Appendix D3: Structural and Civil Engineer Design Report

Reg. No.: 2001/001 094/23
Reg. Vat.: 414 0208440

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Our ref: T 1568/RE//001
Date: 18 February 2025

ATTENTION: Mr. Brad Wale

ERF 4351, THEESCOMBE, PORT ELIZABETH – PROPOSED RESIDENTIAL DEVELOPMENT CIVIL SERVICES DESIGN REPORT

1. BRIEF

The offices of Elwandle Projects is appointed as the Structural and Civil Engineers for the design and supervision of the proposed residential development on Erf 4351, in Theescombe.

The development consists of 87 sectional title units with internal roads for vehicular traffic movement.

2. SCOPE OF CIVIL ENGINEERING WORKS

The Scope of Structural Services is for the following:

- Evaluate the Geotechnical Report prepared by a specialist
- Develop a design principle based on the Geotechnical Report.
- Design the structural system for the foundations, at grade as well as suspended slabs and staircases.
- Determine floor levels to avoid flooding in conjunction with Civil drawings
- Design of Civil Services including Roads, Stormwater, Sewer and Water Reticulation
- Monitor construction on site.
- Certification of works on completion.

3. LOCALLITY PLAN

4. SITE TOPOGRAPHY

The property naturally slopes longitudinally from West to East with lesser crossfall from South to North across the site. The lowest point of the property is close the proposed entrance road in the North-Eastern corner of the property.

All stormwater currently flows overland and there no formal stormwater management system on site which we could visibly see. It has to be noted that parts of the property are covered by think bush and trees and may be possible that are stormwater control measures in place which are not visible at the time. Once the property is cleared, we will verify on site.

5. CIVIL SERVICES

5.1 Stormwater

The proposed internal stormwater network for the development will be designed to accommodate a storm of up to a 1:50 year recurrence interval. The municipal requirements call for the stormwater discharge from the proposed development to be throttled and not exceed the pre-development stormwater runoff volumes. In order to accommodate the above-mentioned requirements, a stormwater attenuation facility will be built on erf 4351 as part of the development to manage the stormwater generated by the development. The pond will be positioned in the public open space on the lower side of the property.

The existing stormwater infrastructure in the area surrounding the proposed property comprises of an existing municipal stormwater pipe located in the verge of Bergeus Street towards the Northern side of the development. Our study of the surrounding area, the site layout and topographical survey, showed that this is only feasible connection point for stormwater although it involves construction of a new stormwater pipeline along Saar Avenue towards the municipal stormwater pipe network.

The proposed on-site stormwater network will comprise of a series of precast concrete pipes and channels used in conjunction with various catchpits, to gravitate the stormwater towards the North-Eastern and lowest side of the erf. The above-mentioned attenuation facility will be built in the same area (in the Public open space) within the development and comprise of a grassed pond of roughly 1.3m deep and 1350m³ in volume.

The attenuation pond will be facilitated with an outlet pipe of appropriate size to achieve the required attenuation effect and connect to the existing municipal infrastructure mentioned above.

As far as possible, stormwater generated by the proposed development will discharge into the attenuation pond before draining into the existing municipal infrastructure. The amount of stormwater not draining into the pond will be minimized.

Based on the provisional development layout provided, we estimate the pre-development 1:50 year stormwater runoff to amount to 206 L/s. In turn the expected stormwater runoff after the development has been established is estimated to be 411L/s. The pond will be designed and sized in the detailed design phase in order reduce the post development runoff to be as close as possible to the pre-development runoff as calculated above. The pond will be discussed in detail with the local authorities in terms of its requirement. The current stormwater runoff intensity being discharged into the existing municipal infrastructure will therefore not be increased by a significant margin.

5.2 Water Reticulation

The Human Settlement Design Guidelines (HSDG) provides water usages ranging from the lower to the upper limit and is based on the density of dwelling units per ha.

The density of the development in question is 20 Units per hectare. The given water usage for this density ranges from 600-800 l/unit / day. For the purpose this report we are assuming the lower limit for water usage. Based on this and the number of units, we estimate water usage for the development to be as follows:

Density	Total No.	Water Consumption Rate	Total Water Consumption
20 Units / ha	87 Units	600 L / unit / Day	52'200 L/Day
Total Development Water Consumption (AADD)			**52'200 L/Day**

In using the peak factors for demand zone, a peak factor of 2.2 can be derived which translates to a **Peak Daily Demand equal to 1.329 L/s.**

Based on the GIS information received from Municipality and the site survey information, there are existing 160mm municipal water mains located in Bergeus. The water network in this area is fed from the Chelsea Reservoir with a TWL of 235m. With the higher NGL on the property being roughly 178m, it will yield a static pressure head of 58m or 5.8 bar.

Based on the information set out above, we will utilize a 90mm diameter water connection to the property to ensure adequate flow rates and residual pressures, once friction losses in the pipelines and fittings have been accounted for. An internal pipe network, comprising of UPVC and HDPE pipes with sizes ranging from 90mm to 50 mm, will supply the various dwelling units and fire hydrants as required throughout the development.

Lastly, the water meter and chamber will be positioned next to the security hut at the main entrance to the development for ease of access.

5.3. Sewer Reticulation

The Human Settlement Design Guidelines (HSDG) provides water usages ranging from the lower to the upper limit and is based on the density of dwelling units per ha.

The density of the development in question is 20 Units per hectare. The given sewer runoff for this density ranges from 600-800 l/unit / day. For the purpose this report we are assuming the lower limit for sewer runoff. Based on this and the number of units, we estimate water usage for the development to be as follows:

Based on this we estimate the peak sewer runoff volumes as follows:

Density	Total No.	Sewer Runoff Rate	Total Sewer Runoff
20 Unit / ha	87 Units	600 L / unit / Day	52'200 L/Day
Total Development Sewer Runoff (AADD)			**52'200 L/Day**

In using the peak factors for demand zone, a peak factor of 2.2 can be derived which translates to a **Peak Daily Sewer Runoff equal to 1.329 L/s.**

The internal sewer reticulation network will comprise of a series of interconnected 110mm and 160mm Class 300kpa UPVc sewer pipes installed at a minimum 1:60 /1:80 gradient, depending on the calculated flow velocity. Gradients and pipe sizes will be designed during the detailed design phase to ensure that the flow velocity is maintained at around the 0.7 m/s self-cleansing velocity.

The drainage of the entire development will be gravitated towards the North-Eastern corner of the property. A new bulk sewer line will be extended from the existing sewer line in Bergeus Street to serve the new development.

5.4 Roadways and Parking

All internal roads forming part of the development will comprise of paved surfaces with engineered layer works below it. Pre-cast kerbs will be used to define the road edges and while also acting as a guide for overland stormwater flow where necessary.

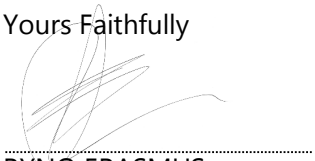
The development will have a singular dedicated entrance off Saar Avenue as per the SDP.

6. **CONCLUSION**

The site conditions and bulk services for the development is such that no special design considerations were required for the development structure.

We trust that you would find the Design Report in order and we are at your disposal should you require any further design information.

Yours Faithfully



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Annexure A: Stormwater Calculations

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Rational Method

1:50 YEAR Pre-DEVELOPMENT

Return Period		50	years
Mean Annual Rainfall (MAR)		450	mm
Terrain		Flat/Permeable	
Area Distribution	Rural	0	%
	Urban	100	%

Rural

Component	Classification	%	Factor	C_s
Surface Slope (C_s)	Vleis and Pans (<3%)	0	0,01	0
	Flat Areas (3 to 10%)	0	0,06	0
	Hilly (10 to 30%)	0	0,12	0
	Steep Areas (>30%)	0	0,22	0
	Total	0	-	**0**
Permeability (C_p)	Very Permeable	0	0,03	0
	Permeable	0	0,06	0
	Semi-permeable	0	0,12	0
	Impermeable	0	0,21	0
	Total	0	-	**0**
Vegetation (C_v)	Thick Bush / Plantation	0	0,03	0
	Light Bush / Farm Lands	0	0,07	0
	Grasslands	0	0,17	0
	No Vegetation	0	0,26	0
	Total	0	-	**0**

Urban

	Use	%	Factor	C_2
Lawns	Sandy, flat (<2%)	0	0,075	0,000
	Sandy, steep (>7%)	10	0,175	0,018
	Heavy soil, flat (<2%)	0	0,150	0,000
	Heavy soil, steep (>7%)	90	0,300	0,270
Residential Areas	Houses	0	0,400	0,000
	Flats	0	0,600	0,000
Industry	Light Industry	0	0,650	0,000
	Heavy Industry	0	0,750	0,000
Business	City Centre	0	0,825	0,000
	Suburban	0	0,600	0,000
	Streets	0	0,825	0,000
	Maximum Flood	0	1,000	0,000
	Total	100	-	**0,288**

Adjustment Factor - F_t	0,83
Rural C_1	0,000
Urban C_2	0,288
Combined C_T	**0,288**

Flow Path	Overland Flow

Roughness Coefficient - r	0,3		
Hydraulic Length - L	357	m	
Height of most remote point - H	9	m	
Area - A	43284	m^2	4,328 ha
Area Reduction Factor - ARF	100,000		
Reduced Area - A	43284	m^2	4,328 ha

Time of Concentration - T_c	0,503	hrs	30,153 min
Point Rainfall	30	mm	
Rainfall Intensity - I	59,695	mm/hr	

Peak Flow - Q	**0,206**	m^3/s
	206,349	ℓ/s

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Return Period		50	years
Mean Annual Rainfall (MAR)		450	mm
Terrain		Flat/Permeable	
Area Distribution	Rural	0	%
	Urban	100	%

Rational Method

1:50 YEAR Post-DEVELOPMENT

Rural				
Component	**Classification**	**%**	**Factor**	**C_s**
Surface Slope (C_s)	Vleis and Pans (<3%)	0	0,01	0
	Flat Areas (3 to 10%)	0	0,06	0
	Hilly (10 to 30%)	0	0,12	0
	Steep Areas (>30%)	0	0,22	0
	Total	0	-	**0**
Permeability (C_p)	Very Permeable	0	0,03	0
	Permeable	0	0,06	0
	Semi-permeable	0	0,12	0
	Impermeable	0	0,21	0
	Total	0	-	**0**
Vegetation (C_v)	Thick Bush / Plantation	0	0,03	0
	Light Bush / Farm Lands	0	0,07	0
	Grasslands	0	0,17	0
	No Vegetation	0	0,26	0
	Total	0	-	**0**

Urban				
	Use	**%**	**Factor**	**C_2**
Lawns	Sandy, flat (<2%)	25	0,075	0,019
	Sandy, steep (>7%)	0	0,175	0,000
	Heavy soil, flat (<2%)	0	0,150	0,000
	Heavy soil, steep (>7%)	0	0,300	0,000
Residential Areas	Houses	40	0,400	0,160
	Flats	0	0,600	0,000
Industry	Light Industry	0	0,650	0,000
	Heavy Industry	0	0,750	0,000
Business	City Centre	0	0,825	0,000
	Suburban	0	0,600	0,000
	Streets	35	0,825	0,289
	Maximum Flood	0	1,000	0,000
	Total	100	-	**0,468**

Adjustment Factor - F_t	0,83
Rural C_1	0,000
Urban C_2	0,468
Combined C_T	**0,468**

Flow Path	Overland Flow

Roughness Coefficient - r	0,04		
Hydraulic Length - L	475	m	
Height of most remote point - H	8	m	
Area - A	43284	m^2	4,328 ha
Area Reduction Factor - ARF	100,000		
Reduced Area - A	43284	m^2	4,328 ha

Time of Concentration - T_c	0,246	hrs	14,774 min
Point Rainfall	18	mm	
Rainfall Intensity - I	73,101	mm/hr	

Peak Flow - Q	**0,411**	m^3/s
	410,892	ℓ/s

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