PROPOSED TOWNSHIP, SITUATED IN DUMFRIES B ON PORTION 1 OF THE FARM NEWINGTON 255 KU, MPUMALANGA PROVINCE

BULK ENGINEERING SERVICES REPORT

JULY 2021, REV 1

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Abbreviations

AADD	-	Average Annual Daily Demand
ADWF	-	Average Dry Weather Flow
DWS	-	Department of Water and Sanitation
IDP	-	Infrastructure Development Plan
kℓ	-	Kilo Litres
kℓ/day	-	Kilo Litres per day
ℓ/s	-	Litres per second
m^3	-	cubic metre
MAP	-	Mean Annual Precipitation
Mℓ /day	-	Mega litres per day
PSC	-	Project Steering Committee
RWS	-	Regional Water Scheme
StatsSA	-	Statistics South Africa
VIP toilet	-	Ventilated Improved Pit toilet
WC	-	Water Committee

1 INTRODUCTION

There is a proposal to develop a township in Dumfries B, on Portion 1 of the farm Newington 255 KU, Mpumalanga Province.
This township will be of mixed land use, but will be mainly residential use.

This report outlines the engineering services needed for the proposed township, i.e. roads, water, sewer, and electricity.

2 SITE DESCRIPTION

The proposed township is situated in Dumfries B (Dumphries B), 38km west of Bushbuckridge town. Bushbuckridge is in turn 100km north from Nelspruit the capital of Mpumalanga Province. The area is administered by Bushbuckridge Local Municipality, under the Ehlanzeni District Municipality. GPS coordinates of site are 24°46'47.44"S 31°19'4.18"E.
The locality map is shown on the figures below.

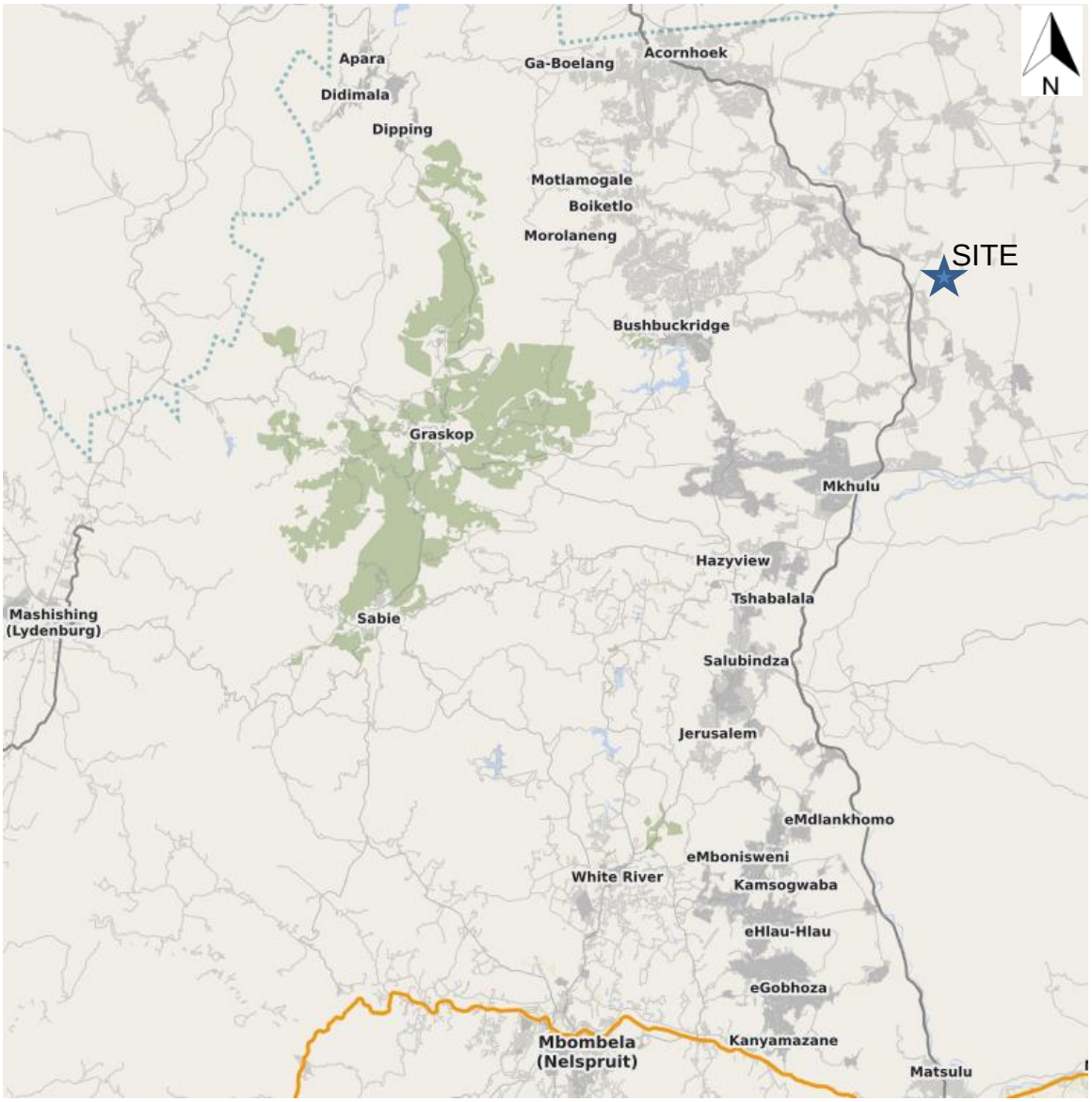

Figure 1: Locality plan

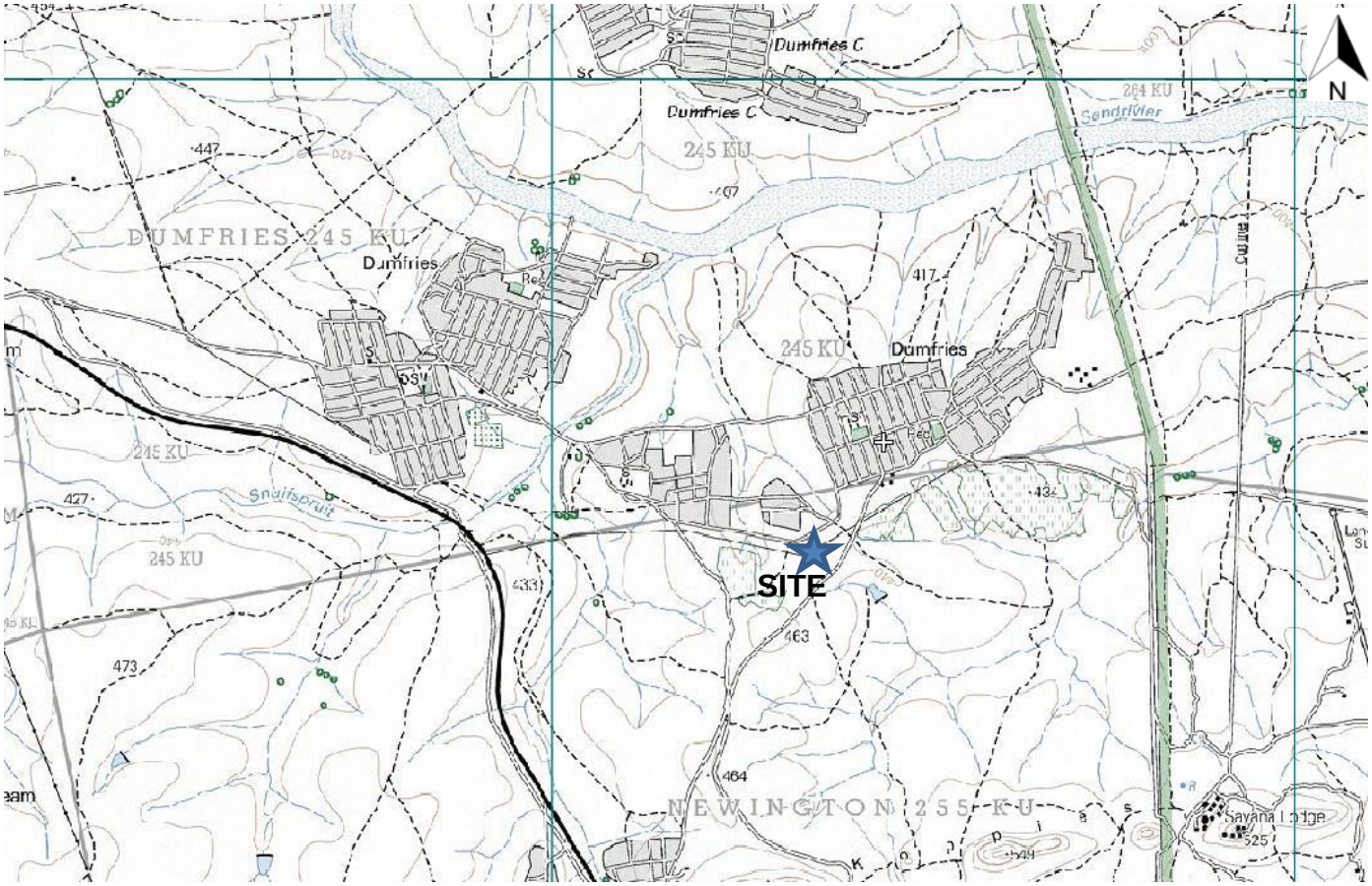

Figure 2 Site locality

3 TOWN PLANNING

The site is currently a bush and is yet to be developed. It is largely vacant, with the exception of a few existing built up structures on the northern tip of the site.

The proposed township land use is shown in the table below.

Table 1 Land use

ZONING	LAND USES	NO. OF ERF	**AREA (HA)**	**AREA (%)**	NOTATION
RESIDENTIAL 1	DWELLING UNIT	543	56.84	64.29	
BUSINESS 1	RETAIL	8	1.22	1.38	
INSTITUTIONAL	CRECHE	3	0.59	0.68	
INSTITUTIONAL	CHURCH	3	0.60	0.68	
GOVERNMENT/MUNICIPAL	MULTI-PURPOSE CENTRE	1	0.55	0.62	
PUBLIC OPEN SPACE	PUBLIC OPEN SPACE	4	10.24	11.58	
ROADS PURPOSES			18.37	20.78	
TOTAL DEVELOPABLE AREA		562	88.41	100%	

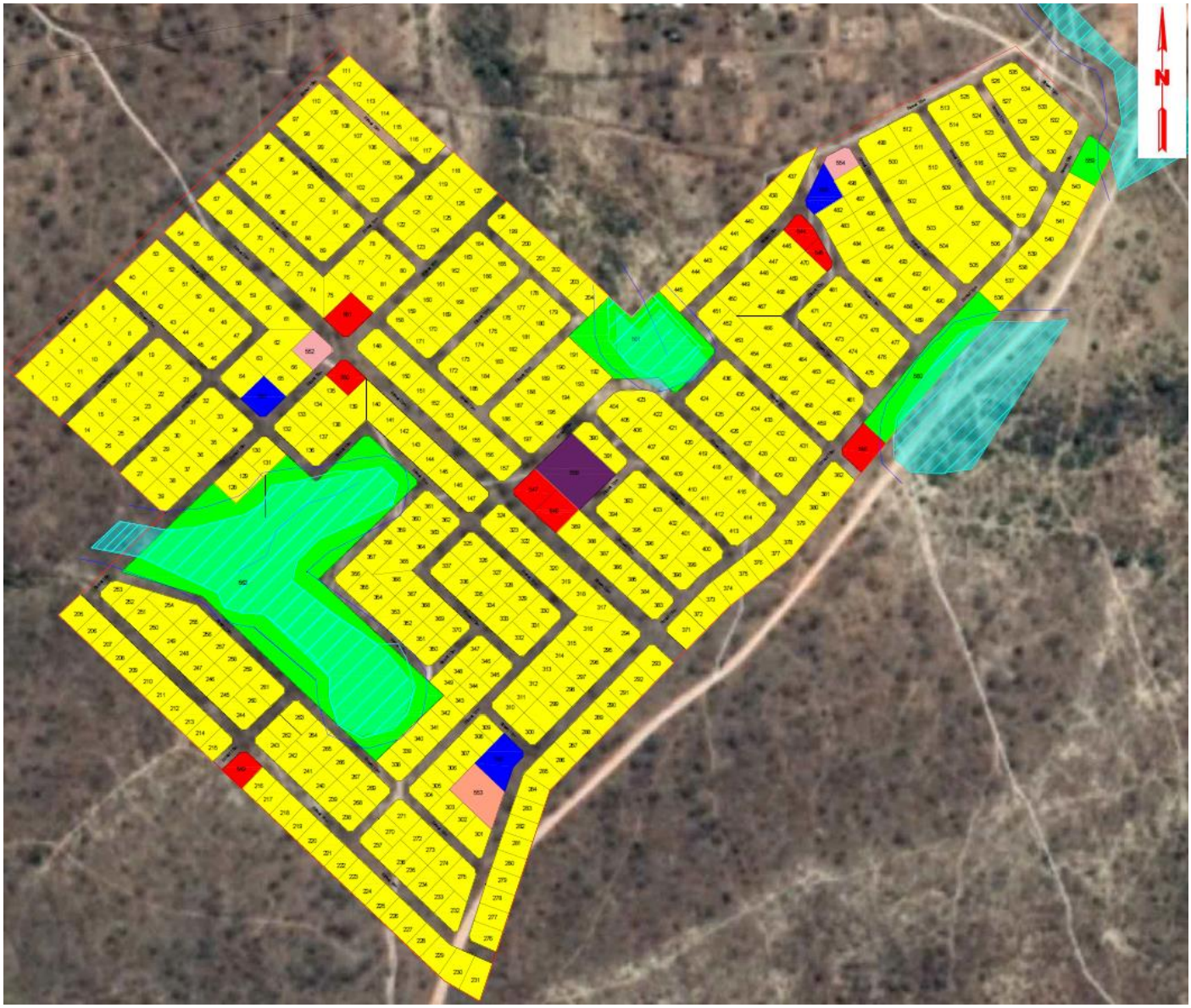

Figure 3 Proposed stands layout

4 TOPOGRAPHY AND ACCESS

The proposed township site slope is generally flat.

Figure 4 Topography

The site is can be accessed through a gravel access road D4392 liking Dumphries B to Matshaye village. This gravel access road is owned by the department of Public Works, Roads and Transport Mpumalanga and maintained through the Bohlabela - Malamule Cost Centre.

An application to connect the township to the existing access road, has to be approved by road authorities prior to construction.

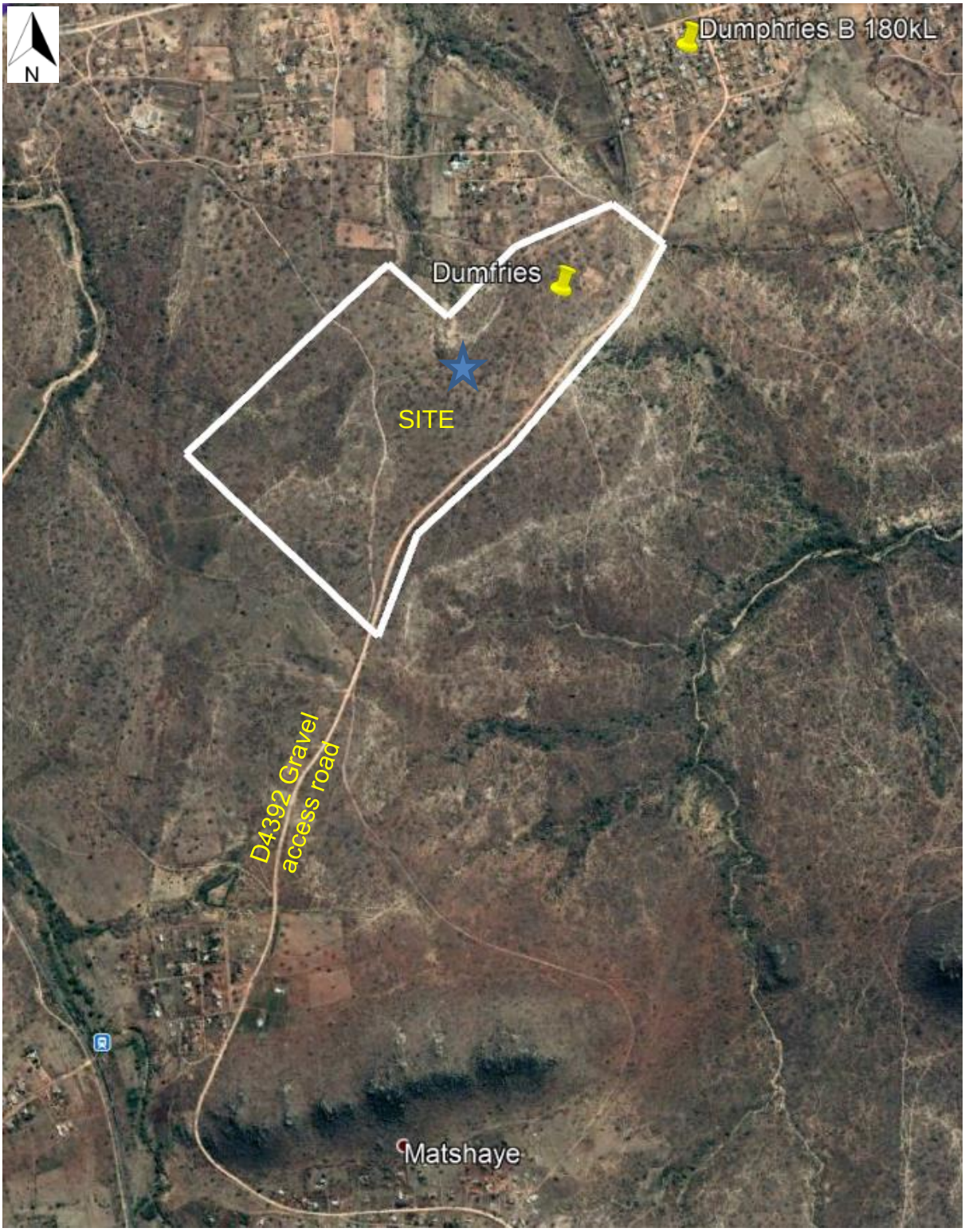

Figure 5 Road for access

5 WATER SERVICE

5.1 Water source

The Dumphries B village water source is the Inyaka Dam Bulk Water Treatment Works (WTW), whose custodian is Bushbuckridge Water. The Inyaka Dam is located at GPS coordinates 24°53'9.31"S 31° 5'4.37"E, some 42km north east to the Dumphries site. Water is conveyed from the Inyaka Bulk WTW to the existing Dumphries 600kℓ command reservoir.

The water meter records could not be obtained for further analysis.

5.2 Storage

The Dumphries 600kℓ command reservoir supplies all the Dumphries areas A, B and C.
The command reservoir feeds the Dumphries B reservoirs, viz;

- 180kℓ and 600kℓ concrete reservoirs.

There is also a ground steel water positioned next to the command reservoir. However, this steel water tank is not connected to the bulk lines.

Figure 6 Water storage

5.3 Water Bulklines

There is an existing 200mm diameter water bulk line linking the 600kℓ command reservoir to the Dumphries B 180kℓ and 600kℓ reservoirs along the D4392 road.

5.4 Water design criteria

The water design criterion to be used is listed in the table below. The water demands and fire flow were adopted from document titled: *The Neighbourhood Planning and Design Guide, Creating Sustainable Human Settlements, developed by, Department of Human Settlements, Published by the South African Government, Version 1.1, The Red Book.*

Table 2 The water design criteria

Item	Design element	Criteria
i.	Average Annual Daily Demand (AADD), for Residential 1	0.6kℓ/c/day
ii.	Group / cluster housing, Medium density	0.5kℓ/unit/day
iii.	Business / commercial, FAR = 0.4	0.65kℓ/100m^2
iv.	Park	12kℓ/hectare
v.	Municipal, FAR = 0.4	0.6kℓ/100m^2
vi.	Institutional, FAR = 0.4	0.6kℓ/100m^2
vii.	Educational, FAR = 0.4	0.6kℓ/100m^2
viii.	Industrial, FAR = 0.4	0.4kℓ/100m^2
ix.	Taxi Rank	0.3kℓ/100m^2
x.	School, crèche, educational buildings	60 ℓ/student
xi.	Hospital, building according to Floor Area Ratio (FAR)	1.2 kℓ/100m^2
xii.	Church buildings	0.3 kℓ/100m^2
xiii.	Church grounds	1.2 kℓ/Ha
xiv.	School, crèche, educational buildings	60 ℓ/student
xv.	School, crèche, educational grounds	12 kℓ/Ha
xvi.	Institutional, FAR = 0.4	0.6 kℓ/100m^2
xvii.	Sport grounds / Recreational	40 kℓ/Ha
xviii.	Residential stands; High density, small sized, with 20 to 12 units/Ha	11 kℓ/Ha/day
xix.	Flats, High density	0.35 kℓ/unit/day
xx.	Stadium: Buildings only	1.5 kℓ/1000seats
xxi.	Stadium: Grounds only	12 kℓ/Ha/day
xxii.	Hotels	0.2 kℓ/person
xxiii.	Golf estate - excluding golf course water requirements. Stand size less than 2670m^2.	3kℓ/stand/day
xxiv.	Garage or filling station	0.8kℓ/100m^2
xxv.	Frail care centres and hospitals, Building according to FAR	1.2kℓ/100m^2
xxvi.	Gross Average Annual Daily Demand (GAADD)	Allow 10% losses
xxvii.	Daily Instantaneous Peak Factor (DIPF)	1.5
xviii.	Design Peak Flow Rate (DPFR) for domestic flows.	25ℓ/s
xxix.	Maximum static head	90m
xxx.	Minimum residual head under conditions of domestic peak flow	10m
xxxi.	Maximum linear flow velocity under conditions of domestic peak flow	3m/s

Item	Design element	Criteria
xxii.	Pipe type	uPVC
xxiii.	Minimum pipe class	9
xxiv.	Fire flow at any one hydrant under the conditions of domestic peak flows (one hydrant at a time)	15 ℓ/s
xxv.	Minimum residual head (fire plus domestic peak flow)	25m
xxvi.	Maximum linear flow velocity under conditions of fire-fighting	3m/s
xxvii.	DWS storage reservoirs sizing criteria: 48 Hrs x AADD Pumped from One Source 36 Hrs x AADD Pumped from Multiple Sources 24 Hrs x AADD Gravity Source	

5.5 Water demands

The estimated water demand for the development is shown in table below.

As per the table below, the water demand calculations indicate that the development will require 526kℓ/d AADD and 578.6kℓ/d Gross Average Annual Daily Demand.

Table 3 Water demand

Land Use	No. of Erven	Area (Ha)	No. of Units	Floor Area Ratio, FAR	Unit flow	Unit of measure	Water Demand	
Residential (Dwelling Unit)	543	56.84	543		0.6	kℓ/erf/day	325.8	kℓ/d
Business 1 (Retail)	8	1.22		0.4	0.650	kℓ/100m^2	31.7	kℓ/d
Institutional (Creche)	3	0.59	100		0.060	kℓ/student	18.0	kℓ/d
Institutional (Church)	3	0.60		0.4	0.600	kℓ/100m^2	14.4	kℓ/d
Government / Municipal (Multi Purpose Centre)	1	0.55		0.4	0.600	kℓ/100m^2	13.2	kℓ/d
Public Open Space	4	10.24			12.0	kℓ/Ha	122.9	kℓ/d
Roads Purposes		18.37						
Totals	562	88.41						
Sub-total Average Annual Daily Demand (AADD)							526.0	kℓ/d
Gross Average Annual Daily Demand (GAADD) (added 10%)							578.6	kℓ/d
Gross Average Annual Daily Demand (GAADD) (added 10%)							6.7	ℓ/s
Multiply by a peak factor (Summer Peak Factor)					1.5	peak factor	867.9	kℓ/d
Multiply by a peak factor (Summer Peak Factor)					1.5	peak factor	10.0	ℓ/s

The Fire flows are presented on the table below.

Table 4 Fire flow demands

Fire category: **Moderate risk 1: Industrial, business, highrise flats ≥ four storeys**	**Quantity**	**Unit**
Total fire flow	50	ℓ/s
Duration of design fire flow	4	Hours
Minimum Flow at one hydrant (ℓ/s)	25	ℓ/s
Fire category: **Low risk: Single residential housing**		
Total fire flow	15	ℓ/s
Duration of design fire flow	1	Hours
Minimum Flow at one hydrant (ℓ/s)	15	ℓ/s

5.6 Water bulk proposed

The central area of the proposed township has elevation just over 10m below that of the command reservoir. This implies that a gravity feed alone from the command reservoir would have stands that may not receive water. A booster pump and a 20m elevated tank would suffice.

The figure below shows the proposed 2km long bulk line (in blue colour), booster pump and elevated tank, to cater for the township.

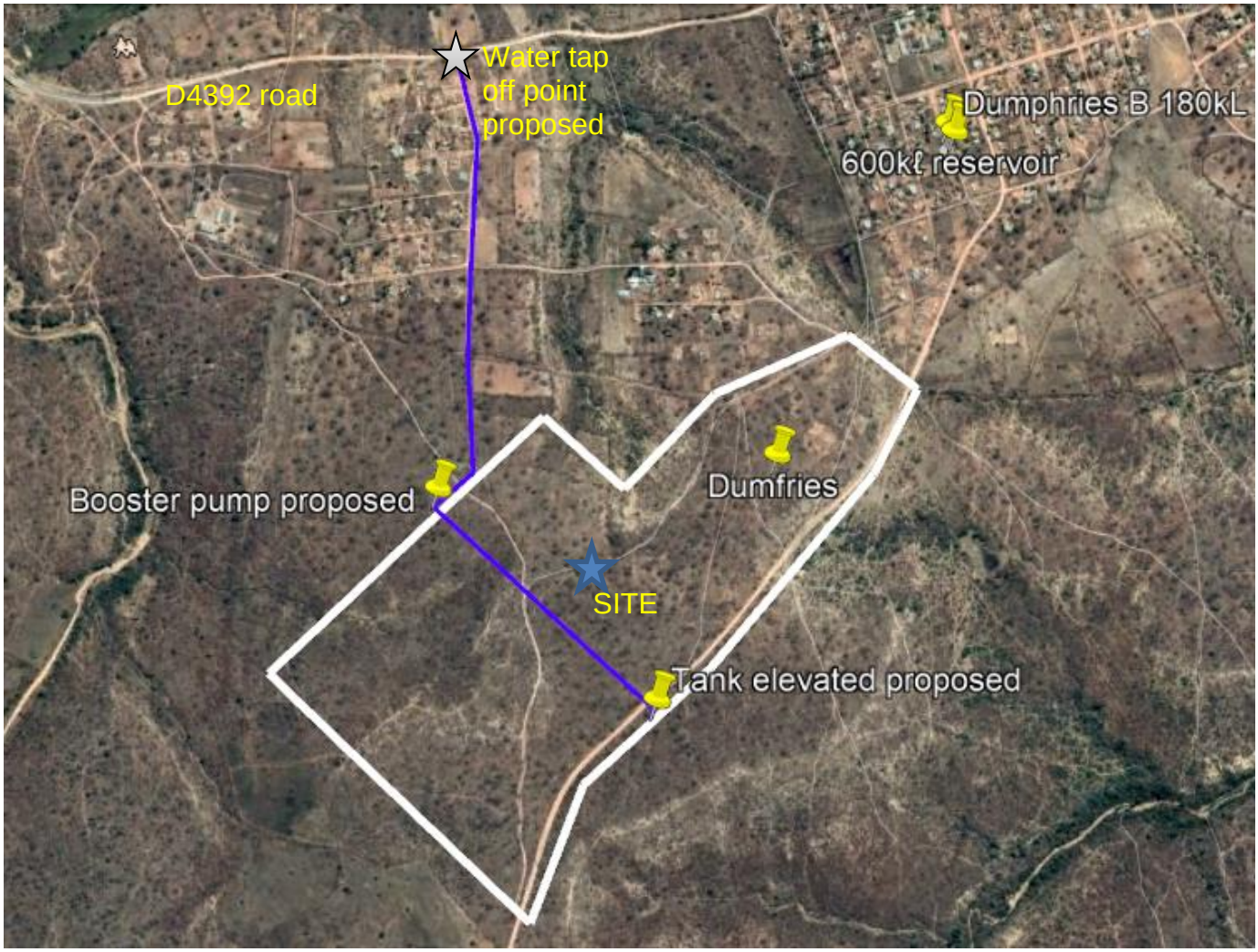

Figure 7 Water bulk line proposed

The capacity of the elevated tank proposed = 2 x AADD = 2 x 526 kℓ
= 1052 kℓ
= <u>say 1100 kℓ</u>

It is proposed that additional water sources would be needed to augment the existing water source through boreholes field with a yield of at least 6.7ℓ/s.
Water reticulation must then be constructed to service the township.

6 SEWER SERVICE

6.1 Existing Wastewater Treatment Works

Dumphries B currently has no existing wastewater treatment works.
Sewer is currently handled onsite through septic tanks and pit toilets.

6.2 Sewer flows

The design guidelines were adopted from the Red Book. The proposed development sewer flow calculations are shown in the table below.

Table 5 Sewer design flow

Land Use	**No. of Erven**	**Area (Ha)**	**Water Demand**		**Sewer Return**	**Sewer Flow**	
Residential (Dwelling Unit)	543	56.84	325.8	kℓ/d	85%	276.9	kℓ/d
Business 1 (Retail)	8	1.22	31.7	kℓ/d	85%	27.0	kℓ/d
Institutional (Creche)	3	0.59	6.0	kℓ/d	85%	15.3	kℓ/d
Institutional (Church)	3	0.60	14.4	kℓ/d	85%	12.2	kℓ/d
Government / Municipal (Multi Purpose Centre)	1	0.55	13.2	kℓ/d	85%	11.2	kℓ/d
Public Open Space	4	10.24	122.9	kℓ/d	85%	104.4	kℓ/d
Roads Purposes	0	18.37	0.0	kℓ/d	85%	-	kℓ/d
Totals	562	88.41	514.0				
Sub-total Sewer ADWF						**436.9**	**kℓ/d**
15% Extraneous flow						65.5	kℓ/d
Gross Sewer						502.4	kℓ/d
Gross Sewer Flow						5.8	ℓ/s
Peak Factor						2.5	
Peak Sewer Flow						14.5	ℓ/s

The new development will have a sewer ADWF of 436.9kℓ/d and a gross sewer flow of 502.4kℓ/d.

6.3 Sewer reticulation

Sewer reticulation must be constructed to service the township on the premise that the following must be in-place:

- A WasteWater Treatment Works (WWTW) to handle the sewer for the whole Dumphries area. Or;
- A WWTW package plant to handle the proposed township sewer flows.

A new WWTW will require a water use licence from the Department of Water and Sanitation (DWS).

If the above conditions are not met, then sewer flow may have to be handled onsite, as currently is the situation in the area.

7 Electricity

There is existing electricity supply infrastructure in the area and adjacent to the site. This can be utilised to supply the development, subject to approval from the power authority.
A separate electrical report for the development is prepared elsewhere.

Figure 8 Electrical infrastructure onsite

8 TOWNSHIP ROADS

There is an existing functioning road network that can be used to access the proposed development.
The municipality is planning to tar D4392 road from Rolle A to Dumphries A within the next few years.

The road infrastructure to service the township will be the standards of the Red Book, TMH, TRH books and the local municipality.
Main access to the township is to be gained through existing bounding road.

8.1 Classification of roads

Table 6 Classification of roads

Description	**Class no.**	**Function**	**Reserve width**	**Roadway width**
Access Road	5d	Access from existing bounding road	16m	7.4m
Internal Service Road	5f	Internal Road	13	6m
Internal Service Road	5f	Internal Road	10	6m

8.2 Geometric Design Standards

Table 7 Class 5d – Access road

Design speed	60km/h
Minimum centre line radii	50m
Minimum gradient	0.5%
Favoured maximum gradient	10%
Maximum grade/grade length	12.5% over 70m
Maximum K-value : Crest	16
: Sag	16

Table 8 Class 5f – Internal roads

Design speed	30km/h
Minimum centre line radii	30m
Minimum gradient	0.5%
Favoured maximum gradient	12%
Maximum grade/grade length	16% over 50m
Maximum K-value : Crest	6
: Sag	8

8.3 Pavement Design

The proposed pavement designs are based on anticipated traffic volumes and ground conditions, a detailed pavement design will require a geotechnical centreline investigation report.
The table below shows the proposed pavement design for the development.

Table 9 Proposed pavement design

Design	Description
Pavement	50mm Premix Asphalt / 80mm Paving blocks / Concrete
Base	150mm Thick commercially graded gravel G1 material compacted to Minimum of 88% of apparent relative density.
Subbase	300mm Thick natural gravel stabilised with Cement to create C3 material compacted to 97% of Mod AASHTO
Upper Selected Layer	150mm Thick Natural gravel G7 material compacted to 97% of Mod AASHTO Density.
Lower Selected Layer	150mm Thick Natural gravel G7 material compacted to 97% of Mod AASHTO Density.
Roadbed & Fill (where required)	150mm Thick layers compacted to 90% of Mod AASHTO Density. Minimum CBR= 3 at 90% of Mod AASHTO Density- G9

9 Stormwater Drainage

Stormwater generated onsite can be channelled to follow the natural slope of the ground, to the lowest point. It is envisioned to use Sustainable Urban Drainage Systems (SuDS) to manage stormwater runoff from the site. A stormwater management plan will need to be submitted to the municipality before construction starts. Extraneous stormwater from above the site will be accommodated over the site.

The stormwater will drain on according to the slope of the natural ground.
The topography of the site promotes the stormwater run-off effectively towards the veld.

Further development of the site will result in an increase of an impermeable surface area, resulting in an increase of the stormwater runoff.

9.1 Stormwater systems

Stormwater runoff onsite will be handled through an internal stormwater system that will be provided to drain the site in a safe and efficient way. It is proposed to make use of SuDS to manage the stormwater runoff before being discharged into the natural water courses.
Stormwater discharge control will be applied in order to reduce the damaging effect of the increase in runoff due to densification.

9.2 Hydrology

The hydrological data used in the design of the stormwater drainage system is shown in the table below.

Table 10 Hydrological data

Hydrological Data	
a) Flood return period	1: 2 years for storm water pipe system. 1: 5 years for the combined storm water Pipe and road systems
b) Average yearly rainfall	800mm
c) Minimum time of concentration and run	As per Local Municipality Guidelines
d) Design Method	Rational method

9.3 Design Standards

The table below lists the standards to be used in the design of the stormwater drainage system:

Table 11 Stormwater design standard

Design Element	**Specification**
a) Minimum pipe size	600mm diameter concrete
b) Minimum pipe gradient	0.67%
c) Storm water details	Local Municipal Standard Details

10 SOLID WASTE

A regional landfill situated nearest the site is to be used to dispose solid waste. The local municipality is responsible for connecting and disposing the solid waste. If the municipality is not able to provide this service, then a private company will need to be appointed by the development owners for the service.
A refuse area with bins will be done onsite and solid waste will be disposed of at the municipal dump site as per the municipal health bylaws.

The Neighbourhood Planning and Design Guide, Creating Sustainable Human Settlements, developed by, Department of Human Settlements, Published by the South African Government, Version 1.1.
The solid waste generation range from 0.41 kg per capita per day in the poor areas, to 1.29 kg per capita per day.
The lower rate of 0.41kg/c/d was adopted for the township. Solid waste will be generated by the development.

Population estimate = 543 residential x 4people per unit = 2172 people

- Solid waste = 0.41kg/per person/day or (0.41kgx365 days)
- Waste generated per day = 0.41x 2172 = 891kg = 0.89 tonne

Waste generated per annum = 0.89x365 = 325 tonne

11 Conclusion

A new WWTW will need to be built to serve a proposed sewer network for the development. Sewer generated onsite may have to be handled onsite prior to the sewer infrastructure build.

The township will improve the housing stock of Dumphries.

Signature: 

Signed by:
PR No.:
For Dalimede Projects (PTY) Ltd

ANNEXURES

ANNEXURE 1 Layout Plan