)
Micro Business (Retail)	ha	2.9	21.00	59.90	2.50	25
Trip Attracting business (Office)	ha	4.1	21.00	86.04	3.59	25
Educational- School	ha	5.1	20.00	102.74	4.28	25
Roads	m^2	101925.0	0.00	0.00	0.00	
Residential (4-8 storey; 50m^2 units)	No.	2682.0	0.25	670.50	27.94	25
Total				**919.18**	**38.30**	

Consumption Assumptions:

- Residential/Flats (High Density): 0.25 kℓ / unit / day
- Retail and Office: 21 kℓ / ha / day
- Educational (School): 20 kℓ / ha / day
- Roads: 0 kℓ / ha / day

Factors used:

- Peak Factor = 3.6

4.3 Foul Sewer

The total estimated future demand for foul sewer has been summarised in Table 4.3 below:

Table 4.3 Stikland South Estimated Foul Sewer Demand

Land use	Unit	Quantity	FS usage per unit (kℓ/day)	FS AADD (kℓ/day)	FS DWP flow (l/s)	FS WWP flow (l/s)
Micro Business (Retail)	ha	2.9	16.80	47.92	1.11	1.28
Trip Attracting business (Office)	ha	4.1	16.80	68.83	1.59	1.83
Educational- School	ha	5.1	13.00	66.78	1.55	1.78
Roads	m^2	101925.0	0.00	0.00	0.00	0.00
Residential (4-8 storey; 50m^2 units)	No.	2682.0	0.25	657.09	15.21	17.49
Total				**840.62**	**19.46**	**22.38**

Consumption assumptions:

- Residential/Flats (High Density): 98% of water demand
- Retail and Office: 80% of water demand
- Educational (School): 65% of water demand
- Roads: 0 kℓ / ha / day

Factors Used:

- Dry weather peak factor (DWPF) = 2
- Wet weather peak factor (WWPF) = 1.15 x DWP

4.4 Solid Waste Management

4.4.1 Brownfield Development

Since brownfield sites are part of the fabric of an existing city or town, a solid waste removal system may exist, which may be able to accommodate the additional volumes of waste. A change in land use brought about by the brownfield development, e.g., the conversion of office blocks into blocks of flats, or using a parking lot to construct an office block, will affect the solid waste management service that is needed.

Brownfield developments are often associated with higher population densities, which will increase waste volumes per area.

The existing topography and access conditions of the site (e.g., widths of streets, steep gradients, and cul-de-sacs) may affect the collection of solid waste, while the availability of space and the geotechnical conditions of the site may determine whether additional waste management facilities can be provided.

Illegal dumping spots may exist and would need to be rehabilitated to deter future dumping at these spots.

4.4.2 Waste Categories Expected

Waste by definition can be described as any matter - whether gaseous, liquid or solid - originating from any residential, commercial or industrial area, which is unnecessary and has no further intrinsic or commercial value.

The following waste categories are expected within this development:

- Domestic and household waste such as foodstuffs, garden waste, old clothing, packing materials such as glass, paper and cardboard, plastics, and, in certain cases, ash.
- Business and commercial waste which consists mainly of packaging materials such as glass, paper and plastics, cans, etc, with a limited quantity of foodstuffs emanating from offices and retail.
- Construction waste, which generally consists of inert materials such as rubble and bulky construction debris.

4.4.3 On-site Storage

The following methods of on-site storage have been identified as suitable for the proposed development:

- Mobile refuse bins for households (120l, 140l and/or 240l)
- Mobile refuse containers (1.0m3 and 1.2m3)
- Bulk containers (4.5m3 to 11.0m3 - at specially demarcated sites, if required)

The method of on-site storage has a significant effect on the collection system to be implemented.

4.4.4 Waste Collection

The following factors were considered when recommending a suitable form of waste collection:

Table 4.4: Factors considered in selecting a form of waste collection

Factor	Key Considerations	Proposed Development
Affordability	Capital and operational costs; community income level	Low-income community Level of Service 5 (highest) Can likely be absorbed into existing waste management infrastructure Paid for via property rates or government subsidy
Accessibility	Road infrastructure and condition	Upgrades required to existing infrastructure; any new roads to be designed to allow for waste collection vehicle manoeuvres
Level of education	Literacy and awareness of waste management	Lower levels of literacy and awareness; can be maintained or promoted via awareness campaigns
On-site storage facilities	Availability and suitability; composition of waste	Mobile bins & containers, bulk containers Non-hazardous, non-toxic waste
Potential benefits	Clean & healthy environment; job creation	Attractive, pedestrian-friendly city
Available facilities and infrastructure	Vehicles and expertise	Less than 5000 households – less than one additional refuse collection vehicle required (Red Book)
Distance to disposal site	Transfer facility requirements	Bellville South Landfill - 8km Athlone Transfer Facility - 20km Coastal Park Landfill – 36km
Pollution potential	Blocked sewer and stormwater infrastructure; illegal dumping & littering	An Integrated Waste Management Plan will be required for any proposed development, in which pollution control measures should be detailed including street cleaning and maintenance of stormwater catchpits, etc

Based on the above factors, it is recommended that a “door-to-door” collection system by means of a rear-end loader and/or load lugger refuse collection vehicle(s) be implemented to support the proposed development.

4.4.5 Street Cleaning

Excerpted from The Red Book:

Wind-blown litter and illegal dumping of uncollected waste are probably the most visible aspects of poor waste management… If not controlled, these become major contributors to blocked stormwater drains and sewers… Street cleaning is unfortunately an unrecoverable cost but a necessary component of the waste collection service that needs to be provided and should be budgeted and planned for in any collection system.

4.4.6 Transfer Stations

The Bellville South Landfill facility, just off Robert Sobukwe Road, is the nearest transfer station to the node, approximately 8km away.

4.4.7 Recycling

Various methods of recycling or reducing waste volumes should be implemented by the future developer(s), such as promoting the use of:

- Think Twice, the CoCT's free door-to-door recycling collection program
- The CoCT’s waste drop-off points
- Home composting and separation of waste at source
- Private recycling drop-off points and collection services

4.5 Development Charges

The DC calculation template, provided by CoCT, was used to determine the amount payable to the CoCT by the future developer.

The anticipated project would attract a DC of +- R 132 million (VAT Inclusive).

For a more detailed breakdown, see Annexure E.

4.6 Connection Fees

Further to the DC, the future developer would be liable for sewer and water connection fees. Although this fee has not been accurately determined, an amount of approximately R1 000 000 should be budgeted for this purpose for the development.

5 STORMWATER STRATEGY

5.1 Introduction & Scope

A Stormwater Strategy Document articulates and indicates a shift in the original way in which stormwater is managed on a particular project. It is a very high-level document which indicates indicative stormwater calculations, reticulation systems, attenuation and treatment facilities, groundwater recharge and reuse opportunities, as well as overland escape routes.

The purpose of this high-level stormwater strategy is to provide a broad, strategic framework for managing stormwater runoff from the future development. It aims to balance environmental sustainability, urban development needs, and compliance with regulatory requirements. Key objectives include:

- **Stormwater Quantity Management**:
  Reduce the risk of flooding by ensuring efficient drainage and runoff management during storm events (see Section 5.4 below).

- **Stormwater Quality Improvement**:
  Implement measures to minimise pollution in runoff and protect receiving water bodies, such as rivers, wetlands, and coastal areas (see Section 5.5 below).

- **Sustainable Urban Development**:
  Integrate water-sensitive urban design (WSUD) principles to support groundwater recharge, reduce impervious surfaces, and promote ecological balance.

- **Infrastructure Planning**:
  Guide the design, upgrade, and maintenance of stormwater systems to ensure long-term functionality and cost-effectiveness. (see Section 5.6 below)

- **Regulatory Compliance**:
  Align stormwater management practices with local and national standards to meet legal obligations and environmental goals (see Section 5.7 below).

5.2 Site Assessment

5.2.1 Topography and Existing Land Use

The site is approximately 114ha in area, of which approximately 25ha is developed (i.e. impervious) area comprising building footprints and roadways. The highest topographical elevation on the site is at the northwestern corner at approximately 97m above mean sea level. The site naturally falls to the south/southeast boundaries of the site, parallel to the existing railway line, reaching elevations of 80m and 73m above mean sea level respectively. This equates to an average slope of approximately 1.5%.

As described in Section 1, the site is largely underutilised (i.e. much of the site area is undeveloped), accommodating Stikland Hospital which includes the Western Cape College of Nursing, the Stikland Hospital Pharmacy, the Stikland Hospital Administration Building, and social functions which include assisted living facilities.

5.2.2 Geological Context

5.2.2.1 Underlying Geology

The area is typically underlain by unconsolidated silty sands of the Springfontyn Formation. These are Quaternary-aged deposits overlying deeper Malmesbury Group shales and Cape Granite bedrock. The geological map of the area indicates that some silcrete (pedogenic) formations should be expected within the silty sands centrally while Malmesbury Group shale bedrock is at the surface or very shallow depth in the northwestern portions of the site.

5.2.2.2 Soil Type

Sandy soils dominate, often with varying amounts of silt and clay, depending on localised conditions. The soils are typically poorly consolidated and can have low cohesion. Silcrete is a pedogenic horizon with cementation varying from weakly cemented to hardpan. Residual soils overlying Malmesbury Group shales are generally silt or clay soils while the shale itself is often very hard rock.

5.2.2.3 Soil Characteristics

- Sandy soils of the Springfontyn Formation are generally highly permeable, leading to good drainage but potentially increased risk of soil erosion.
- The Cape Flats is known for a relatively high water table, especially during the rainy season. Seasonal waterlogging can occur in low-lying areas.
- Silcrete, if well-formed (hardpan), can create excavation difficulties, result in differential founding conditions and promote shallow perched groundwater. It is also generally a good material for road construction.
- Malmesbury Group shales have generally favourable founding conditions but excavation and trenching difficulties, potentially requiring blasting exist where very hard and shallow bedrock occurs. Residual clay soils are prone to consolidation settlement.

5.3 Hydrological Analysis

5.3.1 Design Rainfall Depths

For the management of stormwater, design rainfall is the most important rainfall variable to consider as it is the driver behind peak flows.

Design storm estimates for various recurrence intervals (RI's) and storm durations were sourced from the City of Cape Town's (CCT) design rainfall grid which was developed by Professor Jeff Smithers of the University of KwaZulu-Natal. Professor Smithers was also responsible for the development of the Design Rainfall Estimation Software for South Africa (DRESSA), (Smithers and Schulze, 2002).

This method uses a Regional L-Moment Algorithm (RLMA) in conjunction with a Scale Invariance approach to provide site-specific estimates of design rainfall (depth, duration and frequency), based on surrounding station records. WRC Report No. K5/1060 (WRC, 2002) provides more detail on the verification and validation of the method. The approach to the development of CCT's design rainfall grid and the DRESSA software is understood to be the same.

Table 5.1 below presents the 24-hour design rainfall depths applicable to the site as determined according to the relevant CCT grid points. For the purposes of this analysis, the site's latitude/longitude was taken as point X =18.653691; Y = 33.891004.

Table 5.1: 24-hour Design Rainfall Depth

Recurrence Interval (years)	Rainfall depth (mm)
0.5	15.6
1	25.6
2	37.3
5	50
10	59.3
20	69
50	82.5
100	93.6

Since the calculated Time of Concentration (t_c) of 2.22hours (see Annexure F) is less than 24hours, the modified recalibrated Hershfield relationship was used to calculate the precipitation depths for a duration of 2.22hours.

The modified recalibrated Hershfield relationship is given by

$$\mathbf{Pt,T = 1.13(0.41+0.64\ell nT)(-0.11+0.27\ell nt)(0.79M^{0.69}R^{0.20})}$$

where

Pt,T = precipitation depth for a duration of t minutes and a return period of T years

t = duration in minutes (133.15 minutes in this case)

T = return period

M = 2-year return period daily rainfall (37.3mm in this case)

R = average number of days on which thunder was heard (5 in this case).

These depths are presented in Table 5.2 below for various return periods T.

Table 5.2: Design rainfall depths for duration = tc

T (years)	Pt,T (mm)
2	15.46
5	26.09
10	34.12
20	42.16
50	52.78
100	60.81

The depths in Table 5.2 were utilised to determine the peak flows in the Rational Method (refer to Annexure F).

5.3.2 Terrain Data

A topographical survey of the site had not yet been conducted at the time of writing. Approximate elevations were obtained from Google Earth for the purpose of analysing the existing fall of the terrain. An aerial photograph of the terrain can be seen in the existing stormwater network layouts, Drawing No.'s *HHO-7515-702-1421* and *1422*, presented in Annexure D. Further details regarding the terrain can be found in Section 5.3 above.

5.3.3 Overland Escape Routes

The site naturally drains towards the railway line and roads which bound the site on its southeastern edge, acting as the main receiving area for excess stormwater in the event of major storm events. The surrounding roads are well-served by existing stormwater infrastructure that caters for minor storm events, including underground pipes and culverts capable of managing significant volumes of runoff. The site's natural slope (approximately 1.5% gradient sloping towards the south/southeast boundary) supports the effective conveyance of overland runoff without significant engineering intervention.

Overland flow paths will need to be well-defined and free from obstructions such as buildings, landscaping, or other structures that could impede water flow. To minimise erosion along overland escape routes, stabilising measures such as grassed swales could be implemented.

5.3.4 Soil Runoff Potential

Stikland in Cape Town generally consists of sandy soils typical of the Cape Flats region. These soils are often classified under the Soil Conservation Service (SCS) Curve Number (CN) system as Hydrologic Soil Group A or B, depending on specific conditions.

Hydrologic Soil Group A:

- Sandy or loamy sand soils with high infiltration rates even when thoroughly wetted.
- Well-drained with low runoff potential.
- Common in Stikland if the area is predominantly undisturbed sandy terrain.

Hydrologic Soil Group B:

- Loamy soils with moderate infiltration rates.
- Moderately well-drained, with slightly higher runoff potential than Group A.
- Common in Stikland in areas with slight urbanisation or natural loamier deposits.

In urbanised zones like Stikland Industrial, soil properties can shift due to compaction and impervious surfaces, increasing runoff potential regardless of the original classification. In such cases, Group C or D classifications might apply due to altered hydrology.

5.3.5 Runoff Estimates

The Rational Method (Alternative 3) was utilised to estimate the peak runoff flows for both the existing and proposed scenarios for Stikland South. The following tables summarise the main parameters used for the estimation.

It can be seen in Table 5.3 that the time of concentration for the site is 2.22 hours. This table shows the peak flows for the site in its current state. Of particular importance for the stormwater strategy is the 50-year peak flow for the current site, which is 2.41 m^3/s. This is also the maximum peak flow that may be released from the site post development in the event of a 50-year RI storm.

Table 5.4 shows the post- development peak flows. It can be seen that the 50- year peak flow for the fully developed site is anticipated to be 5.16 m^3/s. The stormwater strategy aims to propose ways to reduce the post- development peak flow of 5.16 m^3/s to 2.41 m^3/s, whilst also achieving the other objectives of the City of Cape Town's Management of Urban Stormwater Impacts Policy.

Table 5.3: Runoff Estimation (Existing Scenario)

RATIONAL METHOD - ALTERNATIVE 3						
Description of catchment	Stikland South: Existing Scenario					
River detail						
Calculated by	PL		**Date**	03/12/2024		
Physical characteristics						
Size of catchment (A)	1.14	km^2	Weather Service Station	BELLVILLE (SAR KWEKERY)		
Longest watercourse (L)	1.5	km	Weather Service Number	0021204_W		
Average slope (S_{av})	0.015	m/m	**Area distribution factors**			
Dolomite area ($D_{\%}$)	0	%	Rural (α)	Urban (β)	Lakes (γ)	
Mean annual precipitation	518	mm	0	1	0	
Rural			**Urban**			
Total C_1 = Cs + Cp + Cv	0		Total (c_2)	100	-	0.32
Time of concentration (T_c)			Notes:			
Defined watercourse	Overland flow					
T_C = ([0,87L]^2/(1000S_av))^0,385	T_C = 0,604(rL/√(S_av	r	0.3			
		Total hours				
hours	2.219 hours	2.22				
Rainfall						
Return period (years), T	**2**	**5**	**10**	**20**	**50**	**100**
Peak flow (m^3/s), Q_T= (C_T I_T A)/3,6	0.71	1.19	1.56	1.92	2.41	2.78

Table 5.4: Runoff Estimation (Proposed Scenario)

RATIONAL METHOD - ALTERNATIVE 3						
Description of catchment	Stikland South: Proposed Scenario					
River detail						
Calculated by	RP		**Date**	13/08/2025		
Physical characteristics						
Size of catchment (A)	1.14	km^2	Weather Service Station	BELLVILLE (SAR KWEKERY)		
Longest watercourse (L)	1.5	km	Weather Service Number	0021204_W		
Average slope (S_{av})	0.015	m/m	**Area distribution factors**			
Dolomite area ($D_{\%}$)	0	%	Rural (α)	Urban (β)	Lakes (γ)	
Mean annual precipitation	518	mm	0	1	0	
Time of concentration (T_c)			Notes:			
Defined watercourse	Overland flow					
T_C = ([0,87L]^2/(1000S_av))^0,385	T_C = 0,604(rL/√(S_av	r	0.3			
		Total hours				
hours	2.219 hours	2.22				
Rainfall						
Return period (years), T	**2**	**5**	**10**	**20**	**50**	**100**
Peak flow (m^3/s), Q_T= (C_T I_T A)/3,6	2.36	1.78	2.32	2.87	3.60	4.14

Refer to Annexure F for the full runoff estimation calculations.

5.3.6 Detention Pond Sizing

For the purposes of a stormwater strategy, it is required to estimate the size, type and location of Best Management Practices (BMP) that would be employed in the development. In the case of Stikland South, the strategy for attenuating peak runoff flows is to provide detention ponds in the lower extremities of the site. It is therefore important to broadly estimate the space required for these detention ponds. The Georgia Stormwater Manual has been used for this purpose. Table 5.5 shows that approximately 5200 m^2 would be required for detention ponds on the site, and a further 17 200m^2 for swales.

Table 5.5: Detention Pond Space Requirement

STIKLAND SOUTH			
Calculated as % of Impervious area of Development		**Space Requirement (m^2)**	
Detention Pond Space Requirement (m^2)	**Area (m^2)**	**Ponds @ 3%**	**Swales @ 10%**
Size of Erf	1 140 992		
Impervious area (roads)	55 170	1655	5517
Building Footprint	116 623	3499	11 662
Building Footprint + Roads	171 793	**5154**	**17 179**

Source: Georgia Stormwater Manual, 2001

Although the Georgia Stormwater Manual recommends 3% of the site's impervious area be set aside for detention ponds, the calculations in Section 5.4.3 show that this would not be adequate. A storage volume of approximately 15000m^3 is required. It is therefore proposed that at least 7500m^2 is provided for future detention ponds on the site at an estimate depth of 2m.

No areas allocated to future stormwater ponds have been indicated on the site layouts for Stikland South; however, a detention pond is proposed at the northern and southwestern extremities of the site.

These interventions are likely to satisfy the City of Cape Town's stormwater management requirements. This will be determined in detail during a future phase of this project and will be addressed in the SWMP.

The space requirements and exact alignments and footprints for swales and ponds can be combined to achieve the most efficient storage and attenuation requirements in the next phase of the project.

The proposed site layout is presented in Annexure G.

5.4 Stormwater Quantity Management

To achieve the flood prevention and mitigation objectives in the City of Cape Town's policies, the City's recommendations include the following criteria:

- 24 hour extended detention of the 1- year RI, 24h storm event.
- Up to 10- year RI peak flow reduced to pre- development level.
- Reduce the 50-year RI peak flow to existing-development level.
- Evaluate the effects of the 100-year RI storm event on the stormwater management system, adjacent property, and downstream facilities. Manage impacts through detention controls and floodplain management.

5.4.1 1-year RI Design Storm Event

24 hour extended detention of the 1- year RI, 24h storm event will be achieved by designing a suitable orifice in the outlet structure and by allowing adequate dead storage volume in the proposed detention ponds. Runoff water captured in the dead storage volume will infiltrate the soil and replenish the ground water, thereby achieving a secondary aim of the City of Cape Town's policy. A small orifice would be designed in the detention pond outlet structure to release the required flow over a 24 hour period following a 24 hour storm.

5.4.2 10-year RI Design Storm Event

This policy requirement necessitates the reduction of up to the 10- year RI peak flow to pre- development level.

The pre-development peak runoff flow for the 10- year RI design storm event has been calculated as being 1.31 m^3/s. The full calculation is presented in Annexure F. The post-development peak runoff flow for this design storm event has been calculated as being 1.78 m^3/s. This means that the latter value would need to be reduced to the former by means of attenuation. This will addressed in the SWMP, but it is anticipated that a suitably sized orifice would be designed in the detention pond outlet structure to release the required flow and the efficient use of swales and best management practices.

5.4.3 50- year RI Design Storm Event

The City of Cape Town policy requires the 50-year RI peak flow to be reduced to existing-development level. This policy objective has been assessed in detail and preliminary calculations were done to estimate the likely quantum of attenuation required. It is anticipated that this policy requirement will govern the sizing of the detention ponds. The hydraulic performance of the system will need to be further developed at SWMP stage.

Utilising the peak flows calculated in Section 5.3.5 above, the following hydrographs were generated for the 50-year storm:

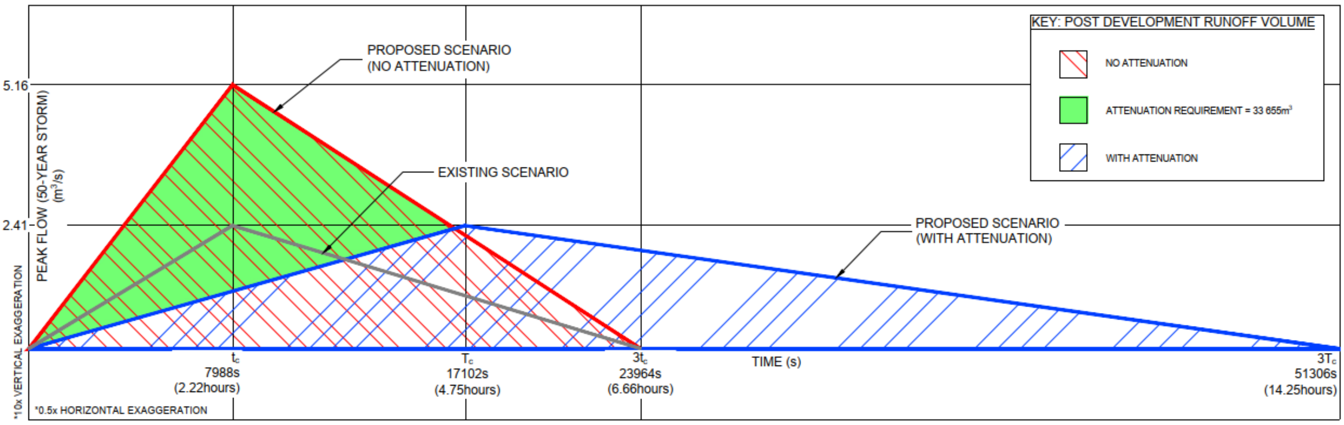

Figure 5.1: Peak flows & attenuation volume requirement (50-year storm)

- The future development's peak flow must be reduced from 3.60m³/s to 2.41m³/s for the 50-year storm.
- The required volume for attenuation has been determined and is illustrated in Figure 5.1 by the green hatching. This represents the required detention volume in order to reduce the peak flows.
- The detention storage volume for the 50- year storm event has been calculated as being approximately 15000m³.
- This would require at least 7500m² of area to be made available for detention ponds on the site, and the average depth of the ponds would be approximately 2.0m.

5.4.4 100- year RI Design Storm Event

The impact of the 100- year RI design storm event will need to be assessed when the Stormwater Management Plan (SWMP) is developed for the site. However, it is anticipated that the significant peak flow attenuation proposed above would mitigate the risk of damage to downstream infrastructure, facilities and properties.

5.5 Stormwater Quality Improvement

To achieve the water quality improvement objectives in the City of Cape Town's policies, the City's recommendations include the following criteria:

- Design storm event for water quality treatment: ½ year RI, 24 hour storm
- Pollutant removal target: SS – 80% ; TP – 45%
- Trap litter, oil and grease at source

The volume of stormwater runoff which must be treated on the future site due to the development is approximately 8500m^3. This value was obtained by multiplying the 0.5-year 24hour rainfall depth (15.6mm) over the area of the site (114ha), scaled by a C factor of 0.4775.

In terms of the Georgia Stormwater Manual, pollutant removal targets can be achieved through the implementation of detention ponds and/or swales. Litter will be trapped by means of trash racks, which would be installed at the detention pond outlets. Oil and grease separators will be considered where appropriate.

5.6 Proposed Infrastructure

5.6.1 System Design

The stormwater infrastructure proposed for the future development of the Stikland South site will comprise a combination of piped underground infrastructure and surface-level storage and treatment facilities. Key components will include:

- Conveyance systems (kerbs & channels, inlets, pipes, culverts, etc.)
- Storage facilities (detention ponds)
- Treatment facilities (bioswales, sediment traps, oil & grease separators)

5.6.2 Maintenance

Maintenance of the future site's stormwater system largely involves ensuing that catch pits and grid inlets on the site are kept clear and free of debris, as per the City's operating procedures.

Inlets, outlets, and chambers (if any) for the proposed detention pond would also require regular cleaning as per the usual operating procedures, with additional cleaning efforts required after big storm events where debris and other blockages could potentially hamper the efficiency of the pond.

5.7 Regulatory and Policy Framework

The following policies govern the management of stormwater on new developments in the City of Cape Town:

- *Management of Urban Stormwater Impacts Policy* (City of Cape Town, RIM, Catchment, Stormwater and River Management Branch)
- *Floodplain and River Corridor Management Policy* (City of Cape Town, RIM, Catchment, Stormwater and River Management Branch) – not applicable to this development.

According to the City of Cape Town's *Management of Urban Stormwater Impacts Policy* all stormwater management systems shall be planned and designed in accordance with best practice criteria and guidelines laid down by Council, to support Water Sensitive Urban Design principles and the following specific sustainable urban drainage system objectives:

- *Improve quality of stormwater runoff;*
- *Control quantity and rate of stormwater runoff*;
- Encourage natural groundwater recharge.

5.8 Groundwater Recharge & Stormwater Reuse Opportunities

5.8.1 Soil and Aquifer Characteristics

The Cape Flats aquifer underlies much of the region, including Stikland, and is known for its high infiltration potential in sandy soils. These characteristics may make the area suitable for managed aquifer recharge (MAR) using stormwater.

5.8.2 Stormwater Infiltration Techniques

- Permeable Surfaces: Introducing permeable pavements in urbanised areas can enhance infiltration at the source.
- Swales and Trenches: Bioswales or infiltration trenches can direct water and allow infiltration.

5.8.3 Environmental Benefits

- Reduced runoff and associated flood risks.
- Replenishment of groundwater levels.

5.8.4 Challenges and Considerations

- Water Quality: Pre-treatment may be necessary to remove pollutants like oils, heavy metals, or nutrients before infiltration.
- Groundwater Protection: Ensure infiltration sites are away from potential contamination sources, such as industrial areas or waste sites.

5.8.5 Stormwater Reuse Opportunities

- Non-Potable Applications:

  Treated stormwater can be reused for irrigation of parks and green spaces in Stikland, industrial cooling, or toilet flushing in buildings.

- Capture and Storage Systems:
  - Rainwater Harvesting: Rooftop and surface runoff can be collected and stored for reuse.
  - Detention and Retention Ponds: These can double as water storage facilities for reuse purposes.
- Industrial Use in Stikland:

  Stikland's industrial zone could benefit from reusing treated stormwater for non-potable processes, reducing reliance on municipal water supplies.

5.8.6 Regulatory and Policy Alignment

Local guidelines like the City of Cape Town's *Water Strategy* should be consulted, which promotes stormwater as a resource.

6 MACRO IMPACT ASSESSMENT

6.1 Potable Water

The main supply for the site appears to be via a DN225 water main at the intersection of Old Paarl Road and De La Haye Avenue. This will need to be confirmed by a survey.

The City of Cape Town will be engaged to conduct a demand assessment to confirm available capacity or any constraints in terms of the estimated AADD of 919.18kℓ/day.

6.2 Foul Sewer

Stikland South's foul sewer is treated at the Bellville WWTW. At the time of our previous investigation in 2022, it was noted that the WWTW has an unallocated treatment capacity of approximately 15Mℓ, which is more than sufficient for the development's discharge which is estimated to have a foul sewer treatment demand of 840.62kℓ/day.

The main connection for the site's foul sewage appears to be a DN200 pipeline crossing Old Paarl Road near De La Haye Avenue. The City of Cape Town will be engaged to conduct a demand assessment to confirm available capacity.

6.3 Stormwater

The development will convert undeveloped and underutilised land into urbanised areas, which will increase impervious surfaces (e.g., roads, buildings), leading to higher runoff.

The site is approximately 114 hectares in area, with 25 hectares already developed. This expansion will significantly impact the volume and rate of stormwater runoff, especially during heavy rainfall events.

The proposed development will require new stormwater infrastructure to manage the increased runoff. A large detention pond with a capacity of approximately 15000m^3 will be required, together with 17500m^2 of swales. Stormwater quality may be improved by trash racks at the detention ponds, sediment traps, and oil/ grease separators.

The existing stormwater infrastructure (e.g., DN300 and DN375 pipes) will need to be assessed and likely upgraded to accommodate the increased stormwater flow and to avoid localised flooding.

6.4 Solid Waste

The development will shift the site from underutilised land to a mixed-use urban area, resulting in significantly higher solid waste generation. However, as the site is within a developed area, the existing municipal waste collection system (e.g., via the City of Cape Town) can likely accommodate the additional waste expected. The Bellville South Landfill, located approximately 8 km away, will serve as the primary disposal site. Other facilities like the Athlone Transfer Station (20 km) and Coastal Park Landfill (36 km) could also be utilised if needed.

7 CONCLUSIONS & RECOMMENDATIONS

7.1 Potable Water

The proposed Stikland South development will generate an estimated annual average daily demand (AADD) of 919.18kℓ/day for potable water. The existing DN225 water in De La Haye Avenue will likely have sufficient capacity to accommodate this demand, but this must be confirmed through a capacity assessment by the City of Cape Town.

Recommendations:

1. Conduct a detailed demand assessment to confirm available capacity in the local distribution system.

2. Ensure connection fees, estimated at R1,000,000 per development block, are budgeted.

3. Design and implement water conservation measures, such as low-flow fixtures, to manage long-term demand.

7.2 Foul Sewer

The proposed Stikland South development is estimated to produce a foul sewer discharge demand of 840.62kℓ/day. Bellville Wastewater Treatment Works (WWTW) has an unallocated treatment capacity of 15 Mℓ/day, sufficient to treat the anticipated load; however, the sewerage system itself must be checked for capacity.

Recommendations:

1. Confirm the capacity and condition of the existing sewer lines bordering the site, particularly the DN150 pipelines.

2. Ensure alignment with City of Cape Town's sewer master plan.

3. Consider incorporating sustainable wastewater practices, such as greywater recycling, to reduce pressure on the municipal system.

7.3 Stormwater

The proposed development at Stikland will have a notable impact on stormwater management, primarily due to the increase in impervious surfaces and the associated runoff. The development will need to incorporate comprehensive stormwater management systems to mitigate flood risks, improve water quality, and enhance groundwater recharge opportunities. It will require the design of upgraded infrastructure and the integration of sustainable water management practices to align with environmental goals and regulatory standards.

Recommendations:

1. Implement detention ponds with a total storage volume of approximately 15000m^3 to meet quality and quantity objectives.

2. Implement swales with a total area of approximately 17200m^2 to complement the management and treatment of runoff by the detention pond.

3. Upgrade the existing stormwater infrastructure, including pipes and culverts, to accommodate increased runoff.

4. Consider the use of Water-Sensitive Urban Design (WSUD) techniques such as permeable pavements and rain gardens to promote infiltration and reduce runoff volumes.

5. Regular maintenance of the stormwater system, including trash racks and sediment traps, to ensure long-term functionality.

7.4 Solid Waste

The development will increase solid waste generation due to higher population density and land use changes. However, the existing municipal waste collection and disposal system, including the Bellville South Landfill located 8 km away, is expected to accommodate this additional volume.

Recommendations:

1. Implement an Integrated Waste Management Plan (IWMP) to address waste collection, storage, and recycling requirements.

2. Provide on-site storage options, including mobile refuse bins and bulk containers, to ensure proper waste segregation and collection.

3. Consider incorporating some of the City's initiatives to promote waste reduction and recycling.

4. Ensure that roads and infrastructure are designed to accommodate waste collection vehicles.

5. Allocate resources for street cleaning and litter management to prevent blockages in stormwater and sewer systems.