Annexure H

Bulk Civil Services Report

PROPOSED TOWNSHIP ESTABLISHMENT ON FARM THE KLOOF 2921 (BLOEMFONTEIN, FREE STATE)

Bulk Civil Services Report

14 October 2016

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IVOYO
PROJECT DEVELOPMENT CONSULTANTS

Report no: 9001_77 The Kloof 2921

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PROPOSED TOWNSHIP ESTABLISHMENT ON FARM THE KLOOF 2921 (BLOEMFONTEIN, FREE STATE)

Bulk Civil Services Report

1. Introduction

Ivoyo Project Development Consultants was requested by Mr. N Devenish from MDA to compile a Bulk Services Report in order to investigate the effect that the establishment of proposed township on The Kloof 2921 will have on existing infrastructure, as well as recommendations on upgrades that might be required.

The site was visited by us and as built information was collected from Mangaung Metro Municipality as well as neighboring developments in order to review the capacity of the existing infrastructure and to verify if spare capacity existed.

This Report reflects the findings of this investigation and makes recommendations regarding the feasibility of such a development in terms of the water, sanitation, stormwater and road access.

2. Current Conditions

The Kloof 2921 is currently registered as a farm with an area of 49 Hectare (Refer to attached S.G. 585/80). The area is currently accessed from the R700 from a formalized intersection completed under the Somerton Development.

The topography of the area varies from steep (2% slopes) to very steep with embankments measuring as steep as 42%. The terrain drains in an a North Westerly direction towards the farm Portion 1/2165 and Somerton Development

The Geology from our visual inspection seems mostly to consist of impermeable rock with an overlay of transported sands and silts.

3. Proposed New Development

The development will consist of mixed land use development with predominantly residential uses as well as a light industrial component. Below is a summary of the expected density from the development.

➢ Single Residential	39	Units
➢ Retirement village	80	Units
➢ Caring resort	120	Beds
➢ Hospital	300	Beds
➢ Gen Residential	179	Units
➢ High Rise Multiple dwellings	1350	Units
➢ Light Industrial	24 349	m^2

4. Sanitation

4.1 Design Criteria

The design criteria are based on the "Guidelines for Human Settlement Planning and Design" or the Red Book as it is commonly known as well as the criteria as set out by the Mangaung Metro Municipality.

The runoffs from the proposed residential units are based on the following criteria:

- The average daily dry weather sewerage production (ADWF) for Single residential and general Residential units will be taken as a 1 000 l/unit/day (High income group, Red Book Table C1).
- The average daily dry weather sewerage production (ADWF) for erven zoned as "Retirement Village" an average daily flow of 750 l/unit/day (Middle income group, Red Book Table C1).
- The average daily dry weather sewerage production (ADWF) for erven zoned as "High rise Multiple dwellings" an average daily flow of 500 l/unit/day (low income group, Red Book Table C1).
- Light Industrial could be left out of the peak wet weather flow calculation as it do not peak at the same time as residential units. The average daily dry weather sewerage production (ADWF) will be taken as 10 000 l/hec/day (Mangaung Metro Municipality).
- The average daily dry weather sewerage run-off for hospitals and caring resorts will be taken as 230 l/bed/day (Mangaung Metro Municipality).

- The recommended peak factor (Pf), as per the Red Book, calculates to 2.0 for the North West outfall with an equivalent erven of 1056 and 3.5 for the South West outfall with an equivalent erven of 17.
- A 15% will be allowed for rainwater infiltration (fvw).
- Thus the peak wet weather flow (PWWF) will be calculated by multiplying the ADWF with the Pf and fvw.

Table 1: Sewage Flow

Description	Number of Erven	Area of Erven	Average Flow	Unit	Average Dry Weather Flow	Peak Wet Weather Flow
South West Drainage Area						
Single Residential	17	14958	1000	l/day/du	17000	0.79
					Total PWWF	**0.79**
North West Drainage Area						
Single Residential	22	15962	1000	l/day/du	22000	0.59
General Residential	179	54357	1000	l/day/du	179000	4.77
Retirement Village	80	54728	750	l/day/du	60000	1.60
High rise multiple du	1350	65211	500	l/day/du	675000	17.97
Caring Resort	120	10000	230	l/day/bed	27600	0.73
Hospital	300	41794	230	l/day/bed	69000	1.84
Light Industrial	2.5 hec	24349	10000	l/hec	24349	0.65
					Total PWWF	**28.14**

4.2 Results of Analysis

As per the requirements of the municipality, the developer must confirm that his development does not negatively affect the current sewer infrastructure.

The North West outfall can ideally link into the development of Summerton adjacent to it. Currently the sewer capacity within Summerton is limited to 15l/s and will it be preferable to rather construct a new Sewer line adjacent to Summerton with some sewer which can be accommodated within the Summerton Development.

Currently the Bulk outfall sewer from Summerton Boundary will also experience capacity problems (as depicted in attached drawings 9001-77-0-600 to 602) and will be required that these lines be upgraded in order to accommodate the proposed development.

We have also made contact with the operator of the Woodland hills Lifestyle Estate Sewer Works and have establish that the current inflow to the works are in the order of 3.1Ml/day. The current plant have a capacity of 5Ml/day and thus is there spare capacity of 1.9Ml/day still available.

Taking into consideration the fact that the area will firstly drain to a pump station located North East of the development next to the N2 Highway (Refer to attached drawing 9001-77-0-600) it can be assumed that the flow to the works will be out of peak and will also reduce the impact on the existing Sewer plant.

Based on our calculations and the available information the existing sewer infrastructure has insufficient capacity to accommodate the additional sewage runoff generated from the proposed new developments, and will Bulk upgrades be required to accommodate the additional flows.

Refer to annexure A: drawing 9001-77-0-600 and 9001-75-0-602 for the sewer runoff drawings.

5. Water

5.1Design Criteria

The design criteria are based on the "Guidelines for Human Settlement Planning and Design" or the Red Book as it is commonly known as well as the criteria as set out by the Mangaung Metro Municipality.

The demands from the proposed residential units are based on the following criteria:

- The annual average water demand (AAWD) for erven zoned Single residential will differ due to property size and wall fall within 1200l/unit/day to 1800l/unit/day thus we assume an average of 1 500 l/unit/day (Figure 9.9: annual average daily water demand for erven in developed areas, Red Book chapter 9).
- The annual average water demand (AAWD) for erven zoned General residential and Retirement Village will be taken as 1000l/unit/day (Residential zones II and III, Red Book Table 9.14).

- The annual average water demand (AAWD) for erven zoned as "High rise Multiple dwellings" an average daily flow of 700 l/unit/day (Residential zone IV, Red Book Table 9.14).
- The annual average water demand (AAWD) for erven zoned as "light industrial" an average daily flow of 28 000l/hec/day (Mangaung Metro Municipality).
- The annual average water demand (AAWD) for hospitals and caring resorts will be taken as 700 l/bed/day (Mangaung Metro Municipality)
- The recommended peak factor (Pf), as per the Red Book, calculates to 4.5 with an equivalent erven (EE) of 1627.
- The peak daily demand is taken as 1.8
- The minimum water pressure under instantaneous peak demand will be taken as 24m

Table 2: Water Demand

Description	Number of Units	Average Flow	Unit	Annual Average Water	Peak Day Demand	Instantaneous Peak Demand
Single Residential	39	1500	l/day/du	58500	1.22	3.05
General Residential	179	1000	l/day/du	179000	3.73	9.32
Retirement Village	80	1000	l/day/du	80000	1.67	4.17
High rise multiple du	1350	700	l/day/du	945000	19.69	49.22
Caring Resort	120	700	l/day/bed	84000	1.75	4.38
Hospital	300	700	l/day/bed	210000	4.38	10.94
Light Industrial	2.5 hec	28000	l/hec	70000	1.46	3.65
				Total (l/sec)	**33.89**	**84.71**

5.2 Results of Analysis

The proposed development falls within Pentagon Park Bulk water zone which receives water from the Heuwelsig Reservoir located South West of the development. The current Bulk water line from this reservoir in the direction to the proposed development is a 400mm dia line and reduces to 200mm dia at the boundary of Wild Olive Estate.

During our desktop study we found that network pipes leading to the development will not be sufficient. We then Engaged with Bigen Africa, who is currently running the bulk master plan on behalf of Mangaung Metro Municipality, if they could indicate if capacity is available in the Pentagon Park Reservoir zone. They have responded and indicated that the Pentagon Park

Reservoir Zone are already experiencing water shortages and is a shortfall capacity reported of 3.5Ml/day.

Thus in order to provide sufficient water to the development alternative supplies should be investigated.

During consultation with Mangaung Metro Municipality it was proposed to investigate the possibility of supplying water to the area from the newly built Naval Hill Reservoir.

In our Investigation we have concluded to two options to provide sufficient water to the area.

Our first option (Refer to attached drawing no 9001-77-0-100) is to construct a new Water line from Navill Hill Reservoir which measures at 5.1km. Our calculations indicated that this pipe will have to be a 630mm dia water line in order to serve the area with sufficient water.

The second option (Refer to attached drawing no 9001-77-0-101) will be to create additional storage capacity in the area. Our proposal will be to construct an 8Ml reservoir on the boundary of Tredenham Hill Development which can be served by a 200mm dia water line from the boundary of Wild Olive Estate.

The cost for option 1 and 2 will be more or less similar and might it be more cost effective to construct the reservoir as there are less existing services that can hinder the construction. The cost for both solutions will how ever be in the order of R 10Mil to R 15Mil.

The best solution for providing water to the area will however need to be discussed with Mangaung to find the best solution that will not effect the existing infrastructure negatively.

6. Stormwater

The Kloof development drains naturally in a North Westerly direction with very steep slopes. Most stormwater are currently directed towards Summerton development. An Open channel is constructed under Summerton development with a capacity of 13.511m³/s (According to As Built drawings).

A first order analysis of the expected stormwater flow from the development was conducted and did it reveal the following results (Refer to attached drawing 9001-77-0-900 and Flood Calculation).

Table 3: Flood Analysis

Analysis Method	1:20 Year (m^3/s)	1:50 Year (m^3/s)	1:100 Year (m^3/s)
Rational	6.322	8.257	10.209

In consultation with the Summerton Development it was established that a stormwater crossing was allowed with in their development to accommodate stormwater from adjacent properties.

The stormwater crossing located in Summerton is four (4) 1200 x 600 Box culverts which indicates a capacity of 7.420m^3/s. The flow from Summerton is indicated to be in the order of 1.392m^3/s thus spare capacity available amounts to 6.028m^3/s.

Thus the current Box culverts allowed for in Summerton in our opinion falls just short of accommodating the 1:20 Year flood from the proposed development. It should however be noted that stormwater transportation culverts could be designed to divide the stormwater further thus ensuring safe flood condition for the development.

In our opinion the current Stormwater infrastructure available should be deemed sufficient and will careful design principals be applied to minimize the risk of flooding to lower laying properties.

7. Access Road

The Proposed The Kloof development will be accessed from the R700 from an existing turnoff for Summerton Development. There will also be access from Wild Olive Estate on the South Eastern boundary of the development.

A Traffic Impact Study does not form part of the scope of work for this report and will one need to be obtained in order to establish the impact the development will have on the existing infrastructure.

The current direct access to the development in our opinion is sufficient to accommodate the additional traffic expected. The external impact will how ever need to be investigated in an in depth Traffic Impact Study.

8. Conclusion and Recommendation

As can be seen from the analyses the additional demands placed on the bulk infrastructure from the development exceeds the capacities available, and will bulk upgrades be required in order to service the development sufficiently.

The Estimated Bulk Contribution that will be required by Mangaung Metro Municipality (Not taking CPA in to account) will be in the order of R 22 Mil (refer to below Calculation).

BULK CONTRIBUTIONS TO MANGAUNG METRO MUNICIPALITY

Description	Unit Contribution per service	Total Area	Total Contribution Required (Sep 2009)
Bulk water contribution	R 18.51	281359	R 5,207,955.09
Bulk sewer contribution	R 20.60	281359	R 5,795,995.40
Roads contribution	R 33.69	281359	R 9,478,984.71
Storm water contribution	R 5.10	281359	R 1,434,930.90
Total Contribution	**R 77.90**	281359	**R 21,917,866.10**

Thus sufficient Bulk contribution will be available to supply Bulk infrastructure to the development.

It is therefore our opinion that the development can be serviced and can therefore be approved.

Compiled By:
Mr. DFH Tolken (Reg Eng Tech)

Reviewed By:
Mr. L Laubscher (Pr Tech Eng, Pr CPM)

14/10/2016
Date:

ANNEXURE: A

Rational Method								
Discription of catchment	De Kloof							
River detail								Aug-16
Calculated by	AS							
Approved by								
Physcial characteristics								
Size of catchment (A)	0.58834	km^2		Rainfall region				
Longest water course (L)	1.6	km		Area distribution factors				
Average slope(S)	0.0315	m/m		Rural	Urban	Lakes		
Dolomite area								
Mean annual rainfall(MAR)	558	mm		20.00%	80.00%			
Rural				**Urban**				
Surface slope	**%**	**Factor**	**Cs**	**Decription**		**%**	**Factor**	**C2**
Vleis and pans		0.000	0	**Lawns**				
Flat area	25%	0.060	0.015	Sandy ,flat(<2%)			0	0
Hilly		0.000	0	Sandy ,steep(>7%)			0	0
Steep area		0.000	0	Heavy soil,flat(<2%)			0	0
Total	25%		0.015	Heavy soil steep(>7%)		55.00%	0.25	0.1375
Permeability	**%**	**Factor**	**Cp**	**Residential**				
Very permeable		0.000	0	Houses		20.00%	0.4	0.08
Permeable		0.000	0	Flats			0	0
Semi -permeable		0.000	0	**Industry**				
Impermeable	50%	0.210	0.105	Light industry		5.00%	0.5	0.025
Total	50%		0.105	Heavy industry			0	0
Vegetation	**%**	**Factor**	**Cv**	**Business**				
Thick bush and plantation		0.000	0	City centre			0	0
Light bush and farm -lands		0.000	0	Suburban			0	0
Grasslands	25%	0.170	0.0425	Streets		20.00%	0.8	0.16
No vegatation		0.000	0	Maximum flood			0	0
Total	25%		0.043	**Total (C2)**		100%		0.403
Time of concentration(Tc)								
Overland flow	Defined watercourse			Notes:		**State which Tc wil be used:**		
$Tc = 0.604\left(\frac{L}{S}\right)^{0.467}$	$Tc = \left(\frac{0.87L^2}{1000Sav}\right)^{0.385}$			Defined Watercourse				
0.961216201	0.36060997							
Run-off coefficient								
Return period(years)T		**2**	**5**	**10**	**20**	**50**	**100**	**Max**
Run -off coefficient C1 **(C1=Cs+cp+Cv)**		0.1625	0.1625	0.1625	0.1625	0.1625	0.1625	
Adjusted for dolimite area (C1d)		0.1625	0.1625	0.1625	0.1625	0.1625	0.1625	
Adjustment factor for initial saturation **(Ft)**		0.75	0.8	0.85	0.9	0.95	1	
Adjusted run-off coeffient (C1d x Ft)		0.122	0.130	0.138	0.146	0.154	0.163	
Combined run-off Coefficient Ct		0.346	0.348	0.350	0.351	0.353	0.355	
Rainfall								
Return period (years)T		**2**	**5**	**10**	**20**	**50**	**100**	**Max**
Point rainfall(mm) Pt		18.666	25.418	32.170	39.716	51.630	63.545	
Point intensity(mm/hr) Pit		51.763	70.486	89.209	110.135	143.175	176.216	
Area reductionfactor(%)		1.000	1.000	1.000	1.000	1.000	1.000	
Avarage intensity(mm/hr)		51.763	70.486	89.209	110.135	143.175	176.216	
Peak Flow (m^3/s) $Qt = \frac{CtItA}{3.6}$		**2.930**	**4.009**	**5.097**	**6.322**	**8.257**	**10.209**	

BIGEN AFRICA SERVICES (PTY) LTD

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Manager Engineering Services
Mangaung Metropolitan Municipality
C/O Moshoeshoe Street & George Lubbe Road
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Bloemfontein

Attention : Mr Gerhard Fritz

PRELIMINARY FEEDBACK: BLOEMFONTEIN WATER NETWORK CAPACITY ANALYSIS - DE KLOOF DEVELOPMENT

Dear Sir,

Bigen Africa was contacted by Ivoyo Project Development Consultants via your office to determine whether the existing water network of Bloemfontein has capacity for the De Kloof residential development. The development is located to the north of Pentagon Park in Bloemfontein and will have an annual average daily demand (AADD) of 1,6 Ml/day and a peak demand of 84,7 l/s.

In terms of the status quo network capacity to accommodate the De Kloof development we can give the following feedback:

- The development is situated in the Pentagon Park bulk reservoir zone; this reservoir has insufficient storage capacity and has an available storage capacity shortfall of 3,5 Ml/day.
- The 160mm diameter bulk pipeline where this development will connect to has insufficient capacity to accommodate the future development.

We confirm that we will discuss potential solutions for the preliminary modelling in the northern suburbs during our next planning meeting.

We trust that you find this in order.

Pieter Cilliers Pr.Eng
on behalf of
BIGEN AFRICA SERVICES (PTY) LTD

Copy:

Mr Dirk Tolken – Ivoyo Project Development Consultants: dirk@consulteng.co.za